OU2 FOCUSED FEASIBILITY STUDY DRAFT REPORT

Benning Road Facility
3400 Benning Road, NE
Washington, DC 20019

FOCUSED FEASIBILITY STUDY

DRAFT REPORT
OPERABLE UNIT 2 (WATERSIDE)

Benning Road Facility
3400 Benning Road, N.E.
Washington, DC 20019

PREPARED FOR:

Pepco and Pepco Energy Services
701 9th Street, NW
Washington, DC 20068

PREPARED BY:

AECOM
430 National Business Parkway, STE 190
Annapolis Junction, MD 20701

June 2024

Table of Contents

Figures

Tables

Appendices

Acronyms

AC	Activated Carbon
ARARs	applicable or relevant and appropriate requirements
ARSP	Anacostia River Sediment Project
BAZ	biologically active zone
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BHHRA	Baseline Human Health Risk Assessment
BMPs	best management practices
BTV	background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COC	constituents of concern
COI	Constituents of Interest
COPC	constituents of potential concern
CSM	conceptual site model
CTE	central tendency exposure
DC	District of Columbia
DOEE	Department of Energy and the Environment
EMNR	Enhanced Monitored Natural Recovery
ESCs	soil erosion and sediment control
FFS	Focused Feasibility Study
FS	Feasibility Study
g/yr	grams per year
GAC	granular-activated carbon
GRA	General Response Action
HI	Hazard Index
IC	institutional control
KMY	Kenilworth Maintenance Yard
KPN	Kenilworth Park North
KPS	Kenilworth Park South
LBC	Lower Beaverdam Creek
LIA	Landside Investigation Area
MDE	Maryland Department of the Environment
MLLW	mean lower low water
MNA	Monitored Natural Attenuation
MS4	municipal separate storm sewer system
NA	not applicable
NCP	National Contingency Plan
NEB	Northeast Branches
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRDAR	Natural Resource Damage Assessment and Restoration

Acronyms (continued)

NWB	Northwest Branches
O&M	operation and maintenance
PAC	powdered activated carbon
PAH	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	perchloroethylene
PECS	potential environmental cleanup sites
Pepco	Potomac Electric Power Company
PPE	personal protective equipment
PRG	preliminary remediation goals
PSLs	Project Screening Levels
RA	Remedial Action
RAA	Remedial Action Alternatives
RAO	Remedial Action Objectives
RI	Remedial Investigation
River	Anacostia River
RME	reasonable maximum exposure
ROD	Record of Decision
Site	3400 Benning Road NE, Washington, DC
SWAC	surface-weighted average concentration
TBC	To Be Considered
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEQ	Toxicity Equivalent
TS	Treatability Study
TSCA	Toxic Substances Control Act
UMBC	University of Maryland Baltimore County
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WIA	Waterside Investigation Area

1 Introduction

This draft Focused Feasibility Study (FFS) Report describes the development and evaluation of remedial alternatives based on the findings from the Remedial Investigation (RI) completed by Potomac Electric Power Company (Pepco) at its Benning Road Facility located at 3400 Benning Road NE, Washington, DC (Site) and a segment of the Anacostia River (River) adjacent to the Site.

Pepco is conducting the RI/FS for the Benning Road Facility pursuant to the requirements of a consent decree with the District of Columbia (DC) that was approved by the U.S. District Court on December 1, 2011 (Consent Decree). The RI/FS is conducted consistent with the requirements of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The location of the Site is depicted in **Figure 1-1**. The study areas encompassed for the RI/FS are shown on **Figure 1-2**. The Study Area for the RI/FS consists of a “Landside Investigation Area (LIA)” focused on the Site itself, and a “Waterside Investigation Area (WIA)” focused on the shoreline and sediments in the segment of the Anacostia River in close proximity to the Site. The Site is one of 15 upland properties along the tidal Anacostia River currently identified by District Department of Energy and Environment (DOEE) as potential environmental cleanup sites (PECSs) within the study area for the Anacostia River Sediment Project (ARSP) (**Figure 1-3**).

DOEE determined that the most expeditious approach for completing the Feasibility Study would be to divide the Site into two separate “Operable Units” for the purpose of evaluating, selecting, and implementing remedial actions. The landside area has been designated “Operable Unit 1 (OU1),” and the waterside area has been designated “Operable Unit 2 (OU2).” The decision to manage the Site through two separate operable units reflects the fact that the remedial actions being evaluated for the landside area are distinct from the remedial actions being evaluated for the waterside area and the remedial actions for each operable unit can be implemented independently. This approach also aligns better with the different remedial objectives for each operable unit – the landside remedy is intended to be the final remedy, whereas the waterside remedy is intended to be an Early Action, with the need for possible additional remedial action to be evaluated based on the effectiveness of the Early Action pursuant to the same adaptive management approach adopted for the rest of the Anacostia River under the Anacostia River Sediment Project. A separate Feasibility Study for the landside area (OU1) was approved by DOEE in March 2024 (AECOM, 2024). This Focused Feasibility Study addresses remedial alternatives for Early Action in the waterside area (OU2). The OU2 early action focuses on sediments in the Cove exceeding the interim Remedial Action Level (RAL) of 600 µg/kg total PCBs. This interim RAL is consistent with the RAL selected for Early Actions under ARSP (DOEE, 2020b). As shown in **Figure 3-1**, the total PCB concentrations in the surface sediments of the entire Cove exceed the 600 µg/kg RAL, making the entire Cove a target for the OU2 Early Action. Contaminated sediments in the Waterside Investigation Area outside of the Cove will be addressed, as needed, in a subsequent remedial action.

1.1 Purpose and Scope

The purpose of the Benning Road Facility RI/FS is to: (a) characterize environmental conditions within the Study Area, (b) investigate whether and to what extent past or current conditions at the Site have caused or contributed to contamination of River sediments, (c) assess current and potential risk to human health and the environment posed by conditions within the Study Area, and (d) develop and evaluate potential remedial actions, as may be warranted. The Final Remedial Investigation Report (Final RI Report) for the Benning Road Site was submitted to DOEE on February 28, 2020 (AECOM, 2020a), and was approved by DOEE on March 2, 2020. The Final RI Report addressed the first three objectives outlined above, and this Focused FS Report is prepared to address the development and evaluation of potential early remedial actions for the waterside area.

A substantial portion of the RI focused on field sampling and data analysis to define the nature and extent of chemicals of potential concern (COPCs) in groundwater, soils, and Anacostia River sediment and surface water. Extensive RI data were collected during two phases of investigation, extending from 2013 to 2018, to document the presence and general distribution of COPCs (AECOM, 2020a). A number of different organic and inorganic constituents were detected in these environmental media, and potential risks associated with exposure to these constituents were evaluated in a Site-specific Baseline Human Health Risk Assessment (BHHRA) and a Site-specific Baseline Ecological Risk Assessment (BERA). Potential human health risks were evaluated using conservative risk analysis tools and an extensive Site-specific data set in accordance with U.S. Environmental Protection Agency (USEPA) and DOEE guidance. The human health risk assessment also evaluated fish consumption pathways, relying on fish tissue data collected by DOEE and others from the broader Anacostia River.

The remedy framework proposed by Pepco for addressing areas of elevated concentrations of COPCs within the WIA sediments is intended to fit within the adaptive management strategy for the ARSP described in the Interim Record of Decision (ROD) released on September 30, 2020 (DOEE, 2020b). The Interim ROD calls for eliminating exposure to eleven sediment "hot spots" within the ARSP Study Area through early actions. Sediment within the WIA is being managed separately from the ARSP as part of the Benning Road Facility RI/FS process and is, therefore, not included among these eleven Early Action Areas. The Interim ROD adopts an adaptive management approach to: (1) help reduce the uncertainties from uncontrolled upstream sources; (2) provide information on the performance of the interim remedial action; and (3) inform DOEE's subsequent remedial decision-making, which may involve additional remedial actions in the ARSP study area, or modifications to the selected interim remedy. Although source control is not part of the selected interim remedy, DOEE and the corresponding agencies from Prince George's County, Montgomery County, and the State of Maryland are engaged in efforts to control contaminant sources external to the ARSP study area in the upstream Anacostia River watershed. DOEE views such efforts as critical to achieving the overall cleanup of the study area water bodies (DOEE, 2020b) .

This FFS evaluates potential remedial actions for the waterside area to address elevated contaminant concentrations in sediment within a cove of the Anacostia River near the Site where several outfalls (including Pepco Outfall 013) discharge to the river (the "Cove") as an Early Action. As shown in Figure 3 of the Post-RI Technical Memorandum #2 (AECOM, 2023), concentrations of total PCB congeners in the surface sediments are generally elevated in the Cove sediments as compared to elsewhere in the WIA. Majority of the sediments with total PCB concentrations exceeding the interim RAL of 600 µg/kg are located in the Cove. The remaining areas outside of the Cove but within the WIA would be addressed in the final remedy. The technologies evaluated in this FFS for sediments in the Cove may also be applicable to possible future remedial actions elsewhere in the WIA. As part of the FS process, Pepco conducted a Treatability Study (TS) involving both field data collection and bench-scale studies to support the evaluation of potential remedial alternatives to address sediments in the WIA, specifically in the Cove (AECOM, 2021).

Based on current and baseline conditions presented in the RI and the information collected during the TS, the objectives of this FFS report include the following:

- Identify applicable or relevant and appropriate requirements (ARARs) to be considered or attained for remedial actions.
- Establish specific Remedial Action Objectives (RAOs) that are protective of human health and the environment.
- Develop RAOs that are consistent with the selected risk thresholds and interim remedial action levels identified in the ARSP.
- Develop general response actions that will satisfy RAOs.
- Estimate areas and volumes of contaminated media that must be addressed.

- Identify and screen remedial technologies and process options so that only applicable technologies are retained for remedial alternatives evaluation.
- Develop remedial alternatives from the retained remedial technologies and process options.
- Evaluate selected remedial alternatives against the nine criteria defined in the NCP.
- Conduct a comparative assessment of the remedial alternatives selected for detailed evaluation.

The RAOs, remedial action level (RAL), and the alternatives for the waterside OU described in this FFS report represent Early Action.

1.2 Report Organization

This FFS report is organized into the following sections:

Section 1 – Introduction

Section 2 – Site Conditions and Risk Assessment Summary

Section 3 – ARARs, Remedial Action Objectives, and Preliminary Remediation Goals

Section 4 – General Response Actions, Technologies, and Process Option Screening

Section 5 – Description and Screening of Assembled Alternatives

Section 6 – Detailed Evaluation of Assembled Remedial Alternatives

Section 7 – Comparative Analysis of Remedial Alternatives

Section 8 – References

2 Site Conditions

This section provides a brief overview of conditions within the Waterside Investigation Area to provide relevant and sufficient background to understand the formulation and evaluation of remedial alternatives. The information provided in this section includes: a brief site description and history; RI/FS activities; study area characteristics; an updated conceptual site model (CSM); and a summary of baseline risk assessments. Additional details can be found in the Final Remedial Investigation Report (AECOM, 2020a) and the Final Treatability Study Report (AECOM, 2021).

2.1 WIA Description

The WIA consists of a segment of the Anacostia River in proximity to Pepco's Benning Road site, as shown in **Figure 1-2**. As described in more detail in Section 2.4.2 below, the area includes the Cove and the main channel of the Anacostia River extending approximately 820 feet upstream from the Cove adjacent the former Kenilworth Park South Landfill and downstream approximately 790 feet south of the Benning Road Bridge. The geographic coordinates for the approximate center of the Cove are 38.9016° north latitude and 76.9593° west longitude.

The site is adjacent to the Pepco's Benning Road Facility, a District of Columbia Solid Waste Transfer Station to the north, the Kenilworth Maintenance Yard (KMY) (which is owned by the National Park Service [NPS]) to the northwest, and the Kenilworth Park South (KPS) Landfill. Further details about the layout of Benning Road Facility (i.e., OU1) and current and historical operations can be found **Figure 2-2** to **Figure 2-5** and in the Feasibility Study for the landside area (AECOM, 2024).

2.2 Historical Investigation Activities

The results of sediment sampling conducted by Pepco as part of the Benning site RI are presented in Section 4.7 of the RI Report (AECOM, 202a). In addition, several documented historical environmental investigations of river sediments were conducted by others within the lower Anacostia River, including sampling of sediments within the WIA. A summary of these activities is provided Section 1.8 of the Final RI Report (AECOM, 2020a). Only a limited number of investigations have been conducted specifically in the Cove in addition to the RI conducted by Pepco. These include sediment sampling conducted by DOEE as part of the ARSP RI (DOEE, 2019b), sediment and porewater sampling conducted by University of Maryland Baltimore County (UMBC) in support of the ARSP RI (Ghosh et al., 2019), and forage fish sampling conducted by the Alfred Pinkney and the US Fish and Wildlife Service (Pinkney, 2017; USFWS (U.S. Fish and Wildlife Service), 2019).

2.3 RI/FS Activities

2.3.1 Remedial Investigation

The RI field program consisted of two phases of investigation: Phase I field activities were conducted between January 25, 2013, and December 31, 2014, and Phase II field activities were conducted between December 1, 2017 and July 9, 2018.

The Waterside Investigation Areas were well characterized during the RI, which included the collection and analysis of approximately 530 field samples from multiple environmental media such as sediment, surface water, sediment porewater, as well as sampling of the macroinvertebrate community and toxicity tests. Pepco also completed a background sampling program to establish Site-specific background conditions for Anacostia River surface water, and Anacostia River sediment. On-site samples collected from the WIA are shown in **Figure 2-6A**. Relevant data collected by DOEE as part of the ARSP RI sampling effort were also evaluated in the BHHRA and BERA, as well as the background evaluation. Relevant findings of the RI are discussed further below.

2.3.2 Treatability Study

As part of the FS process, Pepco identified the need for a TS involving both field data collection and bench-scale studies to support the evaluation of potential remedial alternatives to address sediments in the WIA, with a specific focus on the Cove. TS activities were performed in 2020 in accordance with the TS Work Plan approved by DOEE on March 18, 2020 (AECOM, 2020b). The TS activities included:

- Analysis of the effectiveness of sequestration agents (the use of amendments to reduce bioavailability of contaminants by sorption) and other active and inert capping materials.
- Hydrologic/hydraulic data collection and outfall assessment to understand how these data may affect design and performance of remedial alternatives, including restoration.
- Geotechnical evaluations to determine the feasibility of capping systems and ex-situ sediment dewatering.
- Sedimentation studies to evaluate the effect of ongoing upstream sources on the performance of remedial alternatives.

On-site samples collected from the WIA are shown in **Figure 2-6B**. In May 2021, the Final Treatability Study Report (Final TS Report) (AECOM, 2021) was submitted to DOEE. The TS Report was approved by DOEE on May 11, 2021, with the understanding that additional edits would be needed. These additional edits were completed, and the TS Report was finalized in August 2021 (AECOM, 2021).

2.4 WIA Environmental Setting

2.4.1 River Hydrology

The Anacostia River begins in Bladensburg, Maryland, at the confluence of its two major tributaries, the Northwest Branch, and the Northeast Branch, and flows a distance of approximately 8.4 miles before it discharges into the Potomac River in Washington, DC. Because of its location in the Washington metropolitan area, the majority of the watershed is highly urbanized. The Anacostia River is classified as a fresh water tidal estuary (Behm et al., 2003).

River surface elevations generally range from approximately -1.7 feet to 3.3 feet mean lower low water (MLLW). The average variation in the River's stage over a tidal cycle is approximately 1 meter (3.3 feet). The width of the River varies from approximately 60 meters (197 feet) in some upstream reaches to approximately 500 meters (1640 feet) near the confluence with the Potomac, and average depths across the channel transects vary from about 1.2 meters upstream of Bladensburg to about 5.6 meters just downstream of the South Capitol Street Bridge. During base flow conditions, measured flow velocities during the tidal cycle have been in the range of 0.1 to 0.3 meter per second (m/sec) (0.33 to 1 feet per second [ft/sec]) (Katz et al., 2001; Schultz, 2003).

According to the ARSP RI, primary sources of water and sediment to the lower Anacostia River are 14 tributary streams (DOEE, 2019b). Of the tributaries, Lower Beaverdam Creek is the third largest source of water, accounting for 17% of the flow to the Anacostia River; for comparison, the Northwest and Northeast Branches account for 45 and 32% respectively (Warner et al., 1997). The U.S. Geological Survey (USGS), in cooperation with DOEE, initiated a study to determine the loadings (as of 2017) of sediment and sediment-bound potential constituents of concern (potential COCs)[1] from nine tributaries to the Anacostia River (Wilson, 2019). The largest of these tributaries include the Northwest and Northeast Branches, Lower Beaverdam Creek, Watts Branch and Hickey Run. The study measured concentrations of contaminants in both surface sediment and suspended sediment which included PCBs, polycyclic aromatic hydrocarbons (PAHs), organochloride pesticides and trace metals. Total sediment loading from the tributaries to the Anacostia River during 2017 was 3.10E+07 kilograms, with 50% from the Northwest Branch, 33% from the Northeast Branch, 14% from Lower Beaverdam Creek and less than 2% each from Watts Branch and Hickey Run. The contribution from the four smaller tributaries was minimal at approximately 1% of the total sediment. However, the loadings for Lower

[1] The term "potential COC" was established in Pepco's response to DOEE comments in August 2015 to refer to COPCs with potential excess lifetime cancer risk greater than 1 x 10^{-6} or a target endpoint hazard index above 1. The term is used in the Final BHHRA (February 2020). Therefore, the term "potential COC" is used in this FFS report to maintain consistency with the BHHRA.

Beaverdam Creek are considered an underestimate resulting from gaps in turbidity and discharge data. Based on concentration data, Lower Beaverdam Creek was the largest source of PCBs at 75% of the total loading to the Anacostia River, whereas Northwest Branch was the largest source of PAHs accounting for 59% of the total loading. Concentrations of total PAHs in Northeast and Northwest Branches measured by USGS (Wilson, 2019) in 2017 were within the range reported by Foster et al. (2000) and Hwang & Foster (2008). Similarly, recent investigations by Maryland Department of the Environment (MDE) in 2019 (MDE, 2020) have found PCB concentrations up to 2,510 µg/kg in sediments and up to 119 ng/L in the surface water of the Lower Beaverdam Creek tributary. A comprehensive site characterization of on-site process water and on-site process materials, and the soil along the banks of the Lower Beaverdam Creek was completed for the Joseph Smith and Sons (JSS) facility, in 2023 and showed elevated concentrations of PCBs in these media. Overall, PCBs were detected in all soil samples at concentrations ranging from 0.1 to 30 mg/kg. Of the twenty-five locations sampled along the banks of LBC, twenty two locations exhibited total PCB concentrations in excess of 1 mg/kg. Total PCB concentrations in process water samples collected from the JSS site ranged from 0.083 µg/L to 37 µg/L. Total PCB concentrations in two sediment samples from the JSS site were 0.36 and 18 mg/kg. Total PCBs detected in the process material samples collected from the facility ranged from 0.11 mg/kg to 69 mg/kg (ENSAFE, 2023). The facility submitted a Response Action Plan (RAP) and Risk-Based Disposal Approval Application (RBDAA) to MDE and EPA, respectively. The RAP and RBDAA proposed actions to reduce potential for process water and process material to impact the Lower Beaverdam Creek. The most recent round of sampling in March 2023 showed concentrations up to 65.3 ng/L in the surface water and up to 280 ng/L from outfalls discharging to the tributary, both concentrations exceeding the District surface water quality standards. MDE also concluded that outfalls in the vicinity of the JSS site are a significant source of PCBs to LBC (MDE, 2024). MDE is also investigating unidentified potential sources in the vicinity of the Pennsy Drive area adjacent to the Lower Beaverdam Creek upstream of the JSS facility. These results indicate that pollutant loads from tributaries are ongoing.

2.4.2 WIA and Cove Physical Setting

The WIA is approximately 3,800-feet or 0.70-miles long, located in the main stem of the Anacostia River downstream of two of the PECSs (Colmar Manor Landfill and Kenilworth Park North (KPN) Landfill) and adjacent to a portion of the Kenilworth Park South (KPS) Landfill site. The WIA is approximately 3.0 miles downstream of the confluence of Northeast and Northwest Branches and is downstream of Lower Beaverdam Creek, Hickey Run and Watts Branch tributaries. The surface area of the WIA is approximately 35 acres at the mean high water line.

The Cove, which is located just north of the Site adjacent to the former Kenilworth Park South landfill to the north and the NPS Kenilworth Maintenance Yard property to the south, is a relic feature from the filling of a waterway and historical recreational lakes that formerly surrounded KPS and KPN and connected to the main stem of the river to the north of KPN. Under current conditions, much of the Cove is an exposed mudflat at low tide.

Pepco's storm water Outfall 013 discharges to the Cove **(Figure 2-1)**. During the field work for the treatability studies, Pepco identified several potential additional discharges from sites adjacent to the Cove. These include a silt pond located on the KPS landfill site just to the north of the Cove and additional stormwater outfalls that discharge to the Cove (AECOM, 2021). A riprap spillway is located on the southwest side of the silt pond, which appears to be designed to convey overflow from the pond at the former KPS site to the north shore of the Cove (AECOM, 2023). A total of five non-Pepco outfalls in addition to Outfall 013 discharge to the Cove (**Figure 2-7**). Three of these outfalls (Outfall 01, Outfall 03, and Outfall 001) drain the Department of Public Works Transfer Station. However, Outfall 003 does not belong solely to DPW. The origin of the two remaining outfalls is unknown.

Two active electric cable crossings are located in the WIA downstream of the Cove. A 108-inch sanitary sewer pipe is located approximately 5 feet below the Cove surface. Based on information provided by DOEE, this sanitary sewer line is currently operational.

2.4.3 Bathymetry

Topographic and bathymetric survey data were collected in May and June 2020 to verify the current grades in the Cove relative to tidal stages. The survey results are presented in **Figure 2-8**. Bathymetry appears to be similar to the 2013 bathymetry (AECOM, 2020a) with the shallowest areas occurring immediately south of the Benning Road bridge and much of the navigational channel within the WIA at the authorized depth of 8 feet (or greater), except for a small portion of the channel in front of the Cove, where the depth is 6 feet The perimeter of the Cove is at or above MLLW with the side slopes rising steeply to an elevation of 10 to 12 feet. The results of the topographic and bathymetric surveys will be used in evaluating target elevations for various remedy components.

2.4.4 Ecology

Most of the eastern shoreline within the WIA is stabilized with either sheet pile or rock wall. Observations made during the RI indicated riparian vegetation is dense in some areas and sparse in other areas and consists of large trees and shrubs. Tree species include maple, oak, and sycamore. Several bird species were observed on the water and on mudflats in the River on December 17, 2014, including mallards (*Anas platyrhynchos*), gulls (*Laridae* family), Canada geese (*Branta canadensis*), and belted kingfisher (*Megaceryle alcyon*). In addition, wildlife observations were made during sediment sampling activities in November 2014. The following bird species were observed in the vicinity of the WIA:

- Canada geese
- Mallards
- Gulls
- Blue heron (*Ardea herodias*)
- Cormorants (*Phalacrocorax auritus*)
- Bald eagle (*Haliaeetus leucocephalus*) (upstream near National Arboretum)
- Bufflehead ducks (*Bucephala albeola*)
- Egret (*Ardea* sp.)
- Deer (*Cervidae* family)

A review of bird sightings reported by the public at the River Terrace Park (https://ebird.org/hotspot/L11953985?yr=cur&m=&rank=hc) and at Kingman Island North – Langston Golf Course (https://ebird.org/hotspot/L970897?yr=cur&m=&rank=hc) showed that the following bird species are frequently observed in the vicinity of the WIA in addition to those listed above:

- White-throated sparrow
- Red-winged blackbird
- American Crow
- European Starling
- Blue Jay
- Chimney Swift

An additional vegetation survey of the Cove and multiple surrounding freshwater marshes in the area was conducted in 2020 as part of the TS. Types of vegetation observed in the Cove were also observed in nearby freshwater tidal marshes both upstream and downstream, including nearly monotypic stands of *Nuphar lutea*. Dominant species identified in the nearby upstream and downstream freshwater tidal marshes that were not observed in the Cove include *Typha angustifolia* (narrow-leaf cattail) and *Phragmites australis* (common reed).

Approximately 0.67 acres of aquatic vegetation and 0.24 acres of high and low marshes is present in the Cove, the location and extent of which can be seen in **Figure 3-1**. The existing Cove vegetation community is predominately divided between aquatic vegetation, marsh (low and high), and riparian buffer. Aquatic vegetation is a monotypic bed of spatterdock (*Nuphar lutea*). The marsh habitats occur among patches bisected by channels or mudflats and generally support a low diversity plant community that is dominated by pale yellow iris (*Iris pseudacorus*), green arrow arum (*Peltandra virginica*), pickerelweed (*Pontedaria cordata*), crimson eyed rose-mallow (*Hibiscus mosheutos*), spotted lady's-thumb (*Persicaria maculosa*), and Virginia dayflower (*Commelina virginica*). The riparian buffer, which exists primarily within the steep 10-12 feet high bank on the perimeter of the Cove, is a mixture of native and non-native invasive species. Plants on these slopes include garlic mustard (*Alliaria petiolata*), poison ivy (*Toxicodendron radicans*), grape (*Vitis spp*.), raspberry (*Rubus spp.*), multiflora rose (*Rosa multiflora*), Amur honeysuckle (*Lonicera maackii*), tree of heaven (*Ailanthus altissima*), sycamore (*Platanus occidentalis*), black willow (*Salix nigra*), elm (*Ulmus sp.*), and locust (*Robinia sp.*) among others. This riparian area provides a narrow buffer to the adjacent recreation trail and industrial areas.

2.5 Nature and Extent of Contamination

Extensive surface and subsurface sediment characterization was performed for a wide range of analytes during the RI Phase I and Phase II investigations. Concentrations were compared to Project Screening Levels (PSLs) selected from generic, numeric screening levels such as USEPA Region III Risk-based concentrations, D.C. Surface Water Quality Criteria, and Groundwater Quality Criteria. The PSLs were originally developed in the Sampling and Analysis Plan dated February 2013 (AECOM, 2013) and were updated in Section 4.0 of the RI Report (AECOM, 2020a). Individual PSLs and their sources are provided in Tables 4-1 through 4-39 in the RI Report. Analytes exceeding the PSLs were identified as Constituents of Interest (COIs) for further delineation and analysis. An iterative sampling approach was used to delineate the areas where analytes were detected above their screening levels in order to bound these exceedances horizontally and vertically. The results of this sampling for the WIA are summarized below.

2.5.1 COIs for WIA

- Concentrations of several metals, pesticides, PAHs, and PCBs exceeded PSLs in sediment in the WIA. The more elevated levels of these constituents are generally located in the Cove.

- An evaluation of background conditions in a reach of the River approximately 0.5 mile upstream of the Site indicates that the levels of most COIs in surface sediment in the WIA were consistent with Site-specific background conditions. WIA surficial sediment PCB concentrations exceeded background concentrations in some locations. The highest concentrations of PCBs are within the Cove.

2.6 Risk Assessment Summary

The baseline human health risk assessment conducted as part of the Remedial Investigation (AECOM, 2020a, Appendix AA) evaluated potential cancer risks and noncancer hazards to human health based on potential receptors' exposures to sediment, surface water, and fish tissue[2] in the WIA. Consistent with guidance, reasonable maximum exposure (RME) and central tendency exposure (CTE) scenarios were evaluated to provide information on a range of potential exposures and risks. This included evaluation of potential high-end consumers of self-caught fish in the uncertainty analysis. As requested by DOEE, the BHHRA identified potential chemicals of concern (COCs) as those COPCs which pose a potential excess lifetime cancer risk greater than 1×10^{-6} or a target endpoint Hazard Index (HI) above 1 for the RME receptor scenario.

The BERA (AECOM, 2020a, Appendix BB) evaluated the potential for risks to ecological receptors posed by constituents in surface sediment and surface water in the WIA. A summary of the risk assessment findings for the Waterside Investigation Area is presented below.

2.6.1 Summary of Waterside BHHRA Findings

The BHHRA identified the following potential receptors and exposure pathways for the WIA:

- **Current/future recreational anglers** who may be exposed via incidental ingestion of and dermal contact with fringe surface sediment and surface water within the WIA, and via consumption of Upper Anacostia River fish.
- **Current/future swimmers and waders** who may be exposed via incidental ingestion of and/or dermal contact with fringe surface sediment and surface water within the WIA.

[2] The fish consumption exposure pathway was evaluated using fish tissue data collected by the U.S. Fish and Wildlife Service (Pinkney, 2017) from the Upper Anacostia River, representing an approximately 3-mile reach of the river that includes the WIA. The fish tissue data reflect overall conditions within the several mile-long river reach that was sampled (or possibly the larger home range for some of the species sampled) and may not reflect conditions within the WIA (fish sample collection points were not specified in Pinkney [2017]).

- **Current/future shoreline workers** who may be exposed via incidental ingestion of and/or dermal contact with fringe surface sediment and surface water within the WIA.

To place the WIA risk evaluation into a regional context, the following regional reaches were also evaluated for potential exposure via fish consumption: (1) Lower Anacostia River (downstream of the CSX bridge), (2) Upper Potomac River (upstream of the 14th Street bridge), and (3) Lower Potomac River (downstream of the 14th Street bridge). The BHHRA also evaluated fish tissue collected from the upstream non-tidal Anacostia River (north of the Maryland state line) as an area which DOEE has determined represents background for fish tissue.

As indicated in **Figure 2-9**, the noncancer HI for the recreational angler exceeds 1 under the RME scenario in all areas except the Upper Non-Tidal Anacostia (HI of 0.6). For the swimmer, wader, and shoreline worker receptors, the noncancer HI is below 1 for all scenarios. Based on the BHHRA, the fish consumption exposure pathway poses risks in excess of acceptable risk management benchmarks (throughout the tidal Anacostia and Potomac Rivers), while risks from direct contact exposures to sediment and surface water in the WIA are all below the risk management benchmarks for the Benning RI/FS (cancer risk no greater than 1×10^{-5} and HI no greater than 1).

As indicated in **Figure 2-10**, potential cancer risks for the WIA are within the USEPA's target risk range of 10^{-6} to 10^{-4} with the exception of the RME recreational angler who consumes fish from the Upper Potomac River (cancer risk of 2×10^{-4}). The cumulative potential cancer risks for the receptors who may contact fringe surface sediment and surface water are at the low end of USEPA's target risk range, including the swimmer (RME cancer risk of 2×10^{-6}), wader (RME cancer risk of 4×10^{-6}), and shoreline worker (RME cancer risk of 4×10^{-6}).

Table 2-1 presents the potential COCs and media with risks greater than 10^{-6} or a target endpoint HI of 1 for the WIA. The 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)-Toxicity Equivalent (TEQ) is the only potential COC identified for fringe surface sediment based on the slight exceedance of 10^{-6} for direct contact exposure (maximum risk of 2×10^{-6} for the shoreline worker). Total PCBs, PCB-TEQ, and dieldrin are identified as potential COCs for fish consumption. No chemicals in surface water pose risks above 10^{-6} or a HI of 1. The chemicals identified as potential COCs in the Upper Anacostia area for fish consumption are also identified in other regional reaches, and in some cases, at higher cancer risk and noncancer hazard levels (e.g., dieldrin).

When a 10^{-5} risk threshold is used, PCBs is the only potential COC for the WIA related to human health (based on fish consumption). The risk posed by PCB-TEQ, which represents a subset of 12 PCB congeners with presumed dioxin-like toxicity, is lower than the risk posed by total PCBs (sum of all detected congeners including any considered dioxin-like). Therefore, any action focused on total PCBs is expected to address the subset of dioxin-like congeners.

The evaluation of fish consumption risk in the BHHRA used data from composite fish tissue samples collected by the U.S. Fish and Wildlife Service (Pinkney, 2017; USFWS (U.S. Fish and Wildlife Service), 2019). As previously noted, the data represent conditions throughout the approximately 3.2-mile Upper Anacostia River sampling area and are not necessarily representative of conditions in the WIA, a segment of the river approximately 0.7 miles long. Further, and as discussed in the BHHRA, the data are indicative of a regional impact on fish tissue body burdens that may be attributable, at least in part, to sources other than sediment within the Upper Anacostia River reach or the WIA in particular (AECOM, 2020a).

2.6.2 Summary of Waterside BERA Findings

The BERA (AECOM, 2020a, Appendix BB) evaluated the potential for risks to ecological receptors posed by constituents in surface sediment and surface water in the WIA including:

- Direct contact with sediment and porewater by benthic macroinvertebrates;
- Ingestion of contaminated food sources by warmwater fish; and
- Ingestion of contaminated prey items (i.e., fish) and abiotic media (i.e., sediment) by wildlife.

The BERA concluded that there are low to indeterminate risks to benthic invertebrates in the WIA due to a lack of constituent bioavailability in sediment and sediment porewater[3]. In addition, incremental risks in the WIA are largely indistinguishable from the anthropogenic, urban background conditions of the lower Anacostia River. Based on macroinvertebrate community metrics, the potential for benthic invertebrate risks was greater in upstream background locations than in WIA locations. Concentrations of total PCB congeners in Cove sediments 180 µg/kg to 11,800 µg/kg and were elevated in the Cove relative to elsewhere in the WIA. However, strong relationships between elevated PCB concentrations and reductions in benthic survival, reproduction, or growth (based on two test organisms) or community health were not observed.

No potential for risks were identified for fish and wildlife in the WIA. Surface water and groundwater concentrations were below conservative benchmarks that are protective of fish and other aquatic organisms. These benchmarks were based on DOEE Water Quality Standards for the protection of

[3] The ARSP RI evaluation of bioaccumulation and benthic invertebrates concluded that “body burdens of chemicals in resident invertebrates do not appear to pose unacceptable risk to populations, based on the available tissue-effect levels.”

freshwater aquatic life (DOEE, 2010); USEPA Region 3 Freshwater Screening Benchmarks (USEPA, 2006); and other literature-based toxicological sources (Buchman, 2008; Suter & Tsao, 1996). In addition, comparisons of chemical concentrations detected in fish tissue samples collected near the WIA were similar to samples collected upstream and downstream and were also below critical body residue concentrations for fish associated with observed survival, growth, or reproductive effects. The critical body residues were obtained from Jarvinen & Ankley (1999) and the U.S. Army Corps of Engineers (USACE) Environmental Residue Effects Database. For wildlife, modeled dietary exposures indicated that the potential for risk was below hazard thresholds for all wildlife under the most conservative scenarios considered.

In summary, no potential COCs are identified for the WIA based on the results of the BERA.

2.6.3 Summary of Potential COCs and Media to be Addressed by Remedial Action

PCBs in the Upper Anacostia fish tissue is the only potential COC carried forward for evaluation of remedial alternatives in the Cove for the OU2 FFS. As discussed in Section 3.4 and consistent with the ARSP, the interim remedial action level (RAL) for total PCBs (congeners) of 600 ug/kg is used to identify sediments in the Cove for Early Action.

2.6.4 Summary of PCB Concentrations in Cove Sediments

Concentrations of total PCB Aroclors measured in surface sediments (i.e., in the 0-1 ft. interval) in the Cove ranged from 26 µg/kg (SED7.5C) to 3900 µg/kg (SED7D). Concentrations of total PCB congeners measured in the surface sediments of the Cove ranged from 760 µg/kg (SED6.5E) to 11,800 µg/kg (SED7.5E).

Concentrations of total PCB Aroclors measured in subsurface sediments (i.e., > 1 ft. bgs) in the Cove ranged from < 1.1 µg/kg (R6-21, 2-3 ft.) to 1,500 µg/kg (SED7E, 3-5 ft.). Concentrations of total PCB congeners measured in the subsurface sediments of the Cove ranged from 820 µg/kg (R6-21, 0.9 to 1.9 ft.) to 11,000 µg/kg (SED6.5E, 1-3 ft.). Further details can be found in the ARSP RI report (DOEE, 2019b), the RI report for the Benning Road facility (AECOM, 2020a), and the Post-RI Technical Memorandum #2 (AECOM, 2023).

2.7 Revised Conceptual Site Model

The CSM is designed to integrate in a functional description (1) the major constituents of concern, based on previous Site investigations and the history of Site operations; (2) the potential on-Site and off-Site sources of these constituents; and (3) the possible exposure pathways of these constituents to potential human health and ecological receptors. The CSM addresses possible connections between the landside on-Site potential COC sources and the waterside sediment contamination in the segments of the Anacostia River adjacent to, immediately downstream, and upstream of the Site.

The CSM for the Site has been updated following the completion of the Final RI Report to reflect the fate and transport analyses, exposure pathways and receptors based on the selected 10^{-5} target cancer risk and Hazard Index of 1.0. This updated CSM informs the FFS decisions. The updated CSM is presented as **Figure 2-11** and **Figure 2-12** for On-site Sources and Off-site Sources, respectively. Magenta indicates unacceptable risk pathway based on the BHHRA. General pictorial representation of the Waterside CSMs is presented in **Figure 2-13**.

WIA Summary

Key elements of the waterside CSM include the following:

- The Anacostia River is an urban waterway with a highly developed upland infrastructure. There are numerous off-Site and upstream sources and potential sources of potential COCs. Multiple outfalls (other than Pepco's) discharge into the Waterside Investigation Area and upstream reaches of the River.
- Pathways by which Site-related contaminants may have historically migrated from the LIA to the River are limited. The RI documents that neither current nor historical groundwater discharge from the Site is a significant contributor to surface water or sediment impacts in the Anacostia River. Prior to the construction of the storm drain system in the 1950s, Site stormwater flowed to the on-Site portion of Piney Run, which historically discharged to the Cove. Although portions of the storm drain system are below the groundwater table, investigation of the condition of the storm drains did not reveal evidence of any significant groundwater infiltration. Historical stormwater discharges from the Site via storm drain outfall 013 likely have contributed to sediment conditions in the Cove. However, due to control measures implemented over the years, concentration of PCBs in site stormwater are currently very low compared to upstream background and in compliance with NPDES permit limits. Outfall 101 is not considered to represent a significant pathway in terms of PCB mass, in comparison to Outfall 013, for transport of PCBs from the Site to the river, and does not discharge to the Cove. The most likely pathway for the transport of PCBs from the Site to the Cove is via storm drain discharges at Outfall 013. (See the Landside Feasibility Study (AECOM 2024) for a more detailed description of potential contaminant migration pathways from the Pepco Benning Road site to the river.)
- The Cove includes tidal flats that are regularly inundated and exposed with the ebb and flow of tide, as well as channelized areas that are perennially under water.

- Much of the WIA, including the Cove, is net depositional.
- Data collected during the RI demonstrate that the Site-specific biologically active zone (BAZ) in the Anacostia River sediments ranges from 0.15 to 6.1 inches and averaged 4 inches below the sediment surface.
- The presence of bioaccumulative and biomagnifying potential COCs in surficial sediment and associated media within the WIA indicates that there is a potential linkage between contaminants in these media and fish tissue. However, uncertainties exist regarding the relationship between potential COCs in sediment in the Waterside Investigation Area and fish tissue in the Anacostia River[4].
- Movement of potential COCs into surface water and sediment occurs through resuspension of particulate matter, pore water/surface water exchange, and tidal exchange.
- Ecological receptors in the WIA include benthic infauna, aquatic invertebrates, fish, and wildlife.
- Human use of the Anacostia River includes angling and other recreational activities; the CSM takes into account both current uses as well as future uses, which may increase in the future due to River improvements.

[4] As documented in the Interim ROD, the uncertainties regarding the relationship between potential COCs in sediment and WIA fish tissue will be addressed via a comprehensive baseline and performance program.

3 ARARs, Remedial Action Objectives and Preliminary Remediation Goals

3.1 ARARs

The Consent Decree requires that the RI/FS is to be conducted in accordance with the NCP, applicable CERCLA guidance documents, and applicable District laws and regulations. Under these authorities, response actions must comply with all "Applicable or Relevant and Appropriate Requirements" or "ARARs." The NCP (40 Code of Federal Regulations [CFR] 300.5) defines "Applicable Requirements" and "Relevant and Appropriate Requirements" as follows:

- ***Applicable Requirements*** - "are those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or [District of Columbia] environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site."
- ***Relevant and Appropriate Requirements*** - "are those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or [District of Columbia] environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site."

The determination that a requirement is relevant and appropriate is a two-step process: (1) determination if a requirement is relevant and (2) determination if a requirement is appropriate. In general, this involves comparing a number of site-specific factors, including the characteristics of the remedial action, the hazardous substances present at the site, or the physical circumstances of the site, to those addressed by the statutory or regulatory requirements. In some cases, a requirement may be relevant, but not appropriate, given site-specific circumstances; such a requirement would not be an ARAR for the site. In addition, there is more discretion in determining whether a requirement is relevant and appropriate; it is possible for only part of a requirement to be considered relevant and appropriate in a given case. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be satisfied to the same degree as if it were applicable.

Remedial actions also may be evaluated with reference to an additional category of requirements, referred to as "To Be Considered" (TBC). This category encompasses non-promulgated advisories or guidance issued by the federal or the District government that are not legally binding and do not have the status of ARARs. While TBCs are not promulgated or enforceable, TBCs may be consulted to interpret ARARs or to establish PRGs when ARARs do not exist for particular contaminants or do not sufficiently eliminate identified risks.

The identification of ARARs is site-specific and depends on the chemical contaminants, site/location characteristics, and remedial actions being considered. Each of these three types of ARARs is described further in the following sections.

3.1.1 Chemical Specific ARARs

Chemical-specific ARARs are numeric values that define concentrations of specific hazardous contaminants deemed to be protective of human health and the environment under site-specific exposure conditions. The potential chemical-specific ARARs for the WIA are described in **Table 3-1** and provide a basis for the numerical values used to develop Site PRGs in Section 3.3.

3.1.2 Location Specific ARARs

Location-specific ARARs serve to protect individual characteristics, resources, and specific environmental features on a site, such as wetlands, water bodies, floodplains, and sensitive ecosystems. Location-specific ARARs may affect or restrict remediation and site activities. The general types of location-specific requirements that may be applied to the Benning Road Site include water resources and floodplain regulations. The potential location-specific ARARs and TBCs that apply to the Benning Road Site are described in **Table 3-1**.

3.1.3 Action Specific ARARs

Action-specific ARARs are technology- or activity-based requirements that govern activities or processes that may be implemented on a site, including storage, transportation, and disposal methods of hazardous substances as well as construction of facilities or treatment processes. The potential action-specific ARARs and TBCs that apply to the WIA are described in **Table 3-1**. Because action-specific ARARs and TBCs depend on the components of a particular remedial action, they are discussed further as appropriate for each remedial alternative as part of the detailed evaluation of alternatives.

Federal and District permits may be required for the implementation of remedial action. Permitting requirements generally fall under the action-specific ARARs. D.C. Code § 8-634.01(c) provides an exemption from some permitting requirements for remedial activities conducted on-site. Where this permitting exemption applies, remedial actions conducted on site need to comply only with the substantive aspects of ARARs and not with the corresponding administrative requirements.

In addition, since the scope of the remedial action addressed in the OU2 FFS has been defined by reference to the interim RAL listed in the IROD, the interim RAL can be regarded as an action-specific standard “to be considered” for purposes of the FFS.

3.2 Background PCB Concentrations in WIA Sediments

A background data evaluation was included in Appendix W of the Final RI Report (AECOM, 2020a). The background evaluation was performed using the methodology outlined in the approved Work Plan (AECOM, 2016). USEPA’s ProUCL program was used to conduct the evaluation.

A total of 31 surface sediment samples (0 to 4 inches below sediment surface) were included in the Site-specific background dataset. Surface sediment samples were collected by Pepco at three upstream locations in November and December 2013, and at four additional background/reference sampling locations upstream of the WIA in June 2017, to determine the nature and extent of contamination in sediment at upstream locations unaffected by Site-related activities. The Site-specific background data collected by Pepco were supplemented with data collected by DOEE for the ARSP. Twenty-four samples were collected as part of the ARSP RI upstream of SEDBACK20 in 2014 and 2016 from a depth of 0 to 6 inches below sediment surface.

Background Threshold Value (BTVs) were derived for both total PCB Aroclors and total PCB congeners. Of the samples included in the background dataset, results for total PCB Aroclors were available from 30 samples, and results for total PCB congeners were available for 29 samples. The background evaluation included both statistical tests and graphical evaluation. No outliers were identified in either dataset; therefore, all results were included in the BTV derivation.

The 95% upper tolerance limit (95UTL), which is calculated such that 95% of observations from the background dataset are less than or equal to the statistic (which is the 95% upper confidence limit of the 95^{th} percentile of the dataset) with 95% confidence, was selected preferentially as the BTV statistic per the request of DOEE. The 95UTL statistic selected was based on the distribution of the raw dataset. The total PCB datasets (Aroclors and congeners) fit both a gamma and lognormal distribution, and BTVs were determined as follows based on the gamma distribution:

- Total PCB Aroclors – 0.18 mg/kg
- Total PCB congeners – 0.42 mg/kg

The RAOs (Section 3.3) and the delineation of the impacted areas in the Cove (Section 3.6) are based on the interim RAL of 600 µg/kg (Section 3.4) and not on the background levels.

3.3 Remedial Action Objectives

RAOs are narrative statements that serve as a basis for developing numerical remediation goals and remedial alternatives to protect human health and the environment. RAOs and remedial goals evolve over the course of an RI/FS and become final when the ROD for the response action is signed. RAOs are specific to the areas and media where the risk assessments identified unacceptable risks, as summarized in Section 2.6. Unacceptable risk for the purpose of this FFS is defined as any risk exceeding an excess life-time cancer risk of 1.0E-05 and a non-cancer hazard index of 1.0, consistent with the risk targets used for the ARSP. The RAOs and the delineation of the impacted areas (Section 3.6) in the Cove are, however, based on the interim RAL of 600 µg/kg (Section 3.4). The interim RAL would also be protective of the environment.

The following RAO has been established for the FFS:

- **RAO 1 – Reduce exposure to total PCBs within the biologically active zone in the Cove, to the extent practicable, through early action addressing sediments within the Cove that exceed an interim RAL of 600 µg/kg of total PCBs measured as congeners.** Fish consumption was identified as the primary human health risk driver for the ARSP. PCBs in fish tissue is a regional issue with similar elevated fish tissue concentrations in other reaches of the Anacostia River and in the Potomac River. The presence of bioaccumulative and biomagnifying potential COCs such as PCBs in surficial sediment, surficial sediment pore water, and surface water within the WIA indicates that there is a potential linkage between contaminants in these media and fish tissue. However, any contribution from sediment and pore water in the WIA to fish tissue concentrations throughout the Anacostia River is likely to be small, and remedial action in the WIA would not by itself be expected to have a meaningful impact on overall risk from fish consumption.

  The only risk identified by the BERA is a low to indeterminate risk to benthic macroinvertebrates from potential exposure to potential COCs. However, for the most part, the data collected in support of the RI indicated that key potential COCs have limited bioavailability to macroinvertebrates. Further, the results of the weight-of-evidence assessment for the benthic community also suggest that any incremental risks in the WIA are largely indistinguishable from the anthropogenic, urban background conditions that characterize the Anacostia River as a whole.

  Additionally, sources upstream of the WIA, including Lower Beaverdam Creek, have contributed and continue to contribute PCBs to downstream areas in the river, including the WIA (USFWS, 2019).

  Despite the foregoing uncertainties and continuing upstream sources, risks associated with human consumption of fish can be mitigated by reducing exposure of PCBs within the biologically active zone in the Cove where PCB concentrations are generally higher than the average concentrations in the rest of the WIA and the River. The reduction of PCB exposure within biologically active zone can be achieved as an early action by sequestering PCBs using activated carbon amendments, capping, sediment removal, or a combination thereof.

3.4 Interim RAL for Waterside Investigation Area

Consistent with the ARSP interim remedy, the basis for Early Action remediation of sediments in the Cove is a RAL of 600 µg/kg for total PCBs measured as congeners. Additional details on the development of this interim RAL can be found in the Interim ROD (DOEE, 2020b).

PCB concentrations range from 790-11,800 µg/kg across the Cove, and PCB concentrations in all polygons in the Cove exceed the proposed RAL of 600 µg/kg **(Figure 3-1)**. The concentrations shown in **Figure 3-1** represent the maximum total PCB congeners in 0-1 ft. sediments in each polygon measured across multiple sampling events. All total PCB Aroclor concentrations were converted to equivalent total PCB congener concentrations using the method discussed in Section 3.5 below. The maximum concentrations were then used for delineating polygons to be remediation in the Cove. **Table 3-2** presents all the data used for **Figure 3-1**. The proposed Early Action thus involves remediation of sediments across the entire 3.7-acre Cove.

Although some areas of the WIA outside of the Cove exceed the RAL, the Early Action is limited to the Cove based on the generally elevated levels of PCBs identified in the Cove compared to the rest of the WIA, the concentration of the limited WIA benthic risks within the Cove, the Cove geomorphology and its ability to be isolated from the main stem, its suitability for ecological restoration, and the greater potential for recontamination in areas outside the Cove from continuing upstream sources.

Because the proposed action for the Cove sediments is an early action, no sediment concentration preliminary remediation goal (PRG) was developed at this time. Instead, the objective of remediation will be to reduce bioavailable concentrations of PCBs throughout the biologically active zone and also thereby reduce potential flux of PCBs to the water column and uptake of PCBs by fish. This objective is consistent with the early actions by DOEE for the ARSP and the actions being contemplated by other parties to eliminate exposure to “hot spots” in the river. Cleaning up the Cove fits within the adaptive management approach for the Interim ROD as described in Section 1.1.

Remedial alternatives considered in this FFS would reduce exposure to PCBs in the biologically active zone by sequestration, isolation by capping or removal of contaminated sediment. To be effective over the long term, the remedy also must be designed to prevent recontamination of the biologically active zone as a result of groundwater upwelling through contaminated subsurface sediments. A porewater target concentration of 0.64 ng/L was selected as a cap performance metric for evaluation of effectiveness of the proposed alternatives. This target concentration is based on the surface water quality criterion for protection of human health from fish consumption of 0.064 ng/L, developed by the US Environmental Protection Agency (USEPA) using a 1E-06 cancer risk level and bioaccumulation factor for PCBs in gamefish (DOEE, 2016). Using a 1E-05 risk level, consistent with that adopted for the ARSP, results in a target porewater criterion of 0.64 ng/L. It should be noted that the porewater target discussed is intended to assist with the evaluation of long-term effectiveness of the proposed alternatives. It is not intended to be a performance criterion for the satisfactory implementation of the Early Action ultimately selected for the Cove.

3.5 Aroclor vs. Congener Totals for PCBs

Two types of PCB measurements are used in this evaluation. PCBs measured using USEPA Method 8082 (reported as the sum of Aroclors, tPCBa) were used for a majority of the delineation on the waterside, but a significant amount of congener data was also collected using USEPA Method 1668. Additional congener data was also available from the ARSP RI. Given the low levels of PCBs used in water quality criteria and risk-based calculations and to maintain consistency with the ARSP program, Pepco used congener-based totals (reported as the sum of congeners, tPCBc) for the WIA discussions going forward. For purposes of the WIA, this report uses the sum of congeners for designating total PCBs.

Given the availability of substantial Aroclor and congener sediment sampling data from both the WIA investigations and the ASRP RI, a correlation of total PCBs derived from USEPA Method 8082 (reported as sum of Aroclors, tPCBa) and total PCBs derived from USEPA Method 1668 (reported as the sum of congeners, tPCBc) was investigated for Anacostia River sediments. Results for the 57 Benning RI +DOEE sediment dual detection result pairs for tPCBc / tPCBa were used to derive a mean (2.28) and median (1.77) ratios. In addition, 95% UCL of the ratio (3.43) was also calculated. Plots of the log of sediment concentration correlation for tPCBa vs tPCBc were used to determine where the correlation coefficient $r^2 = 0.781$, and the power regression equation is $y = 2.2739x^{0.9507}$ for the same combination of surface and subsurface sediment datasets. Further details on the tPCBa vs tPCBc correlation can be found in AECOM (2019).

Sediment tPCBa concentrations in Cove sediments were converted to tPCBc concentrations using the 95% UCL of the congener-Aroclor ratios for the purposes of the feasibility evaluation. This method likely overestimates the actual tPCBc concentration in sediments due to application of a single conversion factor. Additional evaluation of the existing dataset, including application of statistical methods to improve the tPCBa vs tPCBc correlation, as well as collection of additional data can be performed during the remedial design phase to refine the Aroclor to congener conversion methods.

3.6 Impact Areas and Volumes

The concentration of total PCB congeners in surface sediment was used to delineate the extent of remediation in the Cove based on the ARSP sediment interim RAL of 600 µg/kg of total PCBs. For each polygon, the maximum PCB congener concentration (either measured or converted from total PCB Aroclors to total PCB congeners) was used to delineate the extent of remediation. **Figure 3-1** shows the maximum total PCB congener concentration in each polygon within the extent of the Cove, with total PCB congener concentrations in all polygons exceeding 600 µg/kg. Thus, extent of remediation is the entire 3.7 acres (161,220 sq. ft.) of the Cove, resulting in approximately 5,970 cubic yards of sediment in the 0-1 ft. interval exceeding the RAL.

4 General Response Actions, Technology and Process Option Screening

This section presents the General Response Actions (GRAs), identifies and screens available technologies and process options under each GRA for sediment in the Cove targeted for Early Action. Technologies are described and then evaluated and screened relative to effectiveness, implementability and cost, following EPA's *Guidance for Conducting RI/FS Under CERCLA* (USEPA, 1988). Technologies retained are then assembled into specific alternatives for each medium. Detailed evaluation of the assembled alternatives is discussed in Section 5.0.

4.1 General Response Actions

GRAs are broad categories of remedial actions that may satisfy the remedial action objective set forth in Section 3.0. General response actions include no action, institutional controls, containment, removal, treatment, disposal, or a combination of these actions.

4.1.1 GRAs for Cove Sediments

The following potential GRAs have been identified for PCBs in Cove sediments in the WIA:

GRA	Description
No Action	No actions are taken under this GRA. While the No Action GRA will not satisfy the RAO, the NCP and CERCLA require consideration of the "no action" alternative as a baseline for comparison of the other GRAs/alternatives.
Institutional Controls	Non-engineered measures such as fish consumption advisories and swimming prohibitions to minimize human exposures to potential COCs and/or of protecting the integrity of an implemented remedy. Institutional controls are not effective for ecological receptors.
Monitored Natural Recovery (MNR)	Reduction in potential COC concentrations though natural fate and transport processes such as physical burial, biotic and abiotic degradation. MNR is monitored for efficacy. Efficacy is evaluated based on monitored rates of attenuation.
Enhanced MNR	Uses technologies to enhance natural processes so remedial goals can be met within an acceptable time period.
Containment	Capping is an effective containment strategy for sediments with a well-documented record of implementation (Palermo et al. 1998a; USEPA, 2005). Type of capping depends on the specific objectives for the remedy such as preventing contact between receptor and contaminated sediment (physical isolation), preventing resuspension and transport (stabilization), or preventing transport of dissolved contaminants from sediment to water column (chemical isolation).
Removal	Partial or complete removal of impacted sediment via hydraulic dredging, mechanical dredging, or dry excavation.
Treatment	In-situ treatment of potential COCs in sediments or ex-situ treatment of potential COCs in sediments following removal.
Disposal	On-site or off-site disposal or beneficial re-use of dredged sediments

4.2 Ancillary Treatment Technologies

Ancillary technologies are those that will be needed to support the implementation of GRAs and they will be considered in the development of the remedial alternatives discussed in **Section 5.0**. These processes are not screened because they are integral to the implementation of many of the GRAs. The applicable ancillary technologies are described below:

- Turbidity Controls – Physical barriers or mechanical controls can be implemented to control the dispersion of suspended solids in order to maintain background levels of turbidity outside of the work area.
    - Silt curtains are commonly used to control turbidity. Silt curtains have varying efficacy based on the background conditions of the waterbody and deployment locations. They are most effective in locations with low velocity, such as at the edge of Cove.
    - Sheet piling and other structures can also be used to create a cofferdam physically isolating the Cove work area from the main stem of the Anacostia River. This approach also allows for the work area to be drained and excavated in the dry.
    - Environmental excavation buckets with gaskets or baffles may be used to reduce particle suspension during sediment removal.
- Erosion and Sedimentation Control Best Management Practices – Best management practices are guidelines on the design, installation, and maintenance of controls to prevent erosion or sedimentation at sites where the ground is disturbed or used for soil stockpiling. Erosion and sediment controls that would be needed during remedy implementation, will be designed and permitted during the remedial design phase.
- Sediment/Soil Dewatering Technologies – Some of the GRAs discussed for sediments utilize processes that will produce sediments for transport and disposal. Economical transport and disposal facility acceptance criteria will require that the sediments produced be dewatered. Dewatering can be achieved in a number of ways including gravity dewatering, use of geotextile dewatering tubes, and/or chemical amendments. The applicability of each of the technologies will be reviewed in the design phase of the selected remedial alternative.
- Wastewater Management Technologies – Excavation dewatering, sediment/soil dewatering, equipment decontamination, and other onsite activities result in the production of wastewater. These waters are potentially impacted by potential COCs and must be managed accordingly. There are options for wastewater management technologies including treatment and discharge back to the Anacostia River, treatment and discharge into the municipal sewer system, and transportation and disposal at an

approved facility. The applicability of each of the technologies will be reviewed in the design phase of the selected remedial alternative.

- Excavation Stability Technologies – Excavations may require additional stabilization based on depth, proximity to structures, and other physical constraints. Some excavation stability technologies include shoring, sloping, and benching.
    - Shoring – The installation of physical supports to allow deep excavation without structural collapse of the soils. Structural design may be required.
    - Sloping – When sidewalls are cut at an angle based on soil composition to prevent structural collapse of soils. Increases excavation footprint.
    - Benching – When sidewalls are cut in steps to prevent structural collapse of soils. Increases excavation footprint.

4.3 Technology/Process Option Screening

The development of remedial alternatives commences with the identification, screening and evaluation of potentially applicable remedial technologies and associated process options. Remedial technologies are general technology options under a GRA. Each technology type can have multiple process options. For example, capping is a containment GRA technology. Process options for capping of sediments could include conventional sand capping, armored capping, or reactive capping. In this FFS, technologies and process options are discussed together. A number of sediment remediation technologies were identified under each potential GRA. These technologies are then evaluated on the basis of effectiveness in meeting the RAO, technical (constructability) and regulatory (meeting ARAR) implementability, and cost. Evaluation for cost at this screening stage is based on qualitative criteria (low, moderate, and high). Detailed costs are presented in **Section 6.0**.

The technology screening/evaluation is summarized in **Table 4-1** for WIA Cove Sediments. Based on this evaluation, one or more representative technologies/process options were retained for each GRA.

The following is a summary of Retained GRAs, technologies, and process options:

GRA	Technology	Process Option
WIA Cove Sediment		
No Action	No Action	No Action
Institutional Controls	Administrative Controls	DOEE Fish Consumption Advisory
		NPS Permitting Requirements (for activities that disturb river bottom)
Containment	Capping	Sand Cap
		Amended Sand Cap
		Soil Cap[5]
		Armored Capping
		Sand + Soil Capping
Removal	Dredging/Excavation	Mechanical Dredging
		Dry Excavation
Treatment	In-Situ Treatment	AC application
	Ex-Situ Treatment	Solidification / Stabilization[6]
Disposal	Dredging and On-Site or Off-Site Disposal/Re-use	Off-Site Disposal/Re-use

These retained technologies and process options are assembled to produce specific remedial alternatives discussed in further detail in Section 4.5. Not all of the retained process options need to be included in development of the assembled alternatives.

PCB sequestration and cover efficacy under Enhanced Monitored Natural Recovery (EMNR) and capping GRAs were investigated during the treatability study phase (AECOM, 2021a). UMBC assessed PCB sequestration effectiveness in Cove sediments for three activated carbon amendment materials: granular-activated carbon (GAC)-amended sand; SediMite and AquaGate+PAC all with the goal of applying activated carbon to the sediment at rates of 1, 3, and 5% (AECOM, 2021a). Porewater concentrations were measured in each sample for total PCBs. Results show that both SediMite and AquaGate+PAC provided substantial reductions in porewater concentrations for all activated carbon dose rates. Reductions in porewater concentrations for SediMite and AquaGate+PAC for the 1%/3%/5% doses were 68%/87%/94% and 81%/98%/99%, respectively. These data show that there appear to be no site-specific conditions within the sediment that would limit the effectiveness of SediMite or AquaGate+PAC in the Cove. While GAC in sand did not exhibit nearly the same porewater concentration reductions (31%/9%/18%), the results suggest reductions are possible albeit not as significant as with the other materials.

[5] "Soil" refers to use of clean top-soil or organic-rich materials as a capping material.

[6] Retained only for management of any wet/dredged sediments.

4.4 Restoration

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Action (RA) process, a site need not be restored to pre-release conditions as long as post-remediation conditions protect against unacceptable risks to human health or the environment from any remaining contaminants. However, as a matter of permit conditions and other regulatory requirements, any disturbed surfaces typically must be restored to their pre-disturbed conditions. Such restoration is referred to as baseline restoration. The purpose of such baseline restoration in the Cove would be to re-establish existing characteristics and habitats to restore regulated resource areas and ecological function disturbed by temporary impacts from remedial activities.

Another type of ecological restoration, which is typically not part of the CERCLA remedial action process, is performed in response to natural resource damages caused by the release of a hazardous substance or oil. In contrast to the baseline restoration under the CERCLA RA process, NRDAR restoration is not focused on controlling risk, but is focused instead on compensating for lost ecosystem services from damage to natural resources by replacing or enhancing those resources (https://www.doi.gov/restoration/primer/remedial). For the Anacostia River, the natural resource trustees (the District, NPS, USFWS, and the National Oceanic and Atmospheric Administration) recently began the process of assessing the nature and extent of natural resource damages resulting from the release of contaminants to the river. Once the damages have been assessed and quantified, the Trustees will seek compensation from responsible parties. Any NRDAR-restoration must align with the district master plan. The process for such restoration may not align with the FFS timeframe. Therefore, this FFS addresses baseline restoration only and NRDAR-restoration (to the extent it is focused on the Cove at all) is deferred until after the damage assessment is completed by the Trustees.

The revised evaluation of alternatives will reflect a preference for less invasive remediation technologies per DOEE Natural Resource Administration (NRA) guidance (21 DCMR §2605 and 21 DCMR 2606 ((DOEE, 2020a), and an emphasis on restoration elements that improve the stability of Cove remedy (e.g., construction of plunge pools and drainage channels, armoring of certain areas susceptible to erosion, and replanting of preserved vegetation). The baseline restoration of remediated areas would include establishing, restoring, and maintaining an ecological system of similar physical and functional type to that which existed prior to implementation of remedial response actions. In keeping with best resource management practices, the alternatives will avoid or minimize temporary and permanent impacts to the extent practicable. To the extent that remedial activities result in permanent impacts to regulated resources, a 2:1 mitigation may be required regardless of the acreage. The project will obtain necessary approvals (in accordance with 21 DCMR Chapters 25 and 26) and address resource impacts and restoration activities associated with these approvals.

4.5 Summary of Assembled Remedial Alternatives

Combinations of the retained GRAs and associated technologies/process options for Cove sediment provided in Section 4.3 are considered in assembling remedial alternatives. Within each assembled alternative, additional options are included for cap materials, AC product to be used for in-situ treatment, and extent of dredging to facilitate screening of the different options for effectiveness using CapSim. In addition, all assembled remedial alternatives include baseline restoration as described in Section 4.4.

Remedial Action Alternatives for WIA Cove Sediment

- **WIA-1:** No Action
- **WIA-2:** Partial Capping (2.3 acre), and Limited Dredging and Capping (0.2 acres)
  - Capping of areas outside of aquatic vegetation
  - Dredging of sediments and capping in polygon SED7G.
  - No treatment over 1.2 acres of area with aquatic vegetation.
- **WIA-3:** Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)
  - Capping of majority of the Cove, including areas with aquatic vegetation
  - Dredging of sediments and capping in polygon SED7G.
- **WIA-4:** In-Situ Treatment (3.5 acres) and Limited Dredging with Capping (0.2 acres)
  - In-situ treatment using SediMite or AquaGate+PAC over majority of the Cove, including areas with aquatic vegetation.
  - Dredging of sediments and capping in polygon SED7G.
- **WIA-5:** Dredging of the Entire Cove (3.7 acres) and Capping
  - Dredging of sediments in the 0-1 ft. interval across the entire Cove and capping
- **WIA-6:** In-Situ Treatment (over 2.5 acres) with Dredging and Capping (over 1.2 acres)
  - In-situ treatment using SediMite or AquaGate+PAC over majority of the Cove, including areas with aquatic vegetation.
  - Dredging of sediments and capping in the remaining part of the Cove.

Additional screening of the foregoing assembled alternatives is discussed in Section 5, followed by detailed evaluation of the retained alternatives in Section 6.0.

5 Description and Screening of Assembled Remedial Alternatives

The assembled remedial alternatives summarized in Section 4.5 were further screened using the following criteria: effectiveness, implementability, and cost as per EPA's RI/FS guidance (USEPA, 1988).

Effectiveness

This criterion evaluates the effectiveness of the assembled remedial alternative for protecting human health and the environment.

Implementability

This criterion evaluates the technical and administrative feasibility of construction, operation, and maintenance of the assembled remedial alternatives.

Cost

This criterion evaluates the costs of remedial alternatives and is intended to be within -50% to 100% of the detailed evaluation cost estimate. Costs include both capital costs and operation and maintenance (O&M) costs. Due to uncertainties in the screening-level cost estimates, this criterion is used as a comparative metric and is not being used to screen out any alternative.

5.1 Effectiveness Evaluation for Assembled Alternatives

The effectiveness of the assembled alternatives was evaluated using CapSim v4.2, a software for simulating transient contaminant transport in sediments and caps, developed by the Reible Research Group at Texas Technical University (Shen et al., 2023). The evaluation was performed for the remedial actions to be implemented under each scenario for each alternative.

The model was populated with site-specific inputs to the extent that data are available, including grain size distribution, organic carbon content, initial surface water and porewater concentration, groundwater upwelling velocity, BAZ depth etc. The model was simulated for a period of 100 years for each of the different assembled alternatives to yield the predicted porewater concentration of PCBs in BAZ post-remediation. For each assembled alternative, simulations were performed using the minimum, average, 95% UCL, and the maximum PCB porewater concentration detected in the Cove as the initial porewater concentration in the surface sediments. For each of the above sub-scenarios, an average post-remediation porewater concentration in the BAZ was calculated by averaging the predicted concentration in the top 10 cm of the sediment/cap layer. Relationships between the initial porewater concentration and the predicted post-remediation porewater concentrations for each of the sub-scenarios were used to estimate model-predicted porewater concentration for each polygon in the Cove. Finally, these predicted porewater concentrations in each polygon were combined with the respective surface area to calculate a post-remediation surface area-weighted porewater concentration for the entire Cove. The post-remediation surface area-weighted concentration for each assembled alternative and their sub-scenarios was compared to the 0.64 ng/L porewater criterion to evaluate the effectiveness of the alternative. A summary of the post-remediation surface area weighted average porewater concentration in the Cove based on CapSim modeling results is presented in the table below.

Alternative #	Scenario	Description	Surface Area Weighted Average PCB Concentration in BAZ Porewater at end of 100 years (ng/L)
WIA-2	N/A	CapSim evaluation not conducted as this scenario was deemed infeasible to implement.	Not Evaluated
WIA-3	3A	Sand Cap (1 ft.)	0.62
	3B	Sand + Soil Cap (1 ft.)	1.9E-03
	3C	Sand Cap w/ 1% AC (1 ft.)	3.8E-04
WIA-4	4A	5% AC Dose via SediMite	0.44
	4B	5% AC Dose via AquaGate + PAC	0.40
WIA-5	5A	Dredging of Entire Cove (0-1 ft) + Sand Cap (1 ft.)	5.63
	5B	Dredging of Entire Cove (0-1 ft) + Additional Dredging (1-3 ft.) at SED6.5E + Sand Cap (1ft.)	2.92
	5C	Dredging of Entire Cove (0-1 ft) + AC-Amended Sand Cap (1 ft.)	3.1E-03
	5D	Dredging of Entire Cove (0-1 ft) + Sand + Soil Cap (1 ft.)	0.024
WIA-6	6A	AC Treatment w/ SediMite + Dredging (0-1 ft.) + Capping w/ Sand + Soil	0.22
	6B	Treatment w/ AquaGate+PAC + Dredging (0-1 ft.) + Capping w/ Sand + Soil	0.19

Notes:

1) Cells highlighted in yellow indicate that SWAC of PCB in porewater of BAZ exceeds the 0.64 ng/L porewater target.
2) Cells highlighted in orange indicate that the SWAC of PCB in porewater of BAZ is within 10% of the 0.64 ng/L porewater target and is thus deemed to be not effective.

Additional sensitivity runs will be evaluated during the remedial design to confirm the required carbon dosage for the in-situ treatment, including but not limited to examining the maximum porewater concentration.

5.2 Screening of Assembled Alternatives for WIA Cove Sediment

5.2.1 WIA-1: No Action

This alternative does not include any remedial action for reducing porewater PCB concentrations in Cove sediments. Some ICs, such as the existing fish consumption advisory and NPS permitting requirements for activities that disturb the sediments, will continue to be implemented as these are applicable for the Anacostia River and are not directly implemented by Pepco.

Effectiveness: This alternative would not be effective in achieving the RAO as no remedial action would be implemented to reduce porewater PCB concentrations in the Cove sediments.

Implementability: This alternative would be easy to implement from both technical and administrative standpoints as no remedial actions would be carried out and no ICs would be implemented by Pepco.

Cost: There is no cost associated with this alternative as no remedial actions would be carried out and no ICs would be implemented.

Conclusion

Although WIA-1 would not be effective in achieving the RAO, it has been retained for detailed analysis to serve as a baseline for comparison with other remedial alternatives.

5.2.2 WIA-2: Partial Capping (2.3 acres), and Limited Dredging and Capping (0.2 acres)

This alternative involves partial capping of the Cove sediments with 1 ft. of suitable capping material, along with dredging and capping over a limited area of the Cove, followed by baseline restoration. Capping would be performed over the part of the Cove with no aquatic vegetation and marshes present (approximately 2.3 acre) to minimize ecological impacts. For feasibility evaluation, it was assumed that no remedial actions would be conducted in polygons SED7E, SED7.5E, SD7F, and approximately half of SED7.5D, comprising an area of approximately 1.2 acres. This 1.2 acres area provides a buffer zone around the aquatic vegetation. Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand.

Approximately 4400 CY of capping material (e.g., sand, AC-amended sand, or sand-soil mixture) would be required over the 2.3 acre extent of capping. Approximately 320 CY of sediments would be dredged from SED7G, requiring an equivalent volume of AC-amended sand. In addition, approximately 300 CY of sediment would be dredged from the Cove for construction of outfall plunge pools and drainage channels.

This alternative would result in a difference in elevation of 1 ft. between the capped and uncapped areas of the Cove sediments.

Effectiveness: A CapSim evaluation for this alternative was not performed as it was deemed infeasible to implement in the Cove (discussed further under “Implementability” criterion below). However, the results from other scenarios generally show that remedial action needs to be implemented across the entire Cove to achieve the 0.64 ng/L porewater criterion. Based on these results, partial capping of the Cove is deemed not effective at achieving the RAOs.

Implementability: Capping is a well-developed and frequently used technique for contaminated sediments. Equipment, personnel, and services needed for implementation are generally readily available. However, this alternative would result in a difference in elevation of 1 ft. between the capped and uncapped areas of the Cove sediments, and this difference in elevation is expected to alter hydrodynamic and ecological conditions in the Cove. Difference in elevation may also cause the cap to subside, potentially impacting the aquatic vegetation as well as exposing the impacted sediments under the cap. While a relatively small volume of sediment would be dredged/excavated, excavation in SED7G would result in impact to the aquatic vegetation in this polygon, potentially requiring mitigation. Obtaining necessary permits and regulatory clearances is expected to be difficult owing to the issues identified above. Some challenges are anticipated with technical implementability due to limited area available for equipment and material staging on the land side and within the Cove. Thus, this alternative is regarded as difficult to implement from both technical and administrative perspectives.

Cost: Total capital cost associated with this alternative is anticipated to be moderate. Direct capital costs for this alternative would be associated with site preparation (including clearing and grubbing, Cove dewatering, installation of portadam/cofferdams, turbidity controls), sediment removal, material and placement costs for the sand cap, sediment dewatering, water treatment and disposal, stabilization, and disposal, and baseline restoration. Indirect capital costs would be associated with project management, remedial design, permitting, construction management, agency review, and monitoring during implementation. O&M costs after remedy implementation are anticipated to be moderate and would comprise periodic reviews and sampling, monitoring, and cap repair and maintenance.

Conclusion

Based on the effectiveness and implementability screening evaluation described above, alternative WIA-2 has not been retained for detailed analysis.

5.2.3 WIA-3: Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)

This alternative involves capping the sediments in nearly the entire Cove with 1 ft. of suitable capping material and performing baseline restoration. Prior to capping the sediments, the existing aquatic vegetation would be removed from the Cove, cleaned on-site to remove any sediments and debris, and preserved in a nursery or a greenhouse. Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. The cap would be installed over the remaining 3.5 acres of the Cove. Overall, this alternative would require approximately

6600 CY of capping material. Results of CapSim modeling indicate that a 1 ft. thick sand-soil dual layer cap or a 1 ft. thick AC-amended sand cap placed over 3.5 acres of the Cove could result in a post-remediation PCB concentration of <0.64 ng/L in the porewater of the BAZ. Similarly, dredging and placement of an AC-amended sand cap in SED7G would be effective at maintaining porewater concentration in BAZ of this polygon below 0.64 ng/L. This alternative would involve dredging nearly 620 CY of sediment from the Cove, including 320 CY of sediment dredged from SED7G, and another 300 CY dredged for construction of outfall plunge pools and drainage channels. After installation of the cap, the vegetation would be replanted over the cap.

Effectiveness: CapSim evaluations performed for a sand cap, sand-soil dual layer cap, and AC-amended sand cap, along with dredging and capping in SED7G, showed that concentrations of PCBs in porewater of BAZ can be maintained below 0.64 ng/L for at least 100 years with either the sand-soil combination cap or the AC-amended sand cap. The sand cap alone was not predicted to meet the porewater target and was eliminated from consideration as a capping material under this alternative. While all capping materials considered under this alternative would isolate the underlying impacted sediments and provide a clean BAZ for benthic organisms, only sand-soil and AC-amended sand were predicted to be effective in meeting the long term porewater criterion. Incorporating AC in the cap is also expected to reduce the potential for recontamination of the cap from depositing sediments by providing additional sorption capacity for PCBs in the short to medium term. A sand-soil dual layer cap with top layer of soil is expected to provide a better habitat for benthic organisms that sand alone, while also reducing the potential for recontamination due to the high organic carbon content of the soil. Thus, this alternative would be effective at reducing exposure to PCBs from impacted sediments.

Implementability: Capping using sand-soil layer cap or using AC-amended sand is a well-developed and frequently used technique for contaminated sediments. Equipment, personnel, and services needed for implementation are generally readily available. A relatively small volume of sediment would be dredged/excavated under this alternative. Some impact on the hydrodynamics and ecological conditions of the Cove is anticipated under this alternative as it would result in a difference in elevation of 1 ft. between the capped area of the Cove and the SED7G polygon. Difference in elevation may also cause the cap to subside, potentially impacting the aquatic vegetation in SED7G as well as exposing the impacted sediments under the cap. However, excavation in SED7G would impact the aquatic vegetation in this polygon, potentially requiring mitigation. This alternative includes removal and replanting of the existing aquatic vegetation in the Cove, which would entail cleaning of the vegetation to remove any attached sediment/debris on-site and finding a suitable location for preserving the vegetation till the capping activities are complete. In addition, there are uncertainties about whether the replanting process will be successful. Assuming a 2:1 wetland mitigation ratio applies, mitigation of approximately 1.8 acres of wetlands may be required even if replanting is successful. Obtaining necessary permits and regulatory clearances is expected to be difficult due to the vegetation removal aspect of this alternative. Furthermore, some challenges are anticipated with technical implementability due to limited area available for equipment and material staging on the land side and within the Cove. Thus, this alternative is regarded as moderate-to-difficult on both technical and administrative implementability criteria.

Cost: Total capital cost associated with this alternative is anticipated to be moderate. Direct capital costs for this alternative would be associated with site preparation (including clearing and grubbing, Cove dewatering, installation of portadam/cofferdams, turbidity controls), vegetation removal and preservation, sediment removal, material and placement costs for the amended sand cap, sediment dewatering, water treatment and disposal, stabilization, and disposal, and baseline restoration, including replanting of the vegetation. Indirect capital costs would be associated with project management, remedial design, permitting, construction management, agency review, wetland mitigation, and monitoring during implementation. O&M costs after remedy implementation are anticipated to be moderate and would comprise periodic reviews and sampling, monitoring, and cap repair and maintenance.

Conclusion

Based on the effectiveness and implementability screening evaluation described above, alternative WIA-3 has been retained for detailed analysis.

5.2.4 WIA-4: In-Situ Treatment (3.5 acres) and Limited Dredging with Capping (0.2 acres)

This alternative involves in-situ treatment of the majority of the sediments in the Cove with commercially available AC-containing products such as SediMite or AquaGate+PAC 10%, along with selective dredging and capping in a small area of the Cove. These remedial actions would be followed by baseline restoration. Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. AC would be applied across the remaining area of the Cove (approximately 3.5 acres).

Products such as SediMite and AquaGate+PAC are typically applied to surface sediments as a thin layer and rely on bioturbation and breakdown of AC into smaller particles for distribution in the BAZ. Based on the TS results, SediMite and AquaGate+PAC 10% reduced the concentration of PCBs in the porewater by 68% (1% AC as SediMite) to 99% (5% AC as AquaGate) compared to untreated controls. Corresponding reductions in bioaccumulation of PCBs in worm tissues exposed to treated sediments ranged from 30% (1% AC as SediMite) to 99% (5% AC as AquaGate) compared to untreated controls. Consistent with these findings from the TS, the CapSim modeling predicts that application of 5% AC dose as either SediMite or AquaGate would keep the PCB concentration in porewater of the BAZ below the 0.64 ng/L criterion for at least 100 years on a surface weighted average basis. Exact AC dose to be applied and selection of the actual product would be decided during the remedial design phase.

In SED7G, dredging of sediments in the 0-1 ft. layer would be followed by capping with area with AC-amended sand cap. This is proposed to address any migration of PCBs from the sub-surface sediments to the rip-rap in the plunge pools that would be constructed in this area of the Cove. The CapSim evaluation predicts that an AC-amended sand cap applied after dredging the sediments in the 0-1 ft. interval would maintain the porewater concentrations in the BAZ below the 0.64 ng/L criterion.

This alternative would involve dredging nearly 620 CY of sediment from the Cove, including 320 CY of sediments being dredged from SED7G, and another 300 CY dredged for construction of outfall plunge pools and drainage channels.

Effectiveness: This alternative would be effective in achieving the RAO. The CapSIM modeling predicts that a 5% AC dose (applied as either SediMite or AquaGate+PAC 10%) and dredging and capping in SED7G would be effective at keeping PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years on a surface weighted average basis. Results from the TS also demonstrate that the remedy would be effective in reducing bioaccumulation in benthic organisms.

Implementability: AC-amendments for in-situ treatment of PCB-impacted sediments, and dredging and capping are both well-developed technologies, for which the equipment, personnel, and services needed are generally readily available. Obtaining necessary permits and regulatory clearances is expected to be moderately difficult as this alternative would result in removal of approximately 5000 sq. ft of aquatic vegetation, likely requiring some mitigation. Some challenges are anticipated with technical implementability due to limited area available for equipment and material staging on the land side and within the Cove. Thus, this alternative is regarded as easy-to-moderate on the technical implementability criterion and moderate-to-difficult on the administrative implementability criterion.

Cost: Total capital cost associated with this alternative is anticipated to be low-to-moderate. Direct capital costs for this alternative would be associated with site preparation (including clearing and grubbing, Cove dewatering, installation of portadam/cofferdams, turbidity controls), sediment removal, amendment material and application costs, sediment dewatering, water treatment and disposal, stabilization, and disposal, and baseline restoration. Indirect capital costs would be associated with project management, remedial design, permitting, construction management, agency review, wetland mitigation costs, and monitoring during implementation. O&M costs after remedy implementation are anticipated to be moderate and would comprise periodic reviews and sampling, monitoring, and cap repair and maintenance.

Conclusion

Based on the effectiveness and implementability screening evaluation described above, alternative WIA-4 has been retained for detailed analysis.

5.2.5 WIA-5: Dredging of the Entire Cove and Capping

This alternative involves dredging of sediments in the entire Cove via mechanical dredging or dry excavation techniques, following which the underlying sediments area would be capped. Prior to dredging, the existing aquatic vegetation would be removed and preserved off-site in a nursery or greenhouse. After completion of the capping activities, the vegetation would be replanted in the Cove as part of baseline restoration.

In mechanical dredging, an excavator or a crane is brought to the site on a barge and utilizes buckets or clamshell-style buckets to remove the target sediments. Removed sediments are loaded onto an adjacent barge which, when full, is brought to a designated location for unloading. In dry excavation, sediments are removed by an excavator and can be performed on near shore sediments that are exposed during low tides or by setting up a cofferdam around the work area and pumping out the water to expose the target sediments.

Four separate scenarios were evaluated using the CapSim model for this alternative.

- 5A - Dredging of Entire Cove (0-1 ft) + Sand Cap (1 ft.)
- 5B - Dredging of Entire Cove (0-1 ft) + Additional Dredging (1-3 ft.) at SED6.5E + Sand Cap (1ft.)
- 5C - Dredging of Entire Cove (0-1 ft) + AC-Amended Sand Cap (1 ft.)
- 5D - Dredging of Entire Cove (0-1 ft) + Sand+Soil Cap (1 ft.)

All scenarios involve dredging of the entire Cove to a depth of 1 ft., while scenario 5B also includes additional dredging in the SED6.5E polygon to a depth of 3 ft. (corresponding to the location and depth of the highest existing porewater concentration in the sub-surface sediments). Under all scenarios, dredging of sediments in the 0-1 ft. layer of SED7G would be followed by capping with area with AC-amended sand cap. This is proposed to address any migration of PCBs from the sub-surface sediments to the rip-rap in the plunge pools that would be constructed in this area of the Cove. With regards to capping, three different types of caps were evaluated: a) sand cap; b) AC-amended sand cap, and c) sand + soil cap.

Results of the CapSim evaluation for the above four scenarios showed that only 5C and 5D were predicted to meet the 0.64 ng/L porewater target for PCB concentrations in the Cove BAZ on a surface weighted average basis. Dredging under both these scenarios, including dredging for creation of outfall plunge pools and drainage channels, would result in 6300 CY of dredged sediment, and would require 6000 CY of capping material. It is expected that WIA-5B also would satisfy the 0.64 ng/L porewater target if this alternative were modified to include a sand + soil cap (although this scenario was not evaluated as part of the CapSim modeling). However, WIA-5D (dredging and capping with sand+soil) already meets the performance criterion without any need for additional dredging of deeper sediments as specified for WIA-5B. Therefore, a possible modification to WIA-5 to include a sand+soil cap was not evaluated.

Effectiveness: Dredging of the entire Cove to a depth of 1 ft. bgs followed by capping of the underlying sediments with either AC-amended sand (5C) or sand-soil mix (5D) could be effective at maintaining PCB concentration in porewater in the BAZ below the 0.64 ng/L criterion for at least 100 years on a surface weighted average basis, thereby reducing exposure from the Cove sediments. The alternative would also permanently remove 6300 CY of PCB-impacted surface sediment from the Cove. Placement of a clean cap would also replace the existing BAZ and isolate any impacted sub-surface sediments. Incorporating AC in the cap is also expected to reduce the potential for recontamination of the cap from depositing sediments by providing additional sorption capacity for PCBs in the short to medium term. A sand-soil dual layer cap with top layer of soil is expected to provide a better habitat for benthic organisms that sand alone, while also reducing the potential for recontamination due to the high organic carbon content of the soil. Thus, this alternative would be effective at reducing exposure to PCBs from impacted sediments.

Implementability: Mechanical dredging and capping are both commonly used process options for remediation of impacted sediments. Materials, equipment, and personnel required for implementation are generally readily available. However, dredging of the entire Cove is expected to produce a 6300 CY of sediments that would need substantial area for management including dewatering and stabilization. Dredged sediments typically contain a high percentage of water, and thus, considerable water management as well as treatment systems for the same are expected to be needed. The area within and around the Cove is likely to be insufficient for staging the dewatering and water treatment systems, as well as for other equipment and materials required as part of this alternative. In addition, considerable area would be needed for staging the backfill materials. Some challenges are thus anticipated with technical implementability due to limited area available for equipment and material staging on the land side and within the Cove. This alternative includes removal and replanting of the existing aquatic vegetation in the Cove, which would entail cleaning of the vegetation to remove any attached sediment/debris on-site and finding a suitable location for preserving the vegetation till the capping activities are complete. In addition, there are uncertainties about whether the replanting process will be successful. Assuming a 2:1 wetland mitigation ratio applies, mitigation of approximately 1.8 acres of wetlands may be required even if replanting is successful. Obtaining necessary permits and regulatory clearances is expected to be difficult due to potential impacts on aquatic vegetation of the Cove. Thus, this alternative is regarded as difficult to implement from both technical and administrative perspectives.

Cost: Total capital cost associated with this alternative is anticipated to be very high. Direct capital costs for this alternative would be associated with site preparation (including clearing and grubbing, turbidity controls), dewatering and installation of portadam/cofferdams, sediment removal, cost of capping materials and placement, sediment dewatering, stabilization, water treatment, sediment and water disposal, and baseline restoration. Indirect capital costs would be associated with project management, remedial design, permitting, construction management, agency review, wetland mitigation, and monitoring during implementation. O&M costs after remedy implementation are anticipated to be low and would comprise periodic reviews and sampling, monitoring, and cap repair and maintenance.

Conclusion

Alternative WIA-5 has been retained for detailed analysis.

5.2.6 WIA-6: In-Situ Treatment (over 2.5 acres) with Dredging and Capping (over 1.2 acres)

This alternative represents a combination of WIA-4 and WIA-5, wherein sediments over 2.5 acre area of Cove are treated with AC-containing, commercially available products such as SediMite or AquaGate+PAC, while sediments in the remaining 1.2 acres of the Cove are dredged to a depth of 1 ft. bgs and capped with either AC-amended sand or a sand-soil cap.

Dredging would be primarily conducted in polygons along the mouth of the Cove, specifically, in SED8C, SED7.5C, SED7B, SED6.5C, and part of SED7D. In addition, sediments in SED7G would also be dredged. The remaining polygons would be treated with a 5% AC dose, delivered as either SediMite or AquaGate+PAC 10%. These specified areas for dredging and in-situ treatment have been developed with the aims of minimizing the extent of dredging (considering the challenges with limited availability of space around the Cove) and reducing impact on the existing aquatic vegetation, while still meeting the 0.64 ng/L criterion for PCBs in porewater. The areas of the Cove to be dredged under this alternative were determined based on the initial porewater concentration in the surface sediments in each of the polygons. The modeled initial porewater concentrations SED6.5C and SED7.5C were 2.4 and 2.2 times higher than the modeled or measured initial porewater concentrations in all other polygons (other than SED7G). Thus, SED6.5C and SED7.5C were selected for dredging. For constructability reasons, part of polygon SED7D (which lies between SED6.5C and SED7.5C), and both SED8C and SED7B (which are adjacent to SED6.5C and SED7.5C) were also selected for dredging. SED6.5D and SED6C each had comparatively low concentrations of total PCBs in the porewater (2.8 ng/L and 2.5 ng/L, both measured), and thus, were not selected for dredging. The overall areas selected for dredging and for in-situ treatment thereby represent optimized extents based on the following considerations:

- Minimizing impact on existing aquatic vegetation by maximizing the extent of in-situ treatment
- Optimizing the extent of dredging based on limited availability of space, initial porewater concentrations, and dredging and capping constructability considerations

Sediments in 1.2 acres of the Cove would be dredged to a depth of 1 ft. bgs, via mechanical means or under dry conditions. Underlying sediments in the dredged area would be capped with 1 ft. of clean material. Dredging of sediments in the 0-1 ft. layer of SED7G would be followed by capping with area with AC-amended sand cap. This is proposed to address any migration of PCBs from the sub-surface sediments to the rip-rap in the plunge pools that would be constructed in this area of the Cove. Options for capping material for the remaining 1 acre of the Cove include AC-amended sand and sand-soil mix, both of which were evaluated under WIA-5 and found to be effective.

Following dredging, capping, and AC treatment, baseline restoration would be performed.

Various options are possible under this alternative, depending upon the AC product used and the material used for capping. CapSim evaluations for in-situ treatment (under WIA-4) and for dredging and capping (under WIA-5) showed that both remedies are predicted to meet the RAO, and thus would meet the RAO when used in combination under WIA-6. Both SediMite and AquaGate+PAC 10%, in combination with dredging and capping with either AC-amended sand or sand-soil mixture were able to meet the 0.64 ng/L porewater target for PCBs in the Cove BAZ on a surface weighted average basis.

Dredging under both these scenarios, including dredging for creation of outfall plunge pools and drainage channels, would result in approximately 3360 CY of dredged sediment, and would require approximately 3070 CY of capping material. Approximately 5000 sq. ft. of mixed high and low march vegetation is present in the SED7G polygon, and removal and replanting of the vegetation in SED7G polygon is included under this alternative.

Effectiveness: Dredging of 1.2 acres of the Cove to a depth of 1 ft. bgs followed by capping of the underlying sediments with either AC-amended sand or sand-soil mix, in combination with in-situ treatment with 5% AC dose across 2.5 acres of the Cove would be effective in achieving the RAO. CapSIM modeling predicts that all potential scenarios possible under this alternative would be effective at keeping the surface weighted average PCB concentration in the porewater of the BAZ below the 0.64 ng/L criterion for at least 100 years, thus reducing exposure from the Cove sediments. The alternative would also remove 3360 CY of PCB-impacted surface sediment from the Cove. Placement of a clean cap would also replace the existing BAZ and isolate any impacted sub-surface sediments. Incorporating AC in the cap is also expected to reduce the potential for recontamination of the cap from depositing sediments by providing additional sorption capacity for PCBs in the short to medium term. A sand-soil dual layer cap with top layer of soil is expected to provide a better habitat for benthic organisms than sand alone, while also reducing the potential for recontamination due to the high organic carbon content of the soil. Both SediMite and AquaGate+PAC 10% were evaluated in the TS and using CapSim for WIA-4 and found to be effective at meeting the 0.64 ng/L porewater target. Thus, this alternative would be effective at reducing exposure to PCBs from impacted sediments.

Implementability: Mechanical dredging and capping, and in-situ treatment via AC are both commonly used process options for remediation of impacted sediments. Materials, equipment, and personnel required for implementation are generally readily available. However, dredging of 1.2 acres of the Cove is expected to produce approximately 3360 CY of sediments that would need substantial area for management including dewatering and stabilization. Dredged sediments typically a high percentage of water, and thus, considerable water management as well as treatment systems for the same are expected to be needed. In addition, considerable area would be needed for staging AC-based products. The area within and around the Cove is likely to be insufficient for staging the dewatering and water treatment systems, as well as for other equipment and materials required as part of this alternative. Some challenges are thus anticipated with technical implementability due to limited area available for equipment and material staging on the land side and within the Cove. Obtaining necessary permits and regulatory clearances is expected to be somewhat difficult as this alternative would result in removal of approximately 5000 sq. ft of aquatic vegetation. Thus, this alternative is regarded as moderately difficult to implement from both technical and administrative perspectives.

Cost: Total capital cost associated with this alternative is anticipated to be high. Direct capital costs for this alternative would be associated with site preparation (including clearing and grubbing, turbidity controls), dewatering and installation of portadam/cofferdams, sediment removal, cost of capping and treatment materials and placement, sediment dewatering, stabilization, water treatment, sediment and water disposal, and baseline restoration. Indirect capital costs would be associated with project management, remedial design, permitting, construction management, agency review, and monitoring during implementation. O&M costs after remedy implementation are anticipated to be low and would comprise periodic reviews and sampling, monitoring, cap repair and maintenance, and amendment replenishment.

Conclusion

Alternative WIA-6 has been retained for detailed analysis.

5.3 Summary of Assembled Alternatives Retained for Detailed Evaluation

Based on the effectiveness, implementability, and cost screening discussed in Section 5.1, the following alternatives have been retained for detailed evaluation.

Remedial Action Alternatives for WIA Cove Sediment

- **WIA-1:** No Action
- **WIA-3:** Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)
- **WIA-4:** In-Situ Treatment (3.5 acres) and Limited Dredging with Capping (0.2 acres)
- **WIA-5:** Dredging of the Entire Cove (3.7 acres) and Capping
- **WIA-6:** In-Situ Treatment (over 2.5 acres) with Dredging and Capping (over 1.2 acres)

A summary of the comparative evaluation discussion is presented in **Table 5-1**.

6 Detailed Evaluation of Assembled Alternatives

The Remedial Action Alternatives (RAAs) developed in Section 5 are subjected to detailed analysis in this section. The RAAs use combinations of active remedial approaches (e.g., dredging, capping, in-situ treatment, etc.) and passive approaches (e.g., institutional controls) to achieve the RAO. In this section, the individual RAAs are evaluated against CERCLA evaluation criteria.

6.1 CERCLA Evaluation Criteria

The NCP and USEPA RI/FS Guidance (USEPA, 1988) requires consideration of nine evaluation criteria in the detailed analysis of alternatives. These nine criteria fall into three distinct categories: Threshold Criteria, Primary Balancing Criteria, and Modifying Criteria. The two "threshold criteria" are protection of human health and the environment, and compliance with the ARARs. RAAs that met the "threshold criteria" are then evaluated according to the five "primary balancing criteria," which include (i) long-term effectiveness and permanence, (ii) reduction of toxicity, mobility, or volume through treatment, (iii) short-term effectiveness, (iv) implementability, and (v) cost. The final two remedy evaluation criteria are "modifying criteria" and include regulatory agency acceptance and community acceptance.

Each alternative is evaluated individually and comparatively against the first seven evaluation criteria. The "modifying criteria" are assessed following the review of the FFS and Proposed Plan by DOEE and consideration of public comment. Agency and public comments are fully addressed in the Record of Decision. Descriptions of each of the nine remedy evaluation criteria are provided below.

1. <u>Overall Protection of Human Health and the Environment</u>: This criterion evaluates whether each alternative provides adequate protection of human health and the environment. This criterion also examines how each alternative manages the site risks in accordance with the RAO.

2. <u>Compliance with ARARs</u>: This criterion evaluates whether each alternative complies with ARARs identified in **Table 3-1**. All RAAs that undergo detailed evaluation are designed to comply with the ARARs through permitting and regulatory reviews of the proposed remedial action.

3. <u>Long-Term Effectiveness and Permanence</u>: This criterion evaluates the magnitude of residual risk that may remain after implementation of an alternative, as well as the adequacy and reliability of controls that may be required to manage the residual risk. This criterion also evaluates long-term monitoring and maintenance requirements.

4. <u>Reduction of Toxicity, Mobility, or Volume Through Treatment</u>: This criterion is used to assess the degree to which an RAA reduces toxicity, mobility, or volume through treatment.

5. Short-Term Effectiveness: This criterion evaluates the effects on human health and the environment during the construction and implementation phase. This criterion also evaluates protection of the community and workers, potential environmental impacts, and planned mitigation until the RAOs are achieved.

6. Implementability: This criterion evaluates the technical and administrative feasibility of implementing each alternative. Technical feasibility relates to the ability of an alternative to be constructed and operated, the reliability of the technology, and whether it can accommodate phased implementation or modifications based on ongoing monitoring. Administrative feasibility considers ability and time required to obtain the necessary approvals and permits and the activities requiring coordination with other services (including off-site treatment, storage, and disposal facilities), equipment, specialists, services, materials, and prospective technologies.

7. Cost: This criterion evaluates the cost of each alternative. Typically, these cost estimates are expected to provide an accuracy of +50 to -30%, and are prepared using available data. They do not represent actual construction cost estimates or real costs at completion. The cost estimates include capital and annual/periodic O&M costs with a 30% contingency. Professional/technical services are estimated as a percentage of the direct capital cost consistent with the USEPA feasibility-study guidance (USEPA, 1988) and include project management and agency review and oversight. Long-term costs are estimated over a 30-year period, and net present worth costs are calculated using a 3% discount rate (determined by Pepco[7]). Key assumptions used for developing cost estimates are provided in **Appendix A**.

8. Regulatory Agency Acceptance: This criterion evaluates the technical and administrative issues and comments that the regulatory agency may have regarding each of the alternatives. This criterion is evaluated in connection with the Proposed Plan.

9. Community Acceptance: This criterion evaluates the issues and concerns the public may have regarding each of the alternatives. This criterion is addressed in the ROD once comments on the Proposed Plan have been received.

A No Action alternative is included as part of alternative evaluation. The No Action alternative does not include any remedial activities or institutional controls and would not achieve the RAO in a reasonable

[7] For commercial entities and for profit corporations, the discount rate will be company-specific as it is related to how the company gets its funds. It is the rate of return that the investors expect or the cost of borrowing money. Pepco determined its company-specific discount rate to be used in the present worth calculations to be 3%. This is also in line with the long-term average published by OMB.

timeframe, but the NCP and CERCLA require consideration of the “no action” alternative as a baseline for comparison of the other GRAs/alternatives. Since the No Action alternative does not meet the threshold criteria (Overall Protection of Human Health and the Environment, and Compliance with ARARs), No Action alternatives are not evaluated for balancing criteria.

6.2 Site-Specific Considerations

This section provides an evaluation of site-specific conditions as they apply to the evaluation criteria. As part of the FFS process, Pepco identified the need to conduct a treatability study (AECOM, 2021) involving both field investigations and bench scale studies to support the evaluation of GRAs for the Cove. This section includes a compilation of site-specific considerations based on the information collected during the remedial investigation and treatability study.

6.2.1 River Features in the Cove Vicinity

A federal navigational channel exists within the WIA outside of the Cove. The authorized channel in this area is part of the overall Anacostia River channel connecting Bladensburg marina with the lower Anacostia channel to the CSX bridge and downstream. The authorized channel within the WIA is 60 feet wide and 8 feet deep (DOEE, 2019b). Current depths of the channel are shown on **Figure 2-8**. The channel depths are at or near the authorized depths. Areas between the navigational channel and the Cove have a water depth between -4 and -10 feet below MLLW. The federal navigation channel authorized depth is relative to mean lower low water. Water depth decreases rapidly near the mouth of the Cove. It may be possible to place temporary moorings in this area just south of the Cove to allow for remedy construction materials to be brought by barge.

6.2.2 Institutional Controls on Waterside

Fish consumption was identified as the primary human health risk driver for the ARSP. PCBs in fish tissue is a regional issue with similar elevated fish tissue concentrations in other reaches of the Anacostia River and in the Potomac River. DOEE administers regional fish consumption advisories to address this human health risk. The United States owns the Anacostia River bottom and NPS regulates construction activities or sediment disturbances within the WIA through a permit process. It is assumed that these two regulatory measures will remain in place, thus serving as institutional controls to limit exposures and protect any remedy installed in the Cove. These institutional controls by themselves are not sufficiently protective but can be used in conjunction with other remedial actions.

6.2.3 Sediment Stability/Hydrodynamic assessment

To support evaluation of the WIA GRAs, which have the potential to impact local hydrodynamic patterns within the Cove as well as to be affected during extreme flooding events, an initial hydrodynamic and sediment stability modeling was conducted. Specifically, this modeling assessed the stability of the final post-remediation Cove surfaces to determine if the application of cover material would be sufficiently stable in the long-term to remain effective and permanent.

The hydrodynamic model incorporated bathymetric conditions surveyed during the TS, data obtained from pressure transducers deployed in the Anacostia River, as well as in-channel flow velocities measured by ADCP units deployed in the Cove. The model was conducted using scenarios incorporating current 50- and 100-year flood event data as well as projected future 100-year flood event conditions. The model analyzed erosion potential based on SEDflume analysis also conducted during the TS. The assessment concluded that, under the extreme flood conditions modeled, potentially erosive conditions exist in a transitional area between the Cove and River suggesting that there is the potential for cover material loss over time under extreme conditions, and that armoring, vegetative cover, or other stabilizing cover material may be needed in the transitional area in order to ensure long-term effectiveness against erosional forces. The hydrodynamic modeling, which has not yet been reviewed by DOEE, will be further evaluated during the remedial design process to assess flow conditions and assess whether armoring or any other engineering controls are required to stabilize the Cove and prevent erosion.

6.2.4 Sediment Redeposition Potential

The initial hydrodynamic and sediment stability modeling also was used to assess the potential for redeposition of sediment from the main stem of the Anacostia River to the Cove during cycles of tidal inundation. The modeling used a particle tracking analysis which simulates sediment transport due to hydrodynamic currents. Native bed material data in the main stem of the River obtained by DOEE and data obtained by Pepco during the TS were used in the model. The model simulated the mass flux of suspended sediment under tidal and storm conditions. Redeposition was tracked by comparing the resuspended material that remains in the River relative to those materials passing to the Cove. The model shows that while the majority of the sediment stays in the River, a small percentage does settle in the Cove both in a daily tide event and during a storm event suggesting that under the baseline restoration approach, there is a limited potential for redeposition from resuspension of sediments in the main stem of the River. The hydrodynamic modeling, which has not yet been reviewed by DOEE, will be further evaluated during the remedial design process.

6.2.5 Potential for Sediment Recontamination from Ongoing Sources

The evaluation of the effectiveness of the WIA RAAs must consider the potential for recontamination of Cove sediments due to redeposition of river sediments during tidal and storm events (as discussed in the preceding section), as well as future deposition of sediments containing potential COCs originating from upstream or adjacent landside areas.

Upstream Sources

Recent reports by DOEE, NPS, the USGS, the USFWS, and the Maryland Department of the Environment (MDE) have identified sources of PCBs in the Anacostia River upstream of the Pepco Benning Facility (DOEE, 2019b; Ghosh et al., 2019; MDE, 2020; NPS, 2019b; Wilson, 2019).

The Final NPS Tributary Sediment Sampling Study Report states that the five largest tributaries to the Anacostia River based on flow and watershed area (i.e., Northwest Branch, Northeast Branch, Lower Beaverdam Creek, Watts Branch, and Hickey Run) have all been identified as sources of PCBs in Anacostia Sediments (NPS, 2019b). These five tributaries account for 95% of the river flow and contribute the largest amount of contaminated suspended sediment to the tidal Anacostia.

Hickey Run, immediately upstream of the WIA on the west side of the river, was identified as a source of PCBs contributing to the Anacostia sediments in the recent NPS Tributary Study Report (NPS, 2019a), the USGS Sediment and Chemical Contaminant Loads in Tributaries to the Anacostia River Washington, District of Columbia, 2016 17 (Wilson, 2019), DOEE Contaminant Source Assessment Report (DOEE, 2019a), and the USFWS report (Ghosh et al., 2019). Numerous Brownfield sites, voluntary cleanup sites, and a rail corridor drain to Hickey Run via an underground storm sewer system. The average concentrations of total PCBs from Hickey Run stormflow and low-flow sediment samples was 69 µg/kg (Wilson, 2019). The current load of PCBs from Hickey Run is estimated to be 9.7g/ yr total and 0.19 g/ yr freely dissolved (Ghosh et al., 2019).

Watts Branch tributary and the adjacent KPN and KPS are immediately upstream of the WIA on the east side of the river. Kenilworth Landfill was operated as an open-burning dump from 1942 to 1968 and as a sanitary landfill from 1968 until 1970. These waste disposal areas were identified as sources of PCBs in the DOEE Remedial Investigation Report (DOEE, 2019b), NPS Tributary Study Report (NPS, 2019a), and the USFWS report (Ghosh et al., 2019). Total Aroclor concentrations measured in river sediments near the KPL site averaged 305 µg/kg and were detected in 11 of 12 samples from the Anacostia River adjacent to the KPL sites. Similar concentrations were observed in sediment samples from Watts Branch (186 to 482 µg/kg). In two subsurface samples adjacent to KPS, concentrations were 1,009 and 1,392 µg/kg. Average concentrations of total PCBs from Watts Branch stormflow and low-flow sediment samples were 34 µg/kg (Wilson, 2019). The current load of PCBs from Watts Branch is estimated to be 4.6 grams per year (g/yr) total and 1.2 g/yr freely dissolved (Ghosh et al., 2019).

Lower Beaverdam Creek (LBC) has been implicated as the dominant source of upstream PCB contaminated sediments (Hwang & Foster, 2008) and dissolved phase PCBs in surface water of the upper Anacostia River (Ghosh et al., 2019). Concentrations of dissolved PCBs in surface water at two locations in Lower Beaverdam Creek exceeded the surface water concentrations in the Anacostia River water by a factor of 5 during the summer of 2016. Both Lower Beaverdam Creek sampling locations had positive net flux (from sediment to surface water) of PCBs 15 to 30 times higher than Watts Branch and 2 times higher than in the Cove near the Pepco 013 outfall at DOEE location R6-32 (Ghosh et al., 2019). Recent investigations of the LBC tributary reported by the USGS Survey (Wilson, 2019), NPS (NPS, 2019B), and the Maryland Department of the Environment (MDE, 2020) have confirmed the presence of PCB hotspot sources in the LBC creek sediments, with surficial sediment concentrations up to 2,510 µg/kg. The average concentration of total PCBs from LBC stormflow and low-flow sediment samples was 130 µg/kg (Wilson, 2019). The current load of PCBs from LBC into the Anacostia River is estimated to be 401 g/yr total and 94 g/yr freely dissolved (Ghosh et al., 2019).

The Northeast Branch (NEB) and Northwest Branch (NWB) of the Anacostia River contribute average concentrations of total PCBs from stormflow and low-flow sediment of 5.9 µg/kg and 6.6 µg/kg, respectively (Wilson, 2019). The current load of PCBs from combined NEB and NWB into the Anacostia is estimated to be 165 g/yr total and 18 g/yr freely dissolved (Ghosh et al., 2019).

<u>Outfall Discharges and Adjacent Sites</u>

During the TS, outfalls to the Cove were sampled to assess potential contributions from upland areas with direct discharge to the Cove. Of the six outfalls discharging to the Cove, Outfall 2 (Pepco 013) contributes the majority of the TSS loading to the Cove due to the large drainage area it serves. The estimated annual TSS loading is 4.88 tons/year which results in an aqueous-phase PCB loading of 3.54 g/yr based the measured PCB concentrations in the samples collected for the TS. In an effort to assess how much of this loading may be retained in the Cove sediment, three sediment mats were installed during the TS to estimate sediment accumulation. Although sediment mat measurements varied significantly, these measurements qualitatively indicate that the Cove is a net depositional area; however, localized flow dynamics make it difficult to assign relative contributions from the targeted sources. Accurate sedimentation rate calculations require multi-year investigations where seasonal influences can be captured. Consequently, sedimentation rates in the Cove are better estimated using the Cs-137 maximum high-resolution core. The SEDMAT sample PCB concentrations ranged from 730-1500 ppb which are similar to the existing surface sediment concentrations elsewhere in the Cove. This suggests localized reworking during storms and tidal exchange rather than new contributions from outfalls. Sediment and PCB loadings from Pepco's Outfall 013 have significantly decreased due to a number of upstream stormwater best management practices (BMPs), treatment and control measures implemented at the Site.

During the field work for the treatability studies, Pepco identified several potential additional discharges from sites adjacent to the Cove. These include a silt pond located on the National Park Service Kenilworth Park South (KPS) Landfill site just to the north of the Cove and several additional stormwater outfalls that discharge to the Cove including three from the D.C. Department of Public Works (DPW) Solid Waste Transfer Station[8].

Sediment, soil, and stormwater samples were collected to evaluate potential discharges to the Cove from the KPS Landfill site and the D.C. DPW Solid Waste Transfer Station. Analytical results from this sampling effort were summarized in a Technical Memorandum (AECOM, 2023). Based on a review of the historical data collected by NPS and the data collected during this investigation, it is reasonable to conclude that historical and current discharges from KPS potentially contributed to the contamination, specifically PCBs and dioxins, in the Cove. All six outfalls (three belonging to DPW, one of Pepco's and two unknown outfalls) discharging into the Cove exhibited contributions of various levels of PCBs, PAHs, and metals to the Cove exceeding surface water quality criteria.

Groundwater Discharge/Underlying Sediments

Potential for recontamination of the benthic zone from underlying impacted sediments and porewater was evaluated using CapSim, as discussed in the evaluation of the effectiveness of the various RAAs.

Summary of Recontamination Potential

Recontamination within the Cove area is possible from upstream sources of PCBs to the Anacostia River and local point sources such as Pepco-owned and non-Pepco outfalls discharging to the Cove, discharges from adjacent KPS landfill site, and discharges from stormwater outfalls from DPW Solid Waste Transfer Station. This recontamination is a potential concern for subaqueous GRAs, such as Containment, Treatment, and Removal.

Source control efforts by MDE for the Lower Beaverdam Creek and those resulting from cleanup of other potential upstream sources can help reduce the potential for recontamination in the Cove. In addition, in accordance with the terms of the facility's NPDES permit, Pepco is implementing a PCB Minimization Plan on the landside to reduce the concentration of PCBs in stormwater discharged from Outfall 013. The objectives of the PCB Minimization Plan are:

a) Identify potential on-site and background sources contributing to PCBs in stormwater runoff from the Site

[8] Three of these outfalls (Outfall 01, Outfall 03, and Outfall 001) drain the Department of Public Waste Works Transfer Station. However, Outfall 003 does not belong solely to DPW.

b) Assess performance of current BMPs and identify additional BMPs and control measures to reduce PCB concentrations in stormwater runoff
c) Evaluate and select additional BMP/control measure options for implementation under an adaptive management approach, and
d) Provide a schedule for implementation of additional PCB control measures.

Inclusion of activated carbon in the remedial alternatives will provide additional sorption capacity for any contaminated sediments depositing in the Cove in the short to medium term. In addition, additional carbon could be placed if warranted based on the results of the performance monitoring.

6.2.6 Sediment Bearing Capacity

Data from the Anacostia River Native and Amended Sediment Erodibility Study included in the TS Report (AECOM, 2021), including density and grain size information, indicate that the Cove sediment is consistent with other sites where a 1 to 2 ft cap has been successfully installed. Bearing capacity and shear strength will be considered during the design to determine differential settlement and/or stability of the selected remedy. Available geotechnical data will be reviewed to estimate the projected bearing capacity/shear strength of the Cove sediment and improvements will be considered as needed. If containment or another capping related action is included in the selected remedial approach, then the detailed design will include procedures for cap placement. Material will be placed in appropriately sized lifts taking into account sediment conditions.

6.2.7 COC Sequestration/Cover Efficacy Assessment

During the TS, sediments amended with three different activated carbon products (Calgon Carbon F-300 GAC with 20-50 mesh size, SediMite™ consisting of 50% by weight of a fine activated carbon with 80-325 mesh size, and AquaGate® made with 10% by weight of a powdered activated carbon with <325mesh size) were studied at three different dosages (1, 3 and 5%) to observe reductions in pore water PCB concentration and macroinvertebrate tissue concentrations (AECOM, 2021).

Porewater concentrations from amended sediments showed that granular size AC is minimally effective in reducing porewater concentration of PCBs even at a dose of 5% by weight of sediment. Both SediMite and AquaGate are effective in reducing porewater PCB concentrations at all dosing levels, with the powdered AC used in AquaGate being the most effective for a given dose. Both 3% and 5% amendment of AC in the 80-325 mesh (SediMite) and all three doses of powdered form (AquaGate) are able to reduce the PCB porewater concentration below the target breakthrough concentration of 6.4 ng/L. Treatment of the sediment with granular size AC showed little change in the bio-uptake of total PCBs in worms, regardless of dosing level. However, both SediMite and AquaGate+PAC effectively reduced tissue PCB concentrations at 3% and 5% dosing levels with the powdered AC used in AquaGate+PAC being the most effective.

The results also demonstrated that effectiveness of AC is strongly correlated to its particle size, finer particles being more efficient. Overall, the sequestration study demonstrated that application of a powdered AC to the study sediments was effective in reducing both porewater PCB concentration and PCB bio-uptake in worms by more than 90% at a dose of 3% or higher.

6.3 Detailed Analysis of RAAs for Cove Sediments

6.3.1 WIA-1: No Action

This alternative does not include any remedial activities to address PCBs in Cove sediment or porewater and would not achieve the RAO in a reasonable timeframe. This alternative serves as a baseline condition against which other remedial alternatives are compared. The following is a summary of the evaluation of this alternative:

Overall Protection of Human Health and the Environment: No actions are proposed as part of this alternative and PCBs would remain in surface sediment with a total PCB concentration greater than the interim RAL. Thus, this alternative is not protective of the environment. DOEE administers regional fish consumption advisories to address human health risk. The United States owns the Anacostia River bottom and NPS regulates construction activities or sediment disturbances within the WIA through a permit process. If these two regulatory measures remain in place, they would serve as ICs to protect human health.

Compliance with ARARs: Because no actions are proposed as part of this remedy, this RAA does not comply with the ARARs.

Since the No Action alternative does not meet the threshold criteria (Overall Protection of Human Health and the Environment, and Compliance with ARARs), it is not evaluated for balancing criteria.

6.3.2 WIA-3: Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)

This alternative involves capping the sediments in the entire Cove with 1 ft. of suitable capping material and performing baseline restoration. Prior to capping the sediments, the existing aquatic vegetation would be removed from the Cove, cleaned on-site to remove any sediments and debris, and preserved in a nursery or a greenhouse. All sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. The cap would be installed over the remaining 3.5 acres of the Cove. Overall, this alternative would require approximately 6600 CY of capping material. The CapSim modeling predicts that a 1 ft. thick sand-soil dual layer cap or a 1 ft. thick AC-amended sand cap placed over 3.5 acres of the Cove in combination with dredging and placement of an AC-amended sand cap in SED7G would result in a post-remediation PCB concentration of <0.64 ng/L in the porewater of the BAZ. This alternative would involve dredging nearly 620 CY of sediment from the Cove, including 320 CY of sediments being dredged from SED7G, and another 300 CY dredged for construction of outfall plunge pools and drainage channels. A conceptual design for this alternative is presented in **Figure 6-1**.

After installation of the cap, the vegetation would be replanted over the cap.

Composition of cap material and thickness will be determined during the design phase. Armoring of the cap may be needed in locations in the Cove that are susceptible to erosion. The need for armoring, locations, and composition and thickness of the armoring material (if required) would be determined during the design phase.

Sediments can be dredged from SED7G and the capping material can be placed in the remaining area of the Cove with or without dewatering of the Cove and both site conditions can be considered viable for implementation. Turbidity controls and monitoring will be conducted during remedial activities, whether work is conducted in the wet or the dry, to manage suspended sediment that may be generated during remedy implementation. For work to be conducted in the dry, a cofferdam (or other suitable hydraulic control) would be required to hydraulically separate the Cove from the main stem of the Anacostia River. Water from within the Cove and any stormwater from the outfalls would be pumped down and discharged to the main stem (with in-line solids removal as needed). Once the Cove has been dewatered, and sediments have been removed from SED7G, any debris as well as vegetation that would otherwise compromise the integrity of the cap would be removed from the surface and surface graded. This alternative also includes removal of 300 CY of sediment to construct outfall plunge pools and drainage channels by dredging or excavation, in addition to the 320 CY of sediments being dredged from SED7G. The 300 CY of dredge material was estimated based on the existing grade and the proposed bottom elevation of the plunge pools and channels.

Once the surface is prepared, the cap can be placed using a variety of wet or dry broadcasting methods. Post-placement sediment coring can be used to ensure that uniform thickness of material is achieved across the Cove.

Under the scenario where a hydraulic barrier is installed and the water level in the Cove is pumped down, equipment and materials can be staged either within the Cove or in a separate staging area adjacent to or downstream of the Cove. The equipment and materials could be transported to the Cove either by water or overland. Water access would require the installation of temporary moorings to allow barges in and out of the Cove area; the temporary moorings would likely be placed just south of the mouth of the Cove. Land access would require temporary closures of the Anacostia Riverwalk Trail and temporary haul roads through the park land.

The maximum concentration of PCBs in the Cove sediment detected was 11.8 mg/kg. Therefore, any sediment removed from the Cove would contain PCBs well below the TSCA threshold of 50 mg/kg which triggers disposal at a TSCA-approved facility. Dewatering and the addition of drying agents would likely be required prior to the disposal of any sediment removed. Water from dewatering operations (expected to be a small quantity for this alternative) would either be treated and disposed of on-site or transported for disposal at an approved off-site facility. Due to stringent water quality criteria for PCBs and the addition of polymers and stabilizers, water from dewatering operations (filtrate) would need treatment prior to its discharge. Filtrate would be treated on site and either discharged to the Anacostia River or to an MS4 system under an appropriate discharge permit. On-site water treatment system and an NPDES discharge permit to release the treated water back to the river would be required for this action to be cost effective. However, off-site disposal of produced water may be required if treatment cannot meet the stringent water quality standards. On-site disposal would be in accordance with an appropriate surface water or municipal separate storm sewer system (MS4) discharge permit. Environmental controls during implementation would include turbidity curtains, soil erosion and sediment controls (ESC), turbidity monitoring, air/odor monitoring, dust suppression measures, and noise monitoring as needed.

Following placement of the cap, regulated resource areas and ecological functions disturbed by remedial activities would be restored to re-establish pre-existing characteristics and habitats. This baseline restoration will also include:

- Replanting the aquatic vegetation on the cap surface.
- Creation of additional wetland area within the Cove as part of any required wetland mitigation.
- Armoring of the outfall areas and channels during the restoration phase to prevent erosion of the cover.

Upon completion of remediation, a periodic monitoring program would be implemented to assess the stability and long-term effectiveness of the cap to ensure compliance with the RAO. During the first several years, it is anticipated that there may be repair/maintenance measures needed to ensure the integrity of the cap. Anticipated repairs may include supplementing any eroded or disturbed areas of the cap. Repairs may also include adding additional riprap protection to increase the cap stability. These repairs, if needed, would be carried out promptly based on findings of periodic inspections and monitoring. As such, it is not anticipated that the short-term disturbances/damages would significantly affect the pore water breakthrough concentrations. A long-term operations, maintenance, and monitoring (OMM) plan prepared during the remedial design phase will define specific OMM requirements.

Overall Protection of Human Health and the Environment: Under this alternative, 1 ft. cap comprising either AC-amended sand or a sand-soil layers would be installed over 3.5 acres of impacted sediments in the Cove. In addition, all sediments from SED7G (0.2 acres) would be dredged and capped with AC-amended sand. CAPSIM modeling predicts that this alternative would maintain the concentration of PCBs in porewater of the BAZ below the criterion of 0.64 ng/L on a surface weighted average basis for at least 100 years. DOEE administers regional fish consumption advisories to address human health risk. The United States owns the Anacostia River bottom and NPS regulates construction activities or sediment disturbances within the WIA through a permit process. If these two regulatory measures remain in place, they would serve as ICs to protect human health. Therefore, this alternative is protective human health and the environment.

Compliance with ARARs: The remedial design process would identify specific regulatory requirements applicable to each component of the remedy and would establish procedures to comply with these requirements. The design process will also include identifying and obtaining all applicable Federal and District permits to conduct the remedial action. Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions. Thus, this alternative would meet the ARARs identified in **Table 3-1**.

Long-term Effectiveness and Permanence: The Cove is located within a generally low energy, depositional area of the Anacostia River except within outfall areas and channels. Surfaces in outfall areas and channels would be armored with riprap to prevent erosion of the placed cap material. Accordingly, it is anticipated that the cap and underlying sediments will remain generally stable. f CapSim modeling predicts that a one foot AC-amended sand cap or sand-soil dual-layer cap placed on top of existing sediments would maintain the surface weighted average PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years. The sand cap alone was not able to meet this porewater criterion and was eliminated from consideration as a capping material under this alternative. Incorporating AC in the cap is also expected to reduce the potential for recontamination of the cap from depositing sediments by providing additional sorption capacity for PCBs in the short to medium term. A sand-soil dual layer cap with a top layer of soil is expected to provide a better habitat for benthic organisms that sand alone, while also reducing the potential for recontamination due to the high organic carbon content of the soil. Design would incorporate measures to reduce recontamination from known sources (as discussed in Section 6.2.5). Attainment of the RAO would be tracked under a long term monitoring (LTM) program wherein pore water concentrations would be measured to assess the effectiveness of the remedy. The monitoring program and specific performance criteria will be developed and described in the baseline and performance monitoring plan to be prepared during the remedial design phase. Regulatory measures by DOEE (fish advisories) and NPS (permitting of activities that disturb the river bottom) are assumed to remain in effect as ICs to protect human health. Therefore, this alternative provides long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume Through Treatment: Placement of a cap over the entire Cove, in combination with selective dredging, would reduce the overall mobility of PCBs in the underlying sediments, leading to lowered PCB concentrations in the porewater in the BAZ, as supported by the results of CAPSIM modelling. The cap would also function as a clean BAZ for benthic organisms, thus reducing toxicity of PCBs to benthic organisms. This alternative would remove approximately 620 CY of impacted sediments from the Cove, thereby leading a minor reduction in the volume of contaminated sediments in the Cove.

Short-term Effectiveness: The remedy can be installed in four to six months. This remedy will have an immediate improvement on PCB concentrations present in the Cove as a result of replacing the existing BAZ with a clean substrate. This remedy would eliminate the existing benthic community temporarily, but the benthic community is expected to fully recolonize once the cap installation is complete. This remedy would also require removal of the aquatic vegetation prior to commencement of capping activities. Aquatic vegetation would be preserved off-site and replanted after the cap has been placed. Thus, short-to-medium term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation.

Short-term risks to the workers and community during remedy implementation are possible via generation of dust and odors, and increased traffic and disruptions to the Anacostia Trail and local roadways. Impacts to the surrounding community from traffic and movement of trucks associated with transportation of excavated material are anticipated to be minor and temporary. Some impacts on surrounding community from traffic and movement of trucks are possible if trucks are needed to bring the capping material to the site from an off-site staging area. Short-term risks could be mitigated through implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of personal protective equipment (PPE) by workers, implementation of soil erosion control measures, a soil management plan and air monitoring. An air monitoring plan and mitigation measures for any construction/excavation activities would be developed and implemented as part of the remedy. The air monitoring plan is prepared as part of the remedial design and will be compliant with OSHA requirements.

Short-term risks to the environment are possible via generation of suspended sediment and soil erosion and sedimentation from on-land activities. Short term risks to the environment can be mitigated through implementation of turbidity controls and monitoring and ESC measures.

This alternative is expected to generate moderate to high levels of greenhouse gas emissions from movement of trucks due to the large quantity of capping material that would be required.

Implementability: Dredging and capping are both well-developed and frequently used techniques for impacted sediments, for which equipment, personnel, and services needed for implementation are generally readily available. Some impact on the hydrodynamics and ecological conditions of the Cove is anticipated under this alternative as it would result in a difference in elevation of 1 ft. between the capped area of the Cove and the SED7G polygon. Difference in elevation may also cause the cap to subside, potentially impacting the aquatic vegetation in SED7G as well as exposing the impacted sediments under the cap. This alternative includes removal and replanting of the existing aquatic vegetation in the Cove, which would entail cleaning of the vegetation to remove any attached sediment/debris on-site and finding a suitable location for preserving the vegetation till the capping activities are complete. In addition, there are uncertainties about whether the replanting process will be successful. Assuming a 2:1 wetland mitigation ratio applies, mitigation of approximately 1.8 acres of wetlands may be required even if replanting is successful. Obtaining necessary permits and regulatory clearances is expected to be difficult due to potential impacts on existing aquatic vegetation under this alternative. Wetland mitigation requirements are also anticipated. Challenges are anticipated with technical implementability due to limited area available for equipment and material staging on the land side and within the Cove. Logistically, access from the Cove to Pepco's Benning Road Facility, where equipment laydown areas and materials handling potentially could be supported, is impeded by the presence of the Anacostia Riverwalk Trial and Anacostia Avenue. Therefore, barges may be required to move and stage construction equipment, materials, and waste generated during remedy implementation, and/or access to park lands may be needed. Thus, this alternative is regarded as moderate-to-difficult on both technical and administrative implementability criteria.

Cost: The capital cost for this alternative, which includes professional/technical services, capping material purchase and application, and baseline restoration, are estimated to be $6,587,000. O&M costs over 30 years include long-term monitoring, agency reviews, five-year revies, and cap repair/maintenance. The net present value of O&M costs is estimated to be $582,000. The total present worth cost of this alternative is $7,340, 000 (**Table 6-1**). While both mechanical dredging (without dewatering the Cove) and excavation in the dry are viable alternatives, the cost estimates are based on assuming excavation in the dry with the installation of portadams or cofferdams, with sediment dewatering.

6.3.3 WIA-4: In-Situ Treatment (3.5 acres) and Limited Dredging with Capping (0.2 acres)

This alternative involves in-situ treatment of the majority of the sediments in the Cove with AC-containing, commercially available products such as SediMite or AquaGate+PAC 10%, along with selective dredging and capping in a small area of the Cove. These remedial actions would be followed by baseline restoration. All sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. AC would be applied across the remaining extent of the Cove (approximately 3.5 acres). A conceptual design for this alternative is presented in **Figure 6-2**.

Products such as SediMite and AquaGate+PAC are typically applied to surface sediments as a thin layer and rely on bioturbation and breakdown of AC into smaller particles for distribution in the BAZ. Based on TS results, both SediMite and AquaGate+PAC 10% reduced concentration of PCBs in the porewater by 68% (1% AC as SediMite) to 99% (5% AC as AquaGate) compared to untreated controls. Corresponding reductions in bioaccumulation of PCBs in worm tissues exposed to treated sediments ranged from 30% (1% AC as SediMite) to 99% (5% AC as AquaGate) compared to untreated controls. In SED7G, dredging of sediments in the 0-1 ft. layer would be followed by capping with area with AC-amended sand cap. This is proposed to address any migration of PCBs from the sub-surface sediments to the rip-rap in the plunge pools that would be constructed in this area of the Cove.

The CapSim modeling predicts that application of an AC-amended sand cap after dredging the sediments in the 0-1 ft. interval of SED7G, while amending the remaining sediments with 5% AC dose applied as either SediMite or AquaGate+PAC 10% would maintain surface weighted average PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years. Exact AC dose to be applied and selection of the product will be decided during the remedial design phase.

Dredging in the SED7G polygon can be performed with or without dewatering the Cove. Removal by mechanical means would likely involve conventional earth moving equipment and temporary stockpiling within the Cove, on adjacent properties or on moored barges adjacent to the Cove. Turbidity controls and monitoring will be conducted during remedial activities to manage suspended sediment that may be generated during remedy implementation. Sediments in SED7G polygon would be dredged to a depth of 1 ft. below the existing grade. This alternative would involve dredging nearly 620 CY of sediment from the Cove, including 320 CY of sediments being dredged from SED7G, and another 300 CY dredged from other areas of the Cove for construction of outfall plunge pools and drainage channels. The 300 CY of dredge material was estimated based on the existing grade and the proposed bottom elevation of the plunge pools and channels.

Sediments can be dredged from SED7G and amendment materials can be placed in the other areas of the Cove with or without dewatering of the Cove and both site conditions can be considered viable for implementation. Turbidity controls and monitoring will be conducted during remedial activities, whether work is conducted in the wet or the dry, to manage suspended sediment that may be generated during remedy implementation. For work to be conducted with dewatering, a cofferdam (or other suitable hydraulic control) would be required to hydraulically separate the Cove from the main stem of the Anacostia River. Water from within the Cove and any stormwater from the outfalls would be pumped down and discharged to the mainstem (with in-line solids removal as needed). Once the sediments in SED7G have been dredged, any debris as well as vegetation that would otherwise compromise the integrity of the cap would be removed from the surface, following which the surface would be graded. Once the surface is prepared, the AC-amended sand cap can be placed in this area using a variety of wet or dry broadcasting methods. Post-placement sediment coring can be used to ensure that uniform thickness of material is achieved across the polygon. In the remaining areas of Cove, following dewatering, any debris that would otherwise prevent the thin layer amended cover material from making good contact with the underlying sediments would be removed from the surface and surface graded to receive amendment.

When applied without dewatering, the AC amendments rely on bioturbation for effective mixing into the BAZ. When applied under dry conditions, the amendments can be mixed into the top few inches of the sediments via raking or tilling, thereby reducing the dependance on bioturbation.

Once the surface is prepared, the amendment materials are placed as a thin layer using a variety of wet or dry broadcasting methods. Placement of coir mats or similar products on top of the amendment layer may be required to prevent re-suspension and subsequent transport of amendment out of the Cove.

Under the scenario where a hydraulic barrier is installed and the water level in the Cove is pumped down, equipment and materials can be staged either within the Cove or in a separate staging area adjacent to or downstream of the Cove. The equipment and materials could be transported to the Cove either by water or overland. Water access would require the installation of temporary moorings to allow barges in and out of the Cove area; the temporary moorings would likely be placed just south of the mouth of the Cove. Land access would require temporary closures of the Anacostia Riverwalk Trail and temporary haul roads through the park land.

The maximum concentration of PCBs in the Cove sediment detected was 11.8 mg/kg. Therefore, any sediment removed from the Cove would contain PCBs well below the TSCA threshold of 50 mg/kg which triggers disposal at a TSCA-approved facility. Dewatering and the addition of drying agents would likely be required prior to the disposal of any sediment removed. Due to stringent water quality criteria for PCBs and the addition of polymers and stabilizers, water from dewatering operations (filtrate) would need treatment prior to its discharge. Filtrate would be treated on site and either discharged to the Anacostia River or to an MS4 system under an appropriate discharge permit. On-site water treatment system and an NPDES discharge permit to release the treated water back to the river would be required for this action to be cost effective. However, off-site disposal of produced water may be required if treatment cannot meet the stringent water quality standards. Water from dewatering operations (expected to be a small quantity for this alternative) would either be treated and disposed of on-site or transported for disposal at an approved off-site facility. On-site disposal would be in accordance with an appropriate surface water or municipal separate storm sewer system (MS4) discharge permit. Environmental controls during implementation would include turbidity curtains, soil erosion and sediment controls (ESC), turbidity monitoring, air/odor monitoring, dust suppression measures, and noise monitoring as needed.

Following placement of the AC amendment, post-application monitoring for confirming even spreading of AC would be performed and may include methods such as collection cores to verify initial thickness of amendment applied and periodic cores to assess progress on mixing of carbon throughout the bio-active zone. Appropriate test methods will be specified as part of the remedial design.

Following placement of the cap and in-situ treatment, regulated resource areas and ecological functions disturbed by remedial activities would be restored to re-establish pre-existing characteristics and habitats. This baseline restoration will include:

- Replanting the aquatic vegetation on the cap surface.
- Creation of additional wetland area within the Cove as part of wetland mitigation (if 2:1 wetland mitigation is required).
- Armoring of the outfall areas and channels would be conducted during the restoration phase to prevent erosion of the cover.

Upon completion of remediation, a periodic monitoring program would be implemented to assess the stability and long-term effectiveness to ensure compliance with the RAOs. During the first several years, it is anticipated that some replenishment of the AC amendment would be needed, if the monitoring determines that the design quantity of amendment material is not present within certain areas of the Cove due to unexpected erosion or movement of Cove sediments. Other anticipated repairs may include supplementing any eroded or disturbed areas of the cap. Repairs may also include adding additional riprap protection to increase the cap stability. These repairs, if needed, would be carried out promptly based on findings of periodic inspections and monitoring. As such, it is not anticipated that the short-term disturbances/damages would significantly affect the pore water breakthrough concentrations. A long-term operations, maintenance, and monitoring (OMM) plan prepared during the remedial design phase will define specific OMM requirements.

Overall Protection of Human Health and the Environment: Under this alternative, a thin layer of AC amendment would be applied over the Cove sediments and allowed to mix into the BAZ via natural processes. Selective dredging would be carried over approximately 8,520 sq. ft. of the Cove and a 1 ft. AC-amended sand cap would be placed over this area. CapSim modeling predicts that application of an AC-amended sand cap after dredging the sediments in the 0-1 ft. interval of SED7G, combined with amending the remaining sediments with 5% AC dose applied as either SediMite or AquaGate+PAC 10% would maintain surface weighted average PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years, while the TS also demonstrated that both SediMite and AquaGate+PAC can reduce benthic tissue concentrations by 30 to 99% depending on carbon type and dose. DOEE administers regional fish consumption advisories to address human health risk. The United States owns the Anacostia River bottom and NPS regulates construction activities or sediment disturbances within the WIA through a permit process. If these two regulatory measures remain in place, they would serve as ICs to protect human health. Therefore, this alternative is protective human health and the environment.

Compliance with ARARs: The remedial design process would identify specific regulatory requirements applicable to each component of the remedy and would establish procedures to comply with these requirements. The design process will also include identifying and obtaining all applicable Federal and District permits to conduct the remedial action. Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions. Thus, this alternative would meet the ARARs identified in **Table 3-1**.

Long-term Effectiveness and Permanence: The Cove is located within a generally low energy, depositional area of the Anacostia River except within outfall areas and channels. Surfaces in outfall areas and channels would be armored with riprap to prevent erosion of the placed amendments prior to incorporation into the underlying sediment by benthic organisms. Accordingly, it is anticipated that the amendment and underlying sediments will remain generally stable. CapSim modeling predicts that application of an AC-amended sand cap after dredging the sediments in the 0-1 ft. interval of SED7G, combined with amending the remaining sediments with 5% AC dose applied as either SediMite or AquaGate+PAC 10% would maintain surface weighted average PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years. Results from the TS also demonstrate that in-situ treatment with AC could be effective in reducing bioaccumulation in benthic organisms. Incorporating AC in the surface sediments is also expected to reduce the potential for recontamination from depositing sediments by providing additional sorption capacity for PCBs in the short to medium term. Similarly, incorporation of an AC-amended sand cap in SED7G is also expected to reduce potential for recontamination in the short to medium term. Design would incorporate measures to reduce recontamination from known sources (as discussed in Section 6.2.5). Attainment of the RAO would be tracked under a LTM program wherein pore water concentrations would be measured to assess the effectiveness of the remedy. In addition, the distribution of carbon in the area would be measured over time to ensure adequate sequestration capacity is achieved in the cove. The monitoring program and specific performance criteria will be developed and described in the baseline and performance monitoring plan to be prepared during the remedial design phase. Regulatory measures by DOEE (fish advisories) and NPS (permitting of activities that disturb the river bottom) are assumed to remain in effect as ICs to protect human health. Therefore, this alternative provides long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume Through Treatment: In-situ treatment of sediments in the Cove via AC would reduce the overall mobility and toxicity of PCBs in sediment through sequestration, as demonstrated by the TS results and supported through CAPSIM modelling. This alternative would remove approximately 620 CY of impacted sediments from the Cove, thereby leading a minor reduction in the volume of contaminated sediments in the Cove. While studies have noted some impacts on benthic organisms due to the presence of AC (Jonker et al., 2009; Lillicrap et al., 2015; Rämö et al., 2021), these impacts are generally expected to occur at AC concentrations exceeding 5%. Additionally, no significant adverse impacts on survival of *L. variegtus* were observed in the Treatability Study (AECOM, 2021).

Short-term Effectiveness: The remedy can be installed in four to six months. Dredging and capping in SED7G will have an immediate improvement on PCB concentrations in this part of the Cove by permanently removing 620 CY of sediment with PCB concentrations exceeding the RAL and by replacing the BAZ with clean substrate. However, the effect of carbon amendments throughout the rest of the Cove will take additional time due to naturally occurring processes such as bioturbation, deposition, and burial that are required to mix the amendment material into underlying impacted sediments. Short-term disturbance to the ecological habitat in the Cove is expected, especially in the 0.2 acres where dredging and capping are proposed due to the presence of approximately 5000 sq. ft. of mixed high and low march vegetation in this area. The long-term monitoring plan would include monitoring the wetland vegetation. If the health, diversity, or abundance of the vegetation is impacted from the placement of activated carbon, then additional wetland mitigation would be required. However, the habitat is expected to recover after remedy implementation.

Short-term risks to the workers and community during remedy implementation are possible via generation of dust and odors, and increased traffic and disruptions to the Anacostia Trail and local roadways. Impacts to the surrounding community from traffic and movement of trucks associated with transportation of excavated material are anticipated to be minor and temporary. Some impacts on surrounding community from traffic and movement of trucks are possible if trucks are needed to bring the AC and capping material to the site from an off-site staging area. Short-term risks could be mitigated through implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of PPE by workers, implementation of soil erosion control measures, a soil management plan and air monitoring. An air monitoring plan and mitigation measures for any construction/dredging activities will be developed and implemented as part of the remedy. The air monitoring plan is prepared as part of the remedial design and will be compliant with OSHA requirements.

Short-term risks to the environment are possible via generation of suspended sediment and soil erosion and sedimentation from on-land activities. Short term risks to the environment can be mitigated through implementation of turbidity controls and monitoring and ESC measures.

This alternative is expected to generate low levels of greenhouse gas emissions from movement of trucks and other vehicles based on the amount of treatment material that would be required and the fact that only small quantity of sediments would be dredged and disposed under this alternative.

Implementability: Use of AC-amendments for in-situ treatment of PCB-impacted sediments is a well-developed technology for which the equipment, personnel, and services needed are generally readily available. Similarly, dredging and capping is a well-developed technology. Obtaining necessary permits and regulatory clearances is expected to be difficult due to the potential impact on high and low marsh areas in the Cove during dredging in SED7G. Some challenges are anticipated with technical implementability due to limited area available for equipment and material staging on the land side and within the Cove. Logistically, access from the Cove to Pepco's Benning Road Facility, where equipment laydown areas and materials handling potentially could be supported, is impeded by the presence of the Anacostia Riverwalk Trial and Anacostia Avenue. Therefore, barges may be required to move and stage construction equipment, materials, and waste generated during remedy implementation, and/or access to park lands may be needed. Thus, this alternative is regarded as easy-to-moderate on technical implementability criterion and difficult on the administrative implementability criterion.

Cost: The capital cost for this alternative, which includes professional/technical services, carbon amendment purchase and application, and baseline restoration, are estimated to be $5,453,000. O&M costs over 30 years include long-term monitoring, agency reviews, five-year reviews, and amendment replenishment. The net present value of O&M costs is estimated to be $548,000. The total present worth cost of this alternative is $6,170,000 (**Table 6-2**). While both mechanical dredging (without dewatering the Cove) and excavation in the dry are viable alternatives, the cost estimates are based on assuming excavation in the dry with the installation of portadams or cofferdams, with sediment dewatering.

6.3.4 WIA-5: Dredging of the Entire Cove and Capping

This alternative involves dredging of sediments in the Cove via mechanical dredging or dry excavation techniques, following which the underlying sediments over the dredged area would be capped. Prior to dredging, the existing aquatic vegetation would be removed and preserved off-site in a nursery or greenhouse. After completion of the capping activities, the vegetation would be replanted in the Cove as part of baseline restoration. A conceptual design for this alternative is presented in **Figure 6-3.**

In mechanical dredging, an excavator or a crane is brought to the site on a barge and utilizes buckets or clamshell-style buckets to remove the target sediments. Removed sediments are loaded onto an adjacent barge which, when full, is brought to a designated location for unloading. In dry excavation, sediments are removed by an excavator and can be performed on near shore sediments that are exposed during low tides or by setting up a cofferdam around the work area and pumping out the water to expose the target sediments.

The CapSim evaluation showed that there are two viable capping options following dredging of sediments in the 0-1 ft. interval over the 3.5 acre extent: a) placement of 1ft. thick AC-amended sand cap, and b) placement of 1 ft. thick sand-soil dual layer cap. Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. Both AC-amended sand and sand-soil dual layer cap, in combination with dredging and capping in SED7G, were predicted to meet the 0.64 ng/L porewater target for PCB concentrations in the Cove BAZ on a surface area averaged basis. Dredging under both these scenarios, including dredging for creation of outfall plunge pools and drainage channels, would result in 6300 CY of dredged sediment, and would require 6000 CY of capping material.

Mechanical dredging would be performed without dewatering the Cove. Removal by mechanical means would likely involve conventional earth moving equipment and temporary stockpiling within the Cove, on adjacent properties or on moored barges adjacent to the Cove. Turbidity controls and monitoring will be conducted during remedial activities to manage suspended sediment that may be generated during remedy implementation. Sediments would be dredged to a depth of 1 ft. below the existing grade, generating approximately 6300 CY of sediments requiring disposal, including removal of 300 CY of sediment to construct outfall plunge pools and drainage channels by dredging or excavation. The 300 CY of dredge material was estimated based on the existing grade and the proposed bottom elevation of the plunge pools and channels.

Once the Cove has been dredged, any debris as well as vegetation that would otherwise compromise the integrity of the cap would be removed from the surface, following which the surface would be graded. Once the surface is prepared, the cap can be placed using a variety of wet or dry broadcasting methods.

Post-placement sediment coring can be used to ensure that uniform thickness of material is achieved across the Cove.

Equipment and materials can be staged either within the Cove or in a separate staging area adjacent to or downstream of the Cove. The equipment and materials could be transported to the Cove either by water or overland. Water access would require the installation of temporary moorings to allow barges in and out of the Cove area; the temporary moorings would likely be placed just south of the mouth of the Cove. Land access would require temporary closures of the Anacostia Riverwalk Trail and temporary haul roads through the park land.

The maximum concentration of PCBs in the Cove sediment detected was 11.8 mg/kg. Therefore, any sediment removed from the Cove would contain PCBs well below the TSCA threshold of 50 mg/kg which triggers disposal at a TSCA-approved facility. Dewatering of dredged sediment would be required to facilitate its handling and meet requirements for transportation and disposal. Material that is mechanically dredged has a high percent of water. These sediments are typically transported to a staging area, placed on a dewatering pad to drain by gravity, and then mixed with drying/stabilizing agents prior to transportation and disposal. Bench-scale testing conducted during the Treatability Study indicated that the additional of a polymer such as ZapZorbTM along with 10% of Portland cement was able to provide sufficient strength required for disposal (AECOM, 2021a).

Due to stringent water quality criteria for PCBs and the addition of polymers and stabilizers, water from dewatering operations (filtrate) would need treatment prior to its discharge. Filtrate would be treated on site and either discharged to the Anacostia River or to an MS4 system under an appropriate discharge permit. On-site water treatment system and an NPDES discharge permit to release the treated water back to the river would be required for this action to be cost effective. However, off-site disposal of produced water may be required if treatment cannot meet the stringent water quality standards. Environmental controls during implementation would include turbidity curtains, soil erosion and sediment controls (ESC), turbidity monitoring, air/odor monitoring, dust suppression measures, and noise monitoring as needed.

Following placement of the cap, regulated resource areas and ecological functions disturbed by remedial activities would be restored to re-establish pre-existing characteristics and habitats. This baseline restoration will include:

- Replanting the aquatic vegetation on the cap surface.
- Creation of additional wetland area within the Cove as part of wetland mitigation (if 2:1 wetland mitigation is required).

- Armoring of the outfall areas and channels would be conducted during the restoration phase to prevent erosion of the cover.

Upon completion of remediation, a periodic monitoring program would be implemented to assess the stability and long-term effectiveness to ensure compliance with the RAOs. During the first several years, it is anticipated that there may be repair/maintenance measures needed to ensure that the integrity of the remedy. Anticipated repairs may include supplementing any eroded or disturbed cap. Repairs may also include adding additional riprap protection to increase the cap stability. These repairs, if needed, would be carried out promptly based on findings of periodic inspections and monitoring. As such, it is not anticipated that the short-term disturbances/damages would significantly affect the pore water breakthrough concentrations. A long-term operations, maintenance, and monitoring (OMM) plan prepared during the remedial design phase will define specific OMM needs.

Overall Protection of Human Health and the Environment: Under this alternative, sediments in the entire Cove would be excavated to a depth of 1 ft. and capped with a 1 ft. thick layer of AC-amended sand or sand-soil dual layer cap. Both AC-amended sand and sand-soil dual layer cap over 3.5 acre extent, in combination with dredging and capping in SED7G, were predicted to meet the 0.64 ng/L porewater target for PCB concentrations in the Cove BAZ on a surface area averaged basis. Removal of 6300 CY of contaminated sediments and placement of the cap will eliminate PCBs from the BAZ upon completion of remedy construction and reduce exposure to PCBs in underlying sediments. DOEE administers regional fish consumption advisories to address human health risk. The United States owns the Anacostia River bottom and NPS regulates construction activities or sediment disturbances within the WIA through a permit process. If these two regulatory measures remain in place, they would serve as ICs to protect human health. Therefore, this alternative is protective human health and the environment.

Compliance with ARARs: The remedial design process would identify specific regulatory requirements applicable to each component of the remedy and would establish procedures to comply with these requirements. The design process will also involve identifying and obtaining all applicable Federal and District permits to conduct the remedial action. Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions. Thus, this alternative would meet the ARARs identified in **Table 3-1**.

Long-term Effectiveness and Permanence: The Cove is located within a generally low energy, depositional area of the Anacostia River except within outfall areas and channels. Surfaces in outfall areas and channels would be armored with riprap to prevent erosion and improve stability of the cap material. Accordingly, it is anticipated that the cap and underlying sediments will remain generally stable. The CapSim modeling predicts that this alternative (when using AC-amended sand cap or a sand-soil dual layer cap) in combination with dredging and capping in SED7G, would maintain the surface area averaged pore water concentrations of PCBs in the BAZ below the 0.64 ng/L criterion for at least 100 years. Incorporating AC in the cap is also expected to reduce the potential for recontamination of the cap from depositing sediments by providing additional sorption capacity for PCBs in the short to medium term. A sand-soil dual layer cap with top layer of soil is expected to provide a better habitat for benthic organisms that sand alone, while also reducing the potential for recontamination due to the high organic carbon content of the soil. This alternative also permanently removes near 6300 CY of impacted sediment from the Cove. Design would incorporate measures to reduce recontamination from known sources (as discussed in Section 6.2.5). Attainment of the RAO would be tracked under a LTM program wherein pore water concentrations would be measured to assess the effectiveness of the remedy. The monitoring program and specific performance criteria will be developed and described in the baseline and performance monitoring plan to be prepared during the remedial design phase. Regulatory measures by DOEE (fish advisories) and NPS (permitting of activities that disturb the river bottom) are assumed to remain in effect as ICs to protect human health. Nearly 6300 CY of contaminated sediment would also be permanently removed from the Cove. Therefore, this alternative provides long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume Through Treatment: The scenario involving the placement of an AC amended sand cap would provide some treatment for PCBs in underlying sediment. Although this alternative otherwise will not result in any reduction in toxicity, mobility or volume through treatment, nearly 6,300 CY contaminated with PCBs would be permanently removed from the Cove, thereby reducing the volume of contaminated sediments. Placement of a cap would reduce the overall mobility of PCBs in the underlying sediments, leading to lowered PCB concentrations in the porewater in the BAZ, as supported by the results of CAPSIM modelling. The cap would also function as a clean BAZ for benthic organisms, thus reducing toxicity of PCBs to benthic organisms.

Short-term Effectiveness: The remedy can be installed in six months to a year. This remedy will have an immediate improvement on PCB concentrations present in the Cove by permanently removing 6300 CY of sediment with PCB concentrations exceeding the RAL and by replacing the BAZ with clean substrate. This remedy would eliminate the existing benthic community temporarily, but the benthic community is expected to fully recolonize once the cap installation is complete. Short-term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation.

Short-term risks to the workers and community during remedy implementation are possible via generation of dust and odors, and increased traffic and disruptions to the Anacostia Trail and local roadways. Impacts to the surrounding community from traffic and movement of trucks associated with transportation of excavated material are anticipated to be moderate to high but temporary. Some impacts on surrounding community from traffic and movement of trucks are possible if trucks are needed for transporting the capping material to the site from an off-site staging area. Short-term risks could be mitigated through implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of PPE by workers, implementation of soil erosion control measures, a soil management plan and air monitoring. An air monitoring plan and mitigation measures for any construction/excavation activities will be developed and implemented as part of the remedy. The air monitoring plan is prepared as part of the remedial design and will be compliant with OSHA requirements.

Short-term risks to the environment are possible via generation of suspended sediment and soil erosion and sedimentation from on-land activities. Short term risks to the environment can be mitigated through implementation of turbidity controls and monitoring and ESC measures.

This alternative is expected to generate high levels of greenhouse gas emissions from movement of trucks and vehicles due to the large quantity of sediments that would be dredged and disposed, as well as large quantity of capping material that would be required.

<u>Implementability</u>: Mechanical dredging and capping are both commonly used process options for remediation of impacted sediments. Materials, equipment, and personnel required for implementation are generally readily available. However, dredging of the entire Cove is expected to produce a 6300 CY of sediments that would need substantial area for management including dewatering and stabilization. Mechanically dredged sediments typically contain a high percentage of water, and thus, considerable water management as well as treatment systems for the same are expected to be needed. The area within and around the Cove is likely to be insufficient for staging the dewatering and water treatment systems, as well as for other equipment and materials required as part of this alternative. Logistically, access from the Cove to Pepco's Benning Road Facility, where equipment laydown areas and materials handling potentially could be supported, is impeded by the presence of the Anacostia Riverwalk Trial and Anacostia Avenue. Therefore, barges may be required to move and stage construction equipment, materials, and waste generated during remedy implementation, and/or access to park lands may be needed. This alternative includes removal and replanting of the existing aquatic vegetation in the Cove, which would entail cleaning of the vegetation to remove any attached sediment/debris on-site and finding a suitable location for preserving the vegetation till the capping activities are complete. In addition, there are uncertainties about whether the replanting process will be successful. Assuming a 2:1 wetland mitigation ratio applies, mitigation of approximately 1.8 acres of wetlands may be required even if replanting is successful. Obtaining necessary permits and regulatory clearances is expected to be difficult due to potential impacts on aquatic

vegetation of the Cove. Thus, this alternative is regarded as difficult to implement from both technical and administrative perspectives.

Cost: The capital cost for this alternative, which includes professional/technical services, capping material procurement and application, and baseline restoration, are estimated to be $11,930,000. O&M costs over 30 years include long-term monitoring, agency reviews, five-year reviews, and cap maintenance/repair. The net present value of O&M costs is estimated to be $582,400. The total present worth cost of this alternative is $12,690,000 (**Table 6-3**). While both mechanical dredging (without dewatering the Cove) and excavation in the dry are viable alternatives, the cost estimates are based on assuming excavation in the dry with the installation of portadams or cofferdams, with sediment dewatering.

6.3.5 WIA-6: In-Situ Treatment (over 2.5 acres) with Dredging and Capping (over 1.2 acres)

This alternative represents a combination of WIA-4 and WIA-5, wherein sediments over 2.5 acres of Cove are treated with AC-containing, commercially available products such as SediMite or AquaGate+PAC, while sediments in the remaining 1.2 acres of the Cove are dredged to a depth of 1 ft. bgs and capped with either AC-amended sand or a sand-soil cap.

Dredging and capping would be primarily conducted in polygons along the mouth of the Cove, specifically, in SED8C, SED7.5C, SED7B, SED6.5C, and part of SED7D, comprising an area of approximately 1 acre. In addition, sediments in SED7G polygon, comprising an area of 0.2 acre, would also be dredged and capped. The remaining polygons would be treated with a 5% AC dose, delivered as either SediMite or AquaGate+PAC 10%. The areas specified for dredging and for in-situ treatment have been determined with the objective of minimizing the extent of dredging (considering the challenges with limited availability of space around the Cove) and reducing impact on the existing aquatic vegetation, while still meeting the RAO.

A conceptual design for this alternative is presented in **Figure 6-4**.

Sediments in 1.2 acres of the Cove would be dredged to a depth of 1 ft. bgs, via mechanical means or under dry conditions. Underlying sediments in the dredged area would be capped with 1 ft. of clean material. Dredging of sediments in the 0-1 ft. layer of SED7G would be followed by capping with area with AC-amended sand cap. This is proposed to address any migration of PCBs from the sub-surface sediments to the rip-rap in the plunge pools that would be constructed in this area of the Cove. Options for capping material for the remaining 1 acre of the Cove include AC-amended sand and sand-soil mix, both of which were evaluated under WIA-5 and found to be effective.

CapSim modeling for in-situ treatment (under WIA-4) and for dredging and capping (under WIA-5) predicted that both remedies would meet the RAO. Separate CapSim evaluations were not conducted for WIA-6 as

CapSim results for WIA-4 and WIA-5 can be used to evaluate the effectiveness of this alternative. Both SediMite and AquaGate+PAC 10%, in combination with dredging and capping with either AC-amended sand or sand-soil mixture were able to meet the 0.64 ng/L porewater target for PCBs in the Cove BAZ on a surface area averaged basis.

Dredging under both this alternative, including dredging for creation of outfall plunge pools and drainage channels, would result in approximately 3360 CY of dredged sediment, and would require approximately 3070 CY of capping material.

Dredging and capping and placement of amendment materials can be performed with or without dewatering of the Cove and both site conditions can be considered viable for implementation. Turbidity controls and monitoring will be conducted during remedial activities, whether work is conducted in the wet or the dry, to manage suspended sediment that may be generated during remedy implementation. For work to be conducted with dewatering, a cofferdam (or other suitable hydraulic control) would be required to hydraulically separate the Cove from the main stem of the Anacostia River. Water from within the Cove and any stormwater from the outfalls would be pumped down and discharged to the mainstem (with in-line solids removal as needed). Once the Cove has been dewatered, the AC amendments can be applied to the 2.5 acre area of the Cove. The amendment materials are placed as a thin layer using a variety of wet or dry broadcasting methods. Post-placement sediment coring can be used to ensure that uniform thickness of material is achieved across the Cove. Placement of coir mats or similar products on top of the amendment layer may be required to prevent re-suspension and subsequent transport of amendment out of the Cove. In the remaining 1.2 acres, sediments would be dredged to a depth of 1 ft. below the existing grade, generating approximately 2230 CY of sediments requiring disposal, including removal of 300 CY of sediment to construct outfall plunge pools and drainage channels by dredging or excavation. The 300 cubic yards of dredged material was estimated based on the existing grade and the proposed bottom elevation of the plunge pools and channels.

When applied without dewatering, the AC amendments rely on bioturbation for effective mixing into the BAZ. When applied under dry conditions, the amendments can be mixed into the top few inches of the sediments via raking or tilling, thereby reducing the dependance on bioturbation.

Under the scenario where a hydraulic barrier is installed and the water level in the Cove is pumped down, equipment and materials can be staged either within the Cove or in a separate staging area adjacent to or downstream of the Cove. The equipment and materials could be transported to the Cove either by water or overland. Water access would require the installation of temporary moorings to allow barges in and out of the Cove area; the temporary moorings would likely be placed just south of the mouth of the Cove.

Land access would require temporary closures of the Anacostia Riverwalk Trail and temporary haul roads through the park land.

The maximum concentration of PCBs in the Cove sediment detected was 11.8 mg/kg. Therefore, sediment removed from the Cove would contain PCBs well below the TSCA threshold of 50 mg/kg which triggers disposal at a TSCA-approved facility. Dewatering of dredged sediment would be required to facilitate its handling and meet requirements for transportation and disposal. Material that is mechanically dredged has a high percent of water. These sediments are typically transported to a staging area, placed on a dewatering pad to drain by gravity, and then mixed with drying/stabilizing agents prior to transportation and disposal. Bench-scale testing conducted during the Treatability Study indicated that the additional of a polymer such as ZapZorbTM along with 10% of Portland cement was able to provide sufficient strength required for disposal (AECOM, 2021a).

Due to stringent water quality criteria for PCBs and the addition of polymers and stabilizers, water from dewatering operations (filtrate) would need treatment prior to its discharge. Filtrate would be treated on site and either discharged to the Anacostia River or to an MS4 system under an appropriate discharge permit. On-site water treatment system and an NPDES discharge permit to release the treated water back to the river would be required for this action to be cost effective. However, off-site disposal of produced water may be required if treatment cannot meet the stringent water quality standards. Environmental controls during implementation would include turbidity curtains, soil erosion and sediment controls (ESC), turbidity monitoring, air/odor monitoring, dust suppression measures, and noise monitoring as needed.

Following placement of the AC amendment, post-application monitoring for confirming even spreading of AC would be performed and may include methods such as collection cores to verify initial thickness of amendment applied and periodic cores to assess progress on mixing of carbon throughout the bio-active zone. Post-placement sediment coring can be used to ensure that uniform thickness of capping material is achieved across the Cove.

Appropriate test methods will be specified as part of the remedial design.

Following placement of the cap and in-situ treatment, regulated resource areas and ecological functions disturbed by remedial activities would be restored to re-establish pre-existing characteristics and habitats. This baseline restoration will include:

- Replanting the aquatic vegetation on the cap surface.
- Creation of additional wetland area within the Cove as part of wetland mitigation (if 2:1 wetland mitigation is required).

- Armoring of the outfall areas and channels would be conducted during the restoration phase to prevent erosion of the cover.

Upon completion of remediation, a periodic monitoring program would be implemented to assess the stability and long-term effectiveness to ensure compliance with the RAOs. During the first several years, it is anticipated that some replenishment of the AC amendment would be needed, if the monitoring determines that the design quantity of amendment material is not present within certain areas of the Cove due to unexpected erosion or movement of Cove sediments. It is also anticipated that during the first several years, there may be repair/maintenance measures needed to ensure that the integrity of the cap. Anticipated repairs may include supplementing any eroded or disturbed cap. Repairs may also include adding additional riprap protection to increase the cap stability. These repairs, if needed, would be carried out promptly based on findings of periodic inspections and monitoring. As such, it is not anticipated that the short-term disturbances/damages would significantly affect the pore water breakthrough concentrations. A long-term operations, maintenance, and monitoring (OMM) plan prepared during the remedial design phase will define specific OMM needs.

<u>Overall Protection of Human Health and the Environment</u>: Under this alternative, sediments in 2.5 acres of the Cove would be treated with a 5% AC dose, while sediments in the remaining 1.2 acres would be mechanically dredged to a depth of 1 ft. and capped with a 1 ft. thick layer of AC-amended sand or sand-soil mix. CapSIM modeling predicts that all potential scenarios possible under this alternative would be effective at keeping the surface weighted average PCB concentration in the porewater of the BAZ below the 0.64 ng/L criterion for at least 100 years, thus reducing exposure from the Cove sediments. Removal of 3360 CY of contaminated sediments is expected to reduce PCB concentrations in the Cove, while the clean BAZ created by the cap is expected to reduce exposure to PCBs in underlying sediments. DOEE administers regional fish consumption advisories to address human health risk. The United States owns the Anacostia River bottom and NPS regulates construction activities or sediment disturbances within the WIA through a permit process. If these two regulatory measures remain in place, they would serve as ICs to protect human health. Therefore, this alternative is protective human health and the environment.

<u>Compliance with ARARs</u>: The remedial design process would identify specific regulatory requirements applicable to each component of the remedy and would establish procedures to comply with these requirements. The design process will also identify and obtain all applicable Federal and District permits to conduct the remedial action. Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions. Thus, this alternative would meet the ARARs identified in **Table 3-1**.

Long-term Effectiveness and Permanence: The Cove is located within a generally low energy, depositional area of the Anacostia River except within outfall areas and channels. Surfaces in outfall areas and channels would be armored with riprap to prevent erosion and improve stability of the cap material. Accordingly, it is anticipated that the cap, AC-amendment materials, and underlying sediments will remain generally stable. CAPSIM modeling predicts that all potential scenarios under this alternative would keep the surface area averaged porewater concentrations of PCBs in the BAZ below the 0.64 ng/L criterion for at least 100 years. This alternative would also permanently remove 2230 CY of contaminated sediments from the Cove. The remedial design would incorporate measures to reduce recontamination from known sources (as discussed in Section 6.2.5). Attainment of the RAO would be tracked under a LTM program wherein pore water concentrations would be measured to assess the effectiveness of the remedy. In addition, the distribution of carbon, in the areas where it is applied, would be measured over time to ensure adequate sequestration capacity is achieved in the cove. The monitoring program and specific performance criteria will be developed and described in the baseline and performance monitoring plan to be prepared during the remedial design phase. Regulatory measures by DOEE (fish advisories) and NPS (permitting of activities that disturb the river bottom) are assumed to remain in effect as ICs to protect human health. Therefore, this alternative provides long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume Through Treatment: In-situ treatment of sediments in the Cove via AC would reduce the overall mobility and toxicity of PCBs in sediment through sequestration, as demonstrated by the TS results and supported through CAPSIM modelling. In addition, nearly 2230 CY contaminated with PCBs would be permanently removed from the Cove, thereby reducing the volume of contaminated sediments. Placement of a cap would reduce the overall mobility of PCBs in the underlying sediments, leading to lowered PCB concentrations in the porewater in the BAZ, as supported by the results of CAPSIM modelling. The cap would also function as a clean BAZ for benthic organisms, thus reducing toxicity of PCBs to benthic organisms. While studies have noted some impacts on benthic organisms due to the presence of AC (Jonker et al., 2009; Lillicrap et al., 2015; Rämö et al., 2021), these impacts are generally expected to occur at AC concentrations exceeding 5%. Additionally, no significant adverse impacts on survival of *L. variegtus* were observed in the Treatability Study (AECOM, 2021).

Short-term Effectiveness: The remedy can be installed in six months to a year. The effect of carbon amendments will need additional time to allow for bioturbation processes required to mix the amendment material into underlying impacted sediments and natural recovery processes, including deposition and burial of impacted sediments. For part of the Cove that is dredged and capped, this remedy will have an immediate improvement on PCB concentrations present in the Cove by permanently removing 2230 CY of sediment with PCB concentrations exceeding the RAL and by replacing the BAZ with clean substrate. This remedy would eliminate the existing benthic community temporarily, but the benthic community is expected to fully recolonize once the cap installation is complete. Short-term disturbance to the ecological habitat in the Cove is expected. The long-term monitoring plan would include monitoring the wetland vegetation. If the health, diversity, or abundance of the vegetation is impacted from the placement of activated carbon, then additional wetland mitigation would be required. However, the habitat is expected to recover after remedy implementation.

Short-term risks to the workers and community during remedy implementation are possible via generation of dust and odors, and increased traffic and disruptions to the Anacostia Trail and local roadways. Impacts to the surrounding community from traffic and movement of trucks are anticipated to be moderate and temporary. Short-term risks could be mitigated through implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of PPE by workers, implementation of soil erosion control measures, a soil management plan and air monitoring. Pepco will develop and implement an air monitoring plan and mitigation measures for any construction/excavation activities associated with remedy implementation. The air monitoring plan is prepared as part of the remedial design and will be compliant with OSHA requirements.

Short-term risks to the environment are possible via generation of suspended sediment and soil erosion and sedimentation from on-land activities. Short term risks to the environment can be mitigated through implementation of turbidity controls and monitoring and ESC measures.

This alternative is expected to generate moderate levels of greenhouse gas emissions from movement of trucks and other vehicles based on the quantity of sediments that would be dredged and disposed, as well as the amount of capping material that would be required.

Implementability: Mechanical dredging and capping, and in-situ treatment via AC are both commonly used process options for remediation of impacted sediments. Materials, equipment, and personnel required for implementation are generally readily available. However, dredging of the entire Cove is expected to produce approximately 2230 CY of sediments that would need substantial area for management including dewatering and stabilization. Dredged sediments typically contain 50% or more solids, and thus, considerable water management as well as treatment systems for the same are expected to be needed. In addition, considerable area would be needed for staging AC-based products. The area within and around the Cove is likely to be insufficient for staging the dewatering and water treatment systems, as well as for other equipment and materials required as part of this alternative. Obtaining necessary permits and regulatory clearances is expected to be difficult due to the potential impact on high and low marsh areas in the Cove during dredging in SED7G. Thus, this alternative is regarded as moderately difficult to implement from both technical and administrative perspectives.

Cost: The capital cost for this alternative, which includes professional/technical services, purchase and application of carbon amendment and capping materials, and baseline restoration, are estimated to be $7,613,000. O&M costs over 30 years include long-term operations and monitoring. The net present value of O&M costs is estimated to be $564,800. The total present worth cost of this alternative is $8,350,000 (**Table 6-4**). While both mechanical dredging (without dewatering the Cove) and excavation in the dry are viable alternatives, the cost estimates are based on assuming excavation in the dry with the installation of portadams or cofferdams, with sediment dewatering.

6.3.6 Summary

A summary of the detailed analysis performed for the RAAs for WIA Cove sediment is presented in **Table 6-5**. A comparative analysis of these alternatives is discussed in Section 7.0.

7 Comparative Analysis of Remedial Alternatives

7.1 Comparative Evaluation of WIA Cove Sediment Alternatives

Five sediment remedial alternatives were evaluated. These are:

- **WIA-1:** No Action
- **WIA-3:** Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)
- **WIA-4:** In-Situ Treatment (3.5 acres) and Limited Dredging with Capping (0.2 acres)
- **WIA-5:** Dredging of the Entire Cove and Capping
- **WIA-6:** In-Situ Treatment (over 2.5 acres) with Dredging and Capping (over 1.2 acres)

7.1.1 Threshold Criteria

Overall Protection of Human Health and the Environment

Alternative WIA-1 does not include any remedial activities and would not achieve the RAO in a reasonable timeframe. Therefore, WIA-1 would not be protective of the environment. All other alternatives are expected to meet the RAO. In addition, regulatory measures by DOEE (fish advisories) and NPS (permitting of activities that disturb the river bottom) are assumed to serve as ICs to protect human health. Therefore, all alternatives except for WCS-1 meet this criterion.

Compliance with ARARs

As no actions are taken under WCS-1, it would not comply with ARARs. All other alternatives would meet ARARs by addressing regulatory and permitting requirements through remedial design and regulatory review process.

7.1.2 Balancing Criteria

Long-term Effectiveness and Permanence

All alternatives except WIA-1 are expected to maintain porewater concentrations of PCBs below the target breakthrough PCB concentration of 0.64 ng/L in the BAZ for at least 100 years on a surface area averaged basis. The Cove is a low energy environment and is generally stable, but portions of the area within the Cove have the potential to experience episodic scour. For this reason, replenishment of carbon over the life of the remedy may be needed in certain areas under WIA-4 and WIA-6. WIA-4 was ranked moderate as it involves AC application over most of the Cove, while WIA-6 was ranked moderate-to-high due to AC being applied over a smaller area, while also involving dredging and placement of a 1 ft. cap which is expected to provide greater protection against episodic erosion of material in the Cove. Alternative WIA-3 includes 1 ft. thick capping and is expected to provide greater protection against episodic erosion of material within the Cove, WIA-5 involves removal of 0-1 ft. interval of sediments throughout the Cove and also includes a 1 ft. thick cap placed after dredging. WIA-5 was thus ranked high as it removes all surface sediment that exceed the interim RAL, while WIA-3 was ranked moderate-to-high.

Reduction of Toxicity, Mobility and Volume

WIA-3 reduces mobility of PCBs in the porewater via placement of a 1 ft. thick cap on existing sediments and involves removal of only a minor quantity of sediment. WIA-4 involves in-situ treatment of PCBs in the porewater in the BAZ via AC and includes removal of a minor quantity of sediment. WIA-5 removes all the impacted sediment in the 0-1 ft. interval of the Cove, while also reducing the mobility of PCBs in porewater via placement of 1 ft. thick cap over the dredged area. WIA-6 involves a combination of in-situ treatment and dredging and capping while removing approximately 30% of the impacted sediments in the 0-1 ft. interval of the Cove. Based on the above comparison, WIA-3 and WIA-4 were ranked moderate, WIA-6 was ranked moderate-to-high, while WIA-5 was ranked high.

Short-term Effectiveness and Potential Impacts

WIA-3 involves placement of a 1 ft. cap over the impacted sediments while WIA-5 involves dredging of sediments in the 0-1 ft. interval followed by capping. While both WIA-3 and WIA-5 would be effective in the short-term, potential impacts on the ecological habitat in the Cove and on surrounding community, and environment are expected to be high. Both WIA-3 and WIA-5 would result in temporary elimination of the existing benthic community and would require the existing aquatic vegetation in the Cove to be removed. In addition, large quantities of materials would need to be transported in and out of the Cove, resulting in higher levels of traffic, noise, dust generation, and greenhouse gas emissions. Impacts from WIA-5 are expected to be higher than those from WIA-3.

WIA-4 would be less effective in the short-term as some time is needed to allow the AC-amendments to mix into the sediments (except under the scenario in which the material is placed in dry conditions and tilled into the existing sediment). However, impacts on the ecology, community, and environment are expected to be minimal under WIA-4 as it would not eliminate the existing benthic community. WIA-4 would not require removal of the existing aquatic vegetation, except that in SED7G polygon. Wetland mitigation would be required for impacted wetland area in SED7G but the area impacted would be smaller than that impacted in other alternatives. While studies have noted some short-term toxic effects on benthic organisms due to the presence of AC, the benthic community is anticipated to recolonize. In addition, the overall quantity of material to be transported is relatively small and would thus result in lower levels of traffic, noise, dust generation, and greenhouse gas emissions as compared to WIA-3 and WIA-5. WIA-6 involves AC application and dredging over a smaller area as compared to WIA-4 and WIA-5, respectively. WIA-6 would eliminate the benthic community in areas that are being dredged and capped, but would not require removal of the existing aquatic vegetation. Traffic, noise, dust generation, and greenhouse gas emissions are expected to be in between those from WIA-4 and WIA-5. Thus, effectiveness of WIA-6 and impacts from WIA-6 are expected to be intermediate between those from WIA-4 and WIA-5.

Based on the above consideration, WIA-5 was ranked low, WIA-3 and WIA-6 were ranked moderate, while WIA-4 was ranked moderate-to-high.

Implementability

WIA-3 and WIA-5 would require more space and coordination to stage equipment and materials and manage dredged materials. Additionally, impacts on existing aquatic vegetation are expected to be higher for WIA-3 and WIA-5 than those from other alternatives. Thus, WIA-3 and WIA-5 would be more complex in terms of implementation, with WIA-5 being the most difficult to implement of all the alternatives due to the need for handling both dredged sediments and capping materials.

WIA-4 is anticipated to be most readily implementable alternative due to smaller quantity of material required to be handled and fewer anticipated impacts on aquatic vegetation compared to other alternatives. WIA-6 would be intermediate between WIA-4 and WIA-5 in terms of material quantities required to be handled and impacts on aquatic vegetation.

Based on the above considerations, WIA-5 was ranked low, WIA-3 was ranked low-to-moderate, WIA-6 was ranked moderate, while WIA-4 was ranked moderate-to-high.

Cost

Based on the total estimated cost for each of the alternatives, WIA-4 was ranked high, WIA-3 was ranked moderate-to-high, WIA-6 was ranked low-to-moderate, while WIA-5 was ranked low.

7.1.3 Summary of Comparative Evaluation and Recommendation

A complete summary of comparative evaluation for WCS Cove Sediment alternatives is presented below. Based on this evaluation, WIA-4 is the preferred alternative, as it would achieve the remedial objectives with the lowest cost and highest implementability.

Evaluation Criteria	WIA-1	WIA-3	WIA-4	WIA-5	WIA-6
	No Action	Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)	In-Situ Treatment (3.5 acres) and Limited Dredging with Capping (0.2 acres)	Dredging of the Entire Cove and Capping	In-Situ Treatment (over 2.5 acres) with Dredging and Capping (over 1.2 acres)
Threshold Criteria					
Overall Protectiveness of Human Health and the Environment	X	✓	✓	✓	✓
ARAR Compliance	X	✓	✓	✓	✓
Balancing Criteria					
Reduction in Toxicity, Mobility and Volume	NA	2	3	5	4
Long-term Effectiveness and Permanence	NA	3	3	5	4
Short-term Effectiveness and Potential Impacts	NA	3	4	2	3
Implementability	NA	2	4	1	3
Cost Effectiveness	NA	4	5	1	2
Total Score	**NA**	**14**	**19**	**14**	**16**
Total cost	**$0**	**$7,340,000**	**$6,170,000**	**$12,690,000**	**$8,350,000**

8 References

AECOM. (2013). *Final Sampling and Analysis Plan. Prepared for Pepco and Pepco Energy Services. February.*

AECOM. (2016). *Technical Memorandum #2, Refined Background Evaluation Work Plan. Appendix D of Remedial Investigation/Feasibility Study Work Plan Addendum 3. Benning Road Facility, Washington DC. Prepared for Pepco and Pepco Energy Services, Washington DC.*

AECOM. (2019). *Draft Forensics Analysis and Source Evaluation Report. Prepared for Pepco and Pepco Energy Services. July.*

AECOM. (2020a). *Remedial Investigation Report—Final (February 2020)*. https://www.benningservicecenter.com/library/documents/RemedialInvestigationReport(Final)/RemedialInvestigationReport(Final)_February2020.pdf

AECOM. (2020b). *Treatability Study Work Plan, Final. Benning Road Facility, 3400 Benning Road, NE, Washington, DC 20019. March.*

AECOM. (2021). *Treatability Study Report—Final*. https://www.benningservicecenter.com/library/documents/TreatabilityStudyReport_08-25-21.pdf

AECOM. (2023). *Post-RI Technical Memorandum #2: Additional Data Collection at the Waterside Investigation Area Cove Benning Road Facility, 3400 Benning Road, NE, Washington, DC*.

AECOM. (2024). *Landside (Operable Unit 1) Feasibility Study: Benning Road Facility. Prepared for Pepco and Pepco Energy Services. March 2024.* https://dcgov.app.box.com/s/p5svsq3hhe8i0wzic1pbxfmqctehgz8z/file/1472537516809

Behm, P., Buckley, A., & Schultz, C. L. (2003). *TAM/WASP Toxics Screening Level Model For The Tidal Portion Of The Anacostia River: Final Report*. D.C. Department of Health, Environmental Health Administration, Bureau of Environmental Quality, Water Quality Division. https://www.potomacriver.org/wp-content/uploads/2014/12/ICPRB03-2.pdf

Buchman, M. F. (2008). *NOAA Screening Quick Reference Tables (SQuiRTs). NOAA OR&R Report 08-1.* (p. 34). Office of Response and Restoration Division National Oceanic and Atmospheric Administration. https://repository.library.noaa.gov/view/noaa/9327

DOEE. (2016). *Department of Energy and Environment: Notice of Second Proposed Rulemaking. Water Quality Standards for 2016 Triennial Review.* https://doee.dc.gov/sites/default/files/dc/sites/ddoe/release_content/attachments/2nd%20Proposed%2 0WQS%202016.pdf

DOEE. (2019a). *Contaminant Source Assessment Report, Anacostia River Sediment Project, Washington, D.C., Department of Energy and Environment Government of the District of Columbia. December.*

DOEE. (2019b). *Remedial Investigation Report: Anacostia River Sediment Project, Washington, D.C.* https://www.dropbox.com/s/uz9d22g6aoh8bhc/DOEE_ARSP_RI_Report_2019December_WithFiguresTables.pdf?dl=0

DOEE. (2020a). *DOEE Wetland and Stream Regulations*.

DOEE. (2020b). *Interim Record of Decision: Early Action Areas in the Main Stem, Kingman Lake, and Washington Channel*. https://www.dropbox.com/s/iunneje3g7a8l8n/Anacostia%20River%20Sediment%20Project_Interim%20Record%20of%20Decision_2020Sept30.pdf?dl=0

ENSAFE. (2023). *Site-Wide Initital Site Characterization Report: Joseph Smith & Sons, 2001 Kenilworth Avenue, Capitol Heights, Prince George's County, Maryland 20743—Revision 01. September 2023.*

Foster, G., D., Roberts Jr., E., C., Gruessner, B., & Velinsky, D. J. (2000). Hydrogeochemistry and transport of organic contaminants in an urban watershed of Chesapeake Bay (USA). *Applied Geochemistry*, *15*(7), 901–915.

Ghosh, U., Lombard, N., Bokare, M., Yonkos, L., & Harrison, R. (2019). *Passive samplers and mussel deployment, monitoring, and sampling for organic constituents in Anacostia River tributaries: 2016-2018 Year 1 Interim Report. U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD. CBFO-C19-02.*

Hwang, H. M., & Foster, G. D. (2008). Polychlorinated biphenyls in stormwater runoff entering the tidal Anacostia River, Washington, DC, through small urban catchments and combined sewer outfalls. *Journal of Environmental Science and Health, Part A*, *43*(6), 567–575.

Jarvinen, A. W., & Ankley, G. T. (1999). *Linkage of effects to tissue residues: Development of a comprehensive database for aquatic organisms exposed to inorganic and organic chemicals.* SETAC Press.

Jonker, M. T. O., Suijkerbuijk, M. P. W., Schmitt, H., & Sinnige, T. L. (2009). Ecotoxicological Effects of Activated Carbon Addition to Sediments. *Environmental Science & Technology*, *43*(15), 5959–5966. https://doi.org/10.1021/es900541p

Katz, C. N., Carlson, A. R., & Chadwick, D. B. (2001). *Draft Anacostia River Seepage and Pore Water Survey Report. Prepared for the Space and Naval Warfare Systems Center*.

Lillicrap, A., Schaanning, M., & Macken, A. (2015). Assessment of the Direct Effects of Biogenic and Petrogenic Activated Carbon on Benthic Organisms. *Environmental Science & Technology*, *49*(6), 3705–3710. https://doi.org/10.1021/es506113j

MDE. (2020). *Lower Beaverdam Creek PCB Investigation*. https://mde.maryland.gov/programs/LAND/MarylandBrownfieldVCP/Documents/Final%20LBC%20Results%20Nov%2019%20Sampling%20-%20Feb%2020.pdf

MDE. (2024). *PCB Source Trackdown in Maryland: March 2024 Update*. Leadership Council for a Cleaner Anacostia River. https://app.box.com/s/2060th5iqhayszqb6cz2mm42o8g2cv9q/file/1472394798263

NPS. (2019a). *Final NPS Tributary Sediment Sampling Study Report, Anacostia River Sediment Project Site, National Capital Region. 18 September.*

NPS. (2019b). *Remedial Investigation Addendum Report, Final. Kenilworth Park Landfill, National Capital Parks East, Washington, DC. June.*

Pinkney, A. E. (2017). *Analysis of contaminant concentrations in fish tissue collected from the waters of the District of Columbia. Final Report. CBFO-C14-03.* U.S. Fish and Wildlife Service, Chesapeake Bay Field Office.

Rämö, R. A., Honkanen, J., Nybom, I., & Gunnarsson, J. S. (2021). Biological Effects of Activated Carbon on Benthic Macroinvertebrates are Determined by Particle Size and Ingestibility of Activated Carbon. *Environmental Toxicology and Chemistry*, *40*(12), 3465–3477. https://doi.org/10.1002/etc.5231

Schultz, C. L. (2003). *Calibration of the TAM/WASP Sediment Transport Model—Final Report*. https://www.potomacriver.org/wp-content/uploads/2014/12/ICPRB03-1.pdf

Shen, X., Lampert, D., Zhang, X., & Reible, D. (2023). *CapSim 4.2* [Computer software].

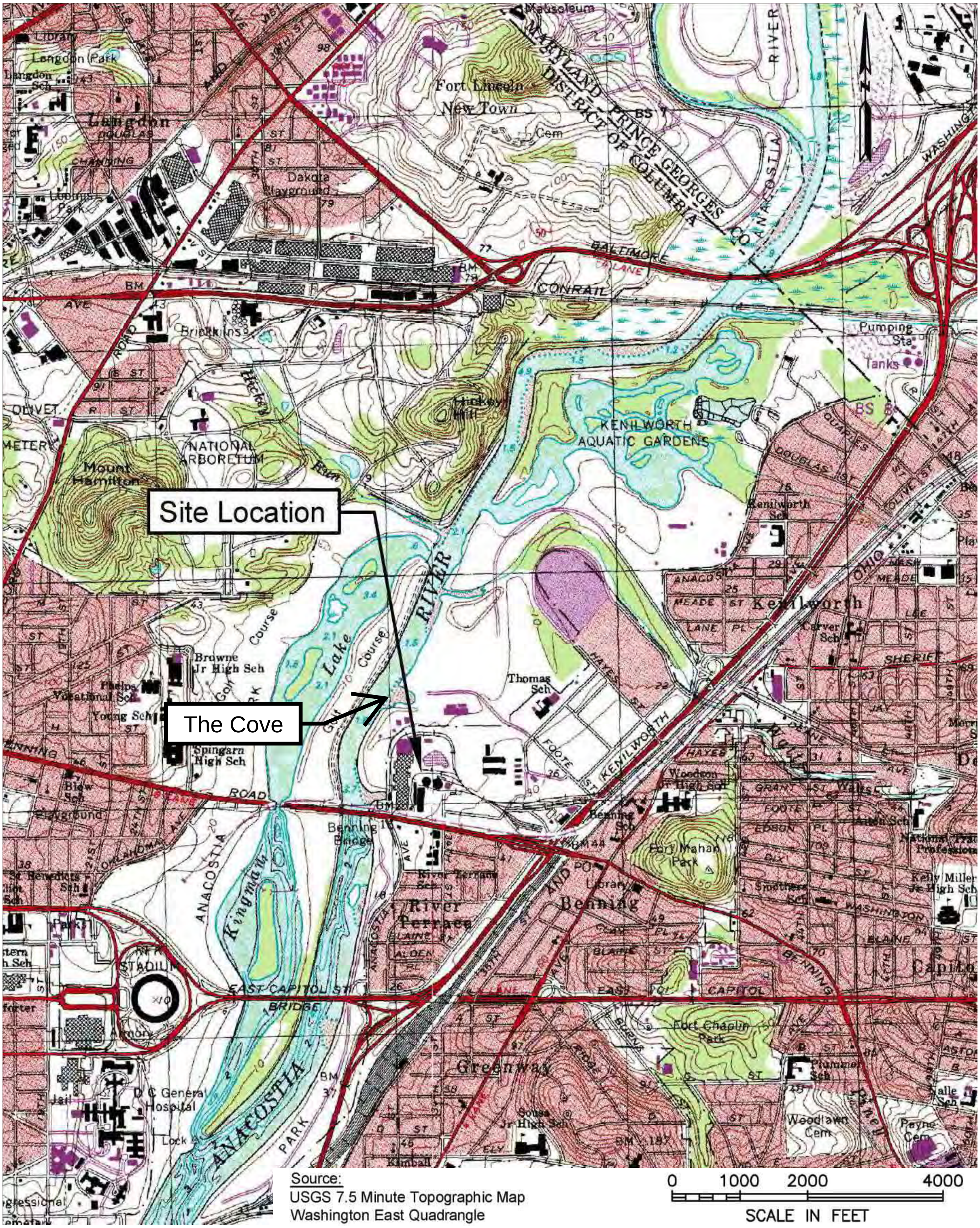
Suter, G. W., & Tsao, C. L. (1996). *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision.* (ES/ER/TM-96/R2). Environmental Sciences Division, Oak Ridge National Laboratory. https://rais.ornl.gov/documents/tm96r2.pdf

USEPA. (1988). *U.S. Environmental Protection Agency Guidance for Conducting RI/FS Under CERCLA.*

USFWS (U.S. Fish and Wildlife Service). (2019). *Passive samplers and mussel deployment, monitoring, and sampling for organic constituents in Anacostia River tributaries: 2016-2018 Year 1 Report. CBFO-C19-02. Report Submitted to: Toxics Substance Division, Department of Energy & Environment (DOEE). USFWS, Chesapeake Bay Field Office, University of Maryland College Park, Department of Environmental Science and Technology, and University of Maryland Baltimore County, Department of Chemical, Biochemical and Environmental Engineering. May*.

Wilson, T. P. (2019). *Sediment and Chemical Contaminant Loads in Tributaries to the Anacostia River, Washington, District of Columbia, 2016–17: U.S. Geological Survey Scientific Investigations Report 2019–5092* (Scientific Investigations Report) [U.S. Geological Survey Scientific Investigations Report]. https://doi.org/10.3133/sir20195092

Figures



AECOM

Benning Road Facility RI/FS Project
3400 Benning Rd., NE
Washington, DC 20019

Site Location Map

Figure 1-1

Legend

- Outfalls
- National Park Service Kenilworth Maintenance Yard
- D.C. Department of Public Works Solid Waste Transfer Station
- Waterside Investigation Area
- Kenilworth Park South Landfill Boundary
- Benning Road Facility Property Boundary

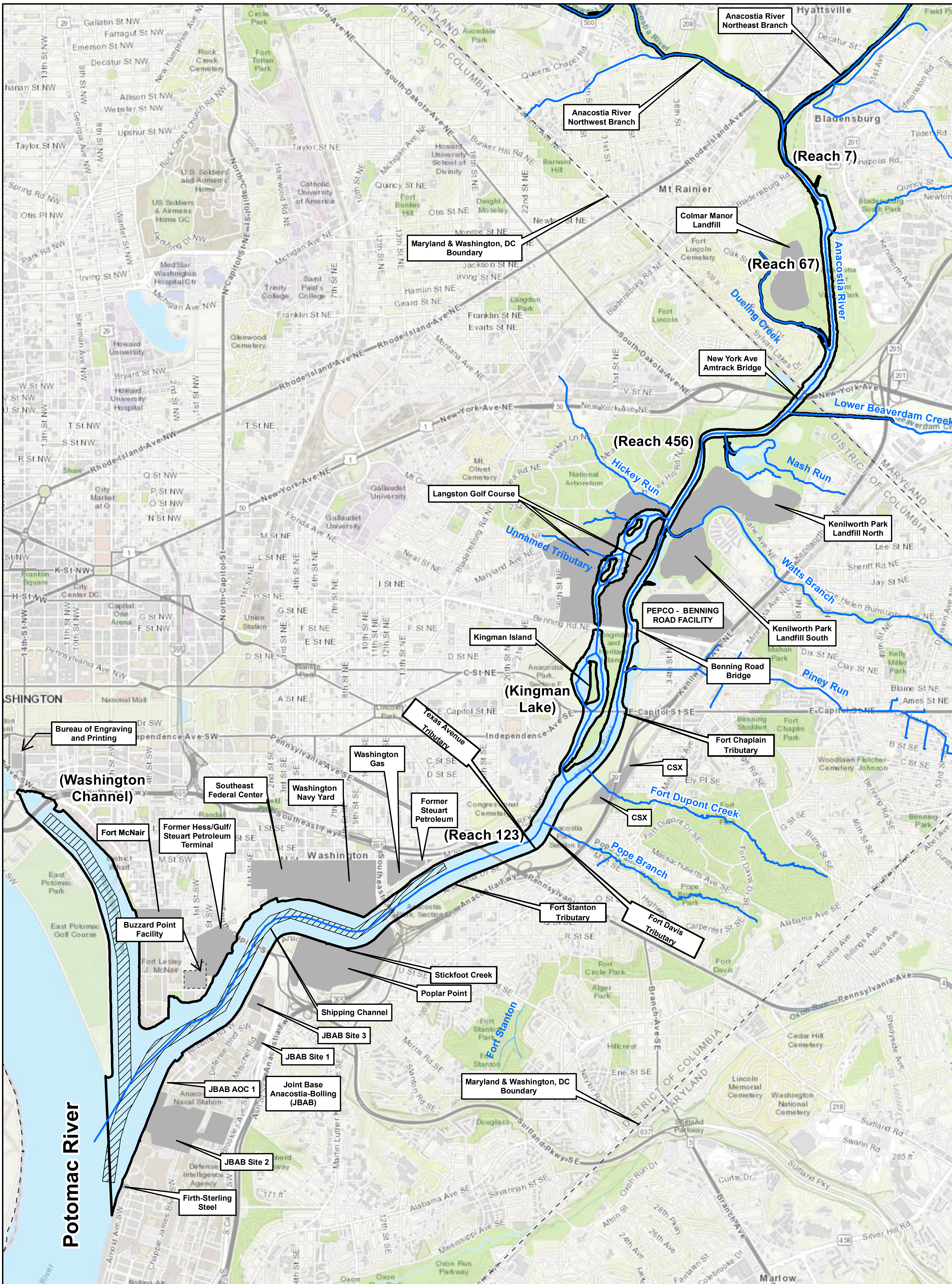
Source
Orthoimagery from Open Data DC, 2023.

AECOM

0 450 Feet

N

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019	SITE PLAN AND INVESTIGATION AREAS
DATE: 5/7/2024 DRWN: JB	FIGURE 1-2



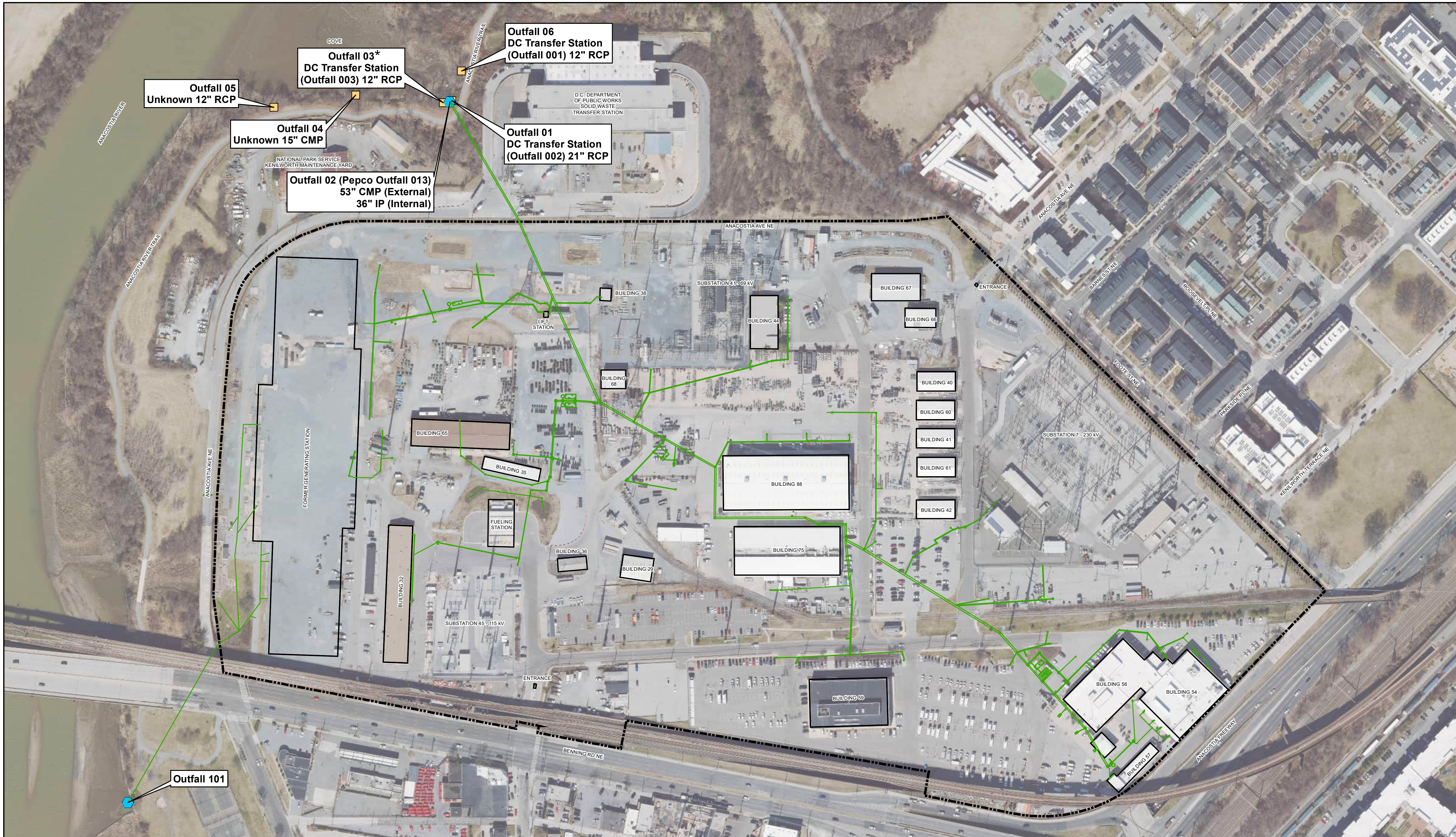
AECOM

BENNING ROAD FACILITY RI/FS PROJECT
3400 BENNING RD., NE
WASHINGTON, DC 20019

SITE VICINITY MAP

Date: 4/10/2023 | Drawn By: JB | Checked By: SED

FIGURE 1-3



Legend

- Storm Drain
- PEPCO Outfall
- Non-PEPCO Outfall
- Benning Road Facility Property Boundary

RCP: Reinforced Concrete Pipe
CMP: Corrugated Metal Pipe
IP: Iron Pipe

*Outfall 03 (DPW Outfall 003) does not belong solely to DPW.

Source
Orthoimergy from Open Data DC, 2021.

0 240 Feet

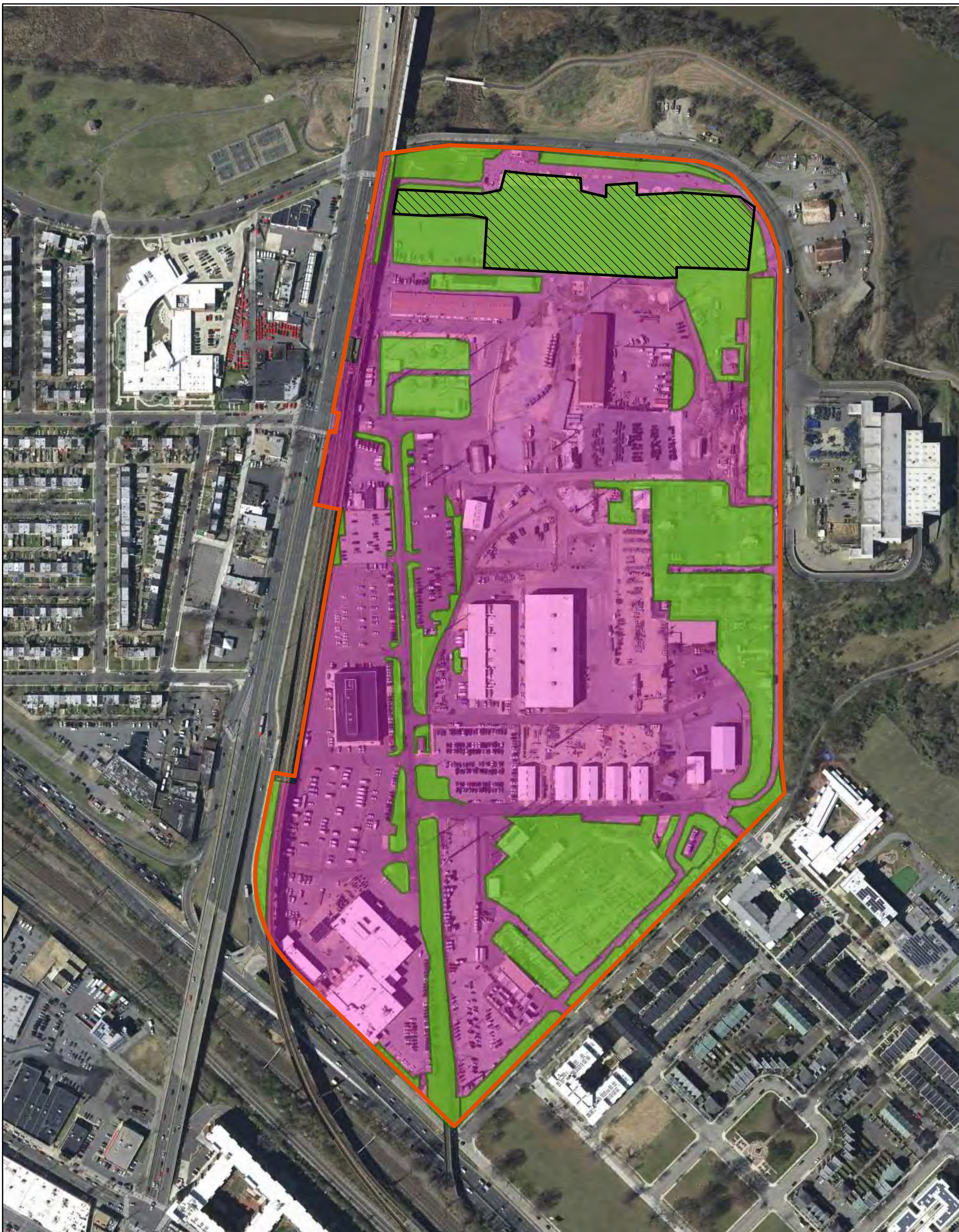
N

AECOM

BENNING ROAD FACILITY RI/FS PROJECT
3400 BENNING RD., NE
WASHINGTON, DC 20019

CURRENT SITE LAYOUT

DATE: 4/26/2023 | DRWN: JB | CHECKED BY: MB | FIGURE 2-1



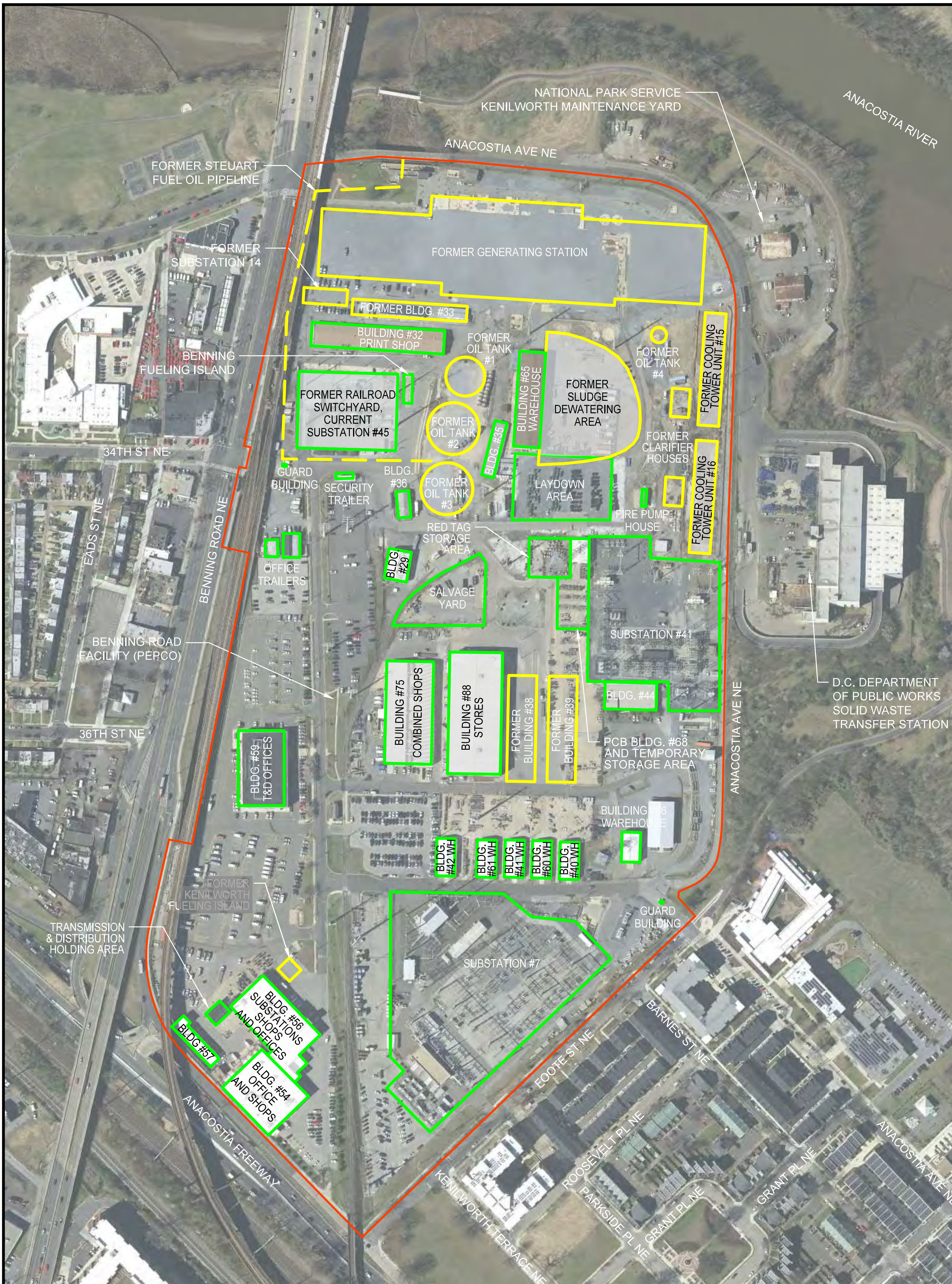
LEGEND

- Benning Road Facility Property Boundary
- Pervious (Grass and Loose Stone)
- Impervious (Paved and Hard-Packed Gravel)
- Former Power Plant Building Foundation

AECOM

0 400 Feet

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019			PERVIOUS VS IMPERVIOUS SITE SURFACE COVER
Date: 9/20/2018	Drawn By: KNS	Checked By: SED	FIGURE 2-2



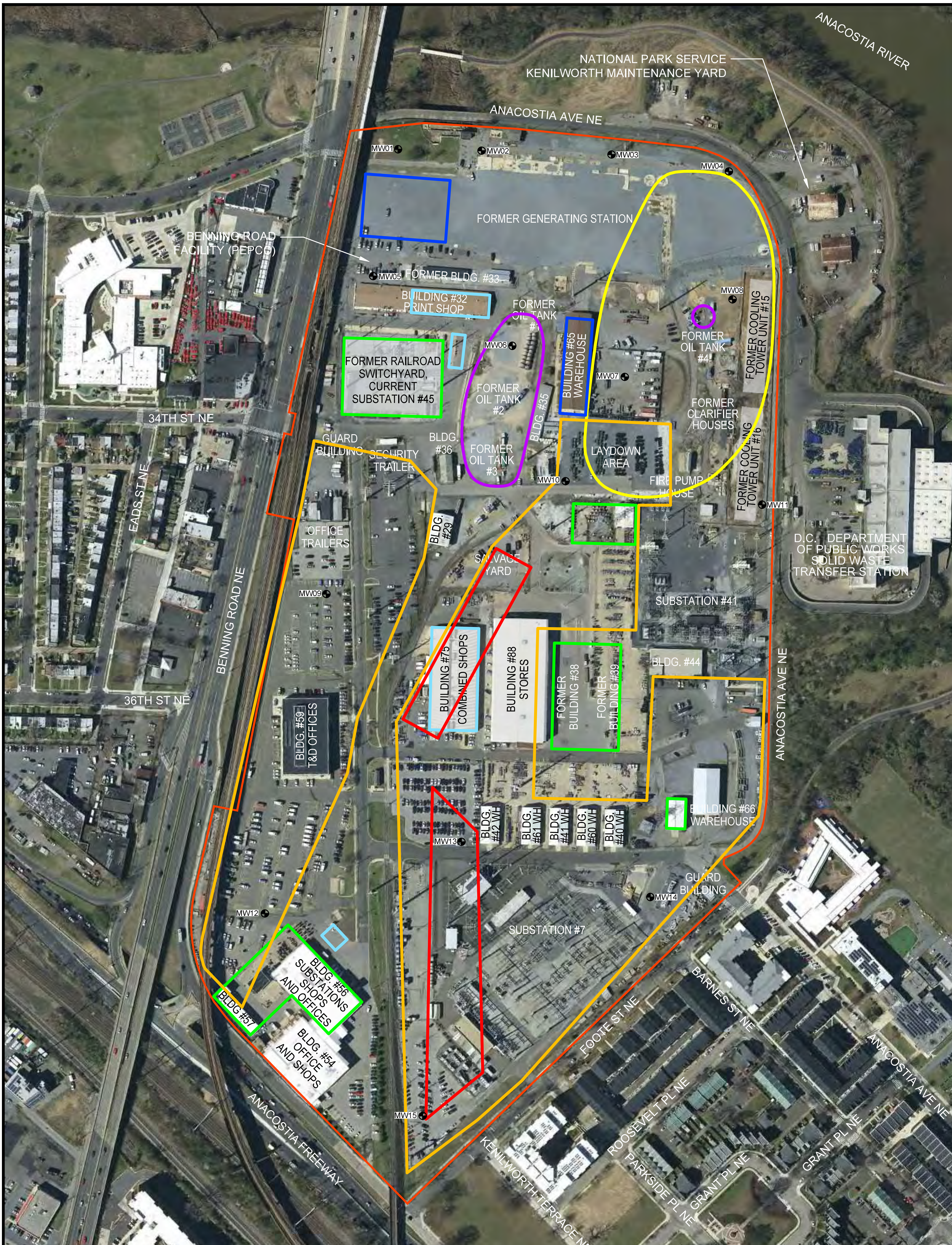
LEGEND:

- CURRENT BUILDING, STRUCTURE, OR AREA
- FORMER BUILDING, STRUCTURE, OR AREA
- PROPERTY BOUNDARY

AECOM

0 125 250 Feet

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019			CURRENT AND HISTORICAL SITE BUILDINGS	
DATE: 09/19/2018	DRAWN BY: LAD	CHECKED BY: RD		FIGURE 2-3



LEGEND:

- PROPERTY BOUNDARY
- EQUIPMENT LAYDOWN AREA (FORMER)
- VEHICLE FLEET SERVICING (REPAIR SHOPS, WASTE OIL STORAGE, FUELING FACILITIES) [CURRENT AND FORMER]
- UTILITY POLE STORAGE AREA (FORMER)
- COAL PILE AREA (FORMER)
- FUEL OIL STORAGE AREA (FORMER)
- TRANSFORMER OPERATIONS AREA (OIL STORAGE, SERVICING, EQUIPMENT SALVAGE) [CURRENT AND FORMER]
- CHLORINATED SOLVENT STORAGE AND/OR USAGE AREA (FORMER)
- MONITORING WELL LOCATION

AECOM

0 125 250 Feet

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019			CURRENT AND FORMER SITE OPERATIONS AREAS
DATE: 09/19/2018	DRAWN BY: LAD	CHECKED BY: RD	FIGURE 2-4

LEGEND:

- (18) TARGET AREA #
- TARGET AREA
- NPDES OUTFALL TO ANACOSTIA RIVER
- BENNING RD FACILITY PROPERTY BOUNDARY
- WATERSIDE INVESTIGATION AREA
- STORM WATER UTILITY
- APPROXIMATE FORMER CONSTRUCTED WETLANDS BOUNDARY
- APPROXIMATE LOCATION OF SEA WALL
- 15,000 GALLON TRANSFORMER OIL UST

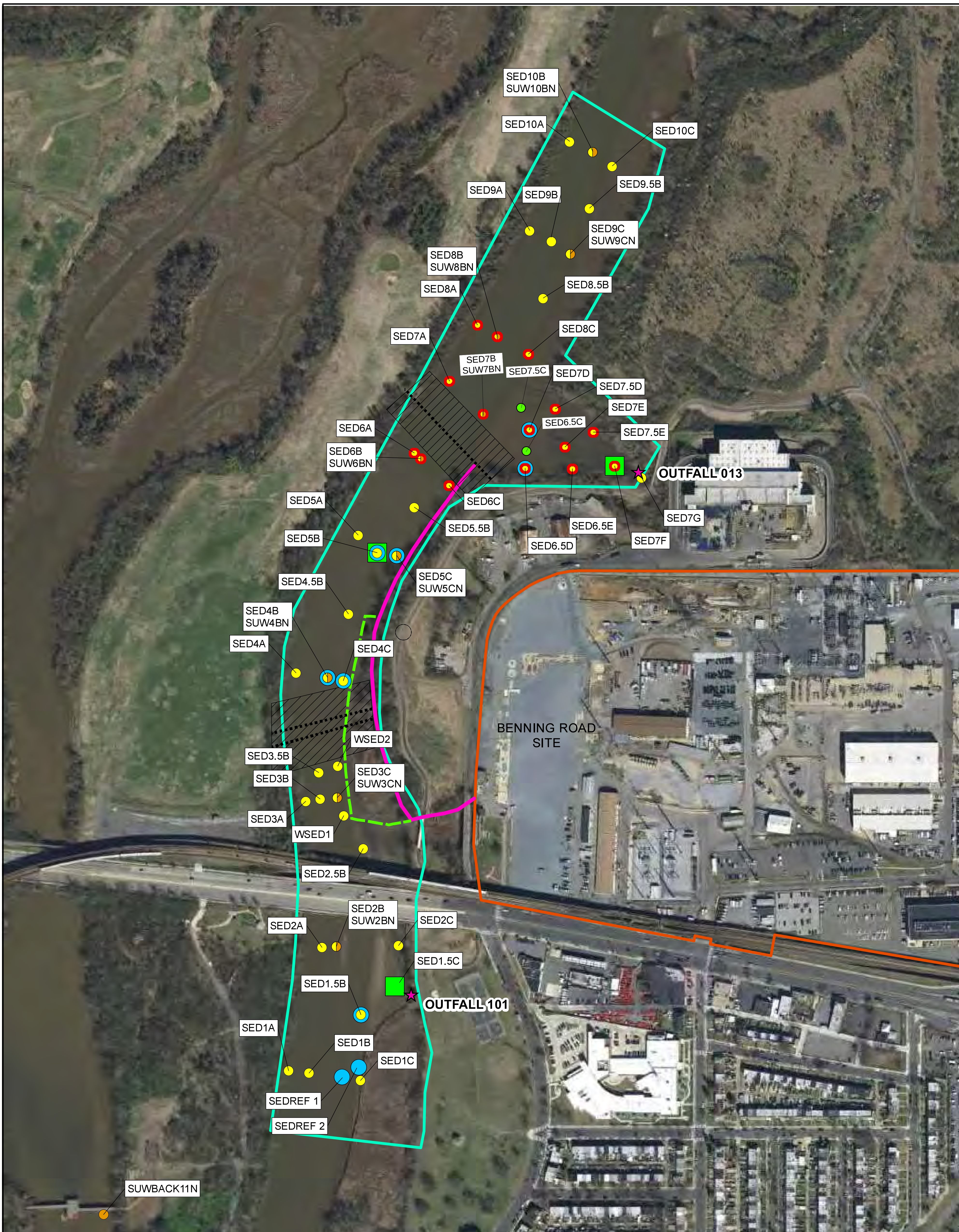
TARGET AREA KEY:

1. FORMER SLUDGE DEWATERING AREA
2. BENNING FUELING ISLAND
3. FORMER 50,000 GAL. AST AND 15,000 GAL. UST No. 2 FUEL OIL
4. 2003 SALVAGE YARD INVESTIGATION
5. 1995 CLEANUP AREA
6. 1991 CLEANUP AREA
7. 1988 PARKING LOT CLEANUP AREA
8. 1985 EXCAVATION AREA
9. GREEN TAG STORAGE AREA
10. RED TAG STORAGE AREA
11. BUILDING #68 (PCB BUILDING)
12. BUILDING #57
13. FORMER BULK STORAGE ASTs WITH LOADING RACK 550 GALLON FUEL OIL UST AND 2,000 GALLON USED OIL UST
14. FORMER RAILROAD SWITCHYARD
15. GENERATING STATION TRANSFORMERS
16. PRINT SHOP
17. STORM DRAIN SYSTEM
18. KENILWORTH FUELING ISLAND MTBE PLUME
19. PCE AND NAPHTHALENE IN GROUNDWATER
20. PAHs IN SOIL

AECOM

0 150 300 Feet

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019			TARGET INVESTIGATION AREAS	
DATE: 09/19/2018	DRAWN BY: JB	CHECKED BY: RD		FIGURE 2-5



LEGEND

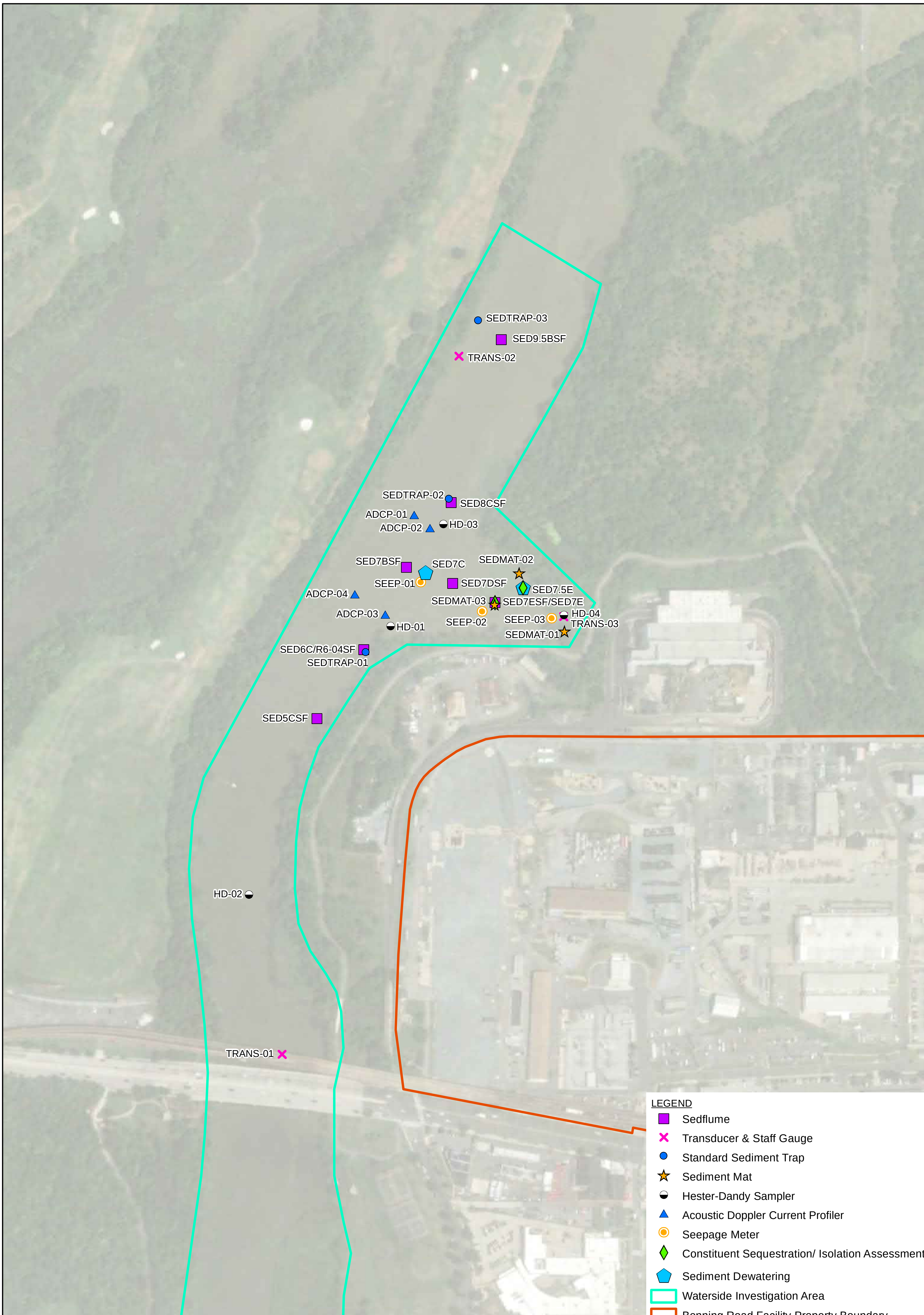
- Outfalls
- 2017 Surface Sediment Sample Location and SPI Survey Location*
- Surface Water Sampling Location
- 2013-2014 Surface and Subsurface Sediment Sample Location
- 2017 Forensics Sediment Sample Location
- 2017 High Resolution Coring Location
- Utility Crossing
- Approximate Former Constructed Wetlands Boundary
- 2023 Surface and Subsurface Sediment Sampling Locations
- 100' Utility Buffer Zone
- Approximate Location of Sea Wall
- Waterside Investigation Area
- Benning Road Facility Property Boundary

*Sample analyses include bulk sediment chemistry, pore water analysis, benthic macroinvertebrate analysis, and laboratory toxicity testing

AECOM

0 400 Feet

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019			WATERSIDE INVESTIGATION AREA SAMPLE LOCATIONS
Date: 2/13/2020	Drawn By: KNS	Checked By: SED	FIGURE 2-6A

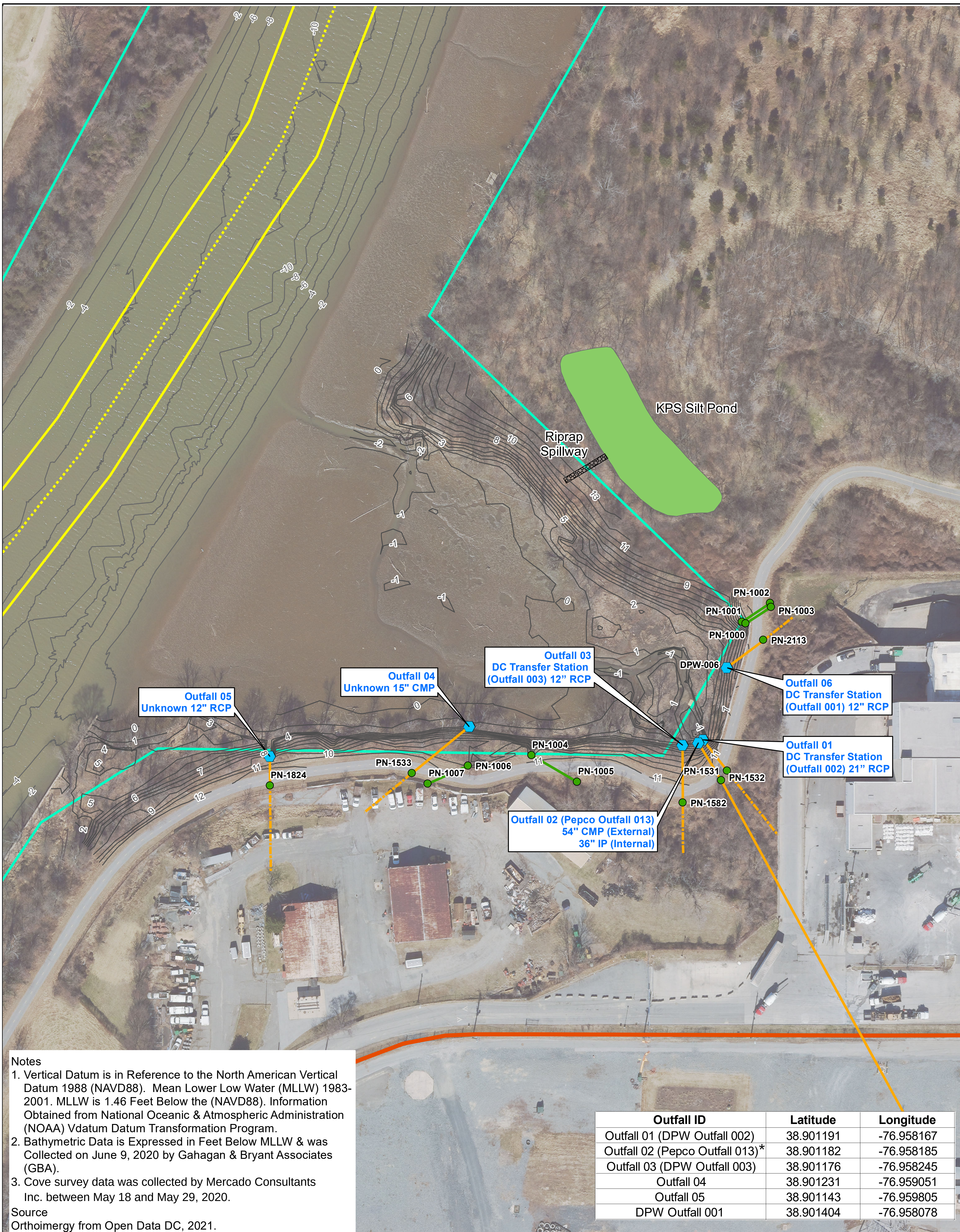


AECOM

BENNING ROAD FACILITY RI/FS PROJECT
3400 BENNING RD., NE
WASHINGTON, DC 20019

TREATABILITY STUDY
SAMPLING/INVESTIGATION LOCATIONS

Date: 11/3/2020	Drawn By: JB	Checked By: SED		FIGURE 2-6B



Notes
1. Vertical Datum is in Reference to the North American Vertical Datum 1988 (NAVD88). Mean Lower Low Water (MLLW) 1983-2001. MLLW is 1.46 Feet Below the (NAVD88). Information Obtained from National Oceanic & Atmospheric Administration (NOAA) Vdatum Datum Transformation Program.
2. Bathymetric Data is Expressed in Feet Below MLLW & was Collected on June 9, 2020 by Gahagan & Bryant Associates (GBA).
3. Cove survey data was collected by Mercado Consultants Inc. between May 18 and May 29, 2020.

Source
Orthoimergy from Open Data DC, 2021.

Outfall ID	Latitude	Longitude
Outfall 01 (DPW Outfall 002)	38.901191	-76.958167
Outfall 02 (Pepco Outfall 013)*	38.901182	-76.958185
Outfall 03 (DPW Outfall 003)	38.901176	-76.958245
Outfall 04	38.901231	-76.959051
Outfall 05	38.901143	-76.959805
DPW Outfall 001	38.901404	-76.958078

LEGEND
- Outfall Locations
- Surveyed Outfall
- Culvert Pipe
- Outfall Pipe
- Unknown Outfall Pipe
- Waterside Investigation Area
- Benning Road Facility Property Boundary
- Navigational Channel
- 1.0' Contour (Cove Survey – May 2020)
- 2.0' Contour (Bathymetry – June 2020)
- KPS Silt Pond
- Riprap Spillway

RCP: Reinforced Concrete Pipe
CMP: Corrugated Metal Pipe
IP: Iron Pipe

*Outfall 03 (DPW Outfall 003) does not belong solely to DPW.

0 100 200 Feet

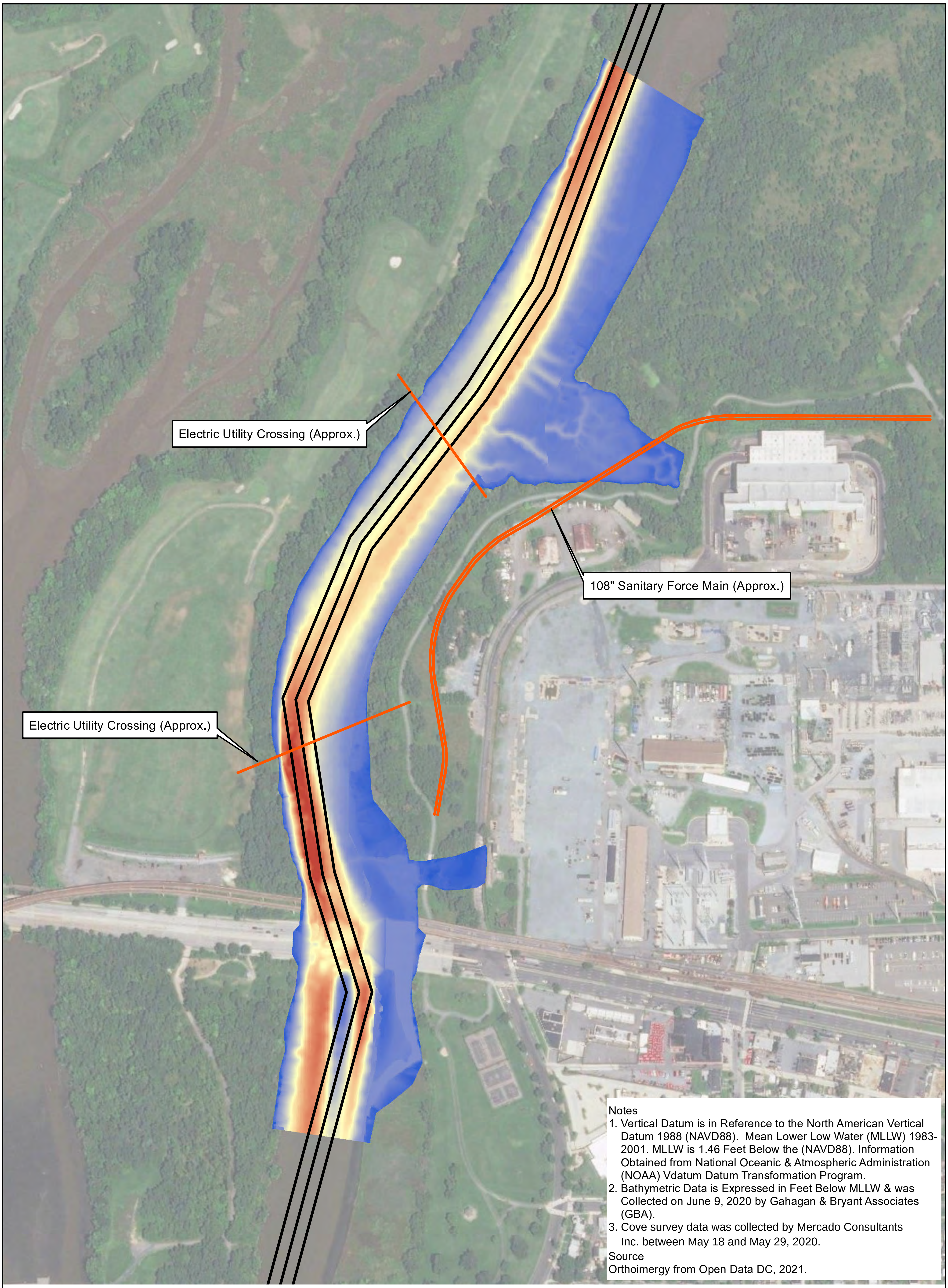
N

AECOM

BENNING ROAD FACILITY RI/FS PROJECT
3400 BENNING RD., NE
WASHINGTON, DC 20019

COVE OUTFALL LOCATIONS

Date: 6/12/2024	Drawn By: JB	Checked By: RD		FIGURE 2-7



Bathymetric survey conducted on June 9, 2020

Bathymetry

Elevation, ft MLLW

7.1

-19.7

Underground Utilities

Navigational Channel

AECOM

0 500 Feet

N S E W

BENNING ROAD FACILITY RI/FS PROJECT 3400 BENNING RD., NE WASHINGTON, DC 20019		WATERSIDE INVESTIGATION AREA BATHYMETRY & TOPOGRAPHY	
Date: 5/4/2022	Drawn By: CMD	Checked By:	FIGURE 2-8

Figure 2-9
Waterside Potential Noncancer Hazards
Benning Road Facility FS Project

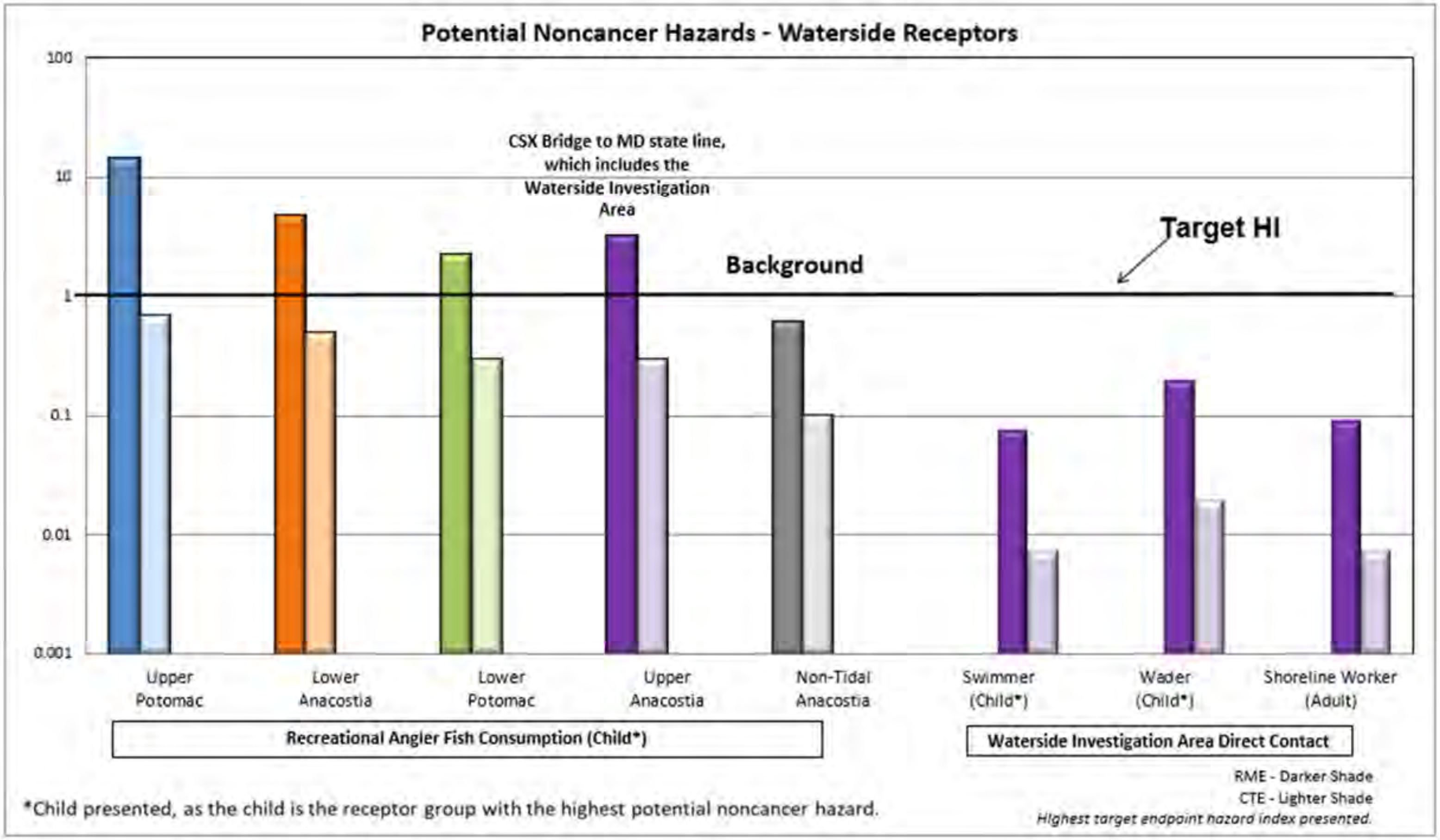


Figure 2-10
Waterside Potential Cancer Risks
Benning Road Facility FS Project

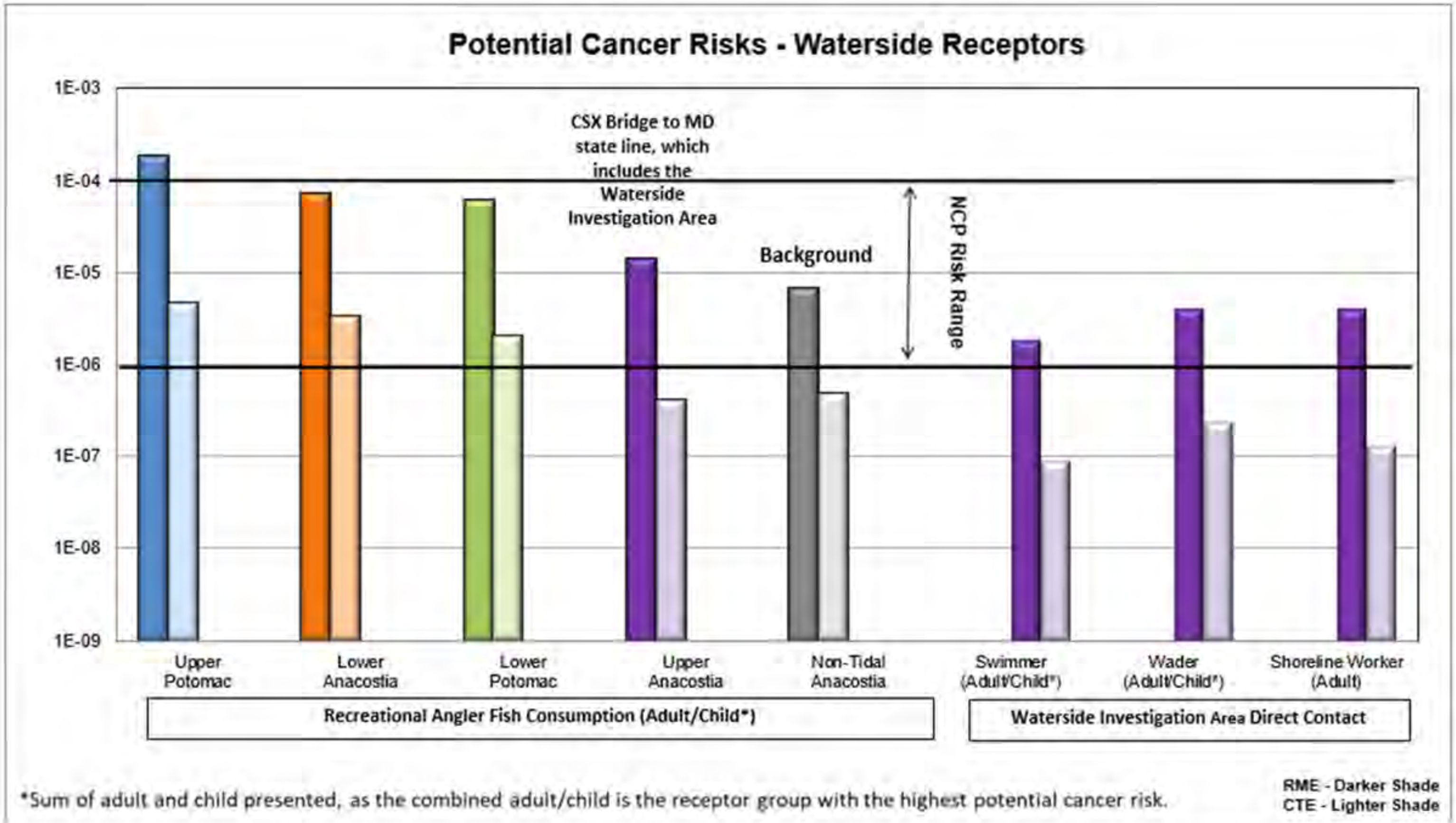


Figure 2-11
Conceptual Site Model - On-site Sources Contributing to Unacceptable Risk
Benning Road Facility RI/FS Project

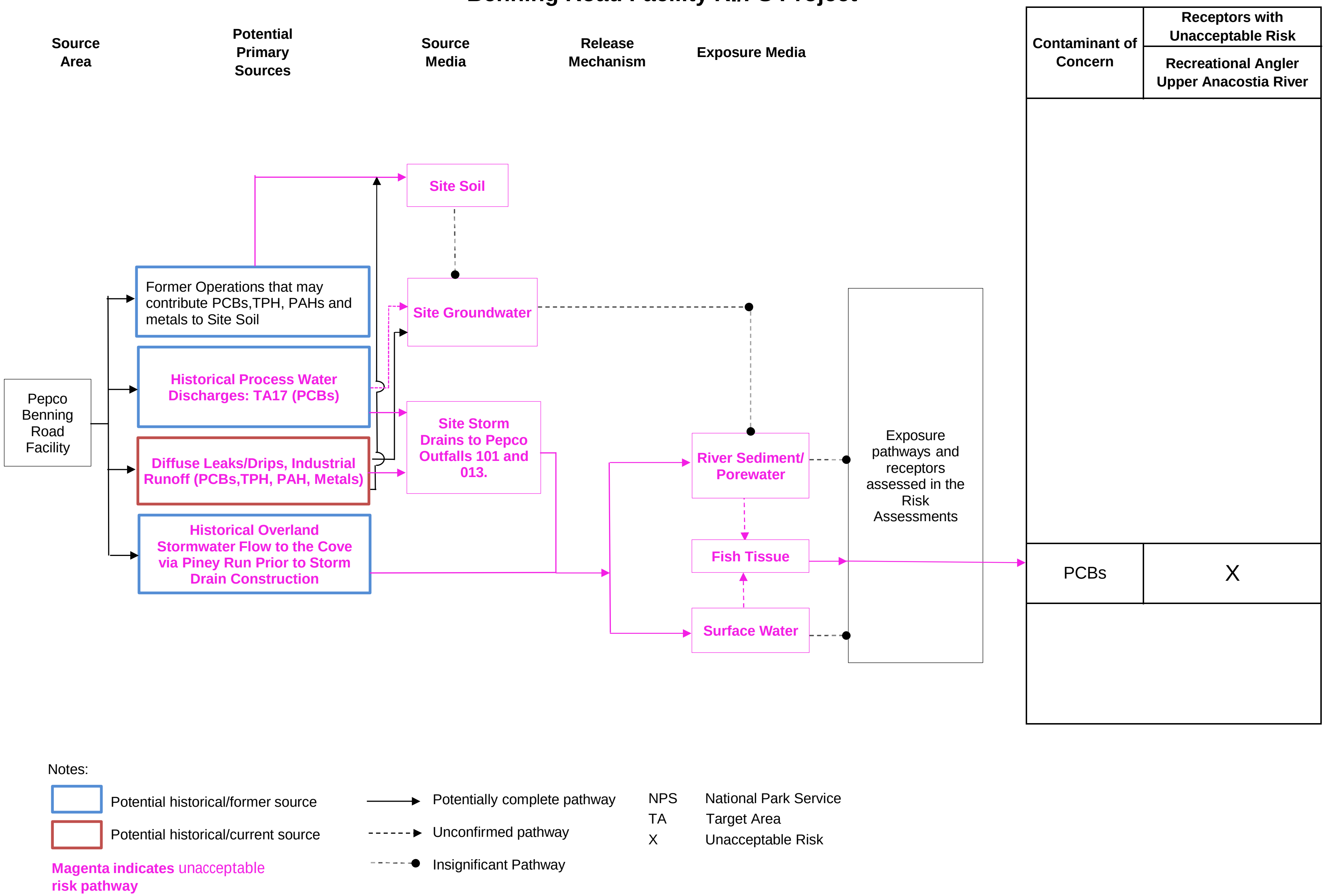
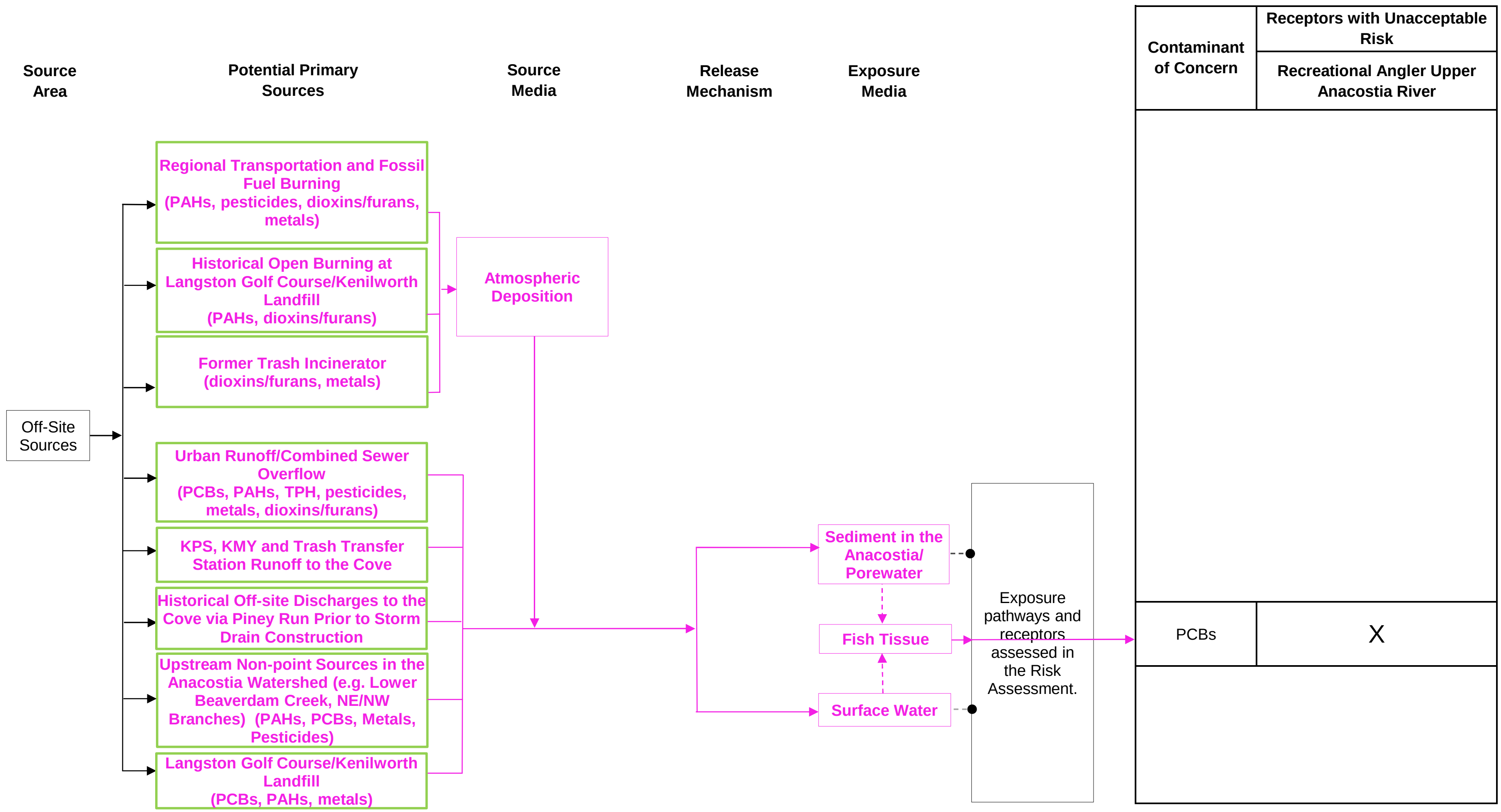


Figure 2-12
Conceptual Site Model - Off-Site Sources Contributing to Unacceptable Risk
Benning Road Facility RI/FS Project



Notes:

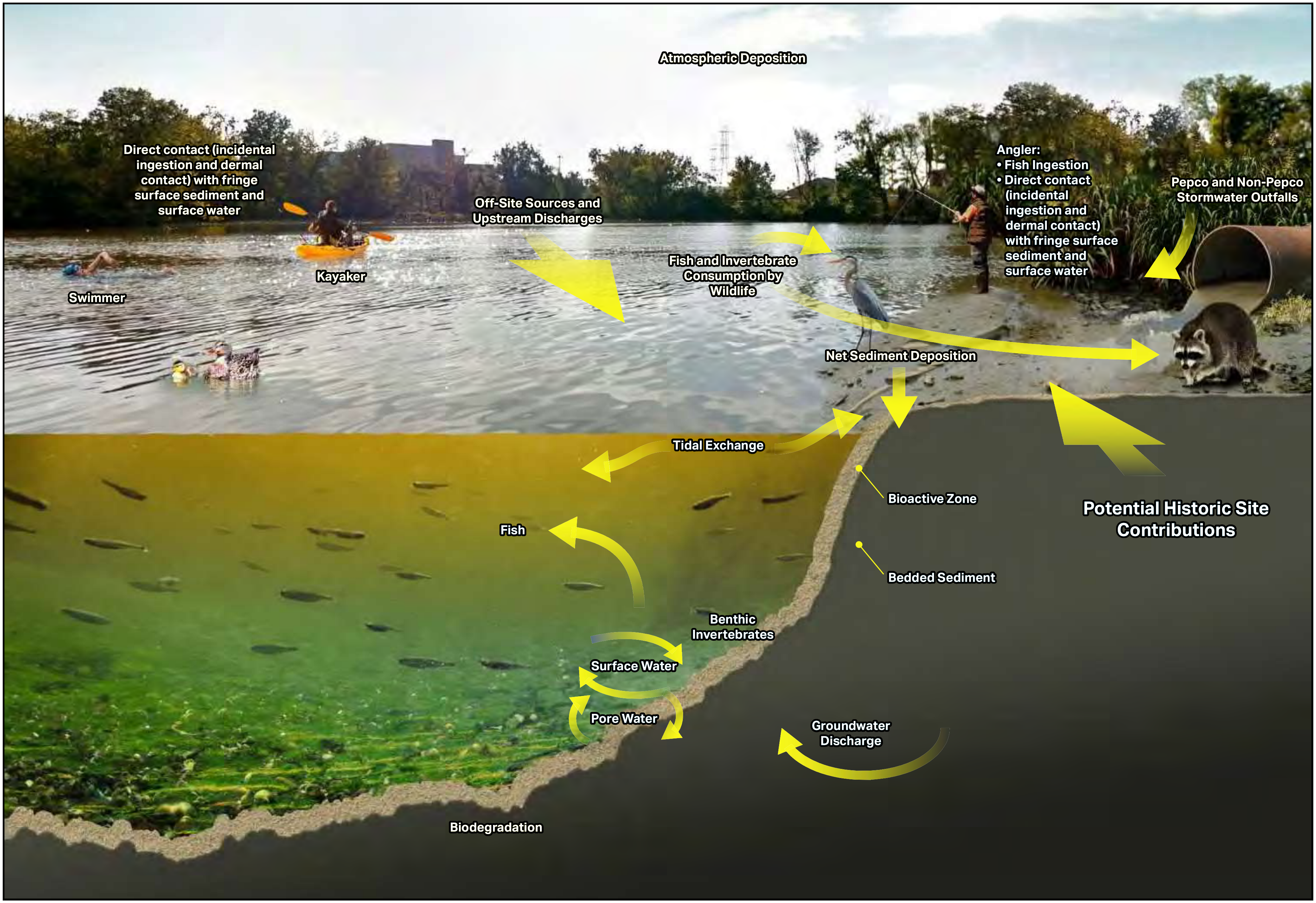
Potentially complete pathway

Unconfirmed pathway

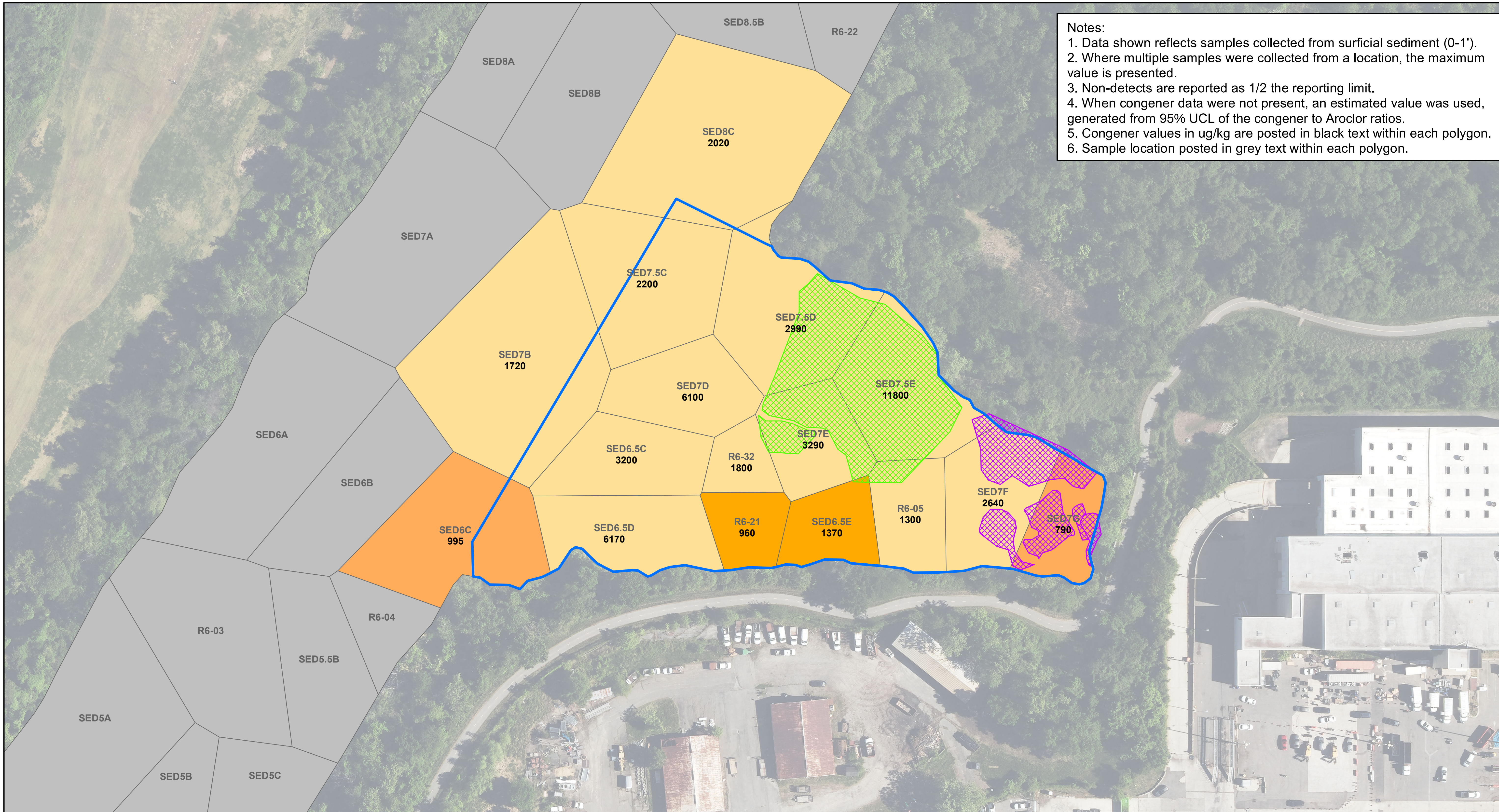
KMY Kenilworth Maintenance Yard

KPS Kenilworth Park South

Magenta indicates Unacceptable Risk Pathway



Waterside Investigation Area Conceptual Model	Benning Road Facility RI/FS Project 3400 Benning Road, NE Washington, DC 20019	AECOM
FIGURE 2-13		



Total PCB Congeners, ug/kg

- < 200
- 200 - 600
- 600 - 1,000
- > 1,000

Existing Aquatic Vegetation (AV): 0.67 AC

Existing Mixed High and Low Marsh: 0.24 AC

Cove Extent

AECOM

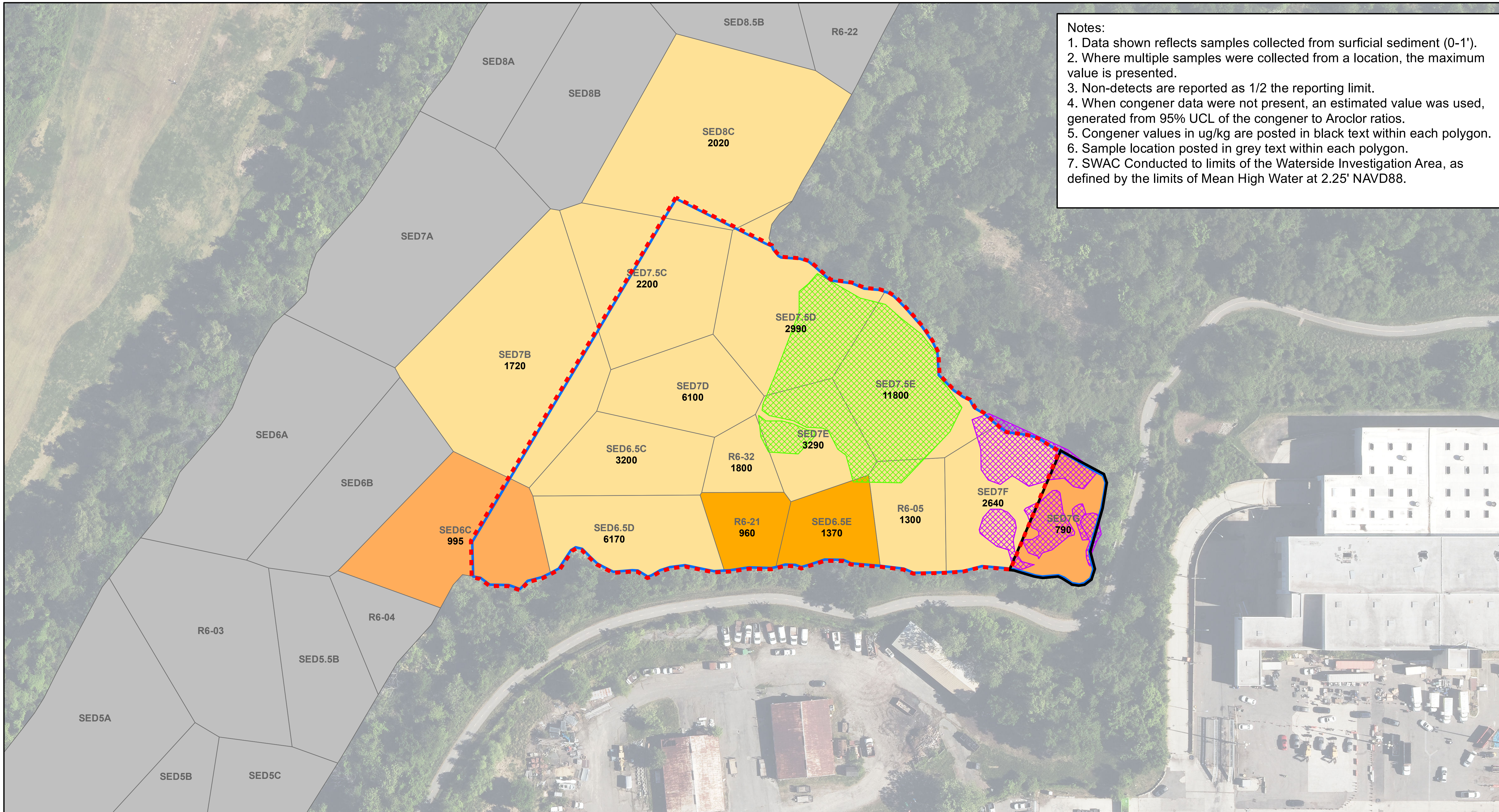
N

0 100 Feet

BENNING ROAD FACILITY FEASIBILITY STUDY
3400 BENNING RD., NE
WASHINGTON, DC 20019

DATE: 4/25/2024 | DRWN: JB

FIGURE 3-1
WATERSIDE INVESTIGATION COVE AREA
TOTAL PCB CONCENTRATION IN SURFACE SEDIMENTS



Notes:
1. Data shown reflects samples collected from surficial sediment (0-1').
2. Where multiple samples were collected from a location, the maximum value is presented.
3. Non-detects are reported as 1/2 the reporting limit.
4. When congener data were not present, an estimated value was used, generated from 95% UCL of the congener to Aroclor ratios.
5. Congener values in ug/kg are posted in black text within each polygon.
6. Sample location posted in grey text within each polygon.
7. SWAC Conducted to limits of the Waterside Investigation Area, as defined by the limits of Mean High Water at 2.25' NAVD88.

Total PCB Congeners, ug/kg
- < 200
- 200 - 600
- 600 - 1,000
- > 1,000

- Existing Aquatic Vegetation (AV): 0.67 AC
- Existing Mixed High and Low Marsh: 0.24 AC
- Cove Extent
- Dredging and Capping Extent
- Capping Extent (without Dredging)

N

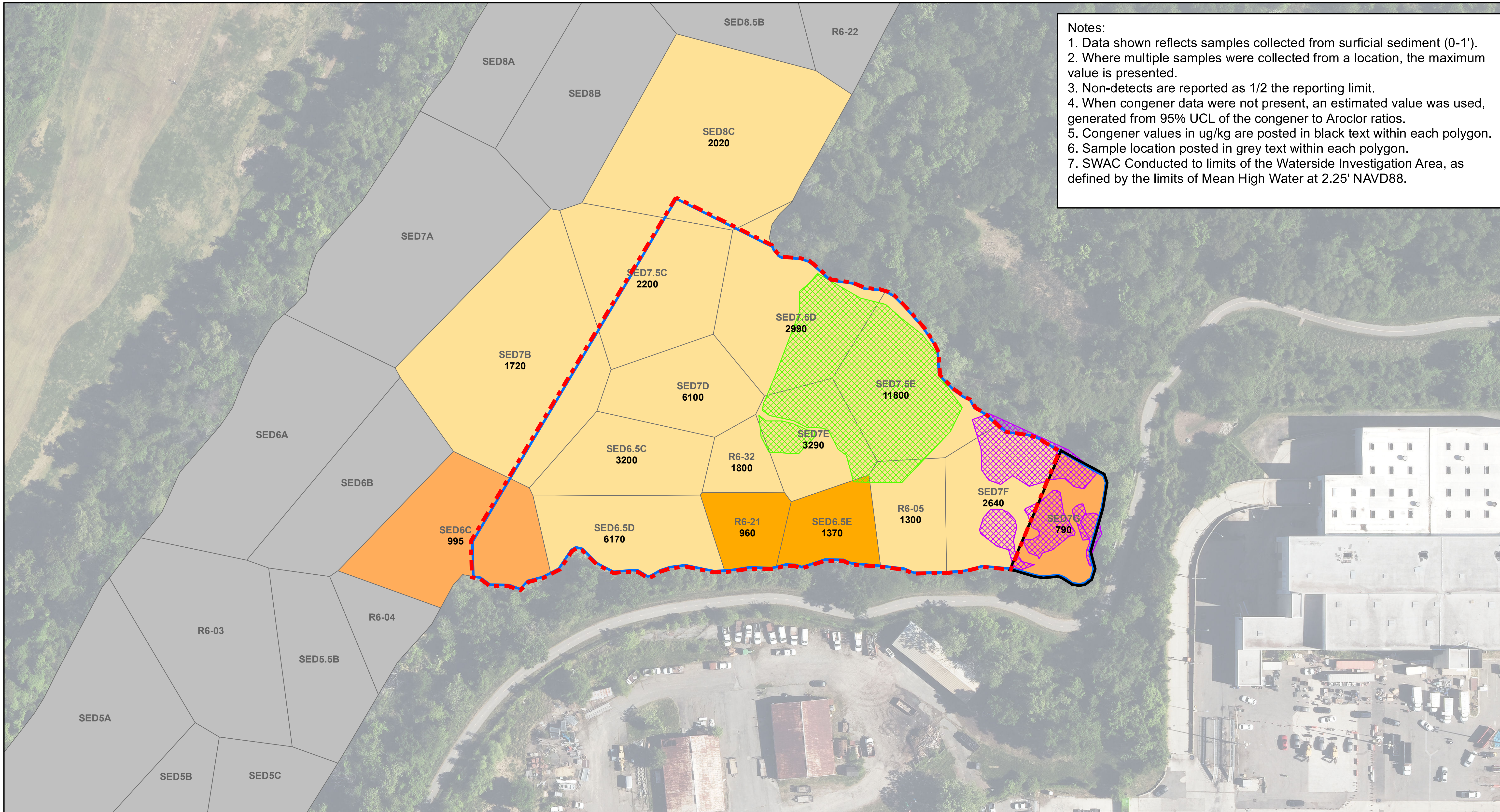
0 100 Feet

AECOM

BENNING ROAD FACILITY FEASIBILITY STUDY
3400 BENNING RD., NE
WASHINGTON, DC 20019

FIGURE 6-1
WATERSIDE INVESTIGATION COVE AREA
CONCEPTUAL DESIGN FOR WIA-3

DATE: 4/25/2024 | DRWN: JB



Total PCB Congeners, ug/kg

- < 200
- 200 - 600
- 600 - 1,000
- > 1,000

- Existing Aquatic Vegetation (AV): 0.67 AC
- Existing Mixed High and Low Marsh: 0.24 AC
- Cove Extent
- Dredging and Capping Extent
- In-Situ Treatment Extent

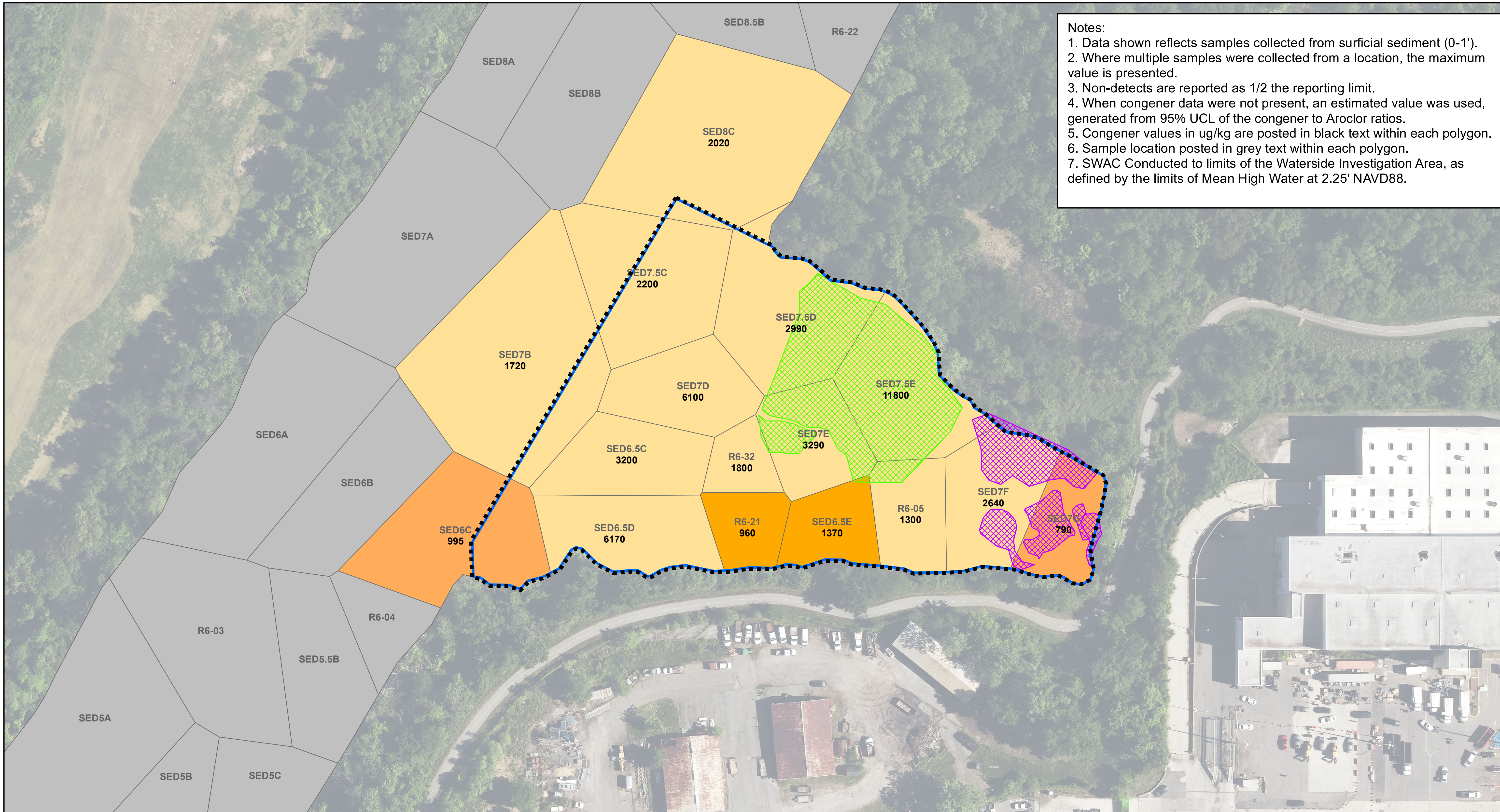
N

0 100 Feet

AECOM

BENNING ROAD FACILITY FEASIBILITY STUDY 3400 BENNING RD., NE WASHINGTON, DC 20019	FIGURE 6-2 WATERSIDE INVESTIGATION COVE AREA CONCEPTUAL DESIGN FOR WIA-4
DATE: 4/25/2024 DRWN: JB	

Notes:
1. Data shown reflects samples collected from surficial sediment (0-1').
2. Where multiple samples were collected from a location, the maximum value is presented.
3. Non-detects are reported as 1/2 the reporting limit.
4. When congener data were not present, an estimated value was used, generated from 95% UCL of the congener to Aroclor ratios.
5. Congener values in ug/kg are posted in black text within each polygon.
6. Sample location posted in grey text within each polygon.
7. SWAC Conducted to limits of the Waterside Investigation Area, as defined by the limits of Mean High Water at 2.25' NAVD88.



Total PCB Congeners, ug/kg
- < 200
- 200 - 600
- 600 - 1,000
- > 1,000

Existing Aquatic Vegetation (AV): 0.67 AC

Existing Mixed High and Low Marsh: 0.24 AC

Cove Extent

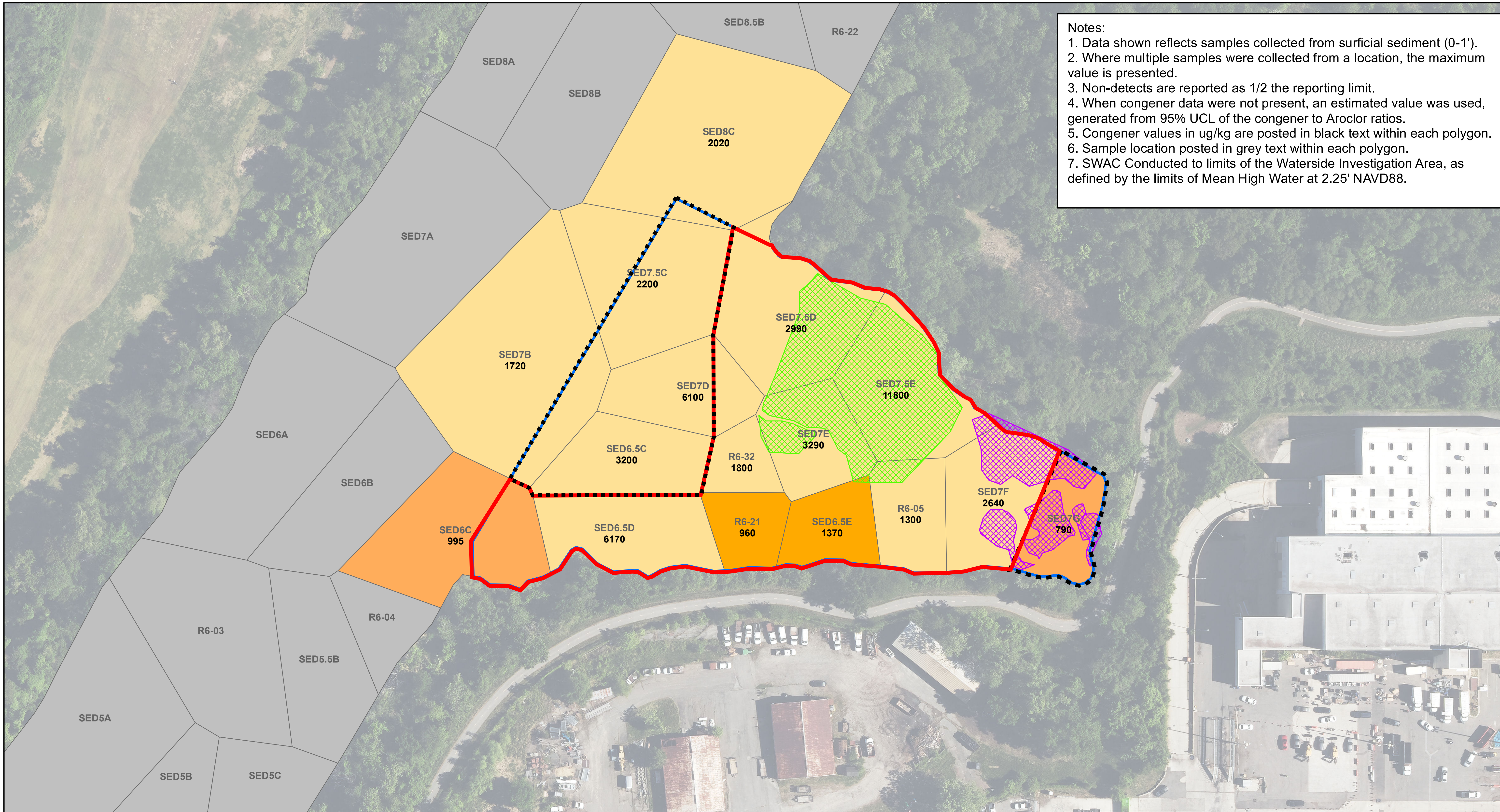
Dredging and Capping Extent

AECOM

BENNING ROAD FACILITY FEASIBILITY STUDY
3400 BENNING RD., NE
WASHINGTON, DC 20019

DATE: 4/25/2024 | DRWN: JB

FIGURE 6-3
WATERSIDE INVESTIGATION COVE AREA
CONCEPTUAL DESIGN FOR WIA-5



Notes:
1. Data shown reflects samples collected from surficial sediment (0-1').
2. Where multiple samples were collected from a location, the maximum value is presented.
3. Non-detects are reported as 1/2 the reporting limit.
4. When congener data were not present, an estimated value was used, generated from 95% UCL of the congener to Aroclor ratios.
5. Congener values in ug/kg are posted in black text within each polygon.
6. Sample location posted in grey text within each polygon.
7. SWAC Conducted to limits of the Waterside Investigation Area, as defined by the limits of Mean High Water at 2.25' NAVD88.

Total PCB Congeners, ug/kg
- < 200
- 200 - 600
- 600 - 1,000
- > 1,000

- Existing Aquatic Vegetation (AV): 0.67 AC
- Existing Mixed High and Low Marsh: 0.24 AC
- Cove Extent
- Dredging and Capping Extent
- In-Situ Treatment Extent

N

0 100 Feet

AECOM

BENNING ROAD FACILITY FEASIBILITY STUDY
3400 BENNING RD., NE
WASHINGTON, DC 20019

DATE: 4/25/2024 | DRWN: JB

FIGURE 6-4
WATERSIDE INVESTIGATION COVE AREA
CONCEPTUAL DESIGN FOR WIA-6

Tables

Table 2-1
Potential COCs and Media for Waterside Investigation Area
Benning Road Facility FS Project

Potential COC	Risk/HI	Upper Anacostia River Fish Consumption	Fringe Surface Sediment Direct Contact	
		Recreational Angler	Recreational Angler	Shoreline Worker and Wader
2,3,7,8-TCDD-TEQ	Risk	--	2E-06	3E-06
Total PCBs	Risk	3E-05	--	--
	HI	3	--	--
PCB-TEQ	Risk	1E-05	--	--
Dieldrin	Risk	5E-06	--	--

Notes:
-- Indicates that cancer risk is less than or equal to 10^{-6} and/or HI is less than or equal to 1. Risk is presented for the sum of the adult and the young child, and the HI is presented for the young child. The older child/teen risk and HI values are lower.
Green highlighting indicates that risk exceeds 10^{-6} but is less than or equal to 10^{-5}.
Blue highlighting indicates that risk exceeds 10^{-5} but is less than or equal to 10^{-4}.
Yellow highlighting indicates that risk exceeds 10^{-4} and/or the target endpoint HI exceeds 1.

Table 3-1 Applicable or Relevant and Appropriate Requirements (ARARs)
Pepco Benning Road OU2 FFS

Brief Description	Citation	Requirement	Waterside
Federal Chemical-Specific			
Clean Water Act (CWA), Ambient Water Quality Criteria	33 USC §§ 1251 et seq. 40 CFR Part 131	Surface water criteria established for protection of human health and/or aquatic organisms.	**Applicable** - to any disturbance or discharge affecting surface waters.
Toxic Substances Control Act (TSCA)	15 USC §§ 2601 et seq., 40 CFR Part 761	PCB remediation, soil disposal, and capping requirements.	**Applicable** – PCB-contaminated sediments may remain in place after completion of remedy.
NPS Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes	NPS; updated February 2016	Guidance on selection of ecological screening values for surface water and sediment	**TBC** – in developing ecological risk assessment in sediment and surface water; broad overlap with EPA and DOEE regulatory criteria.
District Chemical -Specific			
District of Columbia Water Quality Standards for Surface Water	D.C. Code §§8- 103 et seq. 21 DCMR Chapter 11	Water quality standards for surface waters; includes draft TMDLs for oil and grease, organic chemicals, and metals in the Anacostia River.	**Applicable** - to discharges or impacts on surface waters. DC Standards contain some constituents not included in federal standards and some criteria, such as for E. coli, are District-specific.
Federal Location-Specific			
Migratory Bird Treaty Act	16 USC § 703	Protects more than 800 species of birds from unregulated taking.	**Applicable** – to site remediation to the extent the measures involve activities that could affect migratory birds.
Responsibility of Federal Agencies to Protect Migratory Birds	Executive Order 13186, 66 Fed. Reg. 3853 (Jan. 17, 2001)	Directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act, including supporting the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing adverse impacts on migratory bird resources when conducting agency actions.	**TBC** – in designing and implementing site remediation activities that could affect migratory birds.
Endangered Species Act	16 USC §§ 1531 – 1544 50 CFR Part 402	Establishes requirements for protection of federally listed threatened and endangered species and their habitat.	**Not Applicable -** No Critical Habitat within work area
Clean Water Act, Section 404(b)(1) Guidelines	33 USC § 1344 40 CFR 230.10	Establishes criteria for evaluating impacts on waters of the US (including wetlands) and sets forth factors for considering mitigation measures.	**Applicable** – to site remediation involving placement of fill or dredging of material in on-site wetlands and waterways. District- specific conditions are incorporated into federal permit through Water Quality Certification requirement.
Solid Waste Disposal in National Parks	54 USC § 100903 36 CFR Part 6	Prohibits creation of new solid waste disposal units and operation of existing solid waste disposal units within park boundaries, except as specifically provided for in the regulations.	**Applicable** – to NPS management of the park, including the river.
Orders Concerning Floodplains	Executive Order No. 11988 as amended by Executive Order No. 13690 NPS Director's Order No. 77-2: Floodplain Management	Requires consideration of impacts on floodplain areas to reduce flood loss risks; minimize flood impacts on human health, safety, and welfare; and preserve and/or restore floodplain values.	**TBC** – in designing and implementing site remediation activities occurring within the 100-year floodplain.
National Historic Preservation Act	54 USC §§ 300101 et seq. 36 CFR Part 800	Establishes requirements for identification and preservation of historic and cultural resources.	**Not Applicable -** Work Area not of archeological or historical significance
Archaeological and Historic Preservation Act	54 USC §§ 312501 et seq.	Establishes requirements for protection and preservation of archeological and historical resources that may be destroyed through alteration of terrain as a result of federal projects.	**Not Applicable -** Work Area not of archeological or historical significance
Historic sites, Buildings, and Antiquities Act	54 USC §§ 320101 et seq.	Requires consideration of existence and location of historic and prehistoric sites, buildings, objects, and properties of historic and archaeological significance when evaluating remedial alternatives.	**Not Applicable -** Work Area not of historical significance
Archeological Resources Protection Act	16 USC §§ 470aa – ii, et seq. 43 CFR Part 7	Provides for protection of archeological resources located on public lands.	**Not Applicable -** Work Area not of archeological or historical significance
Fish and Wildlife Coordination Act	16 USC §§ 661 et seq.	Requires consideration of impacts on wildlife resources resulting from modification of waterways.	**Applicable** - to site remediation activities involving diversion or other modification of rivers or streams.
Native American Graves Protection and Repatriation Act (NAGPRA)	25 USC § 3001 25 USC § 3002(d) 43 CFR Part 10	Establishes requirements for disposition of Native American remains and objects inadvertently discovered on federal or tribal lands. Response activities resulting in discovery of Native American human remains or related objects must stop until NPS and any appropriate Indian tribes are notified. Requires that reasonable efforts be made to protect Native American human remains or related objects (43 CFR § 10.4).	**Applicable** – to site remediation activities should they involve discovery of Native American remains and objects.
National Park Service Organic Act General Authorities Act, as amended	54 USC § 100101(a) et seq. 36 CFR Part 1 54 USC § 100101(b)	Requires that units of the National Park System be managed in such a manner as to conserve the scenery, natural and historic objects, and wildlife, and in such a manner as to leave them unimpaired for enjoyment of future generations. The General Authorities Act further provides that protection, management, and administration of Park System units shall be conducted in light of the high public value and integrity of the NPS and shall not be exercised in derogation of the values and purposes for which System units have been established.	**Applicable -** to remedial activities within the river bed and boundaries of the park unit.
National Park Resource Protection, Public Use and Recreation	36 CFR Part 2	Prescribes and regulates various activities on lands and waters administered by NPS. For example, Section 2.14 (a) prohibits "(1) Disposing of refuse in other than refuse receptacles. . . . (6)Polluting or contaminating park area waters or water courses."	**Applicable** - to work and waste disposal in the Waterside Area.
National Park Area Nuisance	36 CFR § 5.13	Prohibits creation or maintenance of a nuisance within a park area.	**Applicable -** to work within the Waterside Area or park boundaries.

Table 3-1 Applicable or Relevant and Appropriate Requirements (ARARs)
Pepco Benning Road OU2 FFS

Brief Description	Citation	Requirement	Waterside
Rivers and Harbors Act, Section 10 and Regulations	33 USC § 403 33 CFR Parts 320-330	Requirements for evaluating excavation activities or placement of structures or fill material within tidal navigable waters.	**Applicable** - to site remediation activities involving excavation or filling in the tidal Anacostia River.
NPS Management Policies 2006	Available at: https://www.nps.gov/policy/mp2006.pdf	Provides policies and guidance governing NPS management of natural and cultural resources in national parks, including revegetation of disturbed land. Provides guidance on returning disturbed areas to the natural conditions and processes characteristic of the ecological zone in which damaged resources are situated. The NPS policy on implementation of the non-impairment mandate is set forth in Section 1.4 of NPS Management Policies 2006.	**TBC** – in designing and implementing site remediation activities affecting the park.
District Location-Specific			
Establishment of the Comprehensive Park and Playground System of the National Capital Establishment of Anacostia Park	An Act providing for a comprehensive development of the park and playground system of the National Capital, as amended, Pub. L. No. 68-202, 43 Stat. 463 (1924), Pub. L. No. 69-158, 44 Stat. 374 (1926) Capper- Cramton Act, Pub. L. No. 71-284, 46 Stat. 482 (1930), as amended by Pub. L. No. 79-699, 60 Stat. 960 (1946), Pub. L. No. 82-592, 66 Stat. 781, 791 (1952), and Pub. L. No. 85-707, 72 Stat. 705 (1958)	Parks established as a part of this system, including Anacostia Park, are established, in part, "to prevent pollution of... [the] Anacostia River [], [and] to preserve forests and natural scenery in and about Washington."	**Applicable** – to NPS management of the park, including the river.
General Management Plan for Anacostia Park	Available at: https://parkplanning.nps.gov/parkHome.cfm?parkID=425	The General Management Plan for the Park is the primary guidance document for managing the Park for the next 15 to 20 years. It identifies the preferred vision for the future of the Park and provides the framework for decision making regarding management of the Park's natural and cultural resources.	**TBC** – in designing and implementing site remediation activities. The General Management Plan for Anacostia Park establishes a framework for determining what is required to attain the Organic Act non-impairment requirement.
District of Columbia Flood Hazard Control	D.C. Code §§ 6- 501 to 506 20 DCMR Chapter 31	Regulates placement of fill, grading, excavation, and other disturbances within the defined flood hazard area and/or floodplain of rivers and/or streams.	**Applicable** - to site remediation activities occurring within the flood hazard area or floodplain of on-site rivers/streams.
District of Columbia Historic Preservation	10 DCMR Chapter 25	Requires consideration of existence and location of historic and prehistoric sites, buildings, objects, and properties of historical and archaeological significance when evaluating remedial alternatives.	**Not Applicable** - work area not of historical significance.
Chesapeake 2000 Agreement	Chesapeake 2000 Agreement and Chesapeake Executive Council directives: https://www.chesapeakebay.net/channel_files/19193/chesapeake_2000.pdf	Establishes goals, agreements and directives for protection and restoration of the Chesapeake Bay watershed, including protection and restoration of living resources, vital habitat, and water quality, and stewardship and community engagement.	**TBC -** in designing and implementing site remediation activities.
Anacostia River Watershed Restoration Agreement	Anacostia River Watershed Restoration Program 10 DCMR § 405	Establishes goals to reduce pollutant loads to the watershed, restore ecological integrity to encourage aquatic diversity and encourage a quality urban fishery, restore the spawning range of anadromous fish, encourage the natural filtering capacity of the waterbody by increasing acreage and quality of tidal and non-tidal wetlands, expanding forest cover and creating a continuous corridor of forest along the streams and rivers in the watershed, and increasing public awareness and participation in restoration activities.	**TBC** - in designing and implementing site remediation activities.
Federal Action-Specific			
National Ambient Air Quality Standards- Particulates	42 USC §§ 7409 – 7410 40 CFR Part 50	Establishes maximum concentrations for specified emissions.	**Applicable** – to site remediation activities that generate certain air emissions including dust/particulate emissions.
Clean Water Act Effluent Guidelines and Standards	33 USC §§ 1251 and 1311 et seq. 40 CFR Part 401	Provides requirements for point source discharges of pollutants.	**Applicable** – to site remediation activities that result in point source discharge of pollutants to surface water bodies.
Clean Water Act Stormwater Program	33 USC § 1342 40 CFR Part 122	Regulates discharge of stormwater from industrial and construction activities. Requires implementation of best management practices, inter alia, such as use of stormwater fencing and other measures to prevent discharge of sediments to surface waters.	**Applicable** - to discharges of stormwater to surface waters from remediation that results in soil/sediment disturbance of more than 1 acre of land.
USDOT Hazardous Materials Transportation Act Regulations	49 USC §§ 5101 et seq. 49 CFR 171-180	Establishes classification, packaging, and labeling requirements for shipments of hazardous materials.	**Applicable** – to off-site transportation of hazardous materials.
District Action-Specific			
District of Columbia Hazardous Materials Transportation and Motor Carrier Safety Act	18 DCMR § 1403	Designates primary and alternate routes for transportation of hazardous materials in the District of Columbia.	**Applicable** - for off-site transportation of hazardous materials within the District of Columbia.
District of Columbia Soil Erosion and Sedimentation Control Act and Stormwater Regulations	21 DCMR Chapter 5	Regulates discharge of stormwater from land disturbing activities.	**Applicable** - to site remediation activities that result in land disturbance.
District of Columbia Air Pollution Control Act, Air Quality Regulations	D.C. Code §§ 8- 101 et seq. 20 DCMR Chapter 6	Provides requirements applicable to particulate air pollution sources.	**Applicable** – to site remediation activities that result in generation and emission of particulate or volatile air pollutants.
District of Columbia Air Pollution Control Act, Engine Idling	D.C. Code §§ 8- 101 et seq. 20 DCMR § 900	A vehicle that is parked, stopped, or standing shall not idle for more than three minutes.	**Applicable** – to site remediation activities that involve trucks on the site (e.g., for removal of excavated soils for off-site disposal or importation of clean soil).

Table 3-1 Applicable or Relevant and Appropriate Requirements (ARARs)
Pepco Benning Road OU2 FFS

Brief Description	Citation	Requirement	Waterside
District of Columbia Air Pollution Control Act, Vehicle Exhaust Emissions	D.C. Code §§ 8- 101 et seq. 20 DCMR § 901	The engine, power, and exhaust mechanism of each motor vehicle must be equipped, adjusted, and operated to prevent escape of a trail of visible fumes or smoke for more than 10 consecutive seconds	**Applicable** – to site remediation activities that involve trucks or other motorized equipment on the site (e.g., for removal of excavated soils for off-site disposal or importation of clean soil).
District of Columbia Air Pollution Control Act, Odorous or Other Nuisance Air Pollutants	D.C. Code §§ 8- 101 et seq. 20 DCMR § 903	Prohibits an emission into the atmosphere of odorous or other air pollutants from any source in any quantity and of any characteristic, and duration which is, or is likely to be injurious to the public health or welfare, or which interferes with the reasonable enjoyment of life and property	**Applicable** – to site remediation activities that result in generation and emission of air pollutants.
District of Columbia Hazardous Waste Regulations	20 DCMR Chapter 42	Prohibits disposal of any hazardous waste or mixture of hazardous waste and any other constituent into or on any land or water in the District of Columbia, except that hazardous waste management units unable to achieve clean closure shall be considered landfills and subject to the closure and post-closure requirements for landfills as specified in the federal RCRA regulations applicable to the unit in question.	**Applicable** – to site remediation activities that involve leaving hazardous wastes on site.

Table 3-2 Cove PCB Dataset
Sediment (0-1 bgs.)
Pepco Benning Road OU2 FFS

Sample Location ID	Sample ID	Sample Date	Stample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PCBs, Total Aroclors (ug/kg)	PCBs, Total Congeners (ug/kg)
R6-05	RI-R6-05-SS	08/04/14	N	0.0	0.5	1400	*1300*
R6-21	RI-R6-21-SS	04/29/15	N	0.0	0.5	420	*960*
R6-32	P2-R6-32-SS	06/28/16	N	0.0	0.5	730	*1800*
SED6.5D	SED6.5D00EN	06/09/17	N	0.0	0.3	160	549*
	SED6.5D00FN	06/27/17	N	0.0	1.0	2800	5500
	SED6.5D00N	11/25/13	N	0.0	0.5	1800	*6174**
SED6.5E	SED6.5E00EN	06/08/17	N	0.0	0.3	250	760
	SED6.5E00N	11/25/13	N	0.0	0.5	400	*1372**
SED6C	SED6C00EN	06/07/17	N	0.0	0.3	290	*995**
	SED6C00N	11/14/13	N	0.0	0.5	240	823
SED7.5D	SED7.5D00EN	06/09/17	N	0.0	0.3	540	1852*
	SED7.5D00N	11/25/13	N	0.0	0.5	870	*2984**
SED7.5E	SED7.5E00EN	06/08/17	N	0.0	0.3	780	1400
	SED7.5E00N	11/25/13	N	0.0	0.5	1900	*11800*
SED7B	SED7B00EN	06/07/17	N	0.0	0.3	470	1612*
	SED7B00N	11/13/13	N	0.0	0.5	500	*1715**
	SED7B00R	11/13/13	FD	0.0	0.5	480	1646*
SED7D	SED7D00EN	06/09/17	N	0.0	0.3	53	182*
	SED7D00FN	06/27/17	N	0.0	1.0	3900	*6100*
	SED7D00N	11/25/13	N	0.0	0.5	620	2127*
SED7E	SED7E00AN	06/22/17	N	0.0	0.3	790	2710*
	SED7E00BN	06/22/17	N	0.3	0.7	650	2230*
	SED7E00CN	06/22/17	N	0.7	1.0	780	2675*
	SED7E00EN	06/08/17	N	0.0	0.3	630	980
	SED7E00N	11/25/13	N	0.0	0.5	960	*3293**
SED7F	SED7F00EN	06/08/17	N	0.0	0.3	300	1000
	SED7F00N	11/25/13	N	0.0	0.5	770	*2641**
SED7G	SED7G00N	01/30/14	N	0.0	0.5	230	789*
SED8C	SED8C00EN	06/07/17	N	0.0	0.3	260	892*
	SED8C00N	11/14/13	N	0.0	0.5	590	*2024**
	SED8C00R	11/14/13	FD	0.0	0.5	410	1406*
SED6.5C	SED6.5C-1-011723	01/17/23	N	0.0	0.5	150	1800
	SED6.5C-2-011723	01/17/23	N	0.5	1.0	330	*3200*

Table 3-2 Cove PCB Dataset
Sediment (0-1 bgs.)
Pepco Benning Road OU2 FFS

Sample Location ID	Sample ID	Sample Date	Stample Type	Start Depth (ft bgs)	End Depth (ft bgs)	PCBs, Total Aroclors (ug/kg)	PCBs, Total Congeners (ug/kg)
SED7.5C	SED7-5C-1-011723	01/17/23	N	0.0	0.5	26	270
	SED7-5C-2-011723	01/17/23	N	0.5	1.0	170	*2200*

Notes:

bgs - below ground surface

FD - field duplicate

ft - feet

N - normal

PCBs - polychlorinated biphenyls

ug/kg - micrograms per kilogram

Highlighting indicates an exceedance of the interim RAL of 600 ug/kg for total PCB Aroclors and total PCB congeners.

Underlined and italicized values indicate the maximum concentration when multiple samples are available and are used for Figure 3-1.

When congener data were not present, an estimated value was used (indicated by *) for feasibility evaluation purposes. This estimated value was generated using 95% UCL (3.43) of the congener to Aroclor ratios based on available paired congener and aroclor data. This represents a conservative approach and may oversestimate the actual toal congener concentration. This approach will be revisited or refined during the remedial design phase.

Table 4-1 GRA Screening for Cove Sediments

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
No Action	No action or monitoring implemented	N/A	N/A	N/A	Not Effective	Not Effective	None	None	None	None	Retained as a baseline case
Institutional Controls	Non-engineered methods of minimizing potential human exposure to potential COCs or of protecting an implemented remedy through use restriction. Often used in conjunction with other actions.	Administrative Controls	- Regulatory measures by DOEE (fish advisories) and NPS (permitting of activities that disturb the river bottom) are assumed to serve as ICs to protect human health. - Similar administrative controls proposed as are remedial alternatives for ARSP as per the Interim ROD	Areas where impacts are regional and human health risks are unacceptable	**Not Effective** - Not effective as a standalone remedy - Can be effective at minimizing human exposure at the site - Requires local participation/cooperation - Does not address ecological risks - PCBs remain in place	**Not Effective** - Not effective as a standalone remedy - Can be effective at minimizing human exposure at the site - Requires local participation/cooperation - Does not address ecological risks - PCBs remain in place	Easy	Easy	Low	Low	Retained as these measures are currently in effect and are expected to continue. These measures complement any River-wide remedies and are not exclusively part of Benning remedial action alternatives.
Monitored Natural Recovery	Term used to describe when naturally-occurring processes transform, immobilize, isolate, or otherwise remove potential COCs. Examples of these processes are physical burial of sediments impacted with potential COCs through natural sedimentation, and reduction in concentrations of potential COCs through biological or chemical degradation.	Attenuation via physical, biological, or chemical processes	**Physical burial by natural sedimentation** to create a cover of deposited sediments with potential COC concentrations less than the PRGs within acceptable recovery period	Sites where: • Natural recovery processes are demonstrated and expected to continue at rates at existing rates. • Where human exposure is limited or can be limited by institutional controls. • Where potential COC exposures to biota are already approaching remedial cleanup levels. • Where the sediment bed is stable and likely to remain stable after remedial actions are completed.	**Not Effective** - The average rate of sedimentation within the Cove (estimated to be < 1.2 cm/yr) is likely too slow to allow for the RAO to be met in the near future. Further, the sediments deposited within the Cove appear to be from areas within and outside the Cove with the potential to be impacted.	**Not Effective** - Since the Cove is net depositional, there is potential for the RAO to be met over time and to be effective in the long term. Further, the sediments deposited within the Cove appear to be from areas within and outside the Cove with the potential to be impacted. Therefore, the long term effectiveness of MNR will be dependent on the management of upstream sources	Easy	Easy	None	None	Eliminated as ineffective.
			Reduction in concentrations of potential COCs through biological degradation where native microorganisms present in the sediment degrade potential COCs and break them down into non-toxic byproducts.		**Not Effective** - PCBs do not degrade quickly under natural conditions; therefore, MNR is unlikely to be sufficient to meet PRGs within an acceptable timeframe.	**Not Effective** - PCBs do not degrade substantially under natural conditions; therefore, MNR is unlikely to be sufficient to meet PRGs within an acceptable timeframe	Easy	Easy	None	None	Eliminated as ineffective.
			Reduction of concentrations of potential COCs through chemical degradation where potential COCs are sequestered or transformed by chemical reactions within the sediment.		**Not Effective** - PCBs do not degrade quickly under natural conditions; therefore, MNR is unlikely to be sufficient to meet PRGs within an acceptable timeframe.	**Not Effective** - PCBs do not degrade substantially under natural conditions; therefore, MNR is unlikely to be sufficient to meet PRGs within an acceptable timeframe	Easy	Easy	None	None	Eliminated as ineffective.

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Enhanced Monitored Natural Recovery (EMNR)	Relies on one or more technologies to enhance ongoing natural recovery processes while minimizing the effects on the aquatic environment. EMNR is an acceptable individual remedy if RAOs can be met within the acceptable recovery period. Examples of enhancement technologies include sedimentation and thin layer capping	Enhanced sedimentation or thin-layer capping	**Enhanced sedimentation** is a technology where flow control structures are used to create conditions that allow increased deposition of clean sediments or prevent downstream migration of impacted sediments.	Same as MNR except can be applied where ongoing natural processes are slow as the technology will hasten recovery and/or attenuate flux of potential COCs into newly deposited sediments.	**Not Effective** - The site is generally net depositional at a rate of <1.2 cm/year. - Flow control structures would not be needed to capture sediments; however, discharge control structures which could substantially reduce the reworking of existing sediments under high flow conditions could reduce the concentrations of newly deposited sediments. - Does not prevent the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment or water column.	**Not Effective** - The site is generally net depositional at a rate of <1.2 cm/year. - Flow control structures would not be needed to capture sediments; however, discharge control structures that could prevent the reworking of existing sediments during extreme flow conditions could reduce the concentrations of newly deposited sediments. - Does not prevent the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment or water column.	Moderate	Moderate	Moderate	Moderate	Eliminated as ineffective.
			Thin Layer Cap Placement is a technology where imported clean material (usually sand) is placed where natural sedimentation rates are too low to reach RAOs within the acceptable recovery period. The thin cap is placed to account for the deficit in cap thickness through natural sedimentation.		**Not Effective** - The site is generally net depositional at a rate of <1.2 cm/year. A thin layer cap placement could help accelerate recovery of the surface sediment in the Cove in the short term by covering existing impacted sediments and allowing biological and physical processes to rework the unimpacted sediment into the surface sediment. - Isolated areas, generally near outfalls, experience periodic erosion. - Does not address the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment or water column.	**Not Effective** - The site is generally net depositional at a rate of <1.2 cm/year. A thin layer cap placement could help accelerate recovery of the surface sediment in the Cove in the short term. - Isolated areas, generally near outfalls, experience periodic erosion. - The long term effectiveness is dependent on the stability of the material prior to reworking by biological and physical processes. Since some areas of the Cove are net erosional, the long term effectiveness will also depend on the use of erosion protection and/or energy dissipation structures. - Does not address the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment or water column.	Moderate	Moderate	Moderate	Moderate	Eliminated as ineffective.

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Containment	Installation of a cap over sediments impacted with potential COCs to prevent direct human/ecological contact with underlying impacted sediments and provide a barrier for migration of COCs from the underlying sediments.	**Single Layer Cap**	**Sand Cap:** Placement of sand of specified grain size is placed on top of existing sediments impacted with potential COCs.	Sites where: • Hydrodynamic conditions are not likely to compromise the cap. • Long term risk Reduction outweighs habitat disruption. • Sediment has sufficient strength to support the cap materials. • Cap systems do not impact navigability.	**Potentially Effective** - Conventional sand capping can provide a clean benthic habitat for organisms in the short term. - Isolates contaminated sediments. - Effectiveness dependent upon cap thickness - In the short term, existing habitat is disrupted and will take time to recover. Time to recovery can be hastened with restoration actions.	**Potentially Effective** - In the long term, the new habitat is likely to recover from the application of sand cover - Bioactive zone has the potential to become contaminated by the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment. - Effectiveness dependent upon cap thickness. - Long term performance will also be dependent on the material stability; therefore, erosion protection may be needed to maintain cap thickness which is particularly important near outfalls and on steep slopes.	Moderate	Moderate	Moderate	Moderate	Retained
			Amended Sand Cap: Use of sand enriched with activated or organic carbon and placed on top of existing sediments impacted with potential COCs. Presence of activated and/or organic carbon provides additional sorption capacity for adsorption of hydrophobic COCs such as PCBs compared to the sand cap alone.		**Potentially Effective** - Sand capping can provide a clean benthic habitat for organisms in the short term. - Isolates contaminated sediments. - Effectiveness dependent upon cap thickness - Presence of organic or activated carbon results in attenuation of porewater concentrations, potentially reducing risk to benthic organisms. - In the short term, existing habitat is disrupted and will take time to recover. Time to recovery can be hastened with restoration actions.	**Potentially Effective** - In the long term, the new habitat is likely to recover from the application of sand cover - Bioactive zone has the potential to become contaminated by the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment. - Effectiveness dependent upon cap thickness - Long term performance will also be dependent on the material stability; therefore, erosion protection may be needed to maintain cap thickness which is particularly important near outfalls and on steep slopes.	Moderate	Moderate	Moderate	Moderate	Retained
			Soil Cap: Placement of clean topsoil on top of existing sediments impacted with potential COCs. Soil provides additional chemical isolation, sorptive capacity for hydrophobic contaminants such as PCBs, as well as the necessary organic material to support benthic activity.		**Potentially Effective** - Provides a clean habitat for benthic organisms and isolates contaminated sediments - In the short term, existing habitat is disrupted and will take time to recover. Time to recovery can be hastened with restoration actions. - Sediment layer can provide a better habitat for benthic community than a sand layer.	**Potentially Effective** - Sediment layer can provide a better habitat for benthic community than a sand layer. - In the long term, the new habitat is likely to recover - Caps may become contaminated by the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment. - Long term performance will also be dependent on the material stability; therefore, erosion protection may be needed to maintain cap thickness which is particularly important near outfalls and on steep slopes.	Moderate	Moderate	Moderate	Moderate	Retained

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Containment	Installation of a cap over sediments impacted with potential COCs to prevent direct human/ecological contact with underlying impacted sediments and provide a barrier for migration of COCs from the underlying sediments.	Multi-layer Cap	**Armored Cap:** Placement of a layer of coarse sand, riprap, crushed stone, or gravel on top of a sand/soil cap to reduce erosion of the capping material. An armored cap typically provides limited habitat for benthic organisms but can be desirable for fish habitat.	Sites where: • Hydrodynamic conditions are not likely to compromise the cap. • Long term risk reduction outweighs habitat disruption. • Sediment has sufficient strength to support the cap materials. • Cap systems do not impact navigability.	**Potentially Effective** - Armored capping will help prevent erosion of underlying materials such as sediment or a clean sand or amended cap. The Cove area is net depositional so the anticipated need for armoring is limited to areas subject to periodic erosion such as outfall channels. - Armoring reduces the available benthic zone so the placement area should be minimized.	**Potentially Effective** - Armored capping will help prevent erosion of underlying materials such as sediment or a clean sand or amended cap. The Cove area is net depositional with no anticipated need for armoring except in areas subject to short term erosion. - Armoring limits the available benthic zone so the affected area should be minimized.	Moderate	Moderate	Moderate	Moderate	Retained to be combined with other remedial approaches.
			Sand + Soil Cap: Dual-layer cap comprising a top layer of clean soil and a bottom layer of clean sand. The topsoil layer provides additional chemical isolation, sorptive capacity for hydrophobic contaminants such as PCBs, as well as the necessary organic material to support benthic activity.		**Potentially Effective** - Provides a clean habitat for benthic organisms and isolates contaminated sediments - In the short term, existing habitat is disrupted and will take time to recover. Time to recovery can be hastened with restoration actions. - Sediment layer can provide a better habitat for benthic community than a sand layer.	**Potentially Effective** - Sediment layer can provide a better habitat for benthic community than a sand layer. - In the long term, the new habitat is likely to recover - Caps may become contaminated by the migration of contaminants from upwelling of groundwater through underlying impacted sediment (porewater) into the benthic layers of sediment. - Long term performance will also be dependent on the material stability; therefore, erosion protection may be needed to maintain cap thickness which is particularly important near outfalls and on steep slopes.	Moderate	Moderate	Moderate	Moderate	Retained

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Removal	Dredging/Excavation	Dredging/ Excavation	**Hydraulic Dredging:** Technology where a cutterhead suspends sediments which are then captured by a suction hose in a slurry. The slurry is typically 10% solids. Large volumes of water are removed in this method of dredging and often require considerable water management practices, water treatment capabilities, and discharge permitting.	Sites where: • Contaminant mass and risk of erosion make cap placement impractical. • Required to accommodate for placement of cap materials. • Long term risk reduction outweighs habitat disruption. • Removal is required to maintain outfall channels.	**Effective** - Partially or completely removes PCBs, thereby reducing source of contaminants. - Used in conjunction with capping/backfill to provide clean media for the benthic community. - Short-term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation. - Process option would eliminate the existing benthic community temporarily, but the benthic community is expected to fully recolonize after backfilling of the dredged area(s).	**Highly effective** - Partially or completely removes PCBs, thereby reducing source of contaminants. - Used in conjunction with capping/backfill to provide clean media for the benthic community. - Does not address the potential for recontamination from the river.	Difficult	Difficult	Very High	Low	Eliminated due to high cost and difficulty.
			Mechanical Dredging: Technology where an excavator or crane is brought to the site on a barge and utilizes buckets or clamshell-style buckets to remove the target sediments. Mechanical dredging removes significantly less water as materials removed are typically 50% or more solids.		**Highly effective** - Partially or completely removes PCBs, thereby reducing source of contaminants. - Used in conjunction with capping/backfill to provide clean media for the benthic community. - Short-term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation. - Process option would eliminate the existing benthic community temporarily, but the benthic community is expected to fully recolonize after backfilling of the dredged area(s).	**Highly effective** - Partially or completely removes PCBs, thereby reducing source of contaminants. - Used in conjunction with capping/backfill to provide clean media for the benthic community. - Does not address the potential for recontamination from the river.	Moderate to Difficult	Moderate to Difficult	High	Low	Retained
			Dry Excavation: Technology where sediments are removed by an excavator in the dry. This can be performed on near shore sediments that are exposed during low tides or by setting up a cofferdam around the work area and pumping out the water to expose the target sediments.		**Highly effective** - Partially or completely removes PCBs, thereby reducing source of contaminants. - Used in conjunction with capping / backfill to provide clean media for the benthic community. - Will require a cofferdam and water management to maintain dry conditions within the Cove - Short-term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation. - Process option would eliminate the existing benthic community temporarily, but the benthic community is expected to fully recolonize after backfilling of the dredged area(s).	**Highly effective** - Partially or completely removes PCBs, thereby reducing source of contaminants. - Used in conjunction with capping/backfill to provide clean media for the benthic community. - Does not address potential for recontamination from river. - Will require a cofferdam and water management to maintain dry conditions within the Cove	Moderate to Difficult	Moderate to Difficult	High	Low	Retained

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Treatment	In-Situ or Ex-Situ Treatment	In-Situ Treatment	**AC application:** This process option utilizes high affinity of PCBs and sorption capacity of activated carbon to reduce porewater concentration in the sediments. Commercially available AC-based amendments such as AquaGate and SediMite have been applied at several sites and have demonstrated their efficacy at reducing porewater concentrations.	Sites where: • Areas where removal of potential COCs is not practical. • Areas containing subsurface impacts (no surface impacts) • Areas where subsurface utilities and other structures are not present or have the potential to impede sediment mixing.	**Highly Effective** - The efficacy of sorptive media, such as activated carbon (AC), in sequestering PCBs is well documented and has been used in many river systems. - Amendment helps prevent the recontamination of porewater in the benthic zone by reducing contaminant flux due to upwelling of groundwater through underlying impacted sediment (porewater). - Amendment has been found to be effective in the short term as the amendments sequester PCBs as soon as applied.	**Highly Effective** - The efficacy of sorptive media, such as AC, in capturing and confining PCBs is well documented and has been executed in many river systems. - The long-term effectiveness is dependent on the stability of the applied media as well as the dose applied as sorptive capacity is a function of the concentration of PCBs, other constituents, in the porewater and the general site water chemistry. - Provided the amendment can be reinforced with erosion protection, if needed, and site data are available to determine proper dosing, it is possible to implement reactive amendment to be effective in the long term. - It is possible to apply additional amendment in the future if site conditions change or performance targets are not being met.	Moderate	Moderate	Moderate to High	Low	Retained
			Solidification / Stabilization: Treatment of impacted sediments so that they are physically bound or enclosed within a stabilized mass (solidification), or the sediments are treated chemically with a stabilizing agent to reduce contaminant mobility.		**Limited effectiveness** - Most in-situ solidification / stabilization technologies have limited effectiveness against organic contaminants - Bench-scale treatability studies required to assess effectiveness - Solidified/stabilized sediments not conducive to supporting benthic communities	**Not effective** - Most solidification/stabilization technologies have limited effectiveness against organics - Certain parameters, such as moisture content and temperature, can impact the treatment process, such that bonding, stability, and strength may be affected which can lead to the release PCBs over time. - PCBs remain on site with no chemical modification, therefore, the toxicity associated with exposure to ecological receptors is not eliminated. - Solidified/stabilized sediments not conducive to supporting benthic communities	Moderate	Moderate	Moderate to High	Low	Eliminated as ineffective.
			Phytoremediation: Phytoremediation is process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil and sediments. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phyto-extraction (also called phyto-accumulation), phyto-degradation, and phyto-stabilization.		**Not effective** - Phytoremediation is not effective for contaminants such as PCBs which exhibit strong sorption to sediments and are resistant to degradation.	**Not effective** - Phytoremediation is not effective for contaminants such as PCBs which exhibit strong sorption to sediments and are resistant to degradation.	Moderate	Moderate	Low	Moderate	Eliminated as ineffective.

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Treatment	In-Situ or Ex-Situ Treatment	Ex-Situ Treatment Following Dredging of Sediments	**Thermal Treatment (on-site or off-site):** Thermal treatment options include incineration (high temperature process, typically 870 to 1,200 °C) and thermal desorption (milder temperature process, typically 315 to 590 °C). Incineration volatilizes COPCs from sediments and combusts them in presence of oxygen at high temperature. Thermal desorption heats the sediments at temperatures high enough to volatilize potential COCs, followed by off-gas treatment to destroy the potential COCs. Incineration options include off-site facilities approved by EPA for treatment of PCB-containing soils/sediments. Mobile incineration services are not offered by vendors. Thermal desorption options include on-site and off-site treatment facilities.	• Areas where removal of potential COCs is practical. • Areas where subsurface utilities and other structures are not present. • Where volume of sediment to be treated is small.	**Highly Effective** - PCBs are volatilized and/or destroyed at high temperature. - Effective for PCB-containing soils and sediments. - Additional treatment steps are needed to destroy PCBs in off-gas from thermal desorption treatment. - Dewatering required to achieve acceptable moisture levels prior to treatment.	**Highly Effective** - PCBs are volatilized and destroyed at high temperature. - Once treatment is complete and PRGs are met, long term maintenance or monitoring is typically not required.	Moderate to Difficult	Moderate to Difficult	Very High	Low	Eliminated due to high cost.
			Sediment Washing (on-site or off-site): Mechanical mixing, rinsing, and washing of sediments with water and/or surfactants to remove contaminants. Can be performed on-site or at an off-site facility.		**Not Effective** - Hydrophobic potential COCs such as PCBs can be difficult to separate from sediments particles using aqueous washing fluid. - May need surfactants to be effective for removing PCBs. - Bench-scale testing needed to determine appropriate washing fluid	**Not Effective** - PCBs are removed from the matrices. Once treatment is complete and PRGs are met, long term maintenance or monitoring is typically not required. - Hydrophobic potential COCs such as PCBs can be difficult to separate from sediment particles using aqueous washing fluid - Process generates additional waste stream that would need treatment or disposal.	Moderate to Difficult	Moderate to Difficult	High	Low	Eliminated as ineffective
			Immobilization/Stabilization (on-site or off-site): Treatment of impacted sediments so that they are physically bound or enclosed within a stabilized mass (solidification), or the sediments are treated chemically with a stabilizing agent to reduce contaminant mobility. Can be performed on-site or at an off-site facility.		**Limited effectiveness** - Most immobilization / stabilization technologies have limited effectiveness against organics	**Not effective** - Most immobilization / stabilization technologies have limited effectiveness against organics - Certain parameters, such as moisture content and temperature, can impact the treatment process, such that bonding, stability, and strength may be affected which can lead to the release PCBs over time.	Moderate	Moderate to Difficult	High	Low	Eliminated as ineffective.

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Treatment	In-Situ or Ex-Situ Treatment	Ex-Situ Treatment Following Dredging of Sediments	**Dehalogenation (off-site):** Use of chemical reagents and reduction processes to destroy or chemically alter PCB congeners to a less toxic form. Typically achieved by replacement of the chlorine molecules or decomposition and partial volatilization of PCBs. The most commonly process utilized for dehalogenation is Base catalyzed Decomposition (BCD) wherein carbon-chlorine bonds in PCBs are cleaved using highly reactive atomic hydrogen generated using bases, catalysts, hydrogen donors, and other proprietary reagents.	• Areas where removal of potential COCs is practical. • Areas where subsurface utilities and other structures are not present. • Where volume of sediment to be treated is small.	**Potentially Effective** - PCBs are destroyed or converted to less toxic forms. - Dehalogenation is effective at treating PCBs. Bench-scale studies using site specific sediments are needed to confirm effectiveness. - May not be effective for all congeners and site-specific tests are needed to confirm effectiveness	**Effective** - Dehalogenation is effective at treating PCBs. - However, high moisture content, particle size, clay content, presence of co-contaminants may impact effectiveness. - May not be effective for all congeners. - May cause an increase in the concentration of lower chlorinated congeners due to dechlorination of higher chlorinated congeners.	Difficult	Moderate to Difficult	High	Low	Eliminated due to high cost and difficulty.
			Vitrification (on-site or off-site): Use of solidification methods that use heat to melt and convert waste material into glasslike crystalline products. Volume of the vitrified product is usually 20-45% less than untreated sediment volume. Can be performed on-site or at an off-site facility.		**Effective** - Organic compounds such as PCBs are completely oxidized during the vitrification process - Certain parameters, like moisture content, temperature, and presence of other constituents apart from PCBs, can impact with the effectiveness of the treatment process.	**Effective** - Organic compounds such as PCBs are completely oxidized during the vitrification process.	Moderate to Difficult	Moderate to Difficult	High to Very High	Low	Eliminated due to high cost.
			Solvent Extraction with Spent Solvent Destruction: Use of chemical solvents under controlled pressure and temperature conditions to separate potential COCs from sediments, followed by destruction of COPCs in spent solvent. Reduces the overall volume of the hazardous waste to be treated.		**Potentially Effective** - PCBs are separated from the sediments. - Effective for PCB-containing sediments. - Treatability tests are needed to confirm if mass transfer or equilibrium partitioning are the rate controlling steps. - Additional treatment steps are needed to destroy PCBs in the spent solvent.	**Effective** - Solvent extraction is effective at removing PCBs from sediments. PCBs are not degraded or destroyed. - High moisture content, particle size, clay content, presence of co- contaminants may impact effectiveness.	Moderate to Difficult	Moderate to Difficult	High	Low	Eliminated
			Solidification / Stabilization: Treatment of impacted sediments so that they are physically bound or enclosed within a stabilized mass (solidification), or the sediments are treated chemically with a stabilizing agent to reduce contaminant mobility.		**Limited effectiveness** - Most in-situ solidification / stabilization technologies have limited effectiveness against organic contaminants - Bench-scale treatability studies required to assess effectiveness - Solidified/stabilized sediments not conducive to supporting benthic communities	**Not Effective** - Most solidification/stabilization technologies have limited effectiveness against organics - Certain parameters, such as moisture content and temperature, can impact the treatment process, such that bonding, stability, and strength may be affected which can lead to the release PCBs over time. - PCBs remain on site with no chemical modification, therefore, the toxicity associated with exposure to ecological receptors is not eliminated. - Solidified/stabilized sediments not conducive to supporting benthic communities	Moderate	Moderate to Difficult	Moderate to High	Low	Eliminated as in-situ treatment option. Retained for management of wet / dredged sediments

Table 4-1 GRA Screening for Cove Sediments (continued)

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained / Eliminated
					Short Term	Long Term	Technical	Administrative	Capital	O&M	
Disposal	On-site or off-site Disposal of Dredged Sediments	On-site or off-site disposal/re-use	**On-site disposal/re-use:** Disposal of dredged sediments at on-site landfills with or without treatment, or re-use of treated sediments as backfill.	Areas where appropriate on-site or off-site facilities for safe disposal of dredged sediments are available.	**Effective** - Excavated sediments are contained on-site (with or without prior treatment), thereby reducing potential for future human and ecological exposure.	**Effective** - Excavated sediments are contained on-site (with or without prior treatment), thereby reducing potential for future human and ecological exposure. - Contaminated sediments remain on-site and may pose risks in the future.	Difficult	Difficult	High	High	Eliminated due to high cost and difficulty.
			Off-site disposal/re-use: Disposal of dredged sediments at off-site facilities such as permitted landfills, TSCA Subtitle C landfills (hazardous waste), TSCA Subtitle D landfills (solid waste), and EPA-approved thermal treatment facilities. This process option is applicable for both treated and untreated sediments. Treated sediments may be re-used at other sites depending upon effectiveness of treatment.		**Highly Effective** - Excavated sediments are contained off-site (with or without prior treatment), thereby permanently reducing on-site human and ecological exposure.	**Highly Effective** - Excavated sediments are contained off-site (with or without prior treatment), thereby permanently reducing on-site human and ecological exposure. - Off-site disposal eliminates potential future exposure or release from site.	Moderate	Moderate	High	Low	Retained

Table 5-1 Description and Screening of Assembled Alternatives

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
WIA-1: No Action	- No remedial actions implemented for reducing porewater PCB concentrations in Cove sediments. - Some ICs, such as the existing fish consumption advisory and NPS permitting requirements for activities that disturb the sediments, will continue to be implemented as these are applicable for the Anacostia River and are not directly implemented by Pepco.	**Not Effective**	**Easy**	None	Retained as a baseline measure
WIA-2: Partial Capping (2.3 acres), and Limited Dredging with Capping (0.2 acres)	- Capping would be performed over the part of the Cove with no aquatic vegetation and marshes present (approximately 2.3 acre) to avoid minimize ecological impacts. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Baseline restoration including armoring, construction of plunge pools and channels, and wetland mitigation.	**Not Effective** - Based on CapSim evaluations for other alternatives, remedial actions for only a part of the Cove would not achieve the 0.64 ng/L porewater criterion.	**Difficult** - Capping and dredging are well-developed technologies and services, equipment, and personnel are readily available. - Implementation would result in a 1 ft. elevation difference between the capped and uncapped areas of the Cove. - This may potentially impact hydrodynamic and ecological conditions in the Cove as well as the aquatic vegetation. - Excavation in SED7G would result in impact to the aquatic vegetation in this polygon and obtaining permit and regulatory clearances is expected to be difficult.	Moderate	Eliminated as ineffective.
WIA-3: Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)	- Removal of existing aquatic vegetation and off-site preservation. - Capping would be performed over 3.5 acres of the Cove. Potential capping options for a 1 ft. thick cap include sand, AC-amended sand, and a sand-soil dual layer cap. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Baseline restoration, including construction of plunge pools and channels, armoring, wetland mitigation, and replanting of vegetation.	**Effective** - Concentrations of PCBs in porewater of BAZ can be maintained below 0.64 ng/L for at least 100 years with either the sand-soil combination cap or the AC-amended sand cap. - Placement of a clean cap would isolate underlying impacted sediments and provide a clean BAZ for benthic organisms. - Incorporating AC or soil into the cap is expected to be reduce potential for recontamination of the cap.	**Moderately Difficult** - Dredging and capping are well-developed technologies and services, equipment, and personnel are readily available. - Obtaining permit and regulatory clearances is expected to be difficult due to potential impacts on aquatic vegetation in the Cove. - Vegetation replanting may not be successful. - Limited area available within and around the Cove for staging of equipment and materials.	Moderate	Retained
WIA-4: In-Situ Treatment (3.5 acres), and Limited Dredging with Capping (0.2 acres)	- In-situ treatment of sediments in 3.5 acres of the Cove with AC-containing, commercially available products such as SediMite or AquaGate+PAC 10%. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Baseline restoration, including construction of plunge pools and channels, wetland mitigation, armoring, and replanting of vegetation.	**Effective** - CapSIM modeling indicate a 5% AC dose (applied as either SediMite or AquaGate+PAC 10%) and dredging and capping in SED7G would be effective at keeping PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years on a surface weighted average basis. - Results from the TS also demonstrate that in-situ treatment would be effective in reducing bioaccumulation in benthic organisms.	**Moderately Difficult** - In-situ treatment, and capping and dredging are well-developed technologies and services, equipment, and personnel are readily available. - Excavation in SED7G would result in impact to the aquatic vegetation in this polygon and obtaining permit and regulatory clearances is expected to be difficult. - Limited area available within and around the Cove for staging of equipment and materials.	Low-to-Moderate	Retained

Table 5-1 Description and Screening of Assembled Alternatives (continued)

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
WIA-5: Dredging of the Entire Cove and Capping	- Removal of existing aquatic vegetation and off-site preservation. - Dredging of sediments in the 0-1 ft. interval across the entire Cove, followed by capping. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Potential capping options for the rest of the Cove include AC-amended sand and sand-soil dual layer cap. - Baseline restoration, including construction of plunge pools and channels, armoring, wetland mitigation, and replanting of vegetation.	**Effective** - CapSim evaluations show that dredging of the entire Cove to a depth of 1 ft. bgs followed by capping of the underlying sediments with either AC-amended sand or sand-soil mix could be effective at maintaining PCB concentration in porewater in the BAZ below the 0.64 ng/L criterion for at least 100 years on a surface weighted average basis. - Permanently removal of 6300 CY of PCB-impacted sediments from the Cove. - Placement of a clean cap would isolate underlying impacted sediments and provide a clean BAZ for benthic organisms. - Incorporating AC or soil into the cap is expected to be reduce potential for recontamination of the cap.	**Difficult** - Dredging and capping are well-developed technologies and services, equipment, and personnel are readily available. - Obtaining permit and regulatory clearances is expected to be difficult due to potential impacts on aquatic vegetation in the Cove. - Vegetation replanting may not be successful. - Limited area available within and around the Cove for staging of equipment and materials. - Considerable water management as well as treatment systems for the same are expected to be needed.	Very High	Retained
WIA-6: In-Situ Treatment (2.5 acres), and Dredging and Capping (1.2 acres)	- In-situ treatment of sediments in 2.5 acres of the Cove with AC-containing, commercially available products such as SediMite or AquaGate+PAC 10%. - Dredging of sediments in the 0-1 ft. interval over 1 acre of the Cove, followed by capping. - Potential capping options for the 1 acre of the Cove include AC-amended sand and sand-soil dual layer cap. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Baseline restoration, including construction of plunge pools and channels, armoring, wetland mitigation, and replanting of vegetation.	**Effective** - CapSim evaluations show that this alternative could be effective at maintaining PCB concentration in porewater in the BAZ below the 0.64 ng/L criterion for at least 100 years on a surface weighted average basis. - Permanently removal of 2230 CY of PCB-impacted sediments from the Cove. - Placement of a clean cap would isolate underlying impacted sediments and provide a clean BAZ for benthic organisms. - Incorporating AC or soil into the cap is expected to be reduce potential for recontamination of the cap. - Results from the TS also demonstrate that in-situ treatment would be effective in reducing bioaccumulation in benthic organisms.	**Moderately Difficult** - In-situ treatment, and capping and dredging are well-developed technologies and services, equipment, and personnel are readily available. - Excavation in SED7G would result in impact to the aquatic vegetation in this polygon and obtaining permit and regulatory clearances is expected to be difficult. - Limited area available within and around the Cove for staging of equipment and materials. - Considerable water management as well as treatment systems for the same are expected to be needed.	High	Retained

Note: Restoration would include replanting vegetation and wetland mitigation, which may be necessary for both the dredging and capping alternatives.

Table 6-1 - Cost Estimate for WIA-3

Remedy Components:

1. Selective dredging (1 ft.) in SED7G and capping with AC-amended sand (0.2 acres)
2. Cap placement (1 ft., 3.5 acres)
3. Construction and armoring of plunge pools and channels
4. Implementation of a Long-Term Monitoring Plan
5. Baseline Restoration (includes replanting of vegetation, recontouring of channels, plunge pools, wetland mitigation, and armoring)

Key Assumptions:

1. Work area will be limited to the Cove approximately 3.7 acres.
2. Remedy will include baseline restoration approximately 3.7 acres.

Capital Costs

	Direct Capital Costs	Unit	Unit Cost	Quantity	Total Cost
1	Mobilization/Demobilization	*LS*	$300,000	1.0	$300,000
2	Contractor Plans and Submittals	*LS*	$50,000	1.0	$50,000
3	Site Preparation and Temporary Facilities	*LS*	$600,000	1.0	$600,000
4	Portadam/Cofferdam and Turbidity Control	*Month*	$72,000	4.0	$288,000
5	Dewatering/Outfall Pipe Bypass	*Month*	$60,000	4.0	$240,000
6	Mechanical Dredging	*CY*	$50	620	$31,000
7	Sediment Dewatering and Stabilization	*Ton*	$80	930	$74,400
8	Sediment Transportation and Disposal	*Ton*	$125	930	$116,250
9	Water Transportation and Disposal	*Gal*	$1.00	62612	$62,612
10	Capping Material Supply and Placement	*CY*	$150	6600	$990,000
11	Vegetation Removal, Cleaning, Cultivation, and Replanting	*LS*	$200,000	1.0	$200,000
12	Topographic Survey (Cove)	*Acre*	$10,000	3.7	$37,000
13	Topographic Survey (staging areas)	*Each*	$5,000	2.0	$10,000
14	Baseline Restoration	*Acre*	$50,000	3.7	$185,000
			Direct Capital Cost Subtotal		$3,185,000
15	Contingency	*percent*		30%	$956,000
			Direct Capital Cost Total		$4,141,000

	Indirect Capital Costs	Unit	Unit Cost	Quantity	Total Cost
16	Project Management	*percent*		10%	$318,500
17	Remedial Design	*percent*		20%	$637,000
18	Construction Management & QA Support	*percent*		10%	$318,500
19	Agency Review & Oversight	*percent*		10%	$318,500
20	Environmental Monitoring	*LS*	$45,000	1.0	$45,000
21	Pre-Design Investigation	*LS*	$100,000	1.0	$100,000
22	Baseline and Long-Term Monitoring Plan	*LS*	$33,000	1.0	$33,000
23	Permitting	*LS*	$100,000	1.0	$100,000
24	Institutional Controls	*LS*	$75,000	1.0	$75,000
25	Wetland Mitigation (assuming 2:1 mitigation)	*Acre*	$250,000	2.0	$500,000
			Indirect Capital Cost Total		$2,446,000

CAPITAL COST TOTAL	$6,587,000

	Periodic Costs	Unit	Unit Cost	Quantity	Total Cost
26	Agency Review & Oversight	*Event*	$20,000	6.0	$120,000
27	5 Year Reviews	*Event*	$25,000	6.0	$150,000
28	Topographic Survey	*Event*	$10,000	8.0	$80,000
29	Surface Sediment/porewater Sampling	*Event*	$45,700	8.0	$365,600
30	Cap Repair/Maintenance	*Event*	$100,000	1.0	$100,000
			Periodic Costs Subtotal		$815,600
31	Net Present Value of Periodic Costs				$582,385
32	Contingency	*percent*		30%	$174,716
			Periodic Costs Total		$757,000

TOTAL PRESENT WORTH COST	$7,340,000

Table 6-2 - Cost Estimate for WIA-4

Remedy Components:

1. Selective dredging (1 ft.) in SED7G and capping with AC-amended sand (0.2 acres)
2. Clearing and grubbing to prepare for installation of amendment and restoration
3. Construction and armoring of plunge pools and channels
4. Carbon amendment placement over 3.5 acres
5. Implementation of a Long-Term Monitoring Plan
6. Baseline Restoration (includes recontouring of channels, plunge pools, wetland mitigation, and armoring)

Key Assumptions:

1. Work area will be limited to the Cove approximately 3.7 acres.
2. Remedy will include baseline restoration approximately 3.7 acres.
3. 5% carbon by weight for a 4" BAZ.

Capital Costs

	Direct Capital Costs	Unit	Unit Cost	Quantity	Total Cost
1	Mobilization/Demobilization	*LS*	$300,000	1	$300,000
2	Contractor Plans and Submittals	*LS*	$50,000	1.0	$50,000
3	Site Preparation and Temporary Facilities	*LS*	$600,000	1.0	$600,000
4	Portadam/Cofferdam and Turbidity Control	*Month*	$72,000	4.0	$288,000
5	Dewatering/Outfall Pipe Bypass	*Month*	$60,000	4.0	$240,000
6	Mechanical Dredging	*CY*	$50	620	$31,000
7	Sediment Dewatering and Stabilization	*Ton*	$80	930	$74,400
8	Sediment Transportation and Disposal	*Ton*	$125	930	$116,250
9	Water Treatment and Disposal	*Gal*	$1.0	62600	$62,600
10	Capping Material Supply and Placement	*CY*	$150	400	$60,000
11	Amendment Material Procurement and Transport	*LS*	$350,000	1.0	$350,000
12	Amendment Application	*Acre*	$75,000	3.5	$262,500
13	Armoring Material Supply and Placement	*CY*	$100	1075	$107,500
14	Vegetation Removal, Cleaning, Cultivation, and Replanting	*LS*	$25,000	1	$25,000
15	Topographic Survey (Cove)	*Acre*	$10,000	3.7	$37,000
16	Topographic Survey (staging areas)	*Each*	$5,000	2.0	$10,000
17	Baseline Restoration	*Acre*	$50,000	3.7	$185,000
			Direct Capital Cost Subtotal		$2,800,000
18	Contingency	*percent*		30%	$840,000
			Direct Capital Cost Total		$3,640,000

	Indirect Capital Costs	Unit	Unit Cost	Quantity	Total Cost
19	Project Management	*percent*		10%	$280,000
20	Remedial Design	*percent*		20%	$560,000
21	Construction Management & QA Support	*percent*		10%	$280,000
22	Agency Review & Oversight	*percent*		10%	$280,000
23	Environmental Monitoring	*LS*	$45,000	1.0	$45,000
24	Pre-Design Investigation	*LS*	$100,000	1.0	$100,000
25	Baseline and Long-Term Monitoring Plan	*LS*	$33,000	1.0	$33,000
26	Permitting	*LS*	$100,000	1.0	$100,000
27	Institutional Controls	*LS*	$75,000	1.0	$75,000
28	Wetland Mitigation (assuming 2:1 mitigation)	*Acre*	$250,000	0.24	$60,000
			Indirect Capital Cost Total		$1,813,000
			CAPITAL COST TOTAL		$5,453,000

	Periodic Costs	Unit	Unit Cost	Quantity	Total Cost
29	Agency Review and Oversight	*Event*	$20,000	6	$120,000
30	5 Year Reviews	*Event*	$25,000	6	$150,000
31	Topographic Survey	*Event*	$10,000	8	$80,000
32	Surface Sediment/Porewater Sampling	*Event*	$45,700	8	$365,600
33	Amendment Replenishment	*Event*	$62,000	1	$62,000
			Periodic Costs Subtotal		$777,600
34	Net Present Value of Periodic Costs				$547,610
35	Contingency	*percent*		30%	$164,283
			Periodic Costs Total		$712,000

TOTAL PRESENT WORTH COST	$6,170,000

Table 6-3 - Cost Estimate for WIA-5

Remedy Components:

1. Dredge across the Cove (0-1 ft.)
2. Cap placement (1 ft.)
3. Construction and armoring of plunge pools and channels
4. Implementation of Long-Term Monitoring Plan
5. Baseline Restoration (includes replanting of vegetation, recontouring of channels, plunge pools, wetland mitigation, and armoring)

Key Assumptions:

1. Work area will be limited to the Cove approximately 3.7 acres.
2. Remedy will include baseline restoration approximately 3.7 acres.

Capital Costs

	Direct Capital Costs	Unit	Unit Cost	Quantity	Total Cost
1	Mobilization/Demobilization	*LS*	$300,000	1.0	$300,000
2	Contractor Plans and Submittals	*LS*	$50,000	1.0	$50,000
3	Site Preparation and Temporary Facilities	*LS*	$700,000	1.0	$700,000
4	Portadam/Cofferdam and Turbidity Control	*Month*	$72,000	6.0	$432,000
5	Dewatering/Outfall Pipe Bypass	*Month*	$60,000	6.0	$360,000
6	Mechanical Dredging	*CY*	$50	6300	$315,000
7	Sediment Dewatering and Stabilization	*Ton*	$80	9450	$756,000
8	Sediment Transportation and Disposal	*Ton*	$125	9450	$1,181,250
9	Water Transportation and Disposal	*Gal*	$1.0	636200	$636,200
10	Backfill Material and Placement	*CY*	$150	6610	$991,500
11	Vegetation Removal, Cleaning, Cultivation, and Replanting	*LS*	$200,000	1.0	$200,000
12	Topographic Survey (Cove)	*Acre*	$10,000	3.7	$37,000
13	Topographic Survey (staging areas)	*Each*	$5,000	2.00	$10,000
14	Baseline Restoration	*Acre*	$50,000	3.7	$185,000
			Direct Capital Cost Subtotal		$6,154,000
15	Contingency	*percent*		30%	$1,846,200
			Direct Capital Cost Total		$8,000,000

	Indirect Capital Costs	Unit	Unit Cost	Quantity	Total Cost
16	Project Management	*percent*		10%	$615,400
17	Remedial Design	*percent*		20%	$1,230,800
18	Construction Management & QA Support	*percent*		10%	$615,400
19	Agency Review & Oversight	*percent*		10%	$615,400
20	Environmental Monitoring	*LS*	$45,000	1.0	$45,000
21	Pre-Design Investigation	*LS*	$100,000	1.0	$100,000
22	Baseline and Long-Term Monitoring Plan	*LS*	$33,000	1.0	$33,000
23	Permitting	*LS*	$100,000	1.0	$100,000
24	Institutional Controls	*LS*	$75,000	1.0	$75,000
25	Wetland Mitigation (assuming 2:1 mitigation)	*Acre*	$250,000	2.0	$500,000
			Indirect Capital Cost Total		$3,930,000

			CAPITAL COST TOTAL		$11,930,000

	Periodic Costs	Unit	Unit Cost	Quantity	Total Cost
26	Agency Review & Oversight	*Event*	$20,000	6.0	$120,000
27	5 Year Reviews	*Event*	$25,000	6.0	$150,000
28	Topographic Survey	*Event*	$10,000	8.0	$80,000
29	Surface Sediment/Porewater Sampling	*Event*	$45,700	8.0	$365,600
30	Cap Repair/Maintenance	*Event*	$100,000	1.0	$100,000
			Periodic Costs Subtotal		$815,600
31	Net Present Value of Periodic Costs				$582,385
32	Contingency	*percent*		30%	$174,716
			Periodic Costs Total		$757,000

TOTAL PRESENT WORTH COST	$12,690,000

Table 6-4 - Cost Estimate for WIA-6

Remedy Components:

1. Carbon amendment placement over 2.5 acres of Cove
2. Dredging and capping (0-1 ft.) over 1.2 acres of Cove
3. Construction and armoring of plunge pools and channels
4. Implementation of a Long-Term Monitoring Plan
5. Baseline Restoration (includes recontouring of channels, plunge pools, wetland mitigation, and armoring)

Key Assumptions:

1. Work area will be limited to the Cove approximately 3.7 acres.
2. Remedy will include baseline restoration approximately 3.7 acres.
3. 5% carbon by weight for a 4" BAZ.

Capital Costs

	Direct Capital Costs	Unit	Unit Cost	Quantity	Total Cost
1	Mobilization/Demobilization	*LS*	$300,000	1.0	$300,000
2	Contractor Plans and Submittals	*LS*	$50,000	1.0	$50,000
3	Site Preparation and Temporary Facilities	*LS*	$700,000	1.0	$700,000
4	Portadam/Cofferdam and Turbidity Control	*Month*	$72,000	6.0	$432,000
5	Dewatering/Outfall Pipe Bypass	*Month*	$60,000	6.0	$360,000
6	Mechanical Dredging	*CY*	$50	2230	$111,500
7	Sediment Dewatering and Stabilization	*Ton*	$80	3345	$267,600
8	Sediment Transportation and Disposal	*Ton*	$125	3345	$418,125
9	Water Transportation and Disposal	*Gal*	$1.0	225200	$225,200
10	Backfill Material and Placement	*CY*	$150	2450	$367,500
11	Vegetation Removal, Cleaning, Cultivation, and Replanting	*LS*	$25,000	1	$25,000
12	Amendment Material Procurement and Transport	*LS*	$250,000	1.0	$250,000
13	Amendment Application	*Acre*	$75,000	2.5	$187,500
14	Armoring Material Supply and Placement	*CY*	$100	730	$73,000
15	Topographic Survey (Cove)	*Acre*	$10,000	3.7	$37,000
16	Topographic Survey (staging areas)	*Each*	$5,000	2.0	$10,000
17	Baseline Restoration	*Acre*	$50,000	3.7	$185,000
			Direct Capital Cost Subtotal		$4,000,000
18	Contingency	*percent*		30%	$1,200,000
			Direct Capital Cost Total		$5,200,000

	Indirect Capital Costs	Unit	Unit Cost	Quantity	Total Cost
19	Project Management	*percent*		10%	$400,000
20	Remedial Design	*percent*		20%	$800,000
21	Construction Management & QA Support	*percent*		10%	$400,000
22	Agency Review & Oversight	*percent*		10%	$400,000
23	Environmental Monitoring	*LS*	$45,000	1.0	$45,000
24	Pre-Design Investigation	*LS*	$100,000	1.0	$100,000
25	Baseline and Long-Term Monitoring Plan	*LS*	$33,000	1.0	$33,000
26	Permitting	*LS*	$100,000	1.0	$100,000
27	Institutional Controls	*LS*	$75,000	1.0	$75,000
28	Wetland Mitigation (assuming 2:1 mitigation)	*Acre*	$250,000	0.24	$60,000
			Indirect Capital Cost Total		$2,413,000

			CAPITAL COST TOTAL		$7,613,000

	Periodic Costs	Unit	Unit Cost	Quantity	Total Cost
29	Agency Review & Oversight	*Event*	$20,000	6.0	$120,000
30	5 Year Reviews	*Event*	$25,000	6.0	$150,000
31	Topographic Survey	*Event*	$10,000	8.0	$80,000
32	Surface Sediment/Porewater Sampling	*Event*	$45,700	8.0	$365,600
33	Cap Repair/Maintenance	*Event*	$36,750	1.0	$36,750
34	Amendment Replenishment	*Event*	$44,000	1.0	$44,000
			Periodic Costs Subtotal		$796,350
35	Net Present Value of Periodic Costs				$564,769
36	Contingency	*percent*		30%	$169,431
			Periodic Costs Total		$734,000

			TOTAL PRESENT WORTH COST		$8,350,000

Table 6-5 Comparative Evaluation of Remedial Alternatives

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
WIA-1: No Action	- No remedial actions implemented for reducing porewater PCB concentrations in Cove sediments. - Some ICs, such as the existing fish consumption advisory and NPS permitting requirements for activities that disturb the sediments, will continue to be implemented as these are applicable for the Anacostia River and are not directly implemented by Pepco.	N/A	N/A	N/A	N/A	N/A	N/A	None
WIA-3: Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)	- Removal of existing aquatic vegetation and off-site preservation. - Capping would be performed over 3.5 acres of the Cove. Potential capping options for a 1 ft. thick cap include sand, AC-amended sand, and a sand-soil dual layer cap. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Baseline restoration, including construction of plunge pools and channels, armoring, wetland mitigation, and replanting of vegetation.	**Protective of human health and environment.** - Results from CAPSIM modeling indicate this alternative can maintain the concentration of PCBs in porewater of the BAZ below the criterion of 0.64 ng/L on a surface weighted average basis for at least 100 years.	**Complies with ARARs.** - Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions.	**Provides long-term effectiveness and permanence.** - Surfaces in outfall areas and channels would be armored with riprap to prevent erosion of the placed cap material. - 1 ft. of AC-amended sand cap or sand-soil dual-layer cap on top of existing sediments is expected to can maintain the surface weighted average PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years. - Placement of a clean cap would isolate underlying impacted sediments and provide a clean BAZ for benthic organisms. - Incorporating AC or soil into the cap is expected to be reduce potential for recontamination of the cap.	**Substantial reduction in toxicity and minor reduction in volume of impacted sediments.** - Results from CAPSIM modeling indicate this alternative can maintain the concentration of PCBs in porewater of the BAZ below the criterion of 0.64 ng/L on a surface weighted average basis for at least 100 years. - Minor reduction in volume of impacted sediments via dredging of sediments in SED7G. - Placement of a cap over majority of the Cove, in combination with selective dredging and capping, would reduce the overall mobility of PCBs in the underlying sediments. - The cap would also function as a clean BAZ for benthic organisms, thus reducing toxicity of PCBs to benthic organisms.	**Provides short-term effectiveness.** - Construction timeframe of 4-6 months. - Immediate improvement on PCB concentrations present in the Cove as a result of replacing the existing BAZ with a clean substrate. - Short-to-medium term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation. - Minor and temporary short-term risks to the workers and community during remedy implementation. - Mitigation of short-term risks via implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of PPE by workers, implementation of soil erosion control measures, a soil management plan, turbidity controls, and air monitoring. - Pepco will develop and implement an air monitoring plan and mitigation measures for any construction / excavation activities associated with remedy implementation.	**Moderately Difficult** - Dredging and capping are well-developed technologies and services, equipment, and personnel are readily available. - Vegetation replanting may not be successful. - Limited area available within and around the Cove for staging of equipment and materials. - Access from the Cove to Pepco's Benning Road Facility, where equipment laydown areas and materials handling potentially could be supported, is impeded by the presence of the Anacostia Riverwalk Trial and Anacostia Avenue. - Barges may be required to move and stage construction equipment, materials, and waste generated during remedy implementation, and/or access to park lands may be needed. - Obtaining permit and regulatory clearances is expected to be difficult due to potential impacts on aquatic vegetation in the Cove.	$7,340,000

Table 6-5 Comparative Evaluation of Remedial Alternatives (continued)

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
WIA-4: In-Situ Treatment (3.5 acres), and Limited Dredging with Capping (0.2 acres)	- In-situ treatment of sediments in 3.5 acres of the Cove with AC-containing, commercially available products such as SediMite or AquaGate+PAC 10%. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Baseline restoration, including construction of plunge pools and channels, wetland mitigation, armoring, and replanting of vegetation.	**Protective of human health and environment.** - Results from CapSim modeling indicate that application of an AC-amended sand cap after dredging the sediments in the 0-1 ft. interval of SED7G, while amending the remaining sediments with 5% AC dose applied as either SediMite or AquaGate+PAC 10% can maintain surface weighted average PCB concentration in porewater below the 0.64 ng/L criterion for at least 100 years. - Results from the TS also demonstrate that the application of AC would be effective in reducing bioaccumulation in benthic organisms.	**Complies with ARARs.** - Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions.	**Provides long-term effectiveness and permanence.** - Surfaces in outfall areas and channels would be armored with riprap to prevent erosion of the AC product. - Results from CAPSIM modeling indicate this alternative can maintain the concentration of PCBs in porewater of the BAZ below the criterion of 0.64 ng/L on a surface weighted average basis for at least 100 years. - Incorporation of an AC-amended sand cap in SED7G is also expected to reduce potential for recontamination.	**Substantial reduction in toxicity and minor reduction in volume of impacted sediments.** - Results from CAPSIM modeling indicate this alternative can maintain the concentration of PCBs in porewater of the BAZ below the criterion of 0.64 ng/L on a surface weighted average basis for at least 100 years. - Results from the TS also demonstrate that the application of AC would be effective in reducing bioaccumulation in benthic organisms. - Minor reduction in volume of impacted sediments via dredging of sediments in SED7G.	**Provides short-term effectiveness.** - Construction timeframe of 4-6 months. - Dredging and capping in SED7G will have an immediate improvement on PCB concentrations in this part of the Cove by permanently removing 620 CY of sediment with PCB concentrations exceeding the RAL and by replacing the BAZ with clean substrate. - The effect of carbon amendments throughout the rest of the Cove will take additional time due to naturally occurring processes such as bioturbation, deposition, and burial that are required to mix the amendment material into underlying impacted sediments. - Short-to-medium term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation. - Minor and temporary short-term risks to the workers and community during remedy implementation. - Mitigation of short-term risks via implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of PPE by workers, implementation of soil erosion control measures, a soil management plan, turbidity controls, and air monitoring. - Pepco will develop and implement an air monitoring plan and mitigation measures for any construction / excavation activities associated with remedy implementation.	**Easy to Moderately Difficult** - In-situ treatment, and capping and dredging are well-developed technologies and services, equipment, and personnel are readily available. - Excavation in SED7G would result in impact to the aquatic vegetation in this polygon and obtaining permit and regulatory clearances is expected to be somewhat difficult. - Limited area available within and around the Cove for staging of equipment and materials. - Access from the Cove to Pepco's Benning Road Facility, where equipment laydown areas and materials handling potentially could be supported, is impeded by the presence of the Anacostia Riverwalk Trial and Anacostia Avenue. - Barges may be required to move and stage construction equipment, materials, and waste generated during remedy implementation, and/or access to park lands may be needed.	$6,170,000

Table 6-5 Comparative Evaluation of Remedial Alternatives (continued)

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
WIA-5: Dredging of the Entire Cove and Capping	- Removal of existing aquatic vegetation and off-site preservation. - Dredging of sediments in the 0-1 ft. interval across the entire Cove, followed by capping. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Potential capping options for the rest of the Cove include AC-amended sand and sand-soil dual layer cap. - Baseline restoration, including construction of plunge pools and channels, armoring, wetland mitigation, and replanting of vegetation.	**Protective of human health and environment.** - Results from CapSim modeling indicate that both AC-amended sand and sand-soil dual layer cap over 3.5 acre extent, in combination with dredging and capping in SED7G, were able to meet the 0.64 ng/L porewater target for PCB concentrations in the Cove BAZ on a surface area averaged basis. - Removal of 6300 CY of contaminated sediments is expected to reduce PCB concentrations in the Cove, while the clean BAZ created by the cap is expected to reduce exposure to PCBs in underlying sediments.	**Complies with ARARs.** - Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions.	**Provides long-term effectiveness and permanence.** - Surfaces in outfall areas and channels would be armored with riprap to prevent erosion of the placed cap material. - Results from CapSim modeling indicate that both AC-amended sand and sand-soil dual layer cap over 3.5 acre extent, in combination with dredging and capping in SED7G, were able to meet the 0.64 ng/L porewater target for PCB concentrations in the Cove BAZ on a surface area averaged basis. - Permanent removal of 6300 CY of contaminated sediments. - Placement of a clean cap would isolate underlying impacted sediments and provide a clean BAZ for benthic organisms. - Incorporating AC or soil into the cap is expected to be reduce potential for recontamination of the cap.	**Substantial reduction in toxicity and volume of impacted sediments.** - Results from CapSim modeling indicate that both AC-amended sand and sand-soil dual layer cap over 3.5 acre extent, in combination with dredging and capping in SED7G, were able to meet the 0.64 ng/L porewater target for PCB concentrations in the Cove BAZ on a surface area averaged basis. - Permanent removal of 6300 CY of contaminated sediments. - Placement of a cap would reduce the overall mobility of PCBs in the underlying sediments, leading to lowered PCB concentrations in the porewater in the BAZ.	**Provides short-term effectiveness.** - Construction timeframe of 6-12 months. - Immediate improvement on PCB concentrations present in the Cove as a result of removal of impacted sediments and replacement of the existing BAZ with a clean substrate. - Short-to-medium term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation. - Minor and temporary short-term risks to the workers and community during remedy implementation. - Mitigation of short-term risks via implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of PPE by workers, implementation of soil erosion control measures, a soil management plan, turbidity controls, and air monitoring. - Pepco will develop and implement an air monitoring plan and mitigation measures for any construction / excavation activities associated with remedy implementation.	**Difficult** - Dredging and capping are well-developed technologies and services, equipment, and personnel are readily available. - Obtaining permit and regulatory clearances is expected to be difficult due to potential impacts on aquatic vegetation in the Cove. - Vegetation replanting may not be successful. - Limited area available within and around the Cove for staging of equipment and materials. - Considerable water management as well as treatment systems for the same are expected to be needed. - Access from the Cove to Pepco's Benning Road Facility, where equipment laydown areas and materials handling potentially could be supported, is impeded by the presence of the Anacostia Riverwalk Trial and Anacostia Avenue. - Barges may be required to move and stage construction equipment, materials, and waste generated during remedy implementation, and/or access to park lands may be needed.	$12,690,000

Table 6-5 Comparative Evaluation of Remedial Alternatives (continued)

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
WIA-6: In-Situ Treatment (2.5 acres), and Dredging and Capping (1.2 acres)	- In-situ treatment of sediments in 2.5 acres of the Cove with AC-containing, commercially available products such as SediMite or AquaGate+PAC 10%. - Dredging of sediments in the 0-1 ft. interval over 1 acre of the Cove, followed by capping. - Potential capping options for the 1 acre of the Cove include AC-amended sand and sand-soil dual layer cap. - Sediments in the SED7G polygon (approximately 0.2 acres) would be dredged to a depth of 0-1 ft. and backfilled with a 1 ft. thick cap consisting of AC-amended sand. - Baseline restoration, including construction of plunge pools and channels, armoring, wetland mitigation, and replanting of vegetation.	**Protective of human health and environment.** - Results from CapSIM modeling indicate that all potential scenarios possible under this alternative would be effective at keeping the surface weighted average PCB concentration in the porewater of the BAZ below the 0.64 ng/L criterion for at least 100 years, thus reducing exposure from the Cove sediments. - Removal of 2230 CY of contaminated sediments is expected to reduce PCB concentrations in the Cove, while the clean BAZ created by the cap is expected to reduce exposure to PCBs in underlying sediments.	**Complies with ARARs.** - Remedial actions will be implemented in compliance with the procedures established during the design and permit conditions.	**Provides long-term effectiveness and permanence.** - Surfaces in outfall areas and channels would be armored with riprap to prevent erosion of the placed cap material. - Results from CapSIM modeling indicate that all potential scenarios possible under this alternative would be effective at keeping the surface weighted average PCB concentration in the porewater of the BAZ below the 0.64 ng/L criterion for at least 100 years. - Permanent removal of 2230 CY of contaminated sediments. - Placement of a clean cap would isolate underlying impacted sediments and provide a clean BAZ for benthic organisms. - Incorporating AC or soil into the cap is expected to be reduce potential for recontamination of the cap	**Substantial reduction in toxicity and volume of impacted sediments.** - Results from CapSIM modeling indicate that all potential scenarios possible under this alternative would be effective at keeping the surface weighted average PCB concentration in the porewater of the BAZ below the 0.64 ng/L criterion for at least 100 years, thus reducing exposure from the Cove sediments. - Permanent removal of 2230 CY of contaminated sediments. - Placement of a cap would reduce the overall mobility of PCBs in the underlying sediments, leading to lowered PCB concentrations in the porewater in the BAZ. - Results from the TS also demonstrate that the application of AC would be effective in reducing bioaccumulation in benthic organisms.	**Provides short-term effectiveness.** - Construction timeframe of 6-12 months. - Immediate improvement on PCB concentrations in 2.5 acre area of the Cove as a result of removal of impacted sediments and replacement of the existing BAZ with a clean substrate. - The effect of carbon amendments throughout the rest of the Cove will take additional time due to naturally occurring processes such as bioturbation, deposition, and burial that are required to mix the amendment material into underlying impacted sediments. - Short-to-medium term disturbance to the ecological habitat in the Cove is expected but the habitat is expected to recover after remedy implementation. - Minor and temporary short-term risks to the workers and community during remedy implementation. - Mitigation of short-term risks via implementation of dust suppression measures, dust and odor control plan, a traffic management plan, site control measures, use of PPE by workers, implementation of soil erosion control measures, a soil management plan, turbidity controls, and air monitoring. - Pepco will develop and implement an air monitoring plan and mitigation measures for any construction / excavation activities associated with remedy implementation.	**Moderately Difficult** - In-situ treatment, and capping and dredging are well-developed technologies and services, equipment, and personnel are readily available. - Excavation in SED7G would result in impact to the aquatic vegetation in this polygon and obtaining permit and regulatory clearances is expected to be somewhat difficult. - Limited area available within and around the Cove for staging of equipment and materials. - Considerable water management as well as treatment systems for the same are expected to be needed. - Access from the Cove to Pepco's Benning Road Facility, where equipment laydown areas and materials handling potentially could be supported, is impeded by the presence of the Anacostia Riverwalk Trial and Anacostia Avenue. - Barges may be required to move and stage construction equipment, materials, and waste generated during remedy implementation, and/or access to park lands may be needed.	$8,350,000

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Appendix A

Key Assumptions and Calculations for WIA Cost Estimates

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Key Assumptions and Calculations for WIA Cost Estimates

1. General Assumptions Applicable to All Alternatives

- **A. Sediment Bulk Density:** 1.5 tons/cubic yard
- **B. Direct capital costs:** These include expenditures required for constructing a remedial action. Include costs associated with mobilization, site preparation (including debris removal and grading of the surface), Cove dewatering, construction, equipment, bench and pilot scale studies, capping/treatment material purchase, dredging, sediment transportation and disposal, surveying, restoration, etc.
- **C. Indirect capital costs:** These include expenditures required for implementing the remedial action. These include costs for remedial design, project management, construction management and quality assurance support, agency review and oversight, monitoring, pre-design investigation, permitting and institutional control, and wherever applicable, wetland mitigation.
- **D. Project management costs:** 10% of direct capital cost subtotal
- **E. Remedial design costs:** 20% of direct capital cost subtotal
- **F. Construction management and Quality Assurance (QA) support costs:** 10% of direct capital cost subtotal
- **G. Agency review and oversight costs:** 10% of direct capital cost subtotal
- **H. Contingency on capital costs:** 30% of direct capital cost subtotal
- **I. Contingency on periodic costs:** 30% of net present value
- **J. Discount rate for net present value of periodic costs:** For commercial entities and for profit corporations, the discount rate is based on the entity's specific rate of return that the investors expect or the cost of borrowing money. Pepco determined its company-specific discount rate for the present worth calculations to be 3%. This is also in line with the long-term average published by Federal Office of Management and Budget.

2. Assumption for WIA-3: WIA-3: Capping (3.5 acres), and Limited Dredging with Capping (0.2 acres)

2.1 Remedy Description

- Removal and off-site preservation of existing vegetation in the Cove.
- Construction of channels and plunge pools.
- Capping of entire Cove surface (approximately 3.7 acres) with a 1 ft. thick sand-soil dual layer or AC-amended sand cap.
- Replanting of preserved vegetation.
- Baseline restoration (includes living shoreline at mouth of the Cove).

2.2 Direct Capital Cost Items

- Contractor mobilization/demobilization and preparation of plans and submittals.
- Site preparation and construction of temporary facilities including staging areas.
- Installation of portadam/cofferdam and turbidity control measures.
- Cove dewatering and construction of bypass lines for stormwater from outfalls.
- Mechanical dredging, sediment dewatering and stabilization.
- Transportation and disposal of dredged sediments and water generated from dewatering of dredged sediments.
- Procurement and placement of the capping and armoring material.
- Topographic and/or bathymetric surveys.
- Baseline restoration.

2.3 Indirect Capital Cost Items

- Project management, remedial design, construction management and QA, agency review and oversight.
- Environmental monitoring, pre-design investigation, baseline and long-term monitoring plan.
- Permitting and institutional controls.
- Wetland mitigation.

2.4 Periodic Cost Items

The frequency and total number of events, along with assumptions used for cost estimate of periodic items are presented below:

Item	Event Frequency	Total events over 30 years	Basis for cost estimate
Agency review and oversight	1 event every 5 years	6	Estimated typical cost
5 year reviews	1 event every 5 years	6	Estimated typical cost
Topographic/Bathymetric surveys	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Surface sediment/porewater sampling	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Cap repair/maintenance	1 event at year 3	1	Approximately 10% of capital cost of material supply and placement (Line #10).

2.5 Key Assumptions

- Cost of sediment dewatering and stabilization: $80/ton.
- Cost of sediment transportation and disposal: $125/ton.
- Quantity of water generated from dewatering of dredged sediments assumed to be 50% of the volume of dredged sediments and converted to gallons.
- Water disposal cost assumed to be $1/gallon.
- Capping material quantity based on assuming a 1 ft. thick cap over 3.7 acre area, with 10% material quantity.
- Capping material cost based on assuming AC-amended sand as the capping material. While cap material selection is deferred to the remedial design stage, this is a conservative cost estimate as AC-amended sand is expected to be more expensive than sand and soil used for the dual layer cap.
- Cost of vegetation removal, cleaning, cultivation, and replanting estimated at $200,000, based on approximately 1 acre of vegetated area at a unit cost of $200,000/acre.
- Wetland mitigation costs assume a 2:1 mitigation requirement at a cost of $250,000/acre.

3. Assumption for WIA-4: In-Situ Treatment (3.5 acres) and Limited Dredging with Capping (0.2 acres)

3.1 Remedy Description

- Removal and off-site preservation of existing vegetation in the SED7G polygon.
- Construction of channels and plunge pools.
- Dredging of sediments in the 0-1 ft. interval of SED7G polygon.
- Capping of dredged area in SED7G polygon with AC-amended sand.
- In-situ treatment of 3.5 acres of the Cove with 5% AC dose applied as either SediMite or AquaGate+PAC 10% (Material selection deferred to the remedial design stage).
- Replanting of preserved vegetation.
- Baseline restoration (includes living shoreline at mouth of the Cove).

3.2 Direct Capital Cost Items

- Contractor mobilization/demobilization and preparation of plans and submittals.
- Site preparation and construction of temporary facilities including staging areas.
- Installation of portadam/cofferdam and turbidity control measures.
- Cove dewatering and construction of bypass lines for stormwater from outfalls.
- Mechanical dredging, sediment dewatering and stabilization.
- Transportation and disposal of dredged sediments and water generated from dewatering of dredged sediments.
- Procurement and placement of the amendment, capping, and armoring material.
- Topographic and/or bathymetric surveys.
- Baseline restoration.

3.3 Indirect Capital Cost Items

- Project management, remedial design, construction management and QA, agency review and oversight.
- Environmental monitoring, pre-design investigation, baseline and long-term monitoring plan.
- Permitting and institutional controls.
- Wetland mitigation.

3.4 Periodic Cost Items

The frequency and total number of events, along with assumptions used for cost estimate of periodic items are presented below:

Item	Event Frequency	Total events over 30 years	Basis for cost estimate
Agency review and oversight	1 event every 5 years	6	Estimated typical cost
5 year reviews	1 event every 5 years	6	Estimated typical cost
Topographic/Bathymetric surveys	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Surface sediment/porewater sampling	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Amendment Replenishment	1 event at year 3	1	Approximately 10% of cumulative capital cost of amendment procurement and transport (Line #11) and placement (Line #12).

3.5 Key Assumptions

- Cost of sediment dewatering and stabilization: $80/ton.
- Cost of sediment transportation and disposal: $125/ton.
- Quantity of water generated from dewatering of dredged sediments assumed to be 50% of the volume of dredged sediments and converted to gallons.
- Water disposal cost assumed to be $1/gallon.
- Capping material quantity based on assuming a 1 ft. thick cap over 0.2 acre area, with 10% material quantity.
- Capping material cost based on assuming AC-amended sand as the capping material. While cap material selection is deferred to the remedial design stage, this is a conservative cost estimate as AC-amended sand is expected to be more expensive than sand and soil used for the dual layer cap.
- Procurement and transportation costs for AC-treatment products based on vendor quotes. Higher of the quoted costs used for WIA-4 cost estimates. Material selection and dose is deferred to the remedial design stage.
- AC application cost assumed to be $75,000/acre.
- Armoring over AC application area assumed to consist of a 5 cm thick layer of coarse sand. A 10% material contingency is included in the estimates. Material supply and placement cost assumed to be $100/CY.

- Cost of vegetation removal, cleaning, cultivation, and replanting, for an estimated 0.12 acres of impacted vegetation in SED7G is $24,000, based on approximate unit cost of $200,000/acre. Cost rounded up to $25,000.
- Wetland mitigation costs assume a 2:1 mitigation requirement at a cost of $250,000/acre.

4. Assumption for WIA-5: Dredging of the Entire Cove and Capping

4.1 Remedy Description

- Removal and off-site preservation of existing vegetation in the Cove.
- Dredging of sediments in 0-1 ft. layer of the Cove over an area of 3.7 acres.
- Construction of channels and plunge pools.
- Placement of 1 ft. thick sand-soil dual layer or AC-amended sand cap over the excavated 3.7 acres.
- Replanting of preserved vegetation.
- Baseline restoration (includes living shoreline at mouth of the Cove).

4.2 Direct Capital Cost Items

- Contractor mobilization/demobilization and preparation of plans and submittals.
- Site preparation and construction of temporary facilities including staging areas.
- Installation of portadam/cofferdam and turbidity control measures.
- Cove dewatering and construction of bypass lines for stormwater from outfalls.
- Mechanical dredging, sediment dewatering and stabilization.
- Transportation and disposal of dredged sediments and water generated from dewatering of dredged sediments.
- Procurement and placement of the capping and armoring material.
- Topographic and/or bathymetric surveys.
- Baseline restoration.

4.3 Indirect Capital Cost Items

- Project management, remedial design, construction management and QA, agency review and oversight.
- Environmental monitoring, pre-design investigation, baseline and long-term monitoring plan.
- Permitting and institutional controls.
- Wetland mitigation.

4.4 Periodic Cost Items

The frequency and total number of events, along with assumptions used for cost estimate of periodic items are presented below:

Item	Event Frequency	Total events over 30 years	Basis for cost estimate
Agency review and oversight	1 event every 5 years	6	Estimated typical cost
5 year reviews	1 event every 5 years	6	Estimated typical cost
Topographic/Bathymetric surveys	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Surface sediment/porewater sampling	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Cap repair/maintenance	1 event at year 3	1	Approximately 10% of capital cost of material supply and placement (Line #10).

4.5 Key Assumptions

- Cost of sediment dewatering and stabilization: $80/ton.
- Cost of sediment transportation and disposal: $125/ton.
- Quantity of water generated from dewatering of dredged sediments assumed to be 50% of the volume of dredged sediments and converted to gallons.
- Water disposal cost assumed to be $1/gallon.
- Capping material quantity based on assuming a 1 ft. thick cap over 3.7 acre area, with 10% material quantity.
- Capping material cost based on assuming AC-amended sand as the capping material. While cap material selection is deferred to the remedial design stage, this is a conservative cost estimate as AC-amended sand is expected to be more expensive than sand and soil used for the dual layer cap.
- Cost of vegetation removal, cleaning, cultivation, and replanting estimated at $200,000 based on approximately 1 acre of vegetated area at a unit cost of $200,000/acre.
- Wetland mitigation costs assume a 2:1 mitigation requirement at a cost of $250,000/acre.

5. Assumption for WIA-6: In-Situ Treatment (over 2.5 acres) with Dredging and Capping (over 1.2 acres)

5.1 Remedy Description

- Removal and off-site preservation of existing vegetation in the SED7G polygon.
- Construction of channels and plunge pools.
- Dredging of sediments in the 0-1 ft. interval of SED8C, SED7.5C, SED7B, SED6.5C, SED7G, and part of SED7D polygons (approximately 1.2 acres).
- Capping of dredged area in SED7G polygon with AC-amended sand.
- Capping of remaining dredged area with either AC-amended sand cap or sand-soil dual layer cap.
- In-situ treatment of 2.5 acres of the Cove with 5% AC dose applied as either SediMite or AquaGate+PAC 10% (Material selection deferred to the remedial design stage).
- Replanting of preserved vegetation.
- Baseline restoration (includes living shoreline at mouth of the Cove).

5.2 Direct Capital Cost Items

- Contractor mobilization/demobilization and preparation of plans and submittals.
- Site preparation and construction of temporary facilities including staging areas.
- Installation of portadam/cofferdam and turbidity control measures.
- Cove dewatering and construction of bypass lines for stormwater from outfalls.
- Mechanical dredging, sediment dewatering and stabilization.
- Transportation and disposal of dredged sediments and water generated from dewatering of dredged sediments.
- Procurement and placement of the amendment, capping, and armoring material.
- Topographic and/or bathymetric surveys.
- Baseline restoration.

5.3 Indirect Capital Cost Items

- Project management, remedial design, construction management and QA, agency review and oversight.
- Environmental monitoring, pre-design investigation, baseline and long-term monitoring plan.
- Permitting and institutional controls.
- Wetland mitigation.

5.4 Periodic Cost Items

The frequency and total number of events, along with assumptions used for cost estimate of periodic items are presented below:

Item	Event Frequency	Total events over 30 years	Basis for cost estimate
Agency review and oversight	1 event every 5 years	6	Estimated typical cost
5 year reviews	1 event every 5 years	6	Estimated typical cost
Topographic/Bathymetric surveys	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Surface sediment/porewater sampling	1 event every year for first 3 years; 1 event every 5 years thereafter	8	Estimated typical cost
Cap repair/maintenance	1 event at year 3	1	Approximately 10% of capital cost of material supply and placement (Line #10).
Amendment Replenishment	1 event at year 3	1	Approximately 10% of cumulative capital cost of amendment procurement and transport (Line #12) and placement (Line #13).

5.5 Key Assumptions

- Cost of sediment dewatering and stabilization: $80/ton.
- Cost of sediment transportation and disposal: $125/ton.
- Quantity of water generated from dewatering of dredged sediments assumed to be 50% of the volume of dredged sediments and converted to gallons.
- Water disposal cost assumed to be $1/gallon.
- Capping material quantity based on assuming a 1 ft. thick cap over 2.5 acre area, with 10% material quantity.
- Capping material cost based on assuming AC-amended sand as the capping material. While cap material selection is deferred to the remedial design stage, this is a conservative cost estimate as AC-amended sand is expected to be more expensive than sand and soil used for the dual layer cap.
- Procurement and transportation costs for AC-treatment products based on vendor quotes. Higher of the quoted costs used for WIA-6 cost estimates. Material selection and dose is deferred to the remedial design stage.

- Cost of vegetation removal, cleaning, cultivation, and replanting, for an estimated 0.12 acres of impacted vegetation in SED7G is $24,000, based on approximate unit cost of $200,000/acre. Cost rounded up to $25,000.
- Armoring over AC application area assumed to consist of a 5 cm thick layer of coarse sand. A 10% material contingency is included in the estimates. Material supply and placement cost assumed to be $100/CY.
- Wetland mitigation costs assume a 2:1 mitigation requirement at a cost of $250,000/acre.