FEASIBILITY STUDY REPORT

KENILWORTH PARK LANDFILL
NORTHEAST, WASHINGTON, D.C.
NATIONAL CAPITAL PARKS-EAST

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EXECUTIVE SUMMARY

This Feasibility Study Report (FS) was prepared for the Kenilworth Park Landfill Site (Site), located in Northeast Washington, District of Columbia (District or D.C.), to evaluate potential remedial alternatives for the Site consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The National Park Service (NPS) is the lead agency for response action at the Site.

Site Description

The Site covers 130 acres within Kenilworth Park and Aquatic Gardens, which is part of the Anacostia Park unit of National Capital Parks-East (NACE), in Washington, D.C. The Site comprises two areas divided by the Watts Branch, a tributary to the Anacostia River: Kenilworth Park Landfill North (KPN) and Kenilworth Park Landfill South (KPS). KPN and KPS are 80 acres and 50 acres in size, respectively. The Site is bounded on the north by Kenilworth Marsh; on the east by residential areas; on the south by a District Trash Transfer Station and the Neval Thomas Elementary School; and on the west by the Anacostia River. NPS has determined it is appropriate to divide the Site into two operable units (OUs): OU1 comprises surface soils and subsurface soils including waste material disposed of in the KPN and KPS landfills; OU2 is the shallow groundwater underlying OU1. This FS Report evaluates remedial alternatives for OU1.

Historically, both KPN and KPS were used as recreation areas. KPN has developed athletic fields and was the site of the Kenilworth-Parkside Community Center (Community Center) located at the eastern end of KPN near Anacostia Avenue. The District has demolished the Community Center, with plans to replace it with a new recreation center in the same general area. KPS is currently closed to the public but will be developed for active recreational uses after the completion of the CERCLA process. Future recreational activities for KPS include a bicycle/recreation trail, among other things.

Site History

In 1942, the District began operation of a dump on the Site and burned trash and buried ash there until 1968; it then operated the Site as a sanitary landfill until 1970. During its nearly 30 years of operation, the dump primarily received municipal solid waste and incineration ash, totaling approximately 3.5 million tons of disposed material. In 1970, the landfill ceased operations, was covered, and portions converted to recreation fields.

Site Investigations

Between 1998 and 2009, a number of environmental investigations were undertaken to determine the nature and extent of contamination at the Site, including Preliminary Assessment/Site Inspections (PA/SIs), Remedial Investigations (RIs), and supplemental data collection and reports. Various media were investigated, including surface soil, subsurface soil and buried waste material, sediment, groundwater, surface water, soil vapor, and indoor air. The results of these investigations were used in risk assessments to form the basis for the development of remedial action objectives and identification and evaluation of remedial alternatives. Site contaminants of concern include lead, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and methane gas.

Basis for Site Remediation

The development of remedial alternatives for the Site was based on the results of the Site investigations (the PA/SIs and RIs) and the risk assessments (human health and ecological), as well as analysis of applicable or relevant and appropriate requirements (ARARs) and criteria to be considered (TBCs). A summary of the Site investigation and risk assessment findings is provided below.

Contaminant levels in some of the shallow groundwater within and immediately adjacent to the waste materials in KPN and KPS exceed drinking water standards, but only in a small number of the monitoring wells sampled as part of the RI. The groundwater at or near the Site is not a current source of drinking water and not likely a future source due to insufficient volumes and the local availability of municipal potable water. The deeper Patuxent aquifer beneath the Site is used for water supply in the Indian Head-Waldorf area 25 miles to the southeast of the Site. However, the low-permeability clays underlying the Site, and the upward hydraulic gradient in the Patuxent aquifer, would prevent any contaminants in shallow groundwater at the Site from migrating into the underlying Patuxent aquifer.

The RI concluded that significant groundwater transport of Site contaminants to adjacent surface water bodies was not likely due to: 1) the relatively low (as compared to typical landfills) concentrations of most COCs in Site wells; 2) the sporadic distribution of detected COCs – elevated concentrations are localized at individual wells with no overall dissolved plume; and 3) the presence of low permeability soils between the wastes and adjacent surface waters that significantly reduces groundwater flow away from the Site.

The data do not indicate an overall impact from the Site on surface water or sediment in the adjacent surface water bodies (Anacostia River, Watts Branch, and Kenilworth Marsh). Groundwater transport is the only potential pathway for Site contaminants to migrate to adjacent water bodies and groundwater data collected during the RI do not indicate a significant groundwater transport pathway. NPS has established shallow groundwater as an operable unit (OU2) of the Site. NPS will collect additional groundwater data to supplement existing Site data and prepare an RI Addendum to assess the extent to which hazardous substances in OU2 pose a threat to human health or the environment. As warranted by and consistent with the data collected, the RI Addendum will be used to support the development, evaluation, and selection of response action for OU2, if warranted.

Human Health and Ecological Risk Assessments

Human health risk assessments (HHRAs) were completed to evaluate risks of exposure to contaminants by visitors and workers at the Site. The results indicate complete exposure pathways for adult and child visitors and construction workers to Site soils and Site sediments (e.g., Watts Branch, stormwater detention ponds). Dermal contact, ingestion, and inhalation were the routes of exposure evaluated. The HHRA concluded that carcinogenic risk to the composite child/adult Site visitor was above the CERCLA point of departure for identifying carcinogenic risk, due primarily to the potential ingestion of PCB- and PAH-containing surface soil. The HHRA concluded that the Site does not present an unacceptable carcinogenic risk to construction workers. No unacceptable non-carcinogenic risks were identified for Site visitors or construction workers except a worker scenario involving more than 90 days in an excavation in a specific area and depth where high lead concentrations are present (i.e., in the waste materials).

Methane was not detected inside the Community Center prior to its demolition, indicating that there was no indoor health or safety risk from methane. Similarly, methane was not found to pose a risk beyond the boundaries of the Site. The interior surfaces and the vast majority of land at the edges of the Site do not have any impermeable surface covering and, therefore, provide a relatively easy pathway for any methane that is still being generated by the landfill to be released to the atmosphere in a diffused manner through the existing cover soil or ground surface.

Methane concentrations in subsurface soils, however, were found to present unacceptable risk at several locations within the boundaries of the Site, indicating the potential for safety risks associated with future construction or utility work or other activities that disturb the subsurface waste material. Other than Alternative 1, No Action, perimeter methane monitoring has been included in remedial alternatives developed for the Site to confirm the lack of methane migration off-site in the future.

The ecological risk assessments evaluated risks of exposure to ecological receptors. The results of the ecological risk assessments, combined with additional data collected subsequent to the ecological risk assessment process and considering more recent soil screening levels and guidance, indicate that significant ecological risk is not present at the Site.

Based on these findings, the following Remedial Action Objectives (RAOs) were developed for the Site:

Contaminants in Soil

- Eliminate or minimize contaminant-related constraints to the full utilization and enjoyment of the Site consistent with NPS mandates;
- Meet federal and D.C. ARARs and/or risk-based cleanup goals, whichever are more stringent;
- Prevent exposure to PCBs, PAHs, and metals above risk-based levels in surface soil for Park visitors and utility/construction workers; and
- Prevent exposure to lead in surface and subsurface soil above risk-based levels via direct contact for construction/utility workers.

Methane in the Subsurface

- Prevent exposure to unacceptable levels of methane from landfill gas for Park visitors and utility/construction workers; and
- Prevent exposure to unacceptable levels of methane at on-site or off-site facilities.

Prevention of Future Hazards to Potentially Exposed Waste Materials

- Prevent erosion or future Site activities that could expose buried landfill waste material at the ground surface.

Based on the previous studies, risk assessments, RAOs, and ARARs, chemicals of concern (COCs) were selected and chemical-specific Remediation Goals (RGs) established for PCBs, PAHs, and lead in soil and methane in soil gas as follows:

COCs and RGs
Kenilworth Park Landfill

COC	**Units**	**RG**	**Basis**
PCBs			
Aroclor 1254	mg/kg	0.44	Child/Adult Site Visitor
Aroclor 1260	mg/kg	0.25	Child/Adult Site Visitor
Lead			
Lead Surf/Subsurface [1] (0-15 ft bgs)	mg/kg	455	Construction Worker
Methane			
Property Boundary	% LEL[2]	<100%	RCRA Landfill Gas Regulations 40 CFR § 258.23
Inside Buildings	% LEL[2]	<25%	
Site Worker in a Confined Space	% LEL[2]	<10%	29 CFR § 1910.146
PAHs			
Benzo(a)anthracene	mg/kg	1.23	Child/Adult Site Visitor
Benzo(a)pyrene	mg/kg	0.12	Child/Adult Site Visitor
Dibenzo(a,h)anthracene	mg/kg	0.12	Child/Adult Site Visitor

1. Risk estimation for lead exposure would be based on an area-wide average for the work site, considering both vertical and horizontal distribution of lead.
2. LEL – Lower Explosive Limit is 5% by volume (50,000 ppmv) methane in air

Development and Evaluation of Remedial Alternatives

Five remedial alternatives were evaluated:

Alternative 1: No action;

Alternative 2: Minor regrading combined with institutional controls and 3 years of annual perimeter methane monitoring;

Alternatives 3a and 3b: Soil cap (12-inch cap for Alternative 3a and 24-inch RCRA Subtitle D cap for Alternative 3b), localized shallow excavation and off-site disposal where pre-excavation is required, institutional controls, and perimeter methane monitoring before, during, and after remedial actions; and

Alternative 4: Removal of all accessible waste material and existing cover soils, localized shallow excavation and off-site disposal to accommodate a soil cap around existing development, wetlands restoration, and institutional controls.

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LIST OF ACRONYMS

AOC	Area of Concern
ALM	Adult Lead Model
AMSL	Above Mean Sea Level
ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
BCFs	Bioconcentration Factors
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
bgs	Below Ground Surface
BNA	Base/Neutral and Acid Extractable
BTAG	Biological Technical Assistance Group
CAD	Computer Aided Drafting
CEC	Contaminant of Ecological Concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Contaminant of Concern
cfs	cubic feet per second
cm	Centimeter
cm/hr	Centimeters per Hour
cm/s	Centimeters per Second
COPC	Contaminant of Potential Concern
CPEC	Contaminant of Potential Ecological Concern
cy	Cubic Yards
DCMR	District of Columbia Municipal Regulations
DDT	dichlorodiphenyltrichloroethane
D.C.	District of Columbia
E & E	Ecology and Environment, Inc.
ELCR	Excess Lifetime Cancer Risk
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERT	Environmental Response Team
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FS	Feasibility Study
Ft	Feet
GRA	General Response Action
GSA	General Services Administration
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System
HI	Hazard Index

LIST OF ACRONYMS (continued)

HQ	Hazard Quotient
ICs	Institutional Controls
ICIAP	Institutional Controls Implementation and Assurance Plan
IEUBK	Integrated Exposure Uptake Biokinetic
KPN	Kenilworth Park Landfill North
KPS	Kenilworth Park Landfill South
kg	kilogram
LEL	Lower Explosive Limit
LOAEL	Lowest-Observed-Adverse-Effect Level
LDR	Land Disposal Restrictions
MCL	Maximum Contaminant Level
MF	Migratory Fishery
mg	Milligram
MLE	Most Likely Exposure
MSC	Medium Specific Concentration
MSL	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Not Detected
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NOAEL	No-Observed-Adverse-Effect Level
NOV	Notice of Violation
NPL	National Priorities List
NPS	National Park Service
OSWER	Office of Solid Waste and Emergency Response
O & M	Operation and Maintenance
PA	Preliminary Assessment
PAH	Polycyclic, or Polynuclear Aromatic Hydrocarbon
PEM	Palustrine Emergent Wetlands
PCB	Polychlorinated Biphenyl
PFR	Problem Formulation Report
PPMV	Parts per Million by Volume
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RAGS	Risk Assessment Guidance for Superfund
RBC	Risk-Based Concentration
RBSC	Risk-Based Screening Concentration
RCRA	Resource Conservation and Recovery Act
RG	Remediation Goal
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision

LIST OF ACRONYMS (continued)

SDC	Supplemental Data Collection
SLERA	Screening-Level Ecological Risk Assessment
SI	Site Investigation
SVOCs	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TBC	To Be Considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TGM	Technical Guidance Manual
T&E	Threatened and Endangered
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOC	Volatile Organic Compound
WWF	Warm Water Fishery

1.0 INTRODUCTION

The National Park Service (NPS) has prepared this Feasibility Study (FS) Report for the Kenilworth Park Landfill (the Site), located in Northeast Washington, D.C. (District or D.C.) (see Figure 1-1). The Site covers 130 acres divided by Watts Branch, a tributary to the Anacostia River, and includes the former Kenilworth Park Landfill North (KPN) and Kenilworth Park Landfill South (KPS) (see Figure 1-2). The Site includes two operable units (OUs): OU1 comprises surface soils and subsurface soils, including waste material disposed of in KPN and KPS; OU2 includes shallow groundwater underlying OU1. This FS Report evaluates remedial alternatives for OU1. NPS will prepare a Remedial Investigation (RI) Addendum after collecting additional groundwater data to assess the extent to which hazardous substances in OU2 pose a threat to human health or the environment. As warranted by and consistent with the data collected, the RI Addendum will be used to support the development, evaluation, and selection of a response action for OU2, if warranted.

This FS has been prepared for the two landfill areas together, KPN and KPS, because of: 1) the common historical use of the two sites as former municipal landfills; 2) the common contaminants of concern; 3) the similarity in current and future uses of the areas; and 4) the efficiency to be gained by avoiding the development of parallel documents. This FS has been completed to develop, screen, and evaluate potential remedial alternatives for the Site consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601 *et seq*., and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. NPS is the CERCLA lead agency for response action at the Site.

1.1 PURPOSE OF THE FEASIBILITY STUDY AND ORGANIZATION OF THE REPORT

This FS provides a basis for NPS to select a preferred remedial alternative which will be described in a Proposed Plan and made available for public review and comment. Based upon this FS, the Administrative Record for the Site, and public comments on the Proposed Plan, a Record of Decision (ROD) will be issued in which a remedial action will be selected.

The FS objectives are to:

- summarize the RI reports, including results of the human health and ecological risk assessments, identify the contaminants of concern (COCs), and analyze applicable or relevant and appropriate requirements (ARARs);
- identify feasible remedial technologies for containment, removal, or treatment and disposal of contaminated media (e.g., soil, sediment, or surface water);
- screen and assemble feasible technologies into remedial alternatives for detailed analysis; and
- perform a detailed evaluation and comparison of the remedial alternatives to provide a basis for remedy selection.

This FS Report was prepared utilizing the data and information presented in two RI reports prepared by Ecology and Environment, Inc. (E&E), one for Kenilworth Park Landfill North (KPN) (E&E, 2007a) and the other for Kenilworth Park Landfill South (KPS) (E&E, 2008), as well as associated risk assessment documents and data collected in supplemental sampling efforts (see Appendix A).

The RIs included human health risk assessments and screening-level ecological risk assessments. The screening-level ecological risk assessments were further refined by E&E in additional problem formulation reports for KPN (E&E, 2007b) and KPS (E&E, 2007c).

This FS follows the general process outlined in USEPA *A Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA – Interim Final* (USEPA, 1988a). Figure 1-3 illustrates the steps of a CERCLA FS and provides a framework for how this FS is organized. This report is divided into Sections 1.0 through 7.0, which are summarized below:

Section 1.0 – Introduction: provides background information regarding the Site, including Site location and description, Site history, and regulatory background.

Section 2.0 – Previous Site Investigations: summarizes data collected during previous Site investigations (including supplemental data collection efforts), presents a summary of human health and ecological risk assessments conducted for the Site, and identifies contaminants of potential concern (COPCs) and contaminants of potential ecological concern (COPECs).

Section 3.0 – Basis for Remediation: identifies the applicable or relevant and appropriate requirements (ARARs); develops remedial action objectives (RAOs) and remediation goals (RGs); and provides a summary of RG exceedances at the Site (USEPA, 1988a).

Section 4.0 – General Response Actions and Identification and Screening of Remedial Technologies: develops general response actions (GRAs) to address the contaminants and risks at the Site, identifies appropriate remedial technologies or process options to be evaluated, and screens the technology types and process options.

Section 5.0 – Development and Screening of Remedial Alternatives: describes remedial alternatives developed by combining technologies and/or process options that are retained for further consideration in Section 4.0, and identifies alternatives to be carried forward for detailed evaluation.

Section 6.0 – Detailed Analysis of Alternatives: presents a detailed description and evaluation of each of the alternatives identified in Section 5.0. The analysis of each alternative is performed against the first seven of the nine assessment criteria (USEPA, 1988a). The last two criteria, state and community acceptance, are assessed during the public comment period following issuance of the Proposed Plan. This section also presents the comparative analysis of alternatives relative to the evaluation criteria.

Section 7.0 – Comparative Analysis of Alternatives: evaluates the relative performance of the alternatives with respect to the assessment criteria. This final FS step should provide decision-makers with information from which an appropriate remedy can be selected.

Section 8.0 – References: provides a list of the references and previous studies cited in this report.

1.2 SITE LOCATION AND DESCRIPTION

The Site is located within Kenilworth Park and Aquatic Gardens, which is part of the Anacostia Park unit of National Capital Parks-East (NACE), in Washington, D.C. The Site is bounded on the north by Kenilworth Marsh; on the east by Anacostia Avenue and Hayes and Jay Streets; on the south by a District of Columbia Department of Public Works Transfer Station, Neval Thomas Elementary School, and a NPS maintenance yard; and on the west by the Anacostia River (Figure 1-1). The Site is divided into two areas of concern (AOCs), KPN and KPS, which are shown on Figure 1-2, and two operable units (OUs), surface and subsurface soils (OU1) and shallow groundwater (OU2). Shallow groundwater is considered that groundwater that is present within and immediately beneath the waste materials at the Site. The Site comprises 130 acres: 80 acres in KPN and 50 acres in KPS. The two areas are separated by Watts Branch and the Mayfair Manor and Paradise residential areas. KPN and KPS are connected by an access road (Deane Avenue) that crosses Watts Branch.

Both AOCs are used as recreation areas; however, KPN is more actively used since it has developed athletic fields and includes the former Kenilworth-Parkside Community Center (Community Center) operated by the District of Columbia Sports and Entertainment Commission (DCSEC) and the DC Department of Parks and Recreation[1]. KPS is accessible to the public via the extension of the park access road that runs between Deane Avenue and Foote Street, but the area is not developed for active recreational use. Other than an abandoned public restroom building and the road, KPS is currently undeveloped.

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[1] In 2010, the District demolished the Community Center building with plans to replace it with a new recreation center.

1.3 SITE HISTORY

Historically, the area now comprising the Site was tidal marshland along the east bank of the Anacostia River. The surrounding land was farmed into the early 1900s. As the city of Washington grew, the area around the low lying marshland was developed as a residential area. Later commercial and light industrial development also took place in the surrounding area. The river has been dredged to make the channel both wider and deeper, and nearly all the wetlands adjoining the river have been filled, except where they were dredged to create ornamental lakes, such as Kingman Lake and Kenilworth Aquatic Gardens.

1.3.1 Landfill Operational History

In 1942, the District Refuse Division began operation of a dump on the Site. The city burned trash and buried the resulting ash at the Site. The Site was operated as an open burning dump until 1968, and then continued to operate as a sanitary landfill until 1970. During its nearly 30 years of operation, the dump/landfill primarily received municipal solid waste and very little industrial waste. In 1970, the landfill ceased operations, was covered, and portions converted to recreation fields.

1.3.2 Post-Operational History

KPN after landfill operations ceased

By the 1970s, KPN landfill had ceased operations and had been covered and converted to recreational use. An area of approximately 23 acres in the northeastern-most section of the former landfill (along Anacostia Avenue) was developed by the DC Department of Parks and Recreation (DCPR) and in the mid-1970s DCPR constructed the Kenilworth-Parkside Recreation Center. Although this recreation area was developed and actively managed by DCPR, the property remained under the jurisdiction of NPS. In 2010, the District demolished the Kenilworth-Parkside Recreation Center building, with plans to replace it with a new recreation center in the same general area. In 2004, Congress enacted legislation, Public Law 108-335, Title III §344, authorizing transfer of administrative jurisdiction over KPN to the District, but the transfer has not yet occurred. Subsequent to the 2006 RI data collection effort, DCSEC filled a large area in the eastern portion of KPN to create new athletic fields. This project included the installation of a sprinkler system and other utilities.

During this activity, a "thermos" size unexploded ordnance (munitions shell) was unearthed by a construction worker near the Kenilworth Parkside Community Center. The DC Metropolitan Police Department (DC MPD) and the US Army Corp of Engineers (USACOE) responded to the munitions discovery. The 767th Ordnance Company – Explosive Ordnance Disposal (USACOE) recovered, identified, and destroyed the shell at the Marine Corps Base at Quantico. The Site has never been used as a military installation and no other ordnance have been discovered during the many years of subsurface investigations, excavation and re-working of the landfill surfaces, and filling operations. Although a September 21, 2006 press-release indicated that "as many as three munitions" had been discovered at the Site in recent years, no documentation has been located that describes more than the one shell.

The results of a 1980 landfill gas study (Shadel and Philips, 1980) concluded that usable quantities of methane gas were being generated from the organic material historically placed in the landfill. This finding provided the basis for the installation of a methane collection system in KPN for heating the greenhouses at the adjacent Kenilworth Aquatic Gardens. This system was subsequently dismantled due to problems with the high moisture content of the gas that caused the heating system to be shut down frequently.

KPS after landfill operations ceased

During 1977 and 1978, a major trunk sewer (108 inches in diameter) was laid through the southern edge of KPS (E & E, 2008). This sewer conveys domestic sewage to the Blue Plains wastewater treatment plant. By May 1980, recreational improvements at KPS were largely complete and included playing fields, a public restroom building, and a paved parking area.

Beginning in early 1997, the Park superintendent contracted to cover portions of KPS with fill to improve the recreational fields and address ponding and drainage issues at KPS, a practice that continued through much of 1998, raising the ground surface at KPS in places by as much as 25 feet. The volume of fill is estimated at 400,000 cubic yards (yd^3) based on elevation contours before and after the fill was added. This fill, which contained construction debris, was placed in two locations east and west of Deane Avenue. Fill thickness ranged up to 14 feet on the east side of Deane Avenue and up to 25 feet on the west side of Deane Avenue near the river (E & E, 2008). After filling activities had progressed for over a year, the NPS directed the contractors to suspend work on the east and west sides in August and October of 1998, respectively (E & E, 2008).

In 1999, the NPS hired contractors to modify drainage and re-grade the west side of the fill, remove some rubble, and bring in rip-rap to armor some drainage ways. The same year, NPS hired another contractor to begin crushing and sorting concrete on the east side, extracting reinforcing wire, rebar, and other metal waste, and stockpiling material for removal. Contractors also moved fill out of the 100-year floodplain. The site was further regraded and seeded between 2002 and 2003 to create terraces surrounded by low berms and creating a catchment pond on top of the landfill to reduce runoff from the Site and curtail erosion.

In this FS Report, “new fill” in KPS refers to the material added during the 1997-1998 filling operations, whereas “old fill” refers to the material associated with the D.C. landfill operation that occurred at the Site until the early 1970s.

2.0 PREVIOUS INVESTIGATIONS

2.1 PREVIOUS INVESTIGATIONS - KPN

Listed below is a summary of the investigations conducted at KPN followed by a summary discussion of the nature and extent of contamination for each medium of concern in Section 2.2. The results of these investigations were evaluated and utilized during the preparation of this FS.

2000 Kenilworth Park Landfill North Geoprobe Sampling: NPS conducted a site visit, preliminary sampling of surface soil, and Geoprobe® sampling of subsurface soil and groundwater in June 2000 (E&E, 2000a). Data from this investigation were used in the RI for analyses of the nature and extent of contamination but were not used for the human health risk assessment or the screening-level ecological risk assessment because data of superior quality were subsequently collected.

2002 Preliminary Assessment/Site Investigation of Kenilworth Park Landfill North: E&E conducted a Preliminary Assessment/Site Investigation (PA/SI) at KPN that involved the installation of groundwater monitoring wells and the collection and analysis of soil and groundwater samples (E&E, 2002). The PA/SI report concluded that surface soil contamination should be further analyzed to determine potential health risks and recommended that an RI be prepared.

2005 Collection and analysis of surface soil samples around Parkside Recreation Center, Anacostia Avenue, N.W. Washington D.C. (letter report): E & E conducted a focused soil investigation in areas surrounding the Kenilworth-Parkside Recreation Center for DCSEC (E&E, 2005). The purpose was to investigate the areas where DCSEC planned to construct additional recreational fields. This study concluded that PCB and dieldrin levels in surface soils were below the residential risk-based concentrations (RBCs) and that lead and arsenic levels were comparable to area background concentrations. The report concluded that surface soil did not present unacceptable human health risk for recreational users.

2007 Final Remedial Investigation at the Kenilworth Landfill, N.E. Washington, D.C.: E & E collected additional data and prepared a Final RI Report in November 2007 (E&E, 2007a). This RI Report included a summary of previous investigation results and results of additional field sampling of surface and subsurface soils, sediment, and groundwater conducted in 2006. Additional monitoring wells were installed and sampled and slug tests performed on wells along the margin of the landfill. Groundwater elevation data were collected to determine groundwater flow direction. A baseline human health risk assessment and screening-level ecological risk assessment were also completed and the results included in the RI Report. A summary of and conclusions from the 2007 RI are presented in Section 2.2 below.

2010 Supplemental Data Collection Report – Kenilworth Park Landfill: In October 2008, The Johnson Company collected shallow and deep soil vapor samples and an indoor air sample from the Kenilworth-Parkside Recreation Center for methane analysis, surface soil samples for pH and total organic carbon analysis, and evaluated the adequacy of existing Site topographic information. The results are presented in a supplemental data collection report (JCO, 2010; See Appendix A of this FS) and summarized in Sections 2.2.1 (pH and TOC sample results) and 2.2.4 (methane results) below.

2.2 NATURE AND EXTENT OF CONTAMINATION - KPN

2.2.1 Surface Soil

Surface soil samples were collected from KPN during field sampling efforts for the 2000 NPS investigation, 2001/2002 PA/SI, 2005 DCSEC, 2007 RI, and 2008 – 2009 Supplemental Data Collection. Data from the 2000 NPS investigation are not included in the data presentations that follow, or on the figures in this document, because data of superior quality were subsequently collected (as stated in the RI).

EPA Region 3 RBCs for residential soils adjusted for non-cancer effects to a Hazard Index (HI) of 0.1 were used as screening levels in the HHRA for identifying COPCs. The reported results for compounds exceeding these screening levels are summarized below.

- PAHs: total polycyclic aromatic hydrocarbons (PAHs) were reported at concentrations up to 10.75 mg/kg. The individual PAH benzo(a)pyrene was reported at concentrations up to 1.1 mg/kg. (Human Health Risk Assessment (HHRA) screening level: benzo(a)pyrene 0.022 mg/kg)

- PCBs: Aroclor 1254 was detected at concentrations up to 6.98 mg/kg. Aroclor 1260 was detected at concentrations up to 4.53 mg/kg. Three separate localized areas with consistent levels of Aroclor 1254 greater than 2.0 mg/kg and Aroclor 1260 greater than 1.0 mg/kg are identified in the RI. (HHRA screening levels: Aroclor 1254 0.156 mg/kg; Aroclor 1260 0.32 mg/kg)

- Pesticides: dieldrin was reported at concentrations up to 0.82 mg/kg. Additionally, the 2007 RI reported that aldrin was detected above the screening levels in the 2000 Geoprobe® sampling, but not in subsequent investigations suggesting that the 2009 detection was not representative of Site conditions. (HHRA screening levels: aldrin 0.038 mg/kg; dieldrin 0.040 mg/kg)

- Metals: arsenic was reported at concentrations up to 9.32 mg/kg; lead up to 1,350 mg/kg; and iron up to 24,800 mg/kg. (HHRA screening levels; arsenic 0.43 mg/kg; lead 400 mg/kg; iron 2,300 mg/kg)

Subsequent to the 2006 field work conducted as part of the RI, DCSEC imported a large volume of fill to the eastern portion of KPN, installed a drainage system, and filled the area in order to make sports fields (see Figures 1-2 and 2-1). Consequently, the analytical results for surface soil samples originally collected in what is now the sports field area, no longer represent current conditions, as further discussed in Section 3.3 - Remediation Goal Exceedances.

In 2008, The Johnson Company collected surface soil samples from a number of representative locations at KPN and analyzed them for pH and total organic carbon (TOC). These soil parameters affect the bioavailability of metal and organic contaminants. Results of surface soil pH and TOC analyses are presented in the Supplemental Data Collection Report in Appendix A. TOC was reported between 3,370 mg/kg (0.3%) and 50,100 mg/kg (5.0%) at KPN. The pH of surface soil samples ranged from 6.44 to 7.44. The implications of these TOC and pH values on the conclusions from the ecological risk assessment are discussed in Section 2.8.2.

As described in Section 1.3, the surface soils at KPN were imported after the closure of the landfill operations to cover the waste materials and provide a surface suitable for recreational purposes. As such, the contaminants found in the KPN surface soils are not from the landfill waste materials, but rather were either imported with the cover/fill soils that were brought to the Site from off-site locations, or deposited there potentially via atmospheric deposition from off-site sources.

2.2.2 Subsurface Soil

Subsurface soil and landfill material samples were collected for each of the major reports (2000 NPS investigation, 2001/2002 PA/SI, 2005 DCSEC, and 2007 RI). The reported results for compounds exceeding the screening criteria used in the RI (EPA Region 3 RBCs for residential soils adjusted for non-cancer effects to a HI of 0.1) are summarized below.

- PAHs: total PAHs were reported at concentrations up to 261.6 mg/kg. Benzo(a)pyrene was reported at concentrations up to 12.2 mg/kg (HHRA screening level: benzo(a)pyrene 0.022 mg/kg).

- PCBs: Aroclor 1242 was reported at concentrations up to 0.78 mg/kg, Aroclor 1254 was reported at concentrations up to 0.634 mg/kg, and Aroclor 1260 was reported at concentrations up to 0.92 mg/kg. (HHRA screening levels: Aroclor 1242 0.32 mg/kg; Aroclor 1254 0.16 mg/kg; Aroclor 1260 0.32 mg/kg)

- Metals: arsenic was reported at concentrations up to 11.9 mg/kg; iron up to 130,000 mg/kg; and lead up to 3,040 mg/kg. The maximum concentrations reported for metals from the 2000 NPS investigation locations were much greater than from the other investigations. (HHRA screening levels: arsenic 0.43 mg/kg; iron 2,300 mg/kg; lead 400 mg/kg)

2.2.3 Groundwater

As part of the 2001/2002 PA/SI, nine groundwater monitoring wells were installed and sampled. As part of the RI field investigation in 2006, seven new wells were installed at additional locations in areas that had not been previously characterized (along the Watts Branch and Anacostia River and in the vicinity of the Kenilworth-Parkside Recreation Center). These new wells, which ranged in depth from 10 to 40 feet to intercept the shallow groundwater, were sampled along with PA/SI wells (or replacement wells) and reported in the 2007 RI. Due to the potential for degradation of organics (VOCs, SVOCs, PCBs, and pesticides) and the turbid groundwater samples collected as part of the 2001/2002 PA/SI, groundwater analytical results from a 2000 Geoprobe® investigation and from the 2001/2002 PA/SI were not included in the RI evaluation, since more recent organic compound data were available that better represented current conditions and some of the PA/SI metals data were not representative of dissolved concentrations due to the high turbidity in the samples.

The minimum and maximum reported contaminant concentrations in groundwater from KPN are summarized in Table 2-1. Also shown is the percentage of the total wells sampled that had no detections of the listed compound, along with the percentage of the wells whose samples exceeded any of the screening criteria used in the RI (tap water RBCs, federal maximum contaminant levels – primary and secondary (MCLs), and the D.C. groundwater quality standards). These screening levels are also presented in Table 2-1.

Table 2-1
Summary of Groundwater Quality
Kenilworth Park Landfill North

	Unit	Minimum Detection		Maximum Detection		Wells with No Detection[1]	Wells with Exceedance[1]	MCL[2]	Secondary MCL[3]	RBC[4]	DC[5]
Aluminum	µg/L	980		74,300		0%	100%	N/A	50-200	37,000	N/A
Arsenic	µg/L	11		160		38%	62%	10	N/A	0.045	50
Barium	µg/L	37		2,200		0%	25%	2,000	N/A	7,300	*1,000*
Beryllium	µg/L	2.8		6.7		63%	19%	4	N/A	73	N/A
Cadmium	µg/L	2.0		7.4		75%	6%	5	N/A	18	0.005
Chromium	ug/L	5		210		0%	69%	10	N/A	55,000[6]	100[7]
Iron	µg/L	2,200		405,000		0%	100%	N/A	300	26,000	N/A
Lead	µg/L	7		1,400		0%	81%	15 AL	N/A	N/A	50
Manganese[7]	µg/L	83		4,900		0%	100%	N/A	50	730	N/A
Vanadium	µg/L	5		280		6%	63%	N/A	N/A	37	N/A
Benzo(a)anthracene	µg/L	ND		3	J	81%	19%	N/A	N/A	0.03	N/A
Benzo(a)pyrene	µg/L	ND		2	J	81%	13%	0.2	N/A	0.003	N/A
Benzo(b)fluoranthene	µg/L	ND		3	J	81%	19%	N/A	N/A	0.03	N/A
Bis(2-ethylhexyl)phthalate	µg/L	ND		13		75%	6%	6	N/A	4.80	N/A
Dibenzo(a,h)anthracene	µg/L	ND		0.5	J	94%	6%	N/A	N/A	0.003	N/A
Indeno(1,2,3-cd)pyrene	µg/L	ND		1	J	88%	12%	N/A	N/A	0.03	N/A
Naphthalene	µg/L	ND		38		81%	13%	N/A	N/A	6.5	N/A
Benzene	µg/L	ND		42		81%	19%	5	N/A	0.34	5
Chloroform	µg/L	ND		14		94%	6%	N/A	N/A	0.15	N/A
Methylene chloride	µg/L	ND		9.6	J	88%	6%	N/A	N/A	4.1	N/A
Alpha-BHC	µg/L	ND		0.039	J	88%	12%	N/A	N/A	0.011	N/A
Aroclor 1248	µg/L	ND		0.39	J	94%	6%	0.5	N/A	0.03	N/A
Aroclor 1254	µg/L	ND		0.86		94%	6%	0.5	N/A	0.03	N/A
Dieldrin	µg/L	ND		0.032	J	88%	6%	N/A	N/A	0.0042	N/A

Key:

[1] Total number of wells that were sampled is 16

[2] Maximum contaminant level (MCL) (National Primary Drinking Water Regulations).

[3] Secondary MCLs were established by EPA to address aesthetic considerations in drinking water, such as taste, color and odor, rather than to address risk to human health.

[4] Risk-Based Concentration for Tap Water (EPA Region 3, 2002a).

[4] DC criteria for class G1 groundwater quality (21 DCMR 1150-1158).

[6] Chromium III

[7] nonfood value

µg/L = Micrograms per liter.
MCL = Maximum contaminant level.
N/A Not applicable.
ND = Not detected.
J = Estimated value
AL = Action Level

Groundwater Use for Drinking Water

The groundwater at or near KPN is not a current source of drinking water. The shallow groundwater at KPN, characterized by data from monitoring wells installed during prior investigations, could not yield sufficient volumes to serve as a viable drinking water supply. The deeper Patuxent aquifer beneath the Site is used for water supply in the Indian Head-Waldorf area 25 miles to the southeast of the Site. However, the RI concluded that low-permeability clays underlying KPN and the upward hydraulic gradient in the Patuxent aquifer would prevent any contaminants in shallow groundwater in KPN from migrating into the underlying Patuxent aquifer; therefore no monitoring wells were installed in the Patuxent aquifer.

Groundwater Transport of Contaminants to Surface Water

The water table at KPN generally reflects the topography and flows toward Kenilworth Marsh, Watts Branch, and the Anacostia River. However, the RI generally concluded that significant groundwater transport of dissolved contaminants into the Anacostia River, Kenilworth Marsh, and the Watts Branch was unlikely due to: 1) the presence of low permeability soils (silts and clays) between the waste materials and the surface water bodies limiting the flow of groundwater, and 2) the relatively low concentrations of contaminants in groundwater on the Site and their sporadic distribution (i.e., where contamination is present in the groundwater, it appears to be localized with no apparent overall contaminant plumes). This latter point is demonstrated by the number of wells in KPN with no detections or with detected concentrations below the conservative screening levels that are shown on Table 2-1.

The primary conclusions from the RI regarding groundwater transport of contaminants from KPN to surface water are summarized as follows:

- There are low hydraulic conductivity soils between KPN and the Anacostia River and Kenilworth Marsh limiting groundwater flow to those surface water bodies.

- KPN wells along the Anacostia River were not hydraulically impacted by tidal fluctuations indicating that they are not well connected hydraulically with the River, further indicating that groundwater flow to the River is limited.

- There were no leachate seeps observed anywhere along the toe of the landfill perimeter. Leachate seeps would be an indicator of groundwater transport of contaminants off-site.

- The total maximum groundwater flow from KPN that enters the Anacostia River was conservatively estimated at approximately 0.03 % of the average Anacostia River flow.

- Groundwater concentrations of Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), PCBs, and several metals, were generally relatively low, sporadic across the Site, and localized; and not indicative of a Site-wide plume. Many of the wells are screened across waste materials and the detections were therefore attributed to waste materials in the immediate vicinity of the well.

- Many of the COCs, including polycyclic aromatic hydrocarbons (PAHs), PCBs, and lead, are not very soluble and therefore significant groundwater transport of those compounds is unlikely.

- Iron is fairly wide-spread in groundwater throughout KPN at levels exceeding the screening levels; however, the total amount of iron in groundwater migrating off-site from KPN is limited by the low permeability soils (described above).

NPS has determined that additional shallow groundwater sampling along the perimeter of KPN is warranted to confirm the conclusions above that groundwater transport of COCs from the Site to adjacent water bodies does not pose a threat to human health or the environment. As described in Section 1.0, this will be done as part of an RI Addendum to address OU2 (shallow groundwater at the Site)

2.2.4 Landfill Gas

Landfill gas is generated by bacterial decomposition of organic waste within a landfill. Landfill gas is primarily composed of methane (CH_4) and carbon dioxide (CO_2). In old landfills without gas management systems (collection and use, venting, flaring), landfill gas can migrate into surrounding soils and structures. Public health and safety issues associated with landfill gas arise primarily from its methane content, which at sufficient concentrations could present possible explosion and asphyxiation hazards in structures and confined spaces. The Lower Explosive Limit (LEL) represents a gas concentration above which gas has the potential to explode if an ignition source is present. Environmental Protection Agency (EPA) guidance for evaluating landfill gas sets forth further evaluative steps if methane exists above the LEL (approximately 5% methane by volume) in soil vapor at a landfill property boundary or above 25% of the LEL within structures (EPA, 2005).

Air monitoring was conducted during field sampling efforts for the 2007 RI. Landfill gas screening conducted at three wells completed within the landfill waste materials indicated landfill gasses at levels up to 100% of the lower explosive limit (LEL). The RI recommended a methane survey to evaluate the potential for explosive risks in the future. In response to this recommendation, The Johnson Company installed fifteen subsurface soil vapor probes in the interior and peripheral areas of KPN, and collected an indoor air sample from the Kenilworth-Parkside Recreation Center. The locations of the samples and test results are shown on Figure 2-2.

Methane was not detected in the indoor air sample collected from the Kenilworth-Parkside Recreation Center, indicating there was no risk to that structure or its occupants. Only one soil vapor sample exhibited substantial methane concentrations (KPN-JCO-SV-09S: 37,000 parts per million by volume (ppmv), or 74% of the LEL). Methane was detected in samples from two other soil vapor probes, but both were less than two percent of the LEL. Methane was not detected in the other twelve probes. Detailed results of this testing are presented in the Supplemental Data Collection Report (JCO, 2010) included in Appendix A, and summarized below.

Methane was detected by the laboratory in soil vapor samples from three of fifteen probes in KPN. Methane concentrations in two of the three samples were from deep probes (KPN-JCO-SV-10D and KPN-JCO-SV-12D) located along the landfill boundary with Anacostia Avenue, with methane results of 87 ppmv (0.2 %LEL) and 870 ppmv (1.7 %LEL). These concentrations are at least two orders of magnitude lower than the EPA guidance threshold of 100% of the LEL (approximately 50,000 ppmv) measured at the landfill property boundary. The low values of these detections, combined with the lack of detections in shallow soil vapor in the western portion of KPN and in the other four probes located on the landfill boundary along Anacostia Avenue, indicate that methane is not migrating from KPN at levels of concern.

The third KPN sample with detectable levels of methane was from a shallow probe located west of the Kenilworth-Parkside Recreation Center (KPN-JCO-SV09S) where methane concentrations in the sample and its duplicates ranged from 37,000 to 40,390 ppmv (approximately 80% of the LEL). While the laboratory reported values at KPN-JCO-SV-09S were lower than the field screening result at the same location (435,000 ppmv and >100%LEL), both sets of results identify KPN-JCO-SV-09S as the only location at KPN that approaches or exceeds the LEL.

The vapor probe KPN-JCO-SV-09S was installed in the central part of the landfill where methane would be expected. The vapor sample was collected from below the existing landfill cover surface and, although the sample exceeded the LEL, there likely is not enough oxygen and no ignition source to ignite the methane. Landfill gas that does migrate to the surface would be quickly assimilated into and diluted by the atmosphere. The results do indicate, however, that there is a potential future hazard to construction or utility workers who are involved in subsurface excavations or construction.

2.3 PREVIOUS SITE INVESTIGATIONS - KPS

Listed below is a summary of the Site investigations conducted at KPS, followed by a discussion of the nature and extent of contamination for each medium of concern. The results of these investigations were evaluated and considered during the preparation of this FS.

1998 Report on Sampling the Kenilworth Site, National Park Service N.E., Washington, D.C.: E & E sampled the new fill, the historic subsurface fill from the landfill, the sediments around the former landfill, and collected Geoprobe® samples of groundwater from boreholes around the landfill (E&E, 1998).

2000 Preliminary Assessment/Site Investigation of Kenilworth Park Landfill: E & E conducted a PA/SI at KPS, which identified the presence of contaminants that exceeded residential soil RBCs, MCLs for groundwater, and biological technical assistance group

(BTAG) criteria for sediments (E&E, 2000b). Contaminants identified included PAHs, PCBs, metals, and in one case, phthalates.

2006 Health Consultation Kenilworth Park Landfill – South Side, N.E. Washington, D.C.: The Agency for Toxic Substances and Disease Registry (ATSDR) completed a health consultation in 2006 to evaluate, among other things, potential public health hazards associated with explosion and exposure risks from methane at KPS (ATSDR, 2006). Although this consultation did not include any methane sampling, it identified a methane data gap that was filled during the 2008-2009 Supplemental Data Collection effort described below.

2008 Final Remedial Investigation at the Kenilworth Park South Landfill, N.E. Washington, D.C.: E & E collected additional data and published a Final RI Report for KPS in June 2008 (E&E, 2008). The RI included a summary of previous investigation results and results of additional field sampling of surface and subsurface soils, sediment, and groundwater conducted in 2001. A baseline human health risk assessment and a screening-level ecological risk assessment were also completed and the results included in the RI.

2010 Supplemental Data Collection Report – Kenilworth Park Landfill: In October 2008 and March 2009, The Johnson Company collected shallow and deep soil vapor samples for methane analysis and surface soil samples for pH and total organic carbon analyses. The results are presented in a Supplemental Data Collection Report (JCO, 2010) included in Appendix A.

2.4 NATURE AND EXTENT OF CONTAMINATION - KPS

2.4.1 New Fill and Surface Soil

New fill and surface soils were sampled during field efforts for the 1998 investigation, the 2000 PA/SI, and the 2008 RI. The fill and grading activities conducted at KPS in 1997 and 1998 (Section 1.3.1) resulted in approximately 10 to 30 feet of fill on top of the landfill cover (E & E, 1998). Four locations in the northeast portion of KPS outside the new fill area were sampled during the RI field efforts. No surface soil data exists for PCBs in the areas of the new fill. However, subsurface soil samples from the new fill were collected and analyzed for PCBs, and because there is no indication in the record that different material was placed on the top of the imported fill material, the subsurface soil sample results are considered representative of the surface soils of the new fill.

The reported results for compounds exceeding the screening criteria used in the RI (EPA Region 3 residential RBCs adjusted for non-cancer effects to a HI of 0.1) from the new fill west of Deane Avenue are summarized below:

- PAHs: indeno(1,2,3-cd)pyrene was reported at concentrations up to 13 mg/kg; benzo(a)anthracene up to 8 mg/kg; and benzo(a)pyrene up to 7.9 mg/kg. Benzo(b)fluoranthene and dibenzo(a,h)anthracene also exceeded the screening levels. (HHRA screening levels: indeno(1,2,3-cd)pyrene 0.22 mg/kg; benzo(a)anthracene 0.22 mg/kg; benzo(a)pyrene 0.022 mg/kg; benzo(b)fluoranthene 0.22 mg/kg; dibenzo(a,h)anthracene 0.022 mg/kg)

- Metals: iron was reported at concentrations up to 74,000 mg/kg and arsenic was reported at concentrations up to 43 mg/kg. (HHRA screening levels: iron 5,500 mg/kg; arsenic 0.43 mg/kg)

Reported results for compounds exceeding the screening levels from the new fill or surface soil on the east side of Deane Avenue (new and original fill soils) are summarized below:

- PAHs: benzo(a)anthracene was reported at concentrations up to 29 mg/kg; benzo(k)fluoranthene up to 21 mg/kg; benzo(a)pyrene up to 20 mg/kg; benzo(b)fluoranthene up to 13 mg/kg; indeno(1,2,3-cd)pyrene up to 7.6 mg/kg; and dibenzo(a,h)anthracene up to 0.942 mg/kg. (HHRA screening level: benzo(a)anthracene 0.22 mg/kg; benzo(k)fluoranthene 2.2 mg/kg; benzo(a)pyrene 0.022 mg/kg; benzo(b)fluoranthene 0.22 mg/kg; indeno(1,2,3-cd)pyrene 0.22 mg/kg; dibenzo(a,h)anthracene 0.022 mg/kg)

- PCBs: Aroclor 1242 was reported at concentrations up to 2 mg/kg; Aroclor 1254 up to 3.16 mg/kg; and Aroclor 1260 up to 2.5 mg/kg. (HHRA screening levels: Aroclor 1242 0.32 mg/kg; Aroclor 1254 0.16 mg/kg; Aroclor 1260 0.32 mg/kg)

- Metals: arsenic was reported at concentrations up to 16 mg/kg and lead was reported at concentrations up to 940 mg/kg. (HHRA screening level: arsenic 0.43 mg/kg; lead 400 mg/kg)

- Other SVOCs: dibenzofuran was reported at concentrations up to 9.8 mg/kg.

As with KPN, the surface soils at KPS were imported after the closure of the landfill operations, to cover the waste materials and provide a surface suitable for recreational purposes (see Section 1.3). As such, the contaminants found in the KPS surface soils are not from the landfill waste materials, but rather were either imported with the cover/fill soils that were brought to the Site from off-site locations, or deposited there via atmospheric deposition from fossil fuel combustion sources (e.g., the local PEPCO generating station, area traffic).

During the 2000 PA/SI (E & E, 2000b), three samples were collected on the NPS portion of the Neval Thomas School yard. In 2005, E & E collected additional soil samples from the school yard, both on the NPS-property portion of the school yard and the District property immediately surrounding the school. The reported results for compounds exceeding the RBCs from samples taken on the NPS portion of the school yard are summarized below:

- PAHs: benzo(a)pyrene was reported at concentrations up to 0.25 mg/kg; (HHRA screening level: benzo(a)pyrene 0.022 mg/kg)
- Metals: Arsenic was reported at levels up to 6.8 mg/kg. (HHRA screening level: arsenic 0.43 mg/kg)

There is no indication that the Neval Thomas Elementary School yard, including the portion of NPS property used by the school, received fill during or subsequent to landfill operations and, therefore, surface soils on the school yard likely predate the landfill operational period. Site data indicate that the benzo(a)pyrene concentrations are somewhat higher on the District property than on the NPS portion of the school yard, which lies between the District property and the landfill. This suggests that the landfill is not the source of the majority of benzo(a)pyrene present in school yard samples. Instead, the likely source is atmospheric deposition from fossil fuel combustion at the adjacent PEPCO electrical generating station (that has operated since 1906) and from vehicular traffic in the area.

Arsenic is a naturally-occurring metalloid and typically is present in soil at low concentrations. Arsenic concentrations in all the school yard samples exceeded the screening level, as did the two background samples collected during the PA/SI from Kenilworth Marsh on the other side of KPN. Previous reports concluded that these arsenic concentrations were well within the expected range for natural soils in the eastern U.S., and are therefore considered background.

In 2008, The Johnson Company collected surface soil samples from a number of representative locations at KPS and analyzed for pH and total organic carbon (TOC). These soil parameters may reduce the bioavailability of metal and organic contaminants. Results of surface soil pH and TOC analyses are presented in the Supplemental Data Collection Report in Appendix A.

TOC was reported between 2,050 mg/kg (0.2%) and 175,000 mg/kg (17.5%) at KPS. The pH of surface soil samples ranged from 6.77 to 7.56. The implications of these TOC and pH values on the conclusions from the ecological risk assessment are discussed in Section 2.8.2.

2.4.2 Subsurface Soil/Former D.C. Landfill

Subsurface soil and waste samples were collected during field efforts for the 1998 investigation, the 2000 PA/SI, and the 2008 RI. The reported results for compounds exceeding the screening criteria used in the RI (EPA Region 3 residential RBCs) are summarized below:

- PAHs: indeno(1,2,3-cd)pyrene was reported at concentrations up to 970 mg/kg; chrysene up to 870 mg/kg; and benzo(a)pyrene up to 760 mg/kg (these high concentrations (relative to the screening levels) were in samples collected below 15 ft bgs so human exposure is unlikely). Benzo(a)anthracene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene also exceeded the screening levels. (HHRA screening level: indeno(1,2,3-cd)pyrene 0.22 mg/kg; chrysene 22 mg/kg; benzo(a)pyrene 0.022 mg/kg; benzo(a)anthracene 0.22 mg/kg; benzo(b)fluoranthene 0.22 mg/kg; dibenzo(a,h)anthracene 0.022 mg/kg)

- PCBs: Aroclor 1242 was reported at concentrations up to 2.7 mg/kg and Aroclor 1254 was reported at concentrations up to 93 mg/kg. (HHRA screening levels: Aroclor 1242 0.32 mg/kg; Aroclor 1254 0.16 mg/kg)

- Pesticides: aldrin was reported at concentrations up to 80 mg/kg. (HHRA screening levels: aldrin 0.038 mg/kg)

- Metals: aluminum was reported at concentrations up to 84,000 mg/kg; iron up to 286,000 mg/kg; and lead up to 10,500 mg/kg. Antimony, arsenic, thallium, and vanadium were also detected above the screening levels. (HHRA screening levels: aluminum 7,800 mg/kg; iron 5,500 mg/kg; lead 400 mg/kg; antimony 3.1 mg/kg; arsenic 0.43 mg/kg; thallium 0.55 mg/kg; vanadium 7.8 mg/kg)

- Other SVOCs: bis(2-ethylhexyl)phthalate was reported at concentrations up to 11 mg/kg. (HHRA screening level for bis(2-ethylhexyl)phthalate 46 mg/kg).

2.4.3 Groundwater

The shallow groundwater at KPS was sampled during the 1998 Investigation and the 2000 PA/SI sampling from wells screened across the landfill wastes and analyzed for organic compounds and metals.

The very low levels of organic compounds reported in the groundwater indicate that the Site has had very little impact on groundwater with respect to organic compounds.

The metal concentrations in groundwater, particularly lead, were elevated in the 1998 investigation and 2000 PA/SI groundwater samples. However, the low yield of the wells prevented them from being developed sufficiently to produce non-turbid water, and the elevated metals levels in the groundwater were likely the result of suspended solids in the samples rather than being representative of dissolved concentrations. A second PA/SI round of sampling in some of the same wells (MW-1 through MW-6) showed a 95% decline in lead levels.

The minimum and maximum reported contaminant concentrations in groundwater from KPS are summarized in Table 2-2. Also shown is the percentage of the total wells sampled that had no detections of the listed compound, along with the percentage of the wells whose samples exceeded any of the screening criteria used in the RI (tap water RBCs, federal maximum contaminant levels – primary and secondary (MCLs), and the D.C. groundwater quality standards). These screening levels are also presented in Table 2-2.

Table 2-2
Summary of Groundwater Quality
Kenilworth Park Landfill South

	Unit	**Minimum Detection**		**Maximum Detection**		**Wells with No Detection**[1]	**Wells with Exceedance**[1]	**MCL**[2]	**Secondary MCL**[3]	**RBC**[4]	**DC**[5]
Aluminum	µg/L	ND		1,250		46%	54%	N/A	50-200	37,000	N/A
Antimony	µg/L	ND		14		23%	38%	*6*	N/A	15	N/A
Arsenic	µg/L	ND		25.8		54%	46%	10	N/A	0.045	50
Barium	µg/L	191		6,880		0%	38%	2,000	N/A	7,300	*1,000*
Iron	µg/L	1,390		92,800		0%	100%	N/A	300	26,000	N/A
Lead	ug/L	ND		53.4		54%	15%	15 AL	N/A	N/A	50
Manganese[6]	µg/L	52		3,180		0%	92%	N/A	50	730	N/A
Bis(2-ethylhexyl)phthalate	µg/L	ND		23	J	54%	31%	6		4.80	N/A
1,4-Dichlorobenzene	µg/L	ND		3.4	J	92%	8%	75		0.47	0.47
Aroclor 1242	µg/L	ND		0.327	J	92%	8%	0.5		0.03	N/A

Key:
[1] **Total number of wells that were sampled is 13**
[2] Maximum contaminant level (MCL) (National Primary Drinking Water Regulations).
[3] Secondary MCLs were established by EPA to address aesthetic considerations in drinking water, such as taste, color and odor, and rather than to address risk to human health.
[4] Risk-Based Concentration for Tap Water (EPA Region 3, 2002a).
[5] DC criteria for class G1 groundwater quality (21 DCMR 1150-1158).
[6] nonfood value
µg/L = Micrograms per liter.
MCL = Maximum contaminant level.
N/A Not applicable.
ND = Not detected.
J = Estimated value
AL = Action Level

Groundwater Use for Drinking Water

As with KPN (see Section 2.2.3), the groundwater at or near the Site is not a current source of drinking water, and would not likely be developed as one in the future. Also, as with KPN, the low-permeability clays underlying KPS, and the upward hydraulic gradient in the Patuxent aquifer, would prevent contaminants in shallow groundwater in KPS from migrating downward to the underlying Patuxent aquifer.

Groundwater Transport of Contaminants to Surface Water

The water table in KPS generally reflects the topography with a mounded configuration and resulting radial flow in all directions, including towards the Anacostia River and the Watts

Branch. However, the RI generally concluded that groundwater transport of dissolved contaminants into the Anacostia River and the Watts Branch was likely limited for the same reasons as for KPN: 1) the presence of low permeability soils (silts and clays) between the waste materials and the surface water bodies limiting the flow of groundwater, and 2) the relatively low concentrations of contaminants in groundwater on the Site and their sporadic distribution (i.e., where contamination is present in the groundwater, it appears to be localized with no apparent overall contaminant plumes). As with KPN, this latter point is demonstrated by the number of wells in KPS with no detections or with detected concentrations below the conservative screening levels that are shown on Table 2-2.

The primary conclusions from the RI regarding groundwater transport of contaminants from KPS to surface water are summarized as follows:

- There are low hydraulic conductivity soils between KPS and the Anacostia River limiting groundwater flow to the river.
- KPS wells along the Anacostia River were minimally impacted hydraulically by tidal fluctuations indicating that they are not well connected hydraulically with the River, further indicating that groundwater flow is limited in that direction.
- There were no leachate seeps observed anywhere along the toe of the landfill perimeter. Leachate seeps would be an indicator of groundwater transport of contaminants off-site.
- The total maximum groundwater flow from KPS that enters the Anacostia River was conservatively estimated at about 0.001 % of the average Anacostia River flow.
- Groundwater concentrations of Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), PCBs, and several metals were generally relatively low, sporadic across the site, and localized; and not indicative of a site-wide plume. Many of the wells are screened across waste materials and the detections were therefore attributed to waste materials in the immediate vicinity of the well.
- Many of the COCs, including PAHs, PCBs, and lead, are not very soluble and therefore significant groundwater transport of those compounds is unlikely.

- Iron and manganese are fairly wide-spread in groundwater throughout KPS; however, the total amount of these two compounds in groundwater migrating off-site from KPS is limited by the low permeability soils (described above).

NPS has determined that additional shallow groundwater sampling along the perimeter of KPS is warranted to confirm the conclusions above that groundwater transport of COCs from the Site to adjacent water bodies does not pose a threat to human health or the environment. As described in Section 1.0, this will be done as part of an RI Addendum to address OU2 (shallow groundwater at the Site)

2.4.4 Toxicity Characteristic Leaching Procedure

Subsurface soil samples ranging in depth from 4 to 12 feet below ground surface (ft bgs) were collected and analyzed during RI field efforts using the Toxicity Characteristic Leaching Procedure (TCLP) to determine if the landfill wastes would be considered RCRA hazardous waste. The TCLP analytes included the metals arsenic, barium, cadmium, chromium, lead, selenium, and silver. The samples were collected from five locations in the center of KPS and three locations in the new fill material. None of the samples exceeded the TCLP concentrations for hazardous waste classification.

2.4.5 Background and Off-site Soil Samples

Background soils were sampled during field efforts for the 2000 PA/SI (E & E, 2000b) and the 2008 RI (E & E, 2008). In addition, at the request of the District's Department of Health, 17 additional soil samples were collected from the Neval Thomas Elementary School yard in 2005.

Thirty-one background and off-site soil samples were collected during previous studies leading to the Remedial Investigations (E & E, 2007a; E & E, 2008). Of these, twenty were collected from the school yard of the Neval Thomas Elementary School, two were collected from the Kenilworth Aquatic Gardens, and nine were collected from other areas within the District. Not all background and off-site samples were analyzed for the full suite of analytes.

Four background and off-site sediment samples were collected during the PA/SI; one additional sample was collected for PCB analysis during the RI. The PA/SI sediment samples were collected from the Watts Branch and Anacostia River upstream of the Site. The RI sample was collected from the Grant Street storm sewer outlet. A discussion of the relationship between sediment data in the vicinity of the Site and these background and off-site data is presented in Section 2.6.

Results of background and off-site sampling reported in excess of screening criteria used in the RI (EPA Region 3 residential RBCs for soils and sediments and EPA Region 3 BTAGs for sediment) are summarized below. Surficial soil and sediment samples were combined for the HHRA (since exposure scenarios are similar) but treated as separate data sets in the SLERA/BERA.

PAHs: PAHs were reported at the following maximum concentrations: indeno(1,2,3-cd)pyrene – 671 mg/kg; chrysene – 1060 mg/kg; benzo(a)pyrene – 1030 mg/kg; anthracene – 181 mg/kg (J); benzo(a)anthracene 603 mg/kg; fluoranthene – 2150 mg/kg, phenanthrene – 643 mg/kg; and pyrene –1920 mg/kg. (HHRA screening values: indeno(1,2,3-cd)pyrene 0.22 mg/kg; chrysene 22 mg/kg; benzo(a)pyrene 0.022 mg/kg; anthracene 2,300 mg/kg; benzo(a)anthracene 0.22 mg/kg; fluoranthene 310 mg/kg, phenanthrene 2,300 mg/kg; and pyrene 230 mg/kg; Region 3 BTAG values for sediment: indeno(1,2,3-cd)pyrene 0.017 mg/kg; chrysene 0.166 mg/kg; benzo(a)pyrene 0.15 mg/kg; anthracene 0.0572 mg/kg; benzo(a)anthracene 0.108 mg/kg; fluoranthene 0.423 mg/kg, phenanthrene 0.204 mg/kg; and pyrene 0.195 mg/kg

- PCBs: in sediment, Aroclor 1254 was reported at concentrations up to 0.0571 mg/kg, and Aroclor 1260 up to 0.0641 mg/kg (Region 3 BTAG value for sediment: 0.0227 mg/kg)

- Pesticides: aldrin was reported at concentrations up to 0.080 μg/kg. (HHRA screening values: aldrin 0.038 mg/kg; Region 3 BTAG value for sediment: 0.002 mg/kg)

- Metals: arsenic was reported at concentrations up to 12.4 mg/kg; lead up to 81.3 mg/kg; mercury up to 0.245 mg/kg; and copper up to 54,000 mg/kg. (HHRA screening values: arsenic 0.43 mg/kg; lead 400 mg/kg; mercury 2.3 mg/kg; copper 310 mg/kg; Region 3 BTAG values for sediment: arsenic 9.8 mg/kg; lead 35.8 mg/kg; mercury 0.18 mg/kg; copper 31.6 mg/kg)

The PAH, metals, and PCB concentrations in background and off-site soil samples summarized above are not atypical for urban settings. In particular, PAHs are byproducts of the combustion of fossil fuels and therefore are present in vehicle exhaust and power plant emissions and are deposited on area surface soils through atmospheric deposition. The PEPCO Benning Road Generating Station (a coal and oil fired facility) to the southwest of the Site, which has operated since 1906, and area vehicular traffic are likely sources of PAHs in area soils. Metals and PCBs from anthropogenic sources can also accumulate in urban soils via atmospheric deposition.

The PAH, metals and PCB concentrations in soil samples collected from the Neval Thomas School yard, which is located adjacent to and southeast of KPS and adjacent to and east of the PEPCO generating station, are similar to other background and off-site locations in the area, and therefore are not considered the result of impacts from the KPS landfill. Section 2.4.1 presents a more detailed description of the Neval Thomas School yard sample results.

2.4.6 Landfill Gas

In August 2005, E&E conducted an additional investigation at the Neval Thomas Elementary School to supplement previously collected data at KPS, including monitoring for landfill gas in the school yard and around the building. Methane, carbon dioxide, and oxygen levels were measured at each sampling location, along the western perimeter of the elementary school building, and at stormwater drains, for a total of 34 readings. Atmospheric measurements of the gases were collected from near the ground surface to determine if there was any release of methane from the adjacent landfill on the Neval Thomas School yard. The instrument used was a GEM-500™ Landfill Gas Monitor with a nominal accuracy of 0.1 percent for each parameter. No methane or carbon dioxide was detected above the detection level of the instrument which was 0.1 percent. Oxygen levels ranged from 20.6 to 21.1 which is consistent with the normal oxygen content in air of 20.9%.

ATSDR completed a health consultation in 2006 to evaluate, among other things, potential public health hazards associated with explosion and exposure risks from methane at KPS (ATSDR, 2006). ATSDR concluded that KPS would not pose a public health hazard if re-developed for recreational purposes. However, because at that time there were limited data available on methane in the subsurface, ATSDR could not rule out the potential for lateral migration and accumulation of methane in subsurface soils. Therefore, ATSDR concluded that methane at KPS was an indeterminate public health hazard to construction and utility workers, and potentially to occupants of neighboring buildings.

Based on the findings of ATSDR described above, and NPS's concern that lateral migration of methane towards the school is possible due to the school's proximity to the Site, NPS's contractor, The Johnson Company, conducted supplemental subsurface methane sampling. The Johnson Company installed subsurface soil vapor probes in the interior portions of KPS, along the boundary between KPS and the District Transfer Station to the south, and in the playfield between the school and KPS. Sample locations and test results are shown on Figure 2-3. The results of this testing are presented in the Supplemental Data Collection Report (JCO, 2010) included in Appendix A and described in more detail as follows.

Methane was detected in soil vapor samples from five of twelve installed probes at KPS. Methane was detected in shallow soil vapor in the interior portions of KPS at concentrations of 23,000 ppmv (46% of the LEL) at KPS-JCO-SV-01S and 1,400 ppmv (2.8% of the LEL) at KPS-JCO-SV-03S, but was not detected in shallow soil vapor adjacent to the former public restroom (KPS-JCO-SV-02S). The analytical detections at -01S and -03S were lower than the respective field screening results from the same locations, both of which exceeded 100% of the LEL. Methane was reported by the laboratory above the LEL in two probes near the southern landfill boundary installed northwest of the fence separating the Neval Thomas Elementary School yard from KPS at concentrations of 140,000 ppmv (280% of the LEL) at KPS-JCO-SV-06D and 89,000 ppmv (178% of the LEL) at KPS-JCO-SV-07S (90,840 ppmv in the field duplicate). Methane was not detected in deep soil vapor near the northeast corner of the Neval

Thomas Elementary School property (KPS-JCO-SV-08D). The methane detections at -06D and -07S prompted follow-up soil vapor testing closer to the school. Four soil vapor probes were installed in March 2009 between the school yard fence and the school building and tested for methane. No methane was detected. Two soil vapor probes were also installed in March 2009 along the KPS southern boundary with the District Transfer Station and tested for methane; none was detected in one of the probes and 2,300 ppmv (2.8% of the LEL) was detected in the other probe (which is significantly below the action threshold at a property line of 100% LEL).

2.5 METHANE MIGRATION POTENTIAL

Typically, methane generation in a landfill will peak somewhere between 2 and 7 years after waste placement, depending upon the amount and type of organic material in the waste (EPA, 2005a; ATSDR, 2001). Most methane production occurs within 20 years after waste is placed although small quantities of gas may continue to be emitted from a landfill for 50 or more years (ATSDR, 2001). The Kenilworth Landfill received municipal solid waste (the major source of methane generation) from 1942 to 1970, and has been closed for 41 years. Given the age of the landfill, methane generation peaked some time ago and has been declining for years. The methane data described above in Sections 2.2.4 and 2.4.6 indicate that methane is not present in most of the landfill cover soils and is not present beyond the fill boundaries.

The specific gravity of methane (0.554 @ 70 ˚F) is considerably less than air, so the natural tendency of methane is to migrate vertically upward, rather than horizontally. Impermeable and low permeability surface coverings (e.g., concrete and asphalt) can prevent the gas from escaping to the atmosphere. The vast majority of land at the edges of the Kenilworth landfill does not have any impermeable surface covering and, therefore, would provide a relatively easy pathway for any methane that is still being generated by the landfill to be released to the atmosphere, thereby precluding methane migration beyond the edges of the Site. This has been confirmed by the data collected during the 2009-2010 Supplemental Data Collection effort (report included in Appendix A) that show that although methane is present in some areas within the buried waste material, it is largely absent in soil vapor samples collected from probes installed beyond the edge of the disposal area.

Specifically, samples collected from a series of four soil vapor probes along the eastern Site boundary of KPN (along Anacostia Avenue) had very low or non-detect concentrations of methane. These four probes were installed outside of the landfill materials in very permeable sand and gravel that would be highly conducive to soil gas migration should a horizontal pressure gradient exist. Samples collected from KPS in October 2008 from two soil vapor probes in the southern end of the waste disposal area near the fence line and hedgerow that separates the Site from Neval Thomas Elementary School exhibited relatively high methane concentrations. However, methane was not detected in any of the four additional probes installed in March 2009 within the school yard just beyond the hedgerow (between the edge of the landfill and Neval Thomas Elementary School) in March 2009. The soil at these sample locations consisted of an urban fill of sand/silt, bricks, ash, slag, wood, and glass; material that would not provide an easy migration pathway for methane.

The data indicate that there is not an impermeable barrier causing methane to migrate laterally and that the methane that is still being generated at the Site is able to vent to the atmosphere in a diffused manner through the existing cover soil or through the ground surface at the edges of the landfill. Horizontal migration of landfill gas beyond the immediate periphery of the landfill is therefore not likely occurring.

2.6 SURFACE WATER AND SEDIMENT IN VICINITY OF KPN/KPS

2.6.1 Background

2.6.1.1 Surface Water

Four surface water samples were collected and analyzed during the KPS Preliminary Assessment/Site Investigation (PA/SI); an upstream and downstream sample from the Anacostia River and from the Watts Branch (E & E, 2000b). Organic compounds were analyzed in each of the four samples, with two compounds, bis(2-ethylhexyl)phthalate and acetone, recorded at low levels below the quantification limit. As such, these two compounds were presented as estimated concentrations. Neither of these compounds are contaminants of concern (COC) for the Site. The four samples were also analyzed for metals, 10 of which were reported at detectable levels. Of these, only two, lead and zinc, are metals for which Ambient Water Quality Criteria (both chronic and acute) have been established for freshwater fish (USEPA, 1994). One sample (SW-3), located opposite the landfill, exceeded the chronic criterion for lead in surface water (3.2 µg/L) with a value of 12 µg/L, but that result was qualified in the PA/SI report with the statement that the result "may reflect the presence of suspended solids in the sample." The KPS PA/SI report concluded that the surface water samples collected during the SI did not indicate any significant impact of the Site on surface water quality. No surface water samples were collected during the KPN PA/SI, which relied on the results of the KPS PA/SI sampling to conclude: "There are no direct indications that the former District landfills are impacting surface water" (E & E, 2002). As discussed below, the surface water in the vicinity of the Site is influenced by tidal effects that can confound the interpretation of surface water grab sample data when assessing possible impacts from the Site.

2.6.1.2 Stormwater

The District of Columbia Department of Health has prepared a Watershed Implementation Plan (WIP) (DOH, 2004) for the Watts Branch that includes a map of storm sewer outfalls (approximately 54) and sewersheds (Figure 2-4). As shown on Figure 2-4, there are many storm sewer outfalls that discharge into the Watts Branch and its tributary both upstream and adjacent to the Site. There are also many upstream storm sewer inputs to the Anacostia River. Urban runoff/stormwater discharges are well documented in the literature as being potential sources of all of the COCs at the Site. Local stormwater discharges are discussed in the following section that reviews possible impacts from the Site on sediment in adjacent waterways.

2.6.1.3 Sediment and Tidal Influences

During the PA/SI and RIs, sediment samples were collected and analyzed from the Anacostia River; Watts Branch; the unnamed tributary to Watts Branch that flows on the east side of KPS; an off-site storm sewer outfall at Grant Street that contributes flow to this unnamed tributary; and the Kenilworth Marsh (E&E, 2007; E & E 2008). Figure 2-5 shows all the sediment sample locations from those prior investigations. The reported concentrations from the sediment samples collected from the vicinity of the Site are summarized in Table 2-3. The data are quite variable, no doubt influenced by stormwater inputs and tidal fluctuations; however, in general, the data do not indicate an overall impact from the Site on sediment in the Anacostia River, the Watts Branch, or Kenilworth Marsh, particularly for PAHs and PCBs. This evaluation of the sediment data is discussed in more detail in Section 2.6.2.

The Anacostia River is tidal in the reach that borders the Site. The lower portion of the Watts Branch (the portion within Kenilworth Park) is also tidal. The Remedial Investigation for KPN (E&E, 2007a) states that tidal influence in Watts Branch extends to sample point SD-17 (Figure 2-5). Background sediment samples SMP-A and SMP-B were taken in the Anacostia River upstream of tidal influence. Between SMP-A and SMP-B and the Site is sample point SED-12, located upstream of the Site next to the Kenilworth Marsh area (see the upper right corner of Figure 2-5). The SED-12 sample location is subject to tidal influence as the USGS tide gauge for the Anacostia River is located north of this sample location (USGS, 2010). As with stormwater discharges, the tidal influence in the vicinity of the Site needs to be taken into account when assessing potential impacts from the Site as tidal flow can move water and suspended sediment in upstream directions. Significant sediment transport and re-deposition via tidal influences would typically have the effect of moderating concentration extremes. However, it is still possible to observe significant impacts to sediment from point sources or specific parcels by evaluating upstream to downstream sediment concentrations. The following sections present an evaluation of upstream to downstream sediment data from surface water adjacent to the Site.

Table 2-3 Maximum Concentrations Detected in Sediments
Vicinity of Kenilworth Park Landfill North and South

Parameter	Maximum Concentration(1)	Units	Sample(2)	Sample Location(2)	BTAG level for Freshwater Sediment	Levels far upstream in Anacostia River(3)	Levels upstream in Watts Branch(4)	Levels upstream in Unnamed Stream(5)
Metals								
Aluminum	15,600	mg/kg	KWN-SD-9	Kenilworth Marsh	N/A			
Arsenic (total)	12	mg/kg	SED-3	unnamed stream along east edge of KPS	9.8	6.58	2	NT
Barium	228	mg/kg	KWN-SD-7	Kenilworth Marsh	N/A			
Beryllium	1.8	mg/kg	KWN-SD-7	Kenilworth Marsh	N/A			
Cadmium	27	mg/kg	SED-3	unnamed stream along east edge of KPS	0.99	0.994	ND	NT
Calcium	24,200	mg/kg	KWN-SD-10	Kenilworth Marsh	N/A	660	2,200	NT
Chromium (total)	99.5	mg/kg	SMP-F	Anacostia River	43.4(CrIII)	62.5	11	NT
Cobalt	24.2	mg/kg	KWN-SD-7	Kenilworth Marsh	50	ND	6.4	NT
Copper	122	mg/kg	KWN-SD-7	Kenilworth Marsh	31.6	14	17	NT
Iron	42,400	mg/kg	KWN-SD-7	Kenilworth Marsh	20,000	17,000	10,000	NT
Lead	520	mg/kg	SD-2	sediment pond on KPS	35.8	81.3	36	NT
Magnesium	4,800	mg/kg	SED-13	sediment pond on KPS	N/A	630	1,500	NT
Manganese	970	mg/kg	SED-11	Anacostia River	460	120	86	NT
Mercury	1.8	mg/kg	SD-4D	sediment pond on KPS	0.18	0.245	ND	NT
Nickel	53.5	mg/kg	KWN-SD-9	Kenilworth Marsh	22.7	93	17	NT
Potassium	11,000	mg/kg	SED-9	Anacostia River	N/A	ND	330	NT
Selenium	2.06	mg/kg	SMP-M	Anacostia River	2	ND	ND	NT
Silver	10.5	mg/kg	KWN-SD-18	Wooded area at northern edge of KPN	1	ND	ND	NT
Sodium	510	mg/kg	KWN-SD-7	Kenilworth Marsh	N/A	ND	ND	NT
Vanadium	85	mg/kg	SED-10	Anacostia River	N/A	22	16	NT
Zinc	560	mg/kg	SED-3	unnamed stream along east edge of KPS	121	72	110	NT

Table 2-3 Maximum Concentrations Detected in Sediments
Vicinity of Kenilworth Park Landfill North and South

Parameter	Maximum Concentration(1)	Units	Sample(2)	Sample Location(2)	BTAG level for Freshwater Sediment	Levels far upstream in Anacostia River(3)	Levels upstream in Watts Branch(4)	Levels upstream in Unnamed Stream(5)
Pesticides/PCBs								
Aldrin	35	µg/kg	SED-10	Anacostia River	N/A	ND	ND	NT
alpha-Chlordane	58	µg/kg	SED-3	unnamed stream	N/A	2	7.2	NT
gamma-Chlordane	72	µg/kg	SED-3	unnamed stream	N/A	3.3	7.6	NT
4, 4'-DDD	41J	µg/kg	SED-3	unnamed stream	4.9	ND	7.5	NT
4, 4'-DDE	41J	µg/kg	KWN-SD-7	Kenilworth Marsh	3.2	2.6	14	NT
4, 4'-DDT	24	µg/kg	KWN-SD-15	Watts Branch	1,580	ND	16	NT
Dieldrin	21J	µg/kg	KWN-SD-17	Watts Branch	1.9	ND	ND	NT
Endrin	14J	µg/kg	SED-10	Anacostia River	N/A	ND	ND	NT
Heptachlor epoxide	18J	µg/kg	SED-10	Anacostia River	2.5	ND	ND	NT
Methoxychlor	55J	µg/kg	SED-3	unnamed stream along east edge of KPS	N/A	ND	ND	NT
PCB-1242	354	µg/kg	SMP-L	Anacostia River	22.7	68	36	ND
PCB-1248	310	µg/kg	KWN-SD-14	Watts Branch	N/A	68	36	ND
PCB-1254	571	µg/kg	SMP-L	Anacostia River	22.7	91	88	278
PCB-1260	409	µg/kg	SMP-L	Anacostia River	22.7	64.1	40	194
BNAs (not PAHs)								
Benzoic Acid	10,000	µg/kg	KWN-SD-6	Kenilworth Marsh	650	ND	ND	NT
Benzyl Alcohol	49J	µg/kg	SED-5	ditch at southeastern corner of KPS	N/A	ND	ND	NT
Bis(2-ethylhexyl)phthalate	3,400J	µg/kg	SED-8	Anacostia River	20	410	470	NT
Butyl benzyl phthalate	190J	µg/kg	SD-1	unnamed stream along east edge of KPS	10,900	ND	ND	NT
Di-n-octylphthalate	160J	µg/kg	SED-2	Watts Branch	6,200	55	64	NT
4-Methylphenol	640J	µg/kg	SED-7	Watts Branch	670	ND	ND	NT

Table 2-3 Maximum Concentrations Detected in Sediments
Vicinity of Kenilworth Park Landfill North and South

Parameter	Maximum Concentration(1)	Units	Sample(2)	Sample Location(2)	BTAG level for Freshwater Sediment	Levels far upstream in Anacostia River(3)	Levels upstream in Watts Branch(4)	Levels upstream in Unnamed Stream(5)
Dibenzofuran	130J	µg/kg	SED-4	unnamed stream along east edge of KPS	420	ND	ND	NT
PAHs								
Acenaphthene	2,000	µg/kg	KWN-SD-15	Watts Branch	6.7	ND	ND	NT
Acenaphthylene	150J	µg/kg	SED-14	sediment pond at KPS	5.9	ND	ND	NT
Anthracene	360J	µg/kg	SED-4	unnamed stream along east edge of KPS	57.2	181	110	NT
Benzo(a)anthracene	920	µg/kg	SED-14	sediment pond at KPS	108	603	310	NT
Benzo(a)pyrene	1,290	µg/kg	SMP-G	Anacostia River	150	1,030	330	NT
Benzo(b)fluoranthene	1,880	µg/kg	SMP-I	Anacostia River	3,200	1,470	430	NT
Benzo(g,h,i)perylene	933	µg/kg	SMP-G	Anacostia River	170	445	220	NT
Benzo(k)fluoranthene	3,470	µg/kg	SMP-I	Anacostia River	240	1,320	340	NT
Chrysene	1,200J	µg/kg	SED-8	Anacostia River	166	1,060	430	NT
Dibenzo(a,h)anthracene	240J	µg/kg	SED-14	sediment pond at KPS	33	42	96	NT
Fluoranthene	2,000/2,000J/2,000	µg/kg	SED-4/SED-8/SD-14 &15	unnamed stream along east edge of KPS/Anacostia R./Watts Branch	423	2,150	860	NT
Fluorene	180J	µg/kg	KWN-SD-14	Watts Branch	77.4	ND	ND	NT
Indeno(1,2,3-cd)pyrene	1,500J	µg/kg	SED-8	Anacostia River	17	671	200	NT
2-Methylnaphthalene	640J	µg/kg	SED-7	Watts Branch	20.2	ND	ND	NT
Naphthalene	200J	µg/kg	SED-4	unnamed stream along east edge of KPS	176	ND	ND	NT
Phenanthrene	1,900	µg/kg	SED-4	unnamed stream along east edge of KPS	204	643	340	NT
Pyrene	2,800	µg/kg	SED-4	unnamed stream along east edge of KPS	195	1,920	360	NT
VOCs								

Table 2-3 Maximum Concentrations Detected in Sediments
Vicinity of Kenilworth Park Landfill North and South

Parameter	Maximum Concentration(1)	Units	Sample(2)	Sample Location(2)	BTAG level for Freshwater Sediment	Levels far upstream in Anacostia River(3)	Levels upstream in Watts Branch(4)	Levels upstream in Unnamed Stream(5)
Acetone	92	µg/kg	SED-7	Watts Branch	N/A	5.6	6.7	NT
2-Butanone	35	µg/kg	SED-9	Anacostia River	N/A	ND	ND	NT
Toluene	3.5	µg/kg	SED-9	Anacostia River	N/A	ND	ND	NT

Notes:

(1) Shaded cells indicate values that exceed BTAG levels.

(2) See Figure 2-5 for sample locations

(3) Maximum of samples SED 12, SMP A, SMP B (1999)

(4) Sample SED 1 (1999)

(5) Sample BK 10 (2000)

Key:

BNA = Base/Neutral and Acid Extractable

BTAG = Biological Technical Assistance Group

J = The parameter was analyzed for, but the value is an estimated quantity. The data is usable for many purposes.

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

ND= Not Detected

NT = Not Tested

N/A = Not Applicable

PAH = Polycyclic aromatic Hydrocarbons

PCB = Polychlorinated Biphenyl

VOC = Volatile Organic Compound

2.6.2 Sediment Data Analysis

Sediment concentrations of total PAHs, total PCBs, and lead were graphically plotted from upstream to downstream in the Anacostia River, the Watts Branch (and its unnamed tributary), and the Kenilworth Marsh adjacent to KPN. PAHs, PCBs, and lead are the chemicals of concern at the Site. Graphical data plots along with the individual data postings for total PAHs, PCBs, and lead in sediment samples are shown on Figures 2-6, 2-7, and 2-8, respectively. Following is a brief discussion of observations from these data plots. It should be pointed out that the available sediment data were from samples collected during different investigations at different times. Therefore, the confidence in conclusions drawn from these upstream-downstream data plots created by combining data from different time frames is somewhat reduced.

2.6.2.1 PAHs

Anacostia River

PAH concentrations in Anacostia River sediments are quite variable (ranging from 1.35 mg/kg at SED-12 to 13.78 mg/kg at SMP-G) (see Figure 2-6). One of the lowest of all the reported total PAH concentrations (1.75 mg/kg at SMP-E along the shore adjacent to KPN), and the two highest concentrations (13.78 mg/kg at SMP-G and 12.9 mg/kg at SMP-I), were from samples collected in the river reach adjacent to the Site. However, those two highest concentration samples were located on the west shore, across the river from the Site. Although the tidal nature of this reach of the river could result in contaminant transport from the east to the west bank of the river, it is unlikely that the chemical concentrations found in samples SMP-G and SMP-I mentioned above originated at the Site as concentrations in samples collected along the east shore immediately adjacent to the Site exhibited significantly lower concentrations. A best-fit linear trend line was developed for the PAH concentrations presented in Figure 2-6 (displayed as a dotted line on the PAH-Anacostia River graph in Figure 2-6, as well as on all graphs on Figures 2-6, 2-7 and 2-8) to identify trends in the data sets and to evaluate the correlation and variance of the data. The relatively low slope of the trend line developed for the Anacostia River PAH data indicates a statistically minimal increase in PAH concentration in the reach adjacent to the Site. The very low R^2 (0 - no correlation/high variance; 1 - high correlation/low variance) value indicates no correlative data trends and a high degree of variance in the data set suggesting that the Site does not represent a meaningful source of PAH contamination to the river.

Watts Branch and Unnamed Tributary

PAH concentrations in Watts Branch sediment were relatively low in the three most upstream samples (2.8 mg/kg at SD-17 to 4.03 mg/kg at SED-1) and in the three most downstream samples (4.09 mg/kg at SMP-F to 5.0 mg/kg at SD-13) (Figure 2-6). However, there were elevated PAH concentrations in a segment of the Watts Branch between KPN and KPS (7.95 mg/kg at SD-4/4D to 11.0 mg/kg at SD-15). The sediment PAH concentrations decrease to upstream levels by the time the Watts Branch joins the Anacostia River. There is a storm sewer outfall approximately 120 meters upstream of the locations of the elevated PAH concentration samples that may be contributing to the PAHs there. The linear trend line for PAHs in the Watts Branch indicates a slight upward trend going downstream, but the small slope (3%) provides inconclusive evidence that the trend is statistically meaningful. Furthermore, the very low R^2 value reflects a high degree of variability in the data which is not indicative of a source of contamination at either the KPN or KPS portions of the Site.

In the unnamed tributary, there was an elevated total PAH concentration in an upstream sediment sample located near a storm sewer outfall (12.95 mg/kg at SED-4). Of all the locations along the unnamed tributary, the SED-4 location is least likely to be influenced by KPS. SED-4 is also in close proximity to a storm sewer outfall into the tributary and could be influenced from that source of off-site stormwater. A significantly lower PAH concentration of 3.22 mg/kg was reported at downstream location SED-3 near the confluence with the Watts Branch.

Overall, it cannot be definitively determined from the PAH data that the Site has impacted the sediments in the Watts Branch or the unnamed tributary, but it is quite likely that storm sewer outfalls have caused localized areas of elevated concentrations.

Kenilworth Marsh

Figure 2-6 shows total PAH concentrations in sediment in the Kenilworth Marsh immediately adjacent to KPN to be relatively low (1.2 mg/kg at SD-09 to 8.1 mg/kg at SED-02) except at SED-03 where the PAH concentration was 111.5 mg/kg. A linear trendline for PAHs in Kenilworth Marsh was developed for the data set after excluding the disproportionately high concentration at SED-03 (111.5 mg/kg). The data yielded an R^2 value of 0.47 which is indicative of borderline correlation, but the very low slope of less than 1% indicates the trend is not statistically meaningful. Therefore, the data do not indicate an overall impact on Kenilworth Marsh sediments from KPN.

2.6.2.2 PCBs

Anacostia River

As with PAHs, PCB concentrations in Anacostia River sediment are quite variable. This is reflected by the low R^2 value presented on the Anacostia River graph shown on Figure 2-7. Concentrations adjacent to and downstream of the Site range from 15.5 µg/kg (at SED-01) to 498.5 µg/kg (at SMP-C located at the furthest upstream end of KPN) except at sample location SMP-L where the highest PCB concentration from all sediment samples was reported at 1334 µg/kg (see Figure 2-7). SMP-L is located on the east shore downstream of KPS across the inlet that extends towards the District Transfer Station. Three samples taken near SMP-L, but on the KPS side of the inlet, reported much lower concentrations: SED-10, 341µg/kg; SED-11, 400 µg/kg; and SED-14, 265 µg/kg. Although the developed trend line shown on Figure 2-7 shows an increasing trend with a 10% slope, the trend is refuted by the low R^2 value (high data variability) mentioned above. Overall, the PCB data do not indicate that the Site is impacting Anacostia River sediments.

Watts Branch and Unnamed Tributary

The PCB concentrations in sediment samples from the Watts Branch range from 164 µg/kg (at SED-1) to 242 µg/kg (at SD-15 and SED-6) including both upstream and downstream locations (see Figure 2-7) except at intermediate locations SD-14 and SD-17 where concentrations were 482 µg/kg and 427µg/kg, respectively. The developed trend line for PCBs in the Watts Branch (see Figure 2-7) has a very low slope as well as a very low R^2, both of which indicate a lack of PCB impacts to the Watts Branch from the Site. The data are generally consistent with Anacostia River PCB concentrations, including upstream samples.

In the unnamed tributary, sediment PCB concentrations ranged from 472 µg/kg and 238 µg/kg at the upstream sample locations of KWS-SU-BK-10 and SED-4, respectively, to 750 µg/kg at the downstream sample location SED-3. The SED-3 result is the highest PCB concentration reported from the investigations except at SMP-L in the Anacostia River. At the next downstream location in Watts Branch (SD-15) the PCB concentration was significantly lower at 242 µg/kg.

Kenilworth Marsh

The PCB data in Kenilworth Marsh along KPN are quite variable, ranging from a low of 24.9 µg/kg (at SED-02) to a high of 510 µg/kg (at SD-07) (see Figure 2-7). This variability was quantified by the very low R^2 value calculated from the linear trend line analysis. Approximately one-half of the Kenilworth Marsh samples reported PCBs at levels similar to upstream Anacostia River samples. The PCB data do not appear to indicate an overall impact from KPN on Kenilworth Marsh.

2.6.2.3 Lead

Anacostia River

The lead data from sediment samples in the Anacostia River appear to indicate a slight upward trend from upstream to downstream past the Site, although there is a high degree of variability in the data from one location to the next as shown by the low R^2 value presented on Figure 2-8. Lead concentrations in five of the 12 samples collected along the east bank of the river (immediately adjacent to the Site) were lower than the concentration at the furthest upstream sample. The highest reported lead concentration in Anacostia River sediment samples was at SMP-L (177 mg/kg), as was the case for PCBs (see discussion above); however, the three samples collected immediately across the inlet from SMP-L on the banks of KPS reported lead concentrations that were between 33% and 65% lower than those reported at SMP-L, similar to the pattern shown by PCBs. Overall, the lead data shown on Figure 2-8 is inconclusive as to whether the Site has impacted the Anacostia River sediments.

Watts Branch and Unnamed Tributary

Generally there is a slight upward trend in sediment lead concentrations in the Watts Branch from upstream (36.0 mg/kg at SED-1) to downstream (122 mg/kg at SMP-F), although the data are quite variable (including relatively low concentrations at other downstream locations (e.g., 41.0, 64.0 and 47.2 mg/kg at SD-4/4D, SED-7 and SD-13, respectively (Figure 2-8). The variability of the data is reflected in the very low R^2 value as shown on Figure 2-8. The upstream sample from the unnamed tributary (SED-4) had a reported lead concentration of 98.0 mg/kg, and downstream the concentration increased to 500 mg/kg at SD-1 (the highest lead concentration of any sediment sample from any of the study areas). However, there is a storm sewer outfall between these two locations, and at the next downstream location in Watts Branch (SD-15) the lead concentration was significantly lower at 35.9 µg/kg. The lead data do not indicate that the Site has had an overall impact on the Watts Branch.

Kenilworth Marsh

The lead sediment data from Kenilworth Marsh (Figure 2-8) show a general downward trend in lead concentrations from upstream (103 mg/kg at SED-05) to downstream (25.1 mg/kg at SED-02), although there was an elevated concentration reported at the intermediate sample location SD-07 (214 mg/kg). As indicated by the very low R^2 value shown on Figure2-8, there is a low degree of correlation and a high degree of variance in lead concentration data from this area. Overall, it does not appear that KPN has impacted the sediments in Kenilworth Marsh with lead.

2.6.3 Conclusions

The data collected adjacent to the Site (i.e., the Anacostia River, the Watts Branch, and Kenilworth Marsh) do not indicate an overall impact from COCs at the Site on surface water or sediment, although the data are variable and likely influenced by stormwater inputs and tidal fluctuations. Groundwater transport is the only potential pathway for Site contaminants to migrate to adjacent water bodies and groundwater data collected during the RI do not indicate a significant groundwater transport pathway to surface waters (see Sections 2.2.3 and 2.4.3). However, previous groundwater sample locations may be considered sparse and the number of sampling events limited; the most recent having been completed in 2001 at KPS and in 2006 at KPN. For these reasons, NPS has determined it is appropriate to collect additional groundwater data along the boundaries of the Site and to prepare an RI Addendum using these data to assess the extent to which COCs in shallow groundwater (OU2) are migrating off-site and whether they pose a threat to human health or the environment. If warranted by the additional data collected, the RI Addendum will be used to support the development, evaluation, and selection of response action for OU2.

2.7 TOPOGRAPHIC ASSESSMENT

Currently available topographic data were determined to be usable for the purposes of the FS. Topographic data with one-meter resolution for the entirety of the Site developed from 1999 aerial photos are available from the District of Columbia Geographic Information System (DC GIS). Topographic contours for the Site from the year 2000 are available at one-foot intervals covering the western and central portions of KPN for use in remedial design.

2.8 SUMMARY OF RISK ASSESSMENT RESULTS

The following sections summarize the results of the human health risk assessments presented in the RIs (E&E, 2008, 2007a) and the ecological risk assessments which were presented in the RIs and further developed in problem formulation reports (E&E, 2007b, 2007c).

2.8.1 Human Health Risk Assessment

Human Health Risk Assessments (HHRAs) following CERCLA guidance were performed separately for KPN and KPS. Screening for contaminants of potential concern (COPCs) was based on residential screening criteria to ensure the use of sufficiently conservative screening values. Conceptual models were developed to identify complete exposure pathways. Surface water recreation in Kenilworth Park was not evaluated as an exposure scenario for several reasons. First, Watts Branch is too small to support recreational activities. Second, the park does not provide recreational access to the Anacostia River for water recreation. Additionally, the RI found that the Site does not have a significant contaminant impact on the Anacostia River. For these reasons, surface water recreation in the Anacostia River was not evaluated for human health risk.

The Site and surrounding areas are served by public water supply, so neither groundwater nor surface water was evaluated as a source of potable water. The results of the HHRA do, however, indicate complete exposure pathways for adult and child visitors and construction workers to Site soils and sediments. Dermal contact, ingestion, and inhalation were the routes of exposure evaluated. Site-specific exposure assumptions were developed for these receptors and are presented in Table 2-4. Reasonable Maximum Exposure (RME) point concentrations were based on the upper 95th percentile concentrations, treating the concentration of non-detections as one-half of the detection limit, unless this value was higher than the maximum detected concentration. In that case, the maximum value was used.

Table 2-4
Human Health Risk Assessment Results – Reasonable Maximum Exposure (RME)

Receptor	KPS		KPN	
	Cancer Risk	Non-Cancer Risk HI	Cancer Risk	Non-Cancer Risk HI
Site Visitor – Adult/child composite	2.6 x 10^{-5}		3.1 x 10^{-5}	
Adult 350 days/yr, 2 hrs/day, 24 yrs		0.22		0.5
Child 350 days/yr, 2 hrs/day, 6 yrs		1.6		3.5
Construction Worker 45 days KPS, 70 days KPN, 5 hrs/day	4.5 x10^{-7}	2.3	5.0 x 10^{-7}	2.8

Exposure to lead in soils was evaluated using EPA's 400 mg/kg Residential Exposure Screening Level for surface soils, which is based on the Integrated Exposure Uptake Biokinetic (IEUBK) model for estimating blood lead levels resulting from residential exposure. This is a conservative assumption, because the duration of recreational exposure (the current and expected future use) would be less than residential exposure. Using the Adult Lead Model (ALM), NPS derived a lead Remediation Goal (RG) of 455 mg/kg for an adult site construction worker exposed to surface and subsurface soils for 90 days per year. This exposure duration is longer than the construction worker exposure durations used in the HHRAs for other contaminants (70 days/year at KPN and 45 days/year at KPS) because 90 days per year is the minimum number of days per year allowed in the ALM. The ALM model predictions are based on long-term average exposure concentrations across an exposure area; thus screening concentrations such as the EPA Residential Screening Level of 400 mg/kg or the Site-specific construction/utility worker exposure RG of 455 mg/kg presented below should be interpreted as an average concentration of lead in soil across the exposure area.

2.8.1.1 Kenilworth Park North

The HHRA for KPN was based on data collected in 2002, 2004, 2005, and 2006. Data from depths greater than 15 ft bgs were not included in the subsurface soil exposure point concentration calculations because, as with KPS, it was determined that human exposure is not likely beyond this depth.

Lead screening for surface soils did not indicate unacceptable risk. One sample out of 46 samples exceeded the 400 mg/kg EPA Residential Exposure Screening Level at a concentration of 407 mg/kg. The KPN area-wide average was 137 mg/kg (E&E, 2007a), which is considerably less than the 400 mg/kg residential screening value, so lead is not considered a contaminant of concern for Site visitors.

Much higher levels of lead were encountered at depth, the highest being 3,040 mg/kg at 8 ft bgs at sample location KPN-SB-26. The KPN area-wide average lead concentration for surface and subsurface soils is 268 mg/kg, a value considerably less than 455 mg/kg, the site-specific risk level for worker exposure. Nevertheless, lead was retained as a contaminant of potential concern for site workers at KPN based on maximum concentrations found at depth.

The HHRA concluded that the 3.1 x 10^{-5} carcinogenic risk calculated for the composite adult/child Site visitor is above the point of departure of 1 x 10^{-6} for identifying carcinogenic risk. The 5.0 x 10^{-7} carcinogenic risk calculation for the utility/construction worker was less than 1 x 10^{-6}, indicating no unacceptable risk. The HI for the adult Site visitor was less than one, indicating that non-carcinogenic risk is not a concern. The HIs of 3.5 for the child visitor and 2.8 for the utility/construction worker indicate the potential for non-carcinogenic risk, however the HIs greater than one result primarily from dermal exposure to iron and in both cases, HI values for all target organs (e.g., kidney, liver) are less than one, which indicates that non-carcinogenic risk is not unacceptable.

2.8.1.2 Kenilworth Park South

The HHRA was conducted based on data collected in 1998, 2000, and 2001. Surface and subsurface soil and sediment data were used. The sub-surface data were collected from 1 to 15 ft bgs. The Geoprobe® collected some data at deeper depths, but these data were not used in the HHRA because it is unlikely that human exposure would occur at those depths.

Lead screening for surface soils at KPS did not indicate unacceptable risk. Three samples out of 75 exceeded the 400 mg/kg EPA Residential Exposure Screening Level. However, the average surface soil concentration across this area was 379 mg/kg and the KPS area-wide average was 106 mg/kg (E&E, 2008). Both of these values are less than the 400 mg/kg residential screening value, so lead is not considered a contaminant of concern for site visitors.

Much higher levels of lead were encountered at depth, the highest being 10,500 mg/kg between 6.5 and 7.5 feet bgs at sample location WA-3. The site-wide average lead concentration for surface and subsurface soils was 424 mg/kg, which is less than the 455 mg/kg risk-based worker exposure PRG calculated in the HHRA. If deep excavation work were conducted for an extended period of time in an area where subsurface concentrations average more than 455 mg/kg (the ALM-based PRG), lead exposure may present an unacceptable risk for Site workers.

The HHRA concluded that carcinogenic risk to the composite child/adult site visitor was 2.6×10^{-5}, due primarily to soil ingestion. This is above the point of departure of 1×10^{-6} for identifying carcinogenic risk. The Hazard Index (HI) of 0.22 for the adult visitor was less than one, so no non-carcinogenic hazard was identified for the adult visitor. The HI of 1.6 for the child visitor was greater than one due primarily to soil ingestion, but when the hazard quotient was broken down by target organ (e.g., kidney, liver), the HI values were all less than one. Hazard quotients are calculated for organs that may be affected by each contaminant and the results are summed. There is also a general risk factor that is added to these specific results. The results of the organ-specific risk calculations are considered more definitive measures of risk. Thus, even though the HI is slightly over 1.0 for the child visitor, the fact that the HIs for target organs are less than one indicate that adverse health effects were not predicted for a visitor. For construction workers, the carcinogenic risk calculated was less than 1×10^{-6}, so the Site does not present an unacceptable carcinogenic risk to construction workers. The HI of 2.3 for construction workers exceeds 1.0, but the HI values for target organs were all less than 1.0, indicating that adverse health effects associated with non-carcinogenic Site contaminants are not predicted for construction workers except for lead, which was calculated using the ALM analysis described above. As noted above, the results of the organ-specific risk calculations are considered more definitive as a measure of risk except in the case of lead because the HI approach for lead is not appropriate; the ALM analysis for lead was used instead. The ALM analysis for lead risk was conservatively based on a longer duration of exposure than was used for the organ-specific risk calculations for other contaminants due to the limitations of the ALM model (90 days per year is the minimum exposure duration allowed by the ALM; the HHRA used 70 days/yr at KPN and 45 days/yr at KPS for other contaminants).

The ATSDR visited the Site in 2003 and conducted a Health Consultation, published in 2006, based on the 1998, 2000, and 2001 data. ATSDR identified the potential for methane from the landfill in soil gas as a data gap and recommended additional sampling for methane in soil gas, and PAHs and PCBs in soil in the vicinity of Neval Thomas Elementary School. The ATSDR Health Consultation concluded that KPS did not pose a public health hazard for recreational use. The report also concluded that it could not ascertain the public health hazard presented by the proximity of the elementary school to the closed landfill, and recommended restricting access to the Site due to this undefined hazard.

E &E conducted additional sampling in the vicinity of Neval Thomas Elementary School in 2005 for surface soil contamination and tested for methane in soil gas emanating from the shallow soil. They concluded that methane was not present in shallow soil on school property; however, the measurements were screening analyses in shallow soil only. The levels of benzo(a)pyrene were above the residential RBC in 12 of the 20 soil samples collected in the vicinity of the school; however, only four of the 12 were located on the NPS portion of the school yard. Comparing the school yard samples to residential RBCs is conservative since residential exposure assumes greater exposure duration than would be the case at the school. As noted in Section 2.4.1, the Neval Thomas Elementary School yard did not receive additional fill or waste material during landfill operations, nor has it received any since, so these values are not considered attributable to the landfill and are more likely due to atmospheric deposition from local air emissions such as the PEPCO electric generating station and area traffic. Aroclor 1260 was the only PCB detected on the school yard. The two samples that exceeded the 0.44 mg/kg RG for PCB were located on the side yard off the southwest end of the school building on school property.

2.8.1.3 Summary of Human Health COPCs

Table 2-6 lists the human health COPCs for both KPN and KPS.

Table 2-5
Contaminants of Potential Concern[1]

COPC	HHRA Carcinogenic Risk	Non-Carcinogenic Risk (HI)	HHRA RME Exposure Point Concentration (EPC)[2] mg/kg
KPN Child/Adult Visitor			
Arsenic	5.2×10^{-6}	0.2	4.03
Aroclor 1254	3.0×10^{-6}	NA	1.33
Aroclor 1260	3.0×10^{-6}	NA	0.76
Dieldrin	3.9×10^{-6}	NA	0.23
Benzo(a)anthracene	1.1×10^{-6}	NA	1.35
Benzo(a)pyrene	9.1×10^{-6}	NA	1.13
Dibenzo(a,h)anthracene	6.0×10^{-6}	NA	0.62
Lead	NA	NA	455[3]
KPS Child/Adult Visitor			
Arsenic	7.7×10^{-6}	0.1	5.98
Aroclor 1254	2.6×10^{-6}	NA	1.15
Aroclor 1260	1.8×10^{-6}	NA	0.78
Benzo(a)anthracene	7.5×10^{-7}	NA	0.93
Benzo(a)pyrene	8.0×10^{-6}	NA	1.00
Dibenzo(a,h)anthracene	3.5×10^{-6}	NA	0.43
KPN/KPS Adult Site Worker			
Lead	NA	NA	NA[3]

1. Iron was identified as a contaminant of potential concern in the HHRA, but it is not a CERCLA hazardous substance and the additional soil pH data indicate it would not be bioavailable. Thus, it was not carried forward as a COPC.
2. The HHRA used the upper 95th confidence limit of soil concentrations as the reasonable maximum exposure limit (RME), considering non-detects as one-half of the detection limit.
3. Worker exposure was evaluated using the EPA Adult Lead Model assuming an exposure frequency of 90 days/yr. Based on the ALM model, a Site-wide average concentration for lead of 455 mg/kg was determined to be the acceptable risk-based soil concentration for lead for a site worker. This soil concentration level is applicable to surface and subsurface soils.

2.8.2 *Ecological Risk Assessment*

Screening-Level Ecological Risk Assessments (SLERA) and Baseline Ecological Risk Assessment (BERA) Problem Formulation Reports (PFRs) were performed for KPN and KPS and are reported in E&E 2007 b, c. Contaminants of potential ecological concern (COPECs) were identified at the beginning of each SLERA and revised at the beginning of each PFR by comparing soil and sediment contaminant concentrations to screening benchmarks such as Region III Biological Technical Assistance Group (BTAG) soil and sediment screening values (USEPA, 1995), Toxicological Benchmarks for Soil and Litter Invertebrates (Efroymson*, et al.*, 1997), Toxicological Benchmarks for Wildlife (Sample, *et al.*, 1996), and EPA Soil Screening Levels as available. The SLERAs used the maximum contaminant concentrations for comparison to benchmarks and food chain model exposures. The SLERAs conservatively assumed that contaminants in soil, water, and sediment were 100% bioavailable, that receptors were exposed to the maximum concentrations reported in soil and water, that receptors spent all their time at the Site, and that the concentration of each contaminant in food equaled the concentration of that contaminant in soil or sediment. The receptors chosen for the SLERA hazard quotient (HQ) calculations were:

- Great Blue Heron – aquatic receptor, piscivore
- Meadow vole – small mammal, herbivore
- Short-tailed Shrew – small mammal, insectivore
- American Robin – passerine bird
- Red-tailed Hawk – raptor
- Red fox – carnivore

HQs were calculated for a list of contaminants of potential ecological concern (COPECs) using no observed adverse effect levels (NOAELs) and lowest observed adverse effect levels (LOAELs).

The two PFRs used the same receptors, but modified the exposure assumptions to recognize that the birds would not spend the entire year on-site because they migrate, and the home range of the red-tailed hawk and red fox was larger than the Site. The 95% upper confidence level of contaminant concentration was used as the soil exposure point concentration (EPC) in the PFRs. The assumptions that contaminants were 100% bioavailable and that concentrations in food were equal to concentrations in soil or sediment were not changed. Each PFR was further refined by also using a biota uptake model, which used an estimated concentration of a contaminant in the food based on contaminant uptake models and food chain transfer (E&E, 2007b, 2007c). The biota uptake model assumed that contaminants in soil and sediment were 100% bioavailable.

2.8.2.1 Kenilworth Park North

The soil and sediment data used for the KPN ecological risk assessment were collected for the PA/SI in 2001 and 2002, soil data collected for the District of Columbia Sports and Entertainment Commission in 2005, and data collected for the RI in 2006. Surface water is not present within KPN and the adjacent surface waters, the Anacostia River and Watts Branch, are heavily influenced by off-site sources, so surface water data were not collected other than the KPS samples. Soil and sediment data for metals, semi-volatile organic compounds (SVOCs), pesticides, and PCBs were evaluated in the SLERA and PFR for KPN.

2.8.2.2 Kenilworth Park South

The soil, sediment, and surface water data used for the KPS ecological risk assessment were collected for the PA/SI in 1998, 1999, and 2000; and for the RI in 2001. Two surface water samples were collected from Watts Branch and analyzed for metals. Aluminum, barium, iron, lead, and manganese occurred at concentrations above the BTAG screening values for surface water, so these data were used in the PFR exposure calculations. Pesticide data were not collected at KPS.

2.8.2.3 Contaminants of Potential Ecological Concern

The PFRs identified COPECs for all of the receptors except the aquatic receptor the great blue heron whose HQs did not indicate unacceptable risks. Metals concentrations in soil were responsible for most of the risks identified. Site-specific background and off-site data were collected for the KPN RI in Kenilworth Park, and data collected for the KPS RI at Neval Thomas Elementary School also provided site-specific background and off-site soil data. These data were not used to evaluate COPECs identified in the PFRs. The PFRs conservatively assumed that metals were 100% bioavailable and no site-specific data were available at that time to determine if this assumption was overly conservative.

In 2008, The Johnson Company collected surface soil pH and total organic carbon data (TOC) at the Site (see Sections 2.2.1 and 2.4.1). The pH range for site soils of 6.44 to 7.56 indicates that the soils are well buffered, and as a result the bioavailability and toxicity of metals is significantly reduced. Total organic carbon (TOC) concentrations ranged more widely than the pH data, from 0.2 % to 17.5%. The distribution of the TOC concentrations is heterogeneous, but in areas where the TOC values are in excess of 1%, bioavailability and toxicity of metals and organic contaminants would be reduced. In addition, clay soils were used to cap the landfills, and clay soils tend to bind many metals. Thus, at this site, the assumption of 100% bioavailability significantly overestimates the effect of metals and organic contaminants on biota.

In order to determine COPECs that would be retained for Preliminary Remediation Goal (PRG) development, the COPECs identified in the PFRs were compared to EPA Ecological Soil Screening Levels (SSLs) (USEPA, 2005-2008), Site-specific background concentrations, regional background data provided in EPA soil screening guidance (USEPA, 2007), and the effect of Site-specific soil pH. The mean soil concentrations for Maryland published in the EPA SSL guidance document (USEPA, 2007) were used for regional background concentrations because there are no regional background numbers for D.C. and Kenilworth Park extends to the D.C. – Maryland boundary[2]. TOC data were not considered for this determination due to the wide range of results across the Site. EPCs that would result in HQ=1 based on LOAELs (HQ_l) were calculated and these results are presented in Appendix B. The results of this evaluation are presented in Table 2-7.

The PFRs conducted for KPN and KPS were conservative and tended to overestimate ecological risk. Additional data collected subsequent to the PFR analyses, and more recent soil screening levels and guidance, indicate that significant ecological risk is not present at the Site. At the present time, the Site is well vegetated, so wildlife exposure to soils is further limited. The un-mowed areas provide wildlife habitat in this urban setting. Therefore, soil removal in these areas would result in significant reduction in habitat values without providing significant benefits to ecological receptors. The existing vegetation provides soil stability on the slopes of the filled areas. Removal of this vegetation would increase the risk of erosion, and the possibility that the erosion could expose capped waste materials.

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[2] EPA has produced a comprehensive table of soil background levels by state, but this table does not include the District of Columbia. The Maryland data were used instead of the Virginia data because Maryland is a smaller and more developed state (and thus more similar to D.C. than Virginia), a larger portion of it has geology similar to the District of Columbia, and the District of Columbia was formerly part of Maryland.

Table 2-6
Summary Evaluation of Contaminants of Potential Ecological Concern

COPEC	Receptors[1]	EPC HQ_I=1 mg/kg	SSL Avian mg/kg[2]	SSL Mammalian mg/kg[2]	Max Site-specific Background mg/kg	Maryland Mean Background mg/kg[3]	Other Factors re: Bioavailability	Retain for PRG Development
Aluminum	*Vole*	54	Not calculated	Not calculated	11,000	39,167	Not toxic in soils with pH> 5.5	N
	Shrew	28						
	Robin	11,103						
	Hawk	1,512						
Antimony	Vole	2	Not calculated	0.27	1.2	1.2	95% UCL>than maximum concentration, Surface mean 0.8 < regional background	N
	Shrew	1						
Arsenic	*Vole*	4.61	43	46	12.4	3.8	SSLs and Site-specific background greater than EPCs for HQ_I=1	N
	Shrew	2.42						
	Robin	4						
Barium	Shrew	176	None	2000	285	393	SSL and Site-specific background greater than EPCs for HQ_I=1, Biota uptake HQ_I <1 for all receptors	N
	Robin	42						
Cadmium	*Shrew*	1	0.77	0.36	4.3	NA	Site-specific background > 95% UCL EPC	N
	Robin	2						
Chromium, total	*Shrew*	4	Cr III 26	Cr III 34	62.5	47.9	Soil pH and soil type favor Cr VI; mean concentrations of total Cr approximately equal to background; essential nutrient	N
	Robin	3	Cr VI Not calculated	Cr VI 130				
	Hawk	38						

Notes: [1] Receptor names shown in italics indicate excess risk based on Biota Uptake PFR

[2] USEPA Ecological Soil Screening Levels (see Section 8.0 for USEPA SSL references for specific compounds)

[3] USEPA, 2007, soil screening guidance

Table 2-6
Summary Evaluation of Contaminants of Potential Ecological Concern

COPEC	Receptors[1]	EPC HQ_l=1 mg/kg	SSL Avian mg/kg[2]	SSL Mammalian mg/kg[2]	Max Site-specific Background mg/kg	Maryland Mean Background mg/kg[3]	Other Factors re: Bioavailability	Retain for PRG Development
Cobalt	Vole	3	120	230	29	7.5	SSLs are an order of magnitude higher than 95% UCL EPC	N
	Robin	8						
Copper	Vole	42	28	49	43	20	Soil pH >5 and other conditions limit bioavailability, essential nutrient	N
	Shrew	22						
	Robin	62						
	Fox	421						
Iron	Vole	1396	Not calculated	Not calculated	54,000	28,571	Not toxic in soils with range of pH 5-8	N
	Shrew	728						
	Robin	1013						
	Hawk	13,783						
	Fox	1,793						
Lead	Vole	14	11	56	189	22	Maximum Site-specific background greater than EPCs for HQ_l=1, soil pH and soil type limit bioavailability	N
	Shrew	7						
	Robin	2						
	Hawk	27						
	Fox	169						
Manganese	Shrew	415	4,300	4,000	640	291	SSLs higher than 95% UCL EPC, Biota uptake HQ_l <1 for receptor	N
Mercury	Robin	0.91	Not available	Not available	2.7	Not available	Site-specific background greater than EPCs for HQ_l=1, biota uptake HQ_l<1	N

Notes: [1] Receptor names shown in italics indicate excess risk based on Biota Uptake PFR
[2] USEPA Ecological Soil Screening Levels (see Section 8.0 for USEPA SSL references for specific compounds)
[3] USEPA, 2007, soil screening guidance

Table 2-6
Summary Evaluation of Contaminants of Potential Ecological Concern

COPEC	Receptors[1]	EPC HQ_l=1 mg/kg	SSL Avian mg/kg[2]	SSL Mammalian mg/kg[2]	Max Site-specific Background mg/kg	Maryland Mean Background mg/kg[3]	Other Factors re: Bioavailability	Retain for PRG Development
Nickel	Shrew	117	210	130	27	13	SSLs higher than 95% UCL EPC, Biota uptake HQ_l <1 for receptors	N
	Robin	109						
Selenium	Vole	0.92	1.2	(0.63) 2.7	1.7	0.2	SSLs greater than EPCs for HQ_l=1; pH and soil type limit availability; essential nutrient	N
	Shrew	0.48						
	Robin	1.01						
Thallium	Vole	0.17	Not available	Not available	Not available	Not available	Insufficient data to determine PRG	N
	Shrew	0.09						
	Fox	1.34						
Vanadium	Vole	14	7.8	280	60	63	SSLs greater than EPCs for HQ_l=1, Background greater than EPCs for HQ_l=1	N
	Shrew	7						
	Robin	0.42						
	Hawk	6						
	Fox	149						
Zinc	Vole	895	46	79	290	39	Not bioavailable at pH > 5; essential nutrient; biota uptake HQ_l<1	N
	Shrew	467						
	Robin	126						
	Hawk	1713						

Notes: [1] Receptor names shown in italics indicate excess risk based on Biota Uptake PFR

[2] USEPA Ecological Soil Screening Levels (see Section 8.0 for USEPA SSL references for specific compounds)

[3] USEPA, 2007, soil screening guidance

Table 2-6
Summary Evaluation of Contaminants of Potential Ecological Concern

COPEC	Receptors[1]	EPC HQ_l=1 mg/kg	SSL Avian mg/kg[2]	SSL Mammalian mg/kg[2]	Max Site-specific Background mg/kg	Maryland Mean Background mg/kg[3]	Other Factors re: Bioavailability	Retain for PRG Development
Dieldrin	Robin	0.08	0.022	0.0049	0.0092	Not Available	Screening HQ based on NOAEL because no LOAEL available, mean available data, 0.07 mg/kg same order of magnitude as EPC 0.08 for HQ_n= 1.	N
Acenaphthene	Vole	7	Not available	100 Low Molecular Weight PAH	0.308	Not available	SSL higher than 95% UCL EPC; EPCs for HQ_l=1 approximately equal to 95% UCL	N
	Shrew	4						

Notes:

[1] Receptor names shown in italics indicate excess risk based on Biota Uptake PFR

[2] USEPA Ecological Soil Screening Levels (see Section 8.0 for USEPA SSL references for specific compounds)

[3] USEPA, 2007, soil screening guidance

3.0 BASIS FOR SITE REMEDIATION

This section of the Feasibility Study Report (FS) identifies and describes the requirements forming the basis for Site remedial action.

The primary objective of the FS is to ensure that an appropriate range of remedial alternatives are developed and analyzed in detail such that relevant information concerning these alternatives can be presented to decision-makers and an appropriate remedy selected. This FS was prepared consistent with the requirements of CERCLA, the NCP, and the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, October 1988).

Section 3.1 presents a discussion of federal and District ARARs and TBCs governing the cleanup of hazardous substance releases at the Site. Section 3.2 discusses the development of remedial action objectives (RAOs) and remediation goals (RGs) that are protective of human health and ecological receptors based on the risk assessments performed for the Site. Section 3.3 identifies the areas of contaminated media that exceed the RGs and to which general response actions might be applied. Subsequent Sections 4.0, 5.0, and 6.0 describe general response actions and identify and screen remedial technologies and response actions, develop and screen remedial alternatives, and present a detailed analysis of the remedial alternatives, respectively. Section 7.0 completes the FS with a comparative analysis of the remedial alternatives.

3.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND CRITERIA TO BE CONSIDERED (TBCS)

3.1.1 Overview

The identification of ARARs is performed pursuant to CERCLA Section 121(d), which states that a remedial action selected for a CERCLA site shall attain a degree of cleanup which assures protection of human health and the environment, and attains “legally applicable or relevant and appropriate standard(s), requirement(s), criteria, or limitation(s).”

ARARs are federal and District laws and regulations that will be used to: (1) evaluate the appropriate and necessary extent of Site cleanup; (2) define and formulate remedial action alternatives; and (3) govern implementation and operation of the selected remedy.

ARARs must be either applicable or relevant and appropriate. Applicable requirements are cleanup obligations, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or more stringent state laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a site. Relevant and appropriate requirements are requirements, criteria, or limitations that, while not "applicable," address problems or situations sufficiently similar to those encountered at a site that their use is well suited to the site. Any requirement, or portion thereof, that is determined by the lead agency to be a relevant and appropriate requirement must be attained by a selected remedy to the same degree as if it were determined to be an applicable requirement.

The NCP and relevant CERCLA guidance specify that ARARs may be grouped into three categories: chemical-specific, location-specific, or action-specific (40 CFR § 300.400(g)(1)).

- **Chemical-specific ARARs and TBCs**. Usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, establish an acceptable amount or concentration of a chemical in the ambient environment;

- **Location-specific ARARs and TBCs**. Restrictions placed on the concentration of hazardous substances or the conduct of activity solely because the activities occur in special locations. Location-specific ARARs focus on the protection of such things as wetlands, floodplains, historic landmarks, rare and endangered species, and cultural resources; and

- **Action-specific ARARs and TBCs**. Usually technology- or activity-based requirements involving performance or other action-specific requirements for conducting remedial activities.

Chemical-specific ARARs apply to specific chemicals and their concentrations in specific media in the environment. Thus they are used when developing clean-up levels.

Location-specific ARARs are applicable or relevant and appropriate due to the location of the site, so do not provide standards for clean-up concentrations, although the location in some cases would determine which chemical-specific ARAR to apply. For example, the location of a site may dictate what groundwater classification applies which therefore determines the chemical-specific concentration that would be the applicable standard. Action-specific ARARs relate to the physical actions that will be required to implement the remedial action. There will be situations where a particular requirement could fall into two or more categories.

Once the analysis of ARARs is complete, there may be materials which do not meet all of the requirements of an ARAR, but which still may be considered when evaluating the remedial action alternatives for a CERCLA site. These documents to be considered, or "TBCs," can include, but are not limited to, federal and state environmental and public health criteria, advisories, guidance, and proposed standards that may provide useful information or recommended procedures. While these materials are not potential ARARs, they are evaluated along with ARARS to set protective clean-up levels. Chemical-specific TBC values, such as health advisories and reference doses, may be used in the absence of ARARs or where ARARs are not sufficiently protective to develop clean-up levels.

Table 3-1 presents a summary listing of the chemical-specific, location-specific, and action-specific ARARs and TBCs for the Site. The subsections that follow Table 3-1 provide brief descriptions of some of the more significant ARARs/TBCs for the Site in the context of remedy evaluation and selection.

Table 3-1
Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Materials

ARAR/TBC Type	Brief Description	Citation	Requirement	Comments
CHEMICAL	***FEDERAL***			
	Resource Conservation and Recovery Act (RCRA), Subtitle D	42 USC §§ 6941 et seq. 40 CFR §§ 258.23 and 258.61	Establishes permissible limits of methane concentrations in structures on landfills and in soil gas at the property boundary.	Relevant and appropriate - for the assessment and remediation of methane
	EPA Guidance for Evaluating Landfill Gas Emissions from Closed or Abandoned Facilities	EPA-600/R05/123a Sept. 2005	Guidance for evaluating inhalation risks to off-site receptors as well as the hazards of both on-site and off-site methane explosions and landfill fires.	TBC – for evaluation and remediation of landfill gases
	Clean Water Act, Ambient Water Quality Criteria	33 USC §§ 1251 et seq. 40 CFR Part 131	Surface water criteria established for the protection of human health and/or aquatic organisms.	Applicable - except where D.C. standards are more stringent - surface waters potentially impacted by Site contaminants
	Aquatic Sediment Quality Guidelines (Ontario)	Persuad et al., 1993.	Guidelines for screening contaminants in freshwater sediments.	TBC -for sediment in wetlands or surface water
	National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs)	Safe Drinking Water Act, 42 U.S.C. §§ 300f et seq. 40 C.F.R. Part 141	Human health-based standards, MCLs for public water systems	Relevant and appropriate—although groundwater and surface water at the Site are not currently used as drinking water, they are potential future drinking water sources.
	National Secondary Drinking Water Regulations, Secondary MCLs	Safe Drinking Water Act, 42 U.S.C. §§ 300f et seq. 40 C.F.R. Part 143	Establishes aesthetic standards (secondary MCLs) for public water systems	TBC—although groundwater and surface water at the Site are not currently used as drinking water, they are potential future drinking water sources.
	Toxic Substances Control Act (TSCA)	15 USC §§2601 et seq., 40 CFR Part 761	PCB remediation, soil disposal, and capping requirements.	Relevant and appropriate. Requirements met by compliance with more stringent RCRA Subtitle D landfill closure criteria.
CHEMICAL	***DISTRICT***			
	District of Columbia Water Quality Standards for Surface Water	D.C. Code §§8-103 et seq. DCMR[1] Title 21 Chapter 11	Water quality standards for various classes of surface waters including draft TMDLs for oil and grease, organics and metals in the Anacostia River.	Applicable - to discharges or impacts to surface waters.
	District of Columbia Groundwater Protection and Quality Standards	D.C. Code § 8-103.04 21 DCMR §§ 1150-1158	Water quality standards that are specific to the District groundwater supplies.	Applicable - to groundwater quality at the Site

Table 3-1
Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Materials

ARAR/TBC Type	Brief Description	Citation	Requirement	Comments
	District of Columbia Hazardous Waste Regulations	DCMR Title 20 Chapters 40-47	Sets forth criteria for classification of hazardous waste.	Applicable - to excavate waste material that is hazardous and requires off-site disposal.
LOCATION	***FEDERAL***			
	National Park Service Organic Act	16 USC § 1 et seq.	Requires that national parks be managed in order to conserve the scenery, natural and historic objects, and wildlife in such a manner as to leave them unimpaired for the enjoyment of future generations	Applicable - for Site remediation/restoration
	Establishment of Kenilworth Park	An Act providing for a comprehensive development of the park and playground system of the National Capital as amended, 68th Congress, Sess. I., Ch. 270 (1924), 69th Congress, Sess. I, Chs. 197, 198 (44 Stat. 374, 1926), Capper-Cramton Act, 46 Stat. 482, as amended by 60 Stat. 960, 66 Stat. 781, 791, and 72 Stat. 705	Legislation authorizing the acquisition of lands along the Anacostia River, among other places in the District of Columbia, for “suitable development of the National Capital park, parkway, and playground system.” The purpose of such development was “to prevent pollution of… [the] Anacostia River [], to preserve forests and natural scenery in and about Washington, and to provide for the comprehensive, systematic, and continuous development of park, parkway, and playground systems of the National Capital and its environs…” The Capper-Cramton Act expressly provided for “the extension of the Anacostia Park system up the valley of the Anacostia River…”	Applicable
	Solid Waste Disposal in National Parks	16 USC § 460*l*-22(c) 36 CFR Part 6	Prohibits the creation of new solid waste disposal units and the operation of existing solid waste disposal units within park boundaries, except as specifically provided for in the regulations.	Applicable - to the disposal of solid waste within the Park. None of the potential remedial alternatives contemplates such action at the Site.

Table 3-1
Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Materials

ARAR/TBC Type	Brief Description	Citation	Requirement	Comments
	National Park Resource Protection, Public Use and Recreation	36 CFR Part 2	This regulation prescribes and regulates various activities in National Parks. For example, section 2.1 (a) prohibits "(1) Possessing, destroying, injuring, defacing, removing, digging, or disturbing from its natural state: (i) . . . wildlife or fish. . . . (ii) Plants or the parts or products thereof. . . . (2) Introducing . . . plants . . . into a park area ecosystem. (3) Tossing, throwing or rolling rocks or other items inside caves or caverns, into valleys, canyons, or caverns, down hillsides or mountainsides, or into thermal features." Section 2.2 (a)(2) prohibits "feeding, touching, teasing, frightening or intentional disturbing of wildlife nesting, breeding or other activities." Section 2.14 (a) prohibits "(1) Disposing of refuse in other than refuse receptacles. . . . (6) Polluting or contaminating park area waters or water courses."	Relevant and appropriate to NPS activities.
	National Park Area Nuisance	36 CFR § 5.13	Prohibits the creation or maintenance of a nuisance within a park area.	Relevant and appropriate to NPS activities.
	Protection of Wetlands Order and Clean Water Act Section 404	Executive Order No. 11990 33 USC § 1344(b)(1) 40 CFR Parts 230 and 231	Requires consideration of impacts to wetlands in order to minimize their destruction, loss or degradation and to preserve/enhance wetland values.	Applicable - to remediation activities that would impact wetlands.
	Floodplain Management Order	Executive Order No. 11988	Requires consideration of impacts to floodplain areas in order to reduce flood loss risks, minimize flood impacts on human health, safety and welfare and preserve and/or restore floodplain values.	Applicable – to remediation activities occurring within the 100-year floodplain.
	Endangered Species Act	16 USC §§ 1531 – 1544 50 CFR Part 402	Establishes requirements for the protection of federally listed threatened and endangered species and their habitat.	Applicable – to Site remediation involving activities that could affect threatened or endangered species or their habitat.
	National Historic Preservation Act	16 USC §§ 470 et seq. 36 CFR Part 800	Establishes requirements for the identification and preservation of historic and cultural resources.	Applicable - to Site remediation activities that could impact historic or cultural resources.
	Archaeological and Historic Preservation Act	16 USC §§ 469 et seq.	Provides for the protection and preservation of archeological and historical resources that may be destroyed through the alteration of terrain as a result of federal construction projects.	Applicable - to Site remediation activities that could result in the discovery of archeological or historical resources.
	Historic Sites, Buildings, and Antiquities Act	16 USC §§ 461 et seq.	Requires the consideration of the existence and location of historic and prehistoric sites, buildings, objects, and properties of historical and archaeological significance when evaluating remedial alternatives.	Applicable - to Site remediation activities involving soil disturbance that could impact areas of historical or archaeological significance.

Table 3-1
Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Materials

ARAR/TBC Type	**Brief Description**	**Citation**	**Requirement**	**Comments**
	Archeological Resources Protection Act	16 USC §§ 470aa – ii, et seq. 43 CFR §§ 7-1 et seq.	Provides for the protection of archeological resources located on public lands.	Applicable - to Site remediation activities involving soil disturbance.
	Native American Graves Protection and Repatriation Act (NAGPRA)	25 U.S.C. § 3001 25 U.S.C. § 3002(d) 43 CFR §§ 10.1 – 10.17	Provides for the disposition of Native American remains and objects inadvertently discovered on federal or tribal lands after November 1990. If the response activities result in the discovery of Native American human remains or related objects, the activity must stop while the head of the federal land management agency (in this case, NPS) and appropriate Indian tribes are notified of the discovery. After the discovery, the response activity must cease and a reasonable effort must be made to protect the Native American human remains or related objects. The response activity may later resume (43 CFR Section 10.4).	Applicable – to the discovery of Native American remains and objects during remedial action activities.
	Fish and Wildlife Coordination Act	16 USC §§ 661 et seq.	Requires consideration of impacts to wildlife resources resulting from the modification of waterways.	Applicable - to Site remediation involving the diversion or other modification of rivers and/or streams.
	Legislation for transfer of KPN to District of Columbia	PL 108-335 § 344	Establishes procedure for property transfer and limits future use to public recreational facilities, open space or public outdoor recreational opportunities.	Applicable - for future use of property.
	Rivers and Harbors Act, Section 10 and Regulations	33 USC § 403 33 CFR Parts 320-330	Requirements for evaluating the placement of structures and/or excavation activities within navigable waters.	Applicable - to Site remediation involving excavation activities in the Anacostia River.
	Clean Water Act, Section 404(b)(1) Guidelines	33 USC § 1344 40 CFR 230.10	Establishes criteria for evaluating impacts to waters of the US (including wetlands) and sets forth factors for considering mitigation measures.	Applicable - to Site remediation involving the placement of fill or dredging of material in on-site wetlands and waterways.
	NPS Management Policies 2006	Available at: http://www.nps.gov/policy/mp2006.pdf	Provides policies and guidance for the management of natural and cultural resources by the NPS, including revegetation of disturbed land.	TBC - for Site remediation
LOCATION	***DISTRICT***			
	District of Columbia Flood Hazard Control	D.C. Code §§ 6-501 to 506 DCMR Title 20 Chapter 31	Regulates the 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.

Table 3-1
Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Materials

ARAR/TBC Type	Brief Description	Citation	Requirement	Comments
	District of Columbia Harbor Regulations- Throwing or Depositing Matter in Potomac River	D.C. Official Code § 22-4402	Prohibiting the deposit of any stone, gravel, sand, ballast, dirt, oyster shells, or ashes in the water in any part of the Potomac River or its tributaries in the District of Columbia, or on the shores of the river below the high water mark. Further prohibiting the deposit of "filth of any kind whatsoever" in the Potomac River or its tributaries in the District of Columbia.	Applicable – to Site remediation activities along the shores of the Anacostia. However, Section 22-4402(c) states: "Nothing in this section shall be construed to interfere with the work of improvement in or along the said river and harbor under the supervision of the United States government."
	District of Columbia Protection of Wetlands	DCMR Title 21 Chapter 11	Requires consideration of impacts to wetlands in order to minimize their destruction, loss or degradation and to preserve/enhance wetland values.	Applicable - to remedial activities which would impact wetlands.
	Chesapeake 2000 Agreement	Chesapeake 2000 Agreement and Chesapeake Executive Council directives: www.chesapeakebay.net/c2k.htm	Establishes goals, agreements and directives for the protection and restoration of the Chesapeake Bay watershed, including living resource protection and restoration, vital habitat protection and restoration, water quality protection and restoration, and stewardship and community engagement.	TBC
	Anacostia River Watershed Restoration Agreement	Anacostia River Watershed Restoration Program 10 DCMR § 405	The Anacostia Watershed Restoration Program includes 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 the acreage and quality of tidal and nontidal 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
	District of Columbia Historic Preservation	DCMR Title 10 Chapter 25	Requires the consideration of the existence and location of historic and prehistoric sites, buildings, objects, and properties of historical and archaeological significance when evaluating remedial alternatives.	Applicable - to Site remediation activities involving soil disturbance activities that could impact areas of historical or archaeological significance.
ACTION	***FEDERAL***			
	Hazardous Waste Generation	42 USC §§ 6901 et seq. 40 CFR Part 262	Specifies requirements for hazardous waste packaging, labeling, manifesting, and storage.	Applicable - to excavated RCRA hazardous waste that requires off-site disposal.
	Transportation of Hazardous Waste	42 USC §§ 6901 et seq. 40 CFR Part 263	Specifies requirements for transporters of hazardous waste to obtain a USEPA identification number, compliance with manifest procedures and spill response.	Applicable - to excavated RCRA hazardous waste that is transported for off-site disposal.

Table 3-1
Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Materials

ARAR/TBC Type	Brief Description	Citation	Requirement	Comments
	Treatment, Storage, and Disposal of Hazardous Waste	42 USC §§ 6901 et seq. 40 CFR Part 264	Specifies requirements for the operation of hazardous waste treatment, storage, and disposal facilities.	Relevant and appropriate– to remediation activities that require active on-site hazardous waste management and storage or off-site disposal activities;
	RCRA Subtitle D Municipal Solid Waste Landfill Closure and Post-Closure Requirements	40 CFR § 258.60 and § 258.61	Closure criteria include a final cover system designed to minimize infiltration and erosion. Post-closure care requirements for municipal solid waste landfills include groundwater monitoring and maintenance of the landfill cover.	Relevant and Appropriate – certain substantive provisions are relevant and appropriate for alternatives that involve capping wastes (see Table 3-2).
	National Ambient Air Quality Standards-Particulates	42 USC §§ 7409 – 7410 40 CFR Part 50	Establishes maximum concentrations for specified emissions.	Applicable – to remedial 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 remedial action that results in the point source discharge of pollutants to surface water bodies.
	Clean Water Act Stormwater Program	33 USC § 1342 40 CFR Part 122	Regulates the 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 the discharge of sediments to surface waters.	Applicable - to discharges of stormwater to surface waters from remediation that results in soil disturbance of more than one acre of land; relevant and appropriate for smaller land disturbances; EPA-issued General Permit for Stormwater Discharges from Construction Activities may be TBC
	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 - for off-site transportation of hazardous materials.
ACTION	***DISTRICT***			
	District of Columbia Hazardous Waste Regulations	DCMR Title 20 Chapter 42	Prohibits the disposal of any hazardous waste, 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 that are unable to achieve clean closure shall be considered to be 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.	Relevant and Appropriate - for alternatives which involve leaving hazardous wastes on-site.

Table 3-1
Potential Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) Materials

ARAR/TBC Type	Brief Description	Citation	Requirement	Comments
	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	DCMR Title 21 Chapter 5	Regulates the discharge of stormwater from land disturbing activities.	Applicable - to on-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. DCMR Title 20 Chapter 6	Provides requirements applicable to particulate air pollution sources.	Applicable – to remedial activities that result in the generation and emission of particulate 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 remedial activities that involve trucks 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, 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 the escape of a trail of visible fumes or smoke for more than ten consecutive seconds	Applicable – to remedial activities that involve trucks 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	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 is prohibited	Applicable – to remedial activities that result in the generation and emission of air pollutants

[1] District of Columbia Municipal Regulations

3.1.2 Location-Specific ARARs and TBCs

National Park Service Organic Act, 16 U.S.C. Sections 1-3

The most important statutory directive for the National Park Service is provided by interrelated provisions of the NPS Organic Act of 1916, and the NPS General Authorities Act of 1970, including amendments to the latter law enacted in 1978, known as the "Redwood amendment".

The Organic Act directs the National Park Service "to promote and regulate the use of … national parks … by such means and measures as conform to the fundamental purpose of the said parks … which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Section 1a-1 further provides that "the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established . . . ."

Protection of Wetlands Order

Executive Order No. 11990 mandates, to the extent possible, avoidance of adverse impacts associated with the destruction or loss of wetlands and of any new construction in wetlands if a practicable alternative exists. Section 404(b)(1) of the Clean Water Act, 33 U.S.C. § 1344(b)(1), also prohibits the discharge of dredged or fill material into waters of the United States. Together, these requirements create a standard of "no net loss" of wetlands.

Title 21 DCMR 1101.2 categorizes wetlands as either surface water Class C or D for the protection of fish, wildlife, and human health. Additionally, 21 DCMR 1103.2 protects wetlands from adverse hydrologic modifications, sedimentation, and deposition of toxics or excessive nutrient loads.

Wetland areas in close proximity to the Site include the unnamed stream located to the east of KPS, wetlands to the north of KPN which include Kenilworth Aquatic Gardens, wetland areas along Watts Branch adjacent to KPN, and wetland areas on the banks of the Anacostia River along KPS and portions of KPN. Remedial actions will be implemented in a manner that avoids impacting these wetlands, or provides restoration and/or mitigation for impacted wetlands.

Floodplain Management Order

This requirement mandates that federally funded or authorized actions within the 100-year floodplain avoid, to the maximum extent possible, adverse impacts associated with development of a floodplain. Compliance with this requirement is detailed in USEPA's August 6, 1985 "Policy on Floodplains and Wetlands Assessments for CERCLA Actions." If the selected remedial action may adversely impact the Anacostia River floodplain, specific measures to avoid or minimize those impacts may be required.

The configuration of the Site is such that 100-year flood levels skirt around the Site and should neither inundate nor wash away a cap installed on the majority of areas requiring remediation as part of a capping alternative. Pre-excavation prior to capping may be required along the narrow lower-elevation zones along the edges of the Anacostia River and Watts Branch with robust erosion control measures to prevent obstruction of the floodplain or creating situations that could result in uncontrolled erosion. Historically-placed fill within the 100-year floodplain was removed in 1999.

3.1.3 Action-Specific ARARs and TBCs

RCRA Subtitle D Regulations

The Resource Conservation and Recovery Act (RCRA) Subtitle D Regulations were established to govern the management of solid wastes not regulated as hazardous under RCRA Subtitle C (primarily municipal or household wastes) to protect human health and the environment. These regulations apply to new, existing, and lateral expansions of municipal solid waste landfills that received waste on or after October 9, 1993. Both KPN and KPS had ceased operations and were covered by 1970. The 1997 – 1998 new fill placed in KPS consisted of soil and construction and demolition debris, which is not included in the definition of municipal solid waste (40 CFR 257.2). Therefore, RCRA Subtitle D regulations are not applicable to the Site. However, certain provisions of Subtitle D Part 258 relating to the closure and post-closure care of solid waste landfills are relevant and appropriate to the CERCLA remediation of former municipal landfills. See Table 3-2 for a detailed analysis of the relevant and appropriate provisions of RCRA Subtitle D.

Table 3-2
RCRA Subtitle D ARAR Analysis

RCRA Subtitle D Closure and Post-Closure Requirements (40 CFR Part 258)	Rationale/Function	Relevant?	Appropriate?
Closure (Cover) Design			
Section 258.60(a)(1) through (a)(3): (1) Cover must have a permeability no greater than 10^{-5}cm/s; (2) Infiltration layer must contain a minimum 18 inches of earthen material; and (3) Erosion layer must contain a minimum 6 inches of earthen material that is capable of sustaining native plant growth. Minimum 6	Prevent contact with landfill contents by human and most ecological receptors, precipitation, and surface water; minimize infiltration into the landfill waste to reduce potential for leachate and/or groundwater impacts and minimize erosion of the final cover. Minimize infiltration into the landfill waste to reduce potential for leachate and/or groundwater impacts and minimize erosion of the final cover.	Yes – site was former MSW landfill.	Yes – reduce potential for contaminant migration to groundwater, protect final cover and landfill contents from exposure and erosionYes – protect cap from erosion
Post-Closure Care Requirements			
Physical Inspections and Maintenance:			
Section 258.61(a)(1): Maintain and repair cover as necessary to correct effects of settlement, subsidence, erosion, or other events, and prevent run-on and run-off from eroding or otherwise damaging the final cover.	Maintain the integrity and effectiveness of the final cover.	Yes – site was former MSW landfill.	Yes – ensure long-term effectiveness of the final cover and continued reduction of infiltration and prevent erosion.
Groundwater Monitoring:			
Section 258.61(a)(3): Monitor groundwater in accordance with Subpart E (Sections 258.50 through 258.58).	Demonstrate there is no potential for migration of hazardous constituents from the landfill to the uppermost aquifer.	Yes – site was former MSW landfill and has shallow groundwater.	Yes – Although the RI determined that contaminant migration off-site via groundwater is minimal, this will be confirmed during the OU2 investigation (RI Addendum).
Section 258.50(b): Monitoring requirements in Subpart E may be suspended if it can be demonstrated that there is no	Provide mechanism to terminate groundwater monitoring before the end of the default 30-year		Yes – the results of the OU2 investigation will inform whether groundwater monitoring

Table 3-2
RCRA Subtitle D ARAR Analysis

RCRA Subtitle D Closure and Post-Closure Requirements (40 CFR Part 258)	Rationale/Function	Relevant?	Appropriate?
potential for migration of hazardous constituents to the uppermost aquifer during the post-closure period.	monitoring period.		may be suspended.
Landfill Gases:			
Section 258.61(a): Monitor explosive gases in accordance with 258.23.	Control migration of potentially explosive gases.	Yes – site was former MSW landfill and has potential for explosive gas generation.	Yes – testing during the RI/FS indicated explosive gases were not present in the former Community Center (previously the only occupied structure on the site), and do not exceed LEL at the Site boundary; however, additional boundary monitoring is included as part of the remedial alternatives to confirm the boundary results. The concentration limits in Section 258.23(a) were used to establish RGs for explosive gases (see Section 3.2.3).
Section 258.23(a)(1): Methane concentrations must not exceed 25% of lower explosive limit (LEL) in on-site structures.			
Section 258.23(a)(2): Methane concentrations must not exceed LEL at Site boundary.			
Section 258.23(b): Routine methane monitoring required to ensure concentration limits (above) are not exceeded.			
Administrative Requirement:			
Section 258.60(i): Deed notations must be recorded documenting that the land has been used as a landfill, and that post-closure uses must not disturb the integrity of the cover, monitoring systems, etc.	Documents past use as landfill for future owners, and ensures the future integrity of the cover, monitoring systems, etc.	Yes – site was former MSW landfill.	Yes – ensures awareness that land was formerly used as a landfill and protects against future uses that could jeopardize the integrity of the cover, monitoring systems, etc.

DC Soil Erosion and Sedimentation Control Act and Water Pollution Control Act

Title 21 DCMR, Chapter 5 (Water Quality and Pollution) are the governing regulations for District of Columbia Law 2-23, the Soil Erosion and Sedimentation Control Act of 1977, as amended, and DC Law 5-188, Sections 509 through 518, the Water Pollution Control Act.

The District of Columbia Department of Consumer and Regulatory Affairs (DCRA) 1987 Standards and Specifications for Soil Erosion and Sediment Control have been incorporated by reference into 21 DCMR, Section 501.4. The standards and specifications for land grading and reshaping state that all fill material "shall be free of brush, rubbish, rocks, logs, stumps, building debris and other objectionable materials that would interfere with or prevent construction of satisfactory fills" (see DCRA, 1987, Page 41.03, item 8), and specify slope and vegetative protection requirements.

Additional erosion and sediment control requirements include the following:

- 21 DCMR 538 – Prescribes guidelines for planning erosion and sediment control measures at a site; and
- 21 DCMR 539 – Prescribes principles for designing erosion and sediment control measures.

In addition, 21 DCMR 526.1 requires appropriate stormwater management measures to control or manage run-off during any earth moving or other activity that modifies the land surface, unless the activity is exempt.

Additional stormwater management requirements include:

- 21 DCMR 528 – Provides for a waiver or variance from the stormwater management requirements if stormwater run-off from the property will not adversely impact receiving waters;
- 21 DCMR 529 – Prescribes the minimum stormwater management requirements that must be met before any land may be developed in D.C.; and
- 21 DCMR 530 – Identifies minimum stormwater management measures that, singly or in combination, must be implemented for developments constructed in D.C.

Substantive provisions of D.C. regulations on construction or land disturbing and filling activities may be applicable or relevant and appropriate requirements for remedial alternatives involving excavation, grading and/or application of cover soils at the Site.

3.2 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES AND REMEDIATION GOALS

3.2.1 Remedial Action Objectives

As the first step in the FS process, Section 300.430(e) of the NCP requires the development of Remedial Action Objectives (RAOs) to specify contaminants and media of concern, potential exposure pathways, followed by development of Remediation Goals (RGs). RAOs are developed based on evaluation of COCs and CECs, exposure routes, receptors, and ARARs. The development of RAOs represents an essential element of the overall remedial alternatives development and evaluation process. RAOs are needed to clearly articulate the intent of any remedial activities that may be undertaken to address risks to human health or the ecological receptors at a site. In this FS, RAOs were developed by reviewing the results of the RI, HHRA and screening level ecological risk assessment reports, and interpreting the results in light of NPS's long-term goals and objectives for the Site.

Based on the results of the HHRA, contaminated surface and subsurface soils exceed one or both of the two threshold risk levels of 10^{-6} cancer risk or hazard index of 1.0. The term "subsurface soils" refers to both soils and the wastes in the former landfill, depending upon the depth of cover material in a given location. Therefore, any remedial actions for contaminated soils must address the following RAOs:

- Prevent direct contact (i.e., incidental ingestion, inhalation, and dermal contact) with contaminated soils above acceptable risk levels for human receptors; and
- Eliminate or minimize contaminant-related constraints to the full utilization and enjoyment of the Site consistent with NPS mandates; and
- Meet federal and District ARARs and/or risk-based cleanup goals, whichever is more stringent.

The human health-based RAOs for surface and subsurface soils are further detailed below:

- Prevent exposure to PCBs, PAHs, and metals above risk-based levels in surface soil for Park visitors and utility/construction workers; and

- Prevent exposure to lead in surface and subsurface soil above risk-based levels via direct contact for construction/utility workers.

The KPS HHRA referenced the ATSDR review which cited methane as an undetermined hazard and recommended further investigation. High concentrations of methane were noted in the RI for KPN and further evaluated in October 2008 and March 2009. Study results are summarized in Sections 2.2.4 and 2.4.6 for KPN and KPS, respectively. Based on all of this information, the following RAOs related to methane are established for the Site:

- Prevent exposure to unacceptable levels of methane from landfill gas for Park visitors and utility/construction workers; and
- Prevent exposure to unacceptable levels of methane at on-site or off-site facilities.

There are currently no hazards to the public associated with exposed landfill material such as construction debris or solid waste. However, to maintain public enjoyment of the Site, including current and future recreational activities, the following RAO has been established to prevent future hazards from potentially exposed waste materials if the waste is left in place:

- Prevent erosion or future Site activities that could expose buried landfill material at the ground surface.

The HHRA concluded that excess risk to Site visitors and Site workers resulted from exposure to contaminated soils (both surface and subsurface), but not to other Site media. Therefore, RAOs were not developed for groundwater, surface water, or indoor air (RAOs may be developed in the future for groundwater if the RI Addendum prepared for OU2 indicates that COCs in groundwater pose a risk to human health or the environment). Methane intrusion into buildings was not addressed in the HHRA, but subsequent investigations were conducted to determine whether methane was entering buildings at levels that could pose a risk. The results of these investigations indicate that methane is not entering buildings at the Site.

Risks of exposure to ecological receptors were evaluated in the ecological risk assessment. The results of the ecological risk assessment, combined with additional data collected subsequent to the ecological risk assessment and consideration of more recent soil screening levels and guidance, indicate that no significant ecological risk is present at the Site.

The final Site RAO is derived from the Organic Act and NPS's mission.

- Eliminate or minimize contaminant-related constraints to the full utilization and enjoyment of the Site consistent with NPS mandates

3.2.2 Selection of Human Health Target Risk Levels

It is generally appropriate to develop risk-based PRGs for media where PRGs are not clearly defined by ARARs or where site-specific risk-based PRGs are more stringent than chemical-specific ARARs. The guidance document, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (USEPA, 1991a), indicates that remedial action is generally warranted at a site when the cumulative excess carcinogenic risk is greater than 10^{-6}or the HI exceeds 1.0 based on reasonable maximum exposure (RME) assumptions. Or stated another way, risk-based PRGs are not needed for any constituents in a medium with a cumulative cancer risk of less than 10^{-6} or an HI less than or equal to 1.0. The HHRA identified COPCs in environmental media that may present excess risks or hazards to human receptors. Tables 3-3 and 3-4 present summaries of carcinogenic and non-carcinogenic risks calculated in the HHRA, along with potential PRGs for 10^{-5} and 10^{-6} and HI<1 risk thresholds. Note that the HI approach is not appropriate for evaluating potential non-carcinogenic health effects from exposure to lead. The use of other approaches to develop PRGs for lead is described in Section 3.2.3.

Two primary factors have been considered for the Site in setting carcinogenic risk management-based remediation goals:

- The Site is located within a unit of the National Park System and
- Key uncertainties were identified in the HHRA process

The Organic Act and park legislation mandate that NPS ensures that staff and visitors to Kenilworth Park are appropriately protected and that the Park be managed for recreational purposes, among other things. Also, this legislation and its implementing regulations do not allow the permanent or long-term prohibition of public access to the Site as a component of the selected remedial action.

Based on the above factors, a target risk level of 10^{-6} cumulative excess cancer risk (carcinogenic effects) and a hazard index of 1 (non-carcinogenic effects) are considered protective and have been selected for the Site.

Table 3-3
Current Site Risks and Calculated Risk-Based Soil PRGs for Carcinogenic Contaminants of Potential Concern[1]

COPC	HHRA Carcinogenic Risk	HHRA RME EPC[2] mg/kg	PRG 10^{-6} mg/kg	PRG 10^{-5} mg/kg
KPN Child/Adult Visitor				
Arsenic	5.2×10^{-6}	4.03	0.77	7.74
Aroclor 1254	3.0×10^{-6}	1.33	0.44	4.43
Aroclor 1260	3.0×10^{-6}	0.76	0.25	2.53
Dieldrin	3.9×10^{-6}	0.23	0.06	0.60
Benzo(a)anthracene	1.1×10^{-6}	1.35	1.23	12.27
Benzo(a)pyrene	9.1×10^{-6}	1.13	0.12	1.24
Dibenzo(a,h)anthracene	6.0×10^{-6}	0.62	0.10	1.03
KPS Child/Adult Visitor				
Arsenic	7.7×10^{-6}	5.98	0.77	7.77
Aroclor 1254	2.6×10^{-6}	1.15	0.44	4.42
Aroclor 1260	1.8×10^{-6}	0.78	0.44	4.43
Benzo(a)anthracene	7.5×10^{-7}	0.93	1.24	12.40
Benzo(a)pyrene	8.0×10^{-6}	1.00	0.12	1.24
Dibenzo(a,h)anthracene	3.5×10^{-6}	0.43	0.12	1.24

1. The PRGs were calculated by determining the soil exposure point concentration (EPC) that would result in risk values of 1×10^{-6} and 1×10^{-5}, based on the HHRA exposure assumptions.
2. The HHRA used the upper 95th confidence limit of soil concentrations as the reasonable maximum exposure limit (RME), considering non-detects as one-half of the detection limit.

Table 3-4
Current Risks and Calculated Risk-Based Soil PRGs for Non-Carcinogenic Contaminants of Potential Concern[1]

COPC	HHRA HI	HHRA RME mg/kg	PRG HI=1 mg/kg
KPN Child			
Arsenic	0.2	4.03	43
KPS Child			
Arsenic	0.1	5.98	43
KPS Utility/Maintenance Worker			
Arsenic	0.13	6.71	52

1. The PRGs were calculated by determining the soil exposure point concentration (EPC) that would result in an HI=1, based on the HHRA exposure assumptions.

3.2.3 Development of Human Health Preliminary Remediation Goals

The HHRA evaluated cumulative site-wide risks associated with exposure to contaminated soil and sediment. Section 3.2.2 developed target risk levels for carcinogenic and non-carcinogenic effects. The development of specific potential PRGs for non-carcinogenic and carcinogenic chemicals is presented below.

PRGs for Non-Carcinogenic Risks

For the child and worker scenarios that resulted in HIs greater than 1.0, no HI based on target organs were greater than 1. The HHRA thus concluded that unacceptable non-carcinogenic risk was not likely to occur.

Potential health effects associated with exposure to lead are evaluated separately because the HI approach is not appropriate for lead. The HHRA analysis of risk from lead exposure found the potential for unacceptable risk for site utility and construction workers, based primarily on areas where subsurface lead concentrations were high. Risk-based soil cleanup levels for lead were calculated in the HHRA using the IEUBK model for a child receptor and the ALM for an adult receptor. Using these models, the HHRA concluded that excess risk from exposure to lead for child and adult visitors was not present, but that some areas within the Site could pose excess risk for workers considering an average concentration calculated for the work zone, including both the surface and subsurface soil concentrations likely to be encountered during performance of the work. Therefore, the ALM value of 455 mg/kg for site workers is included as the risk-based PRG for lead. This potential risk-based concentration for lead calculated using the EPA ALM is based on a longer exposure duration than was used for other worker exposure calculations in the HHRA and therefore would be additionally conservative and protective.

PRGs for Carcinogenic Risks

A target risk level of 1 x 10^{-6} cumulative excess cancer risk has been selected for this Site. The COPCs due to carcinogenic risk based on this risk level are arsenic, PCBs (Aroclor 1254 and Aroclor 1260), and PAHs (benzo(a)pyrene, benzo(a)anthracene, and dibenzo(a,h)anthracene).

Arsenic is a naturally occurring element in soil, therefore, evaluating the remediation goal for this element must take into consideration background concentrations. Bioavailability also must be considered. The calculated PRG concentration of arsenic at 1 x 10^{-6} cancer risk is 0.77 mg/kg. Site-specific background concentrations were observed as high as 12.4 mg/kg and the RME concentrations were 4.03 at KPN and 5.98 at KPS. These RME concentrations are well within the expected range for natural soils in the eastern U.S. Arsenic bioavailability increases at high (>8) soil pH levels and decreases in the presence of iron oxides and clay in soil (ATSDR, 2007; EPA, 2005a). The soil pH data collected in 2008 showed the soil pH concentrations to be 6.44 to 7.44. Because arsenic RME concentrations on the Site are present at below site-specific background concentrations, and they are less bioavailable due to the neutral soil pH at the Site, arsenic was not selected as a COC, and therefore no PRG for arsenic was developed.

The calculated site-specific soil concentrations that would result in 1 x 10^{-6} cumulative excess cancer risk based on the site-specific HHRA are less than the RME calculated for the following three PAHs: benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene. Therefore, the calculated risk-based soil concentrations will be used as the PRGs.

Calculations performed to develop these risk-based cleanup goals are presented in Appendix B.

3.2.4 Other PRGs

Potential risks from migration of landfill gas were identified in the ATSDR Health Consultation (ATSDR, 2006). E&E conducted soil gas screening during the installation of monitoring wells, which detected elevated levels of methane in monitoring well boreholes. The Johnson Company conducted supplemental soil gas sampling across the Site and indoor air sampling at the former Kenilworth-Parkside Recreation Center. Methane presents an explosion hazard at concentrations in air between 5% (50,000 ppmv), the lower explosive limit (LEL), and 15% (150,000 ppmv), the upper explosive limit (UEL). Soil vapor sampling for methane found concentrations of methane in the subsurface soil in excess of the LEL at one location at KPN and at two locations at KPS. No methane was detected in most of the other twenty-four probes tested, however, at three locations between 23,000 and 140,000 ppmv methane was detected in the subsurface, which indicates a potential explosion hazard in some areas if construction work penetrated the ground to the depth of the methane. Sampling conducted inside the Kenilworth-Parkside Recreation Center did not identify any detectable methane levels in the building.

The presence of significant concentrations of landfill gas in the subsurface is a potential hazard that will need to be managed, since gas migration could affect on-site buildings. Soil vapor data indicate that off-site migration of methane into adjacent properties is not likely a risk in the future (see Section 2.5). An applicable to be considered (TBC) criterion is the EPA guidance for evaluating risks associated with the potential presence of methane (EPA, 2005). That guidance sets forth evaluative steps if methane is detected above the LEL (approximately 5% methane by volume) in soil vapor at a landfill property boundary or above 25% of the LEL within a structure. These guidance values are selected as PRGs for methane for the Site. In addition, the Occupational Health and Safety Administration regulates worker exposure to hazards from explosive atmospheres in confined spaces such as excavation pits or trenches and a PRG for workers has been included based on those regulations.

3.2.5 *Selection of Remediation Goals*

The PRG that is most protective of a receptor at the selected target risk level for a given analyte is selected as the Site-specific Remediation Goal (RG). A summary of the final COCs/CECs and their associated RGs derived for the Site is provided in Table 3-5.

Table 3-5
COCs and RGs

COC	Units	RG	Basis
PCBs			
Aroclor 1254	mg/kg	0.44	Child/Adult Site Visitor
Aroclor 1260	mg/kg	0.25	Child/Adult Site Visitor
Lead			
Surface/Subsurface [1] (0-15 ft bgs)	mg/kg	455	Construction Worker
Methane			
Property Boundary	% LEL[2]	<100%	RCRA Landfill Gas Regulations 40 CFR § 258.23
Inside Buildings	% LEL[2]	<25%	RCRA Landfill Gas Regulations 40 CFR Part § 258.23
Site Worker in a Confined Space	% LEL[2]	<10%	29 CFR § 1910.146
PAHs			
Benzo(a)anthracene	mg/kg	1.23	Child/Adult Site Visitor
Benzo(a)pyrene	mg/kg	0.12	Child/Adult Site Visitor
Dibenzo(a,h)anthracene	mg/kg	0.12	Child/Adult Site Visitor
1. Risk estimation for lead exposure would be based on an area-wide average for the work site, considering both vertical and horizontal distribution of lead.			
2. LEL – Lower Explosive Limit is 5% by volume (50,000 ppmv) methane in air			

3.3 REMEDIATION GOAL EXCEEDANCES

Remediation Goals (RGs) summarized in Table 3-5 for PCBs, lead, PAHs and methane were compared to available surface, subsurface, and sediment data to determine RG exceedances. The maximum depth evaluated for subsurface soils was 15 feet, identified in the HHRA as the maximum depth for Site construction worker exposure. The RG exceedances for PCBs, lead, and PAHs are shown on Figures 3-1 and 3-2 for KPN and KPS, respectively; and for methane on Figures 2-2 and 2-3 for KPN and KPS, respectively. These exceedences are discussed in further detail in the following sections.

It should be noted that imported fill was brought onto KPN by the District of Columbia in 2006 to build up and level an area for new sports fields (see Figure 2-1), which occurred after the surface soil sampling took place for the RI. Consequently, there are no current surface soil data from that area. This project was near completion when the munitions shell was discovered at KPN. As mentioned previously, the Department of Defense researched its records following the discovery and found no information on the munitions shell or why it was found at Kenilworth Park. The Site has never been used as a military installation and no other ordnance have been discovered during the many years of subsurface investigations, excavation and re-working of the landfill surfaces, or filling operations.

3.3.1 Kenilworth Park Landfill North

3.3.1.1 Lead RG Exceedances

Two of the 23 surface soil samples that were analyzed for lead exceeded the 455 mg/kg RG. All 18 subsurface soil samples exceeded the RG, indicating that lead is a contaminant primarily in buried waste material, rather than in surface soil. The subsurface samples were collected from strata 4-feet bgs or deeper.

The HHRA evaluation for lead in soils at KPN did not find excess risk from lead exposure because the sample locations with high concentrations were located at depths within the waste material and scattered across areas that also had sample locations with lower concentrations, so the resulting overall exposure would not result in blood lead levels that posed excess risk for site visitors or construction workers. If worker exposure for more than 90 days within an individual area and at depths where high lead concentrations had been reported or would be expected (i.e., extended work in an excavation into the waste materials), additional sampling, engineering controls, or another risk analysis may be needed. For this reason, lead was retained as a COC.

3.3.1.2 PCB RG Exceedances

The PCB RGs were set for two Aroclors: Aroclor 1254 – 0.44 mg/kg and Aroclor 1260 – 0.25 mg/kg, based on the 1 x 10^{-6} human health risk. All but two surface sample locations reported PCB concentrations in excess of the 1 x 10^{-6} human health risk threshold. Only three subsurface sample locations reported Aroclor concentrations above screening levels, and the reported values were only slightly above the RGs, indicating that PCBs are primarily a surface soil contaminant.

3.3.1.3 Methane RG Exceedances

Methane concentrations exceeded the Site worker RG at one location (KPN-JCO-SV-09S), where it was reported at concentrations of 74%, 78%, and 81% of the LEL in the primary, duplicate, and lab duplicate samples, respectively. Methane concentrations did not exceed RGs at the property boundaries or inside the Kenilworth-Parkside Recreation Center building on the Site.

3.3.1.4 PAH RG Exceedances

PAH contamination in excess of RGs was reported in over half of the surface soil samples collected at KPN. Benzo(a)pyrene was the primary PAH that exceeded the RGs with a maximum concentration of 1.1 mg/kg (the RG is 0.12 mg/kg)

3.3.2 Kenilworth Park Landfill South

3.3.2.1 Lead RG Exceedances

There are 13 locations in KPS where reported lead concentrations in soil exceed the RG. Two of them are from sediments, one is from surface soils, seven are from subsurface soils, and three are from unknown depths (MW-7, MW-10, and BH-16 sampling depths were identified as "from augers" in the 2000 PA/SI report). It should be noted that the 1998 report stated that the Geoprobe® samples (GS-4, 5, 6, and 8) appeared to be of landfill materials (E & E, 1998) and that the locations of lead RG exceedances identified in samples collected during field efforts for the 2000 PA/SI (MW-7, MW-9, MW-10, BH-8, BH-12, BH-16) and depths (where depth data is available) indicate that these samples may also be from landfill material. These findings suggest that, as with KPN, lead is primarily a subsurface (i.e., buried waste) contaminant.

The HHRA evaluation for lead in soils at KPS did not find excess risk from lead exposure because the sample locations with high concentrations were located at depths within the waste material and scattered across areas that also had sample locations with lower concentrations, so the resulting overall exposure would not result in blood lead levels that posed excess risk for site visitors or construction workers. If worker exposure for more than 90 days within an individual area and at depths where high lead concentrations had been reported, or would be expected, i.e., extended work in an excavation into the waste materials, additional sampling, engineering controls or another risk analysis may be needed. For this reason, lead was retained as a COC.

3.3.2.2 PCB RG Exceedances

Three surface soil sample locations in the northeastern portion of KPS east of Deane Avenue where new fill was not placed in 1997-1998 showed PCB results higher than the RGs. No surface soil samples were collected from the areas of the new fill and analyzed for PCBs, although 18 subsurface samples from the new fill were collected and analyzed for PCBs during the field efforts for the 2000 PA/SI. Those results did not indicate any PCB RG exceedances. It is assumed that the subsurface soil sample results are representative of the surface soil in the area of the new fill. These results suggest that PCB contamination of surface soil in the northeastern portion of KPS (as measured by the three surface soil samples described above) pre-dates, and is unrelated to, the 1997-1998 fill material.

3.3.2.3 Methane RG Exceedances

Methane concentrations exceeded the Site worker RG at three soil vapor locations: SV-01S (46% of the LEL), SV-06D (280% of the LEL), and SV-07S (178% of the LEL in the primary sample, and 181% of the LEL in the duplicate). These locations likely reflect methane concentrations in landfill material. Additional methane testing near the Neval Thomas

Elementary School and D.C. Transfer Station in 2009 did not identify any methane concentrations in excess of the RG, indicating that methane is not migratory beyond the limits of waste disposal and is not a risk to the school or the school yard.

3.3.2.4 PAH RG Exceedances

PAH contamination in excess of RGs was reported in surface soil samples throughout KPS. Benzo(a)pyrene was the most common contaminant. Exceedances were also frequent in the subsurface soil samples.

4.0 GENERAL RESPONSE ACTIONS AND IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

4.1 GENERAL RESPONSE ACTIONS

General response actions describe those actions that will satisfy the RAOs and provide a framework for identifying specific remedial technologies. Like RAOs, they are medium-specific. For the Site, the media of concern and the focus of the RAOs are surface and subsurface soil and soil gas.

General response actions identified for the Site include one or a combination of the following:

- **No action** – no remedial activities would be implemented under the no action alternative. This alternative is required to be considered by the NCP and CERCLA as a baseline against which other alternatives can be compared;

- **Limited actions** – includes institutional controls or administrative actions to limit land use or access. Examples include deed notices and advisories, long-term environmental monitoring, and point-of-use drinking water treatment.

- **Containment** – includes physical barriers or structures to contain contaminated media, to prevent contaminant migration, or to prevent exposure by blocking exposure pathways. Examples include: caps, slurry walls, and sheet piles;

- **Removal** – includes methods to physically remove contaminated media from the environment such as soil excavation;

- **Treatment** – includes technologies or processes to physically or chemically remove or alter contaminants from contaminated media. Treatment may be conducted either *in-situ* or *ex-situ.* Examples of treatment for soil include: thermal treatment, fixation, and solidification.

- **Disposal** – includes methods for final disposition of contaminants or treated media. Examples include: disposal in on-site or off-site permitted facilities.

4.2 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES PROCESS OPTIONS

This section of the FS documents the identification and screening of remedial technology types and process options applicable to each general response action. Technology types and process options retained from the identification and screening step will be used to formulate remedial alternatives discussed in subsequent sections of the FS.

4.2.1 Approach

Remedial alternatives are developed by assembling combinations of applicable technologies and other unit processes into a sequence of actions which address the specific media to which they would be applied and the RAOs that were developed for the Site. Accordingly, the identification and screening of remedial technology types and process options is a necessary and important first step in the development of alternatives.

The NCP and CERCLA guidance emphasize that a range of technology types and process options be identified and evaluated including innovative treatment technologies and treatment technologies that reduce the toxicity, mobility, or volume of contaminants to the extent practicable. However, EPA has developed guidance specific to municipal landfills intended to streamline the RI/FS process (US EPA, 1991). The guidance describes a presumptive remedy that includes remedial technologies appropriate for municipal landfill CERCLA sites, given their typically large volume, low relative toxicity, and heterogeneous waste. The primary remedial technology included in the presumptive remedy is containment (i.e., capping). When appropriate, capping is combined with: treatment or consolidation of highly contaminated soils/waste materials (i.e., "hot spots"); extraction and treatment of contaminated groundwater and leachate to prevent off-site contaminant migration; and passive or active landfill gas (methane) collection and venting or treatment. As described in Sections 2.0 and 3.0, the Site does not have identified “hot spots”; whether contaminated groundwater/leachate is transporting contaminants off-site will be further evaluated as a part of OU2; and the Site does not have concentrations of methane that would warrant passive or active gas collection and venting/treatment.

The matrix of process options developed in this section is not intended to comprise the universe of all processes that exist; it is intended as a broad spectrum of potentially applicable process options considering Site conditions and risk assessment results for the Site. According to CERCLA guidance (1988), the goal is to select at least one representative process for each technology type retained in order to simplify the subsequent development and evaluation of remedial alternatives. Additionally, a 5-year review process is required for any alternative that would leave residual contamination on the Site.

The evaluation of remedial technology types and process options is a two-step process. The first step is an initial screening of technologies and process options. This is generally done on the basis of technical implementability in order to eliminate process options or entire technology types that would clearly be ineffective or unworkable considering site and waste characteristics. The types and concentrations, and physical and chemical properties of the wastes or contaminants can also influence the selection of suitable technologies. Typically, this screening step is site-specific; however, other factors may also need to be considered.

The second step in this process is to evaluate the process options considered to be technically implementable in greater detail in order to select the representative process for each technology type. The evaluation of process options is generally based on three criteria: (1) effectiveness, (2) implementability; and (3) cost. Although these are the same criteria used to screen remedial alternatives prior to detailed analysis, at this stage these criteria are applied only to technologies and process options and not to site-wide alternatives. In addition, the evaluation of process options focuses more on assessing effectiveness and less on implementability and cost. Factors relating to effectiveness include how proven and reliable the process is, how well the process can handle large areas or volumes of contaminated media, and how well the process meets the remediation goals. Implementability focuses on the technical feasibility and availability of the technologies each alternative would employ and the administrative feasibility of implementing the alternative. Alternatives that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period of time may be eliminated from further consideration. Finally, the relative overall costs (for design, construction, operations and maintenance) of each process option, expressed in qualitative terms (e.g., low, average, high), is only considered if it contributes to deciding which specific process option should be retained for the development of remedial alternatives.

The information used to compile technology and process options in this section was obtained from multiple sources including technical literature, regulatory guidance documents, internet resources, and technology evaluations conducted for other sites.

4.2.2 Identification and Screening of Technologies and Process Options

An initial set of technology types and process options was identified for each of the general response actions developed for the Site. Table 4-1 presents a matrix showing representative process options for each of the remedial technologies identified. Technologies and process options are grouped primarily based on combining similar operating principles of technology types. As shown in Table 4-1, several broad technology types are identified for each general response action, and numerous process options are identified within each technology type. The technical feasibility or applicability of the process options are also indicated in Table 4-1.

Table 4-1
General Response Actions, Technology Types,
and Process Options for Remediation

General Response Actions	Remedial Technology Types	Process Options	Technically Feasible
No Action	No Action	No Action	Yes
Limited Action	Reduce Infiltration and Potential for Mobilization of Contaminants	Fill and re-grade depressions and differentially settled areas	Yes
	Institutional Controls	Land use restrictions, inform park officials, and hold public meetings	Yes
Containment	Capping	Soil, asphalt	Yes
		Clay, multi-media	Yes
Removal	Excavation	Removal of soil and landfill contents from Site	Yes
Treatment	Thermal	Incineration, thermal desorption, or pyrolysis	No[2,3]
	Physical / Chemical	Dehalogenation	No[3,4]
		Chemical extraction, or soil washing	No[3]
	In-Situ Treatment	Soil vapor extraction, soil flushing, steam stripping	No[2,4]
		Biodegradation, chemical oxidation	No[2]
		Solidification /stabilization	No[3]
Disposal	Off-site Disposal	Disposal at existing off-site landfill	Yes
	On-site Consolidation	Consolidation within existing landfills	No[5]

[1] Five year reviews would be a part of any General Response Actions/Remedial Technology Types other than No Action and complete removal.
[2] Not feasible for treating inorganics (e.g., lead)
[3] Not feasible for large quantity of low-level contaminated soil
[4] Not feasible for treating semi-volatile or non-halogenated compounds (e.g., PAHs, PCBs)
[5] No hot spots to consolidate (i.e., wide-spread low level contamination) so not feasible.

Only process options with demonstrated effectiveness and applicability to the contaminants identified in Section 3.2, and to the nature and extent of contamination, were retained. For the soil and fill at the Site, which is characterized mainly by large volumes of relatively low levels of contamination, the range of applicable technologies is further limited by the exclusion of more intensive treatment technologies that would be required at sites with more heavily-contaminated material.

Note that the CERCLA “presumptive remedy” for municipal landfills is containment, because the volume and heterogeneity of the waste generally makes treatment or complete removal and off-site disposal impracticable. The framework for this presumptive remedy is presented in *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (USEPA, 1991).

The technically feasible and Site-appropriate process options that were retained in the initial screening as identified in Table 4-1 are described in more detail in Table 4-2.

Table 4-2
Retained Remediation Technologies and Process Options

Remedial Technology Categories and Process Options	**Description**	**Initial Screening Comments**
No Action		
No Action	No action would be taken.	Provides baseline against which other remedial technologies can be compared.
Limited Action		
Engineering Controls	Fencing is installed to restrict access.	Feasible to construct fence to restrict access to contaminated soil in the park.
Institutional Controls	Deed notices and restrictions are generated.	Feasible to restrict use of land in areas with contaminated soil.
	A public awareness program is initiated.	Feasible to develop and implement public awareness programs. Such programs may reduce likelihood of public exposure to contaminants.
Containment		
Soil Cap	Contaminated surface soils are covered with a compacted soil cap (i.e., cover material and top soil).	Feasible and would mitigate direct contact risks and can reduce infiltration (i.e., reduce contaminant mobility and migration potential).
Asphalt Cap	Contaminated soils are covered with a gravel sub-base and a layer of asphalt.	Feasible and would mitigate direct contact risks and can reduce infiltration (i.e., reduce contaminant mobility and migration).
Removal		
Excavation	Excavation involves removal of contaminated soil using backhoes,	Feasible for removal of contaminated soil in select locations; required component of many potential process

Table 4-2
Retained Remediation Technologies and Process Options

Remedial Technology Categories and Process Options	Description	Initial Screening Comments
	bulldozers, and front-end loaders	options.
Disposal		
Off-site Disposal	Excavated soil would be transported to an existing off-site landfill	Feasible for disposal of at least limited quantities of contaminated soil.

5.0 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

This section of the FS documents the development and initial screening of remedial alternatives. The alternatives retained in this process are carried forward for detailed analysis in Section 6.0.

5.1 APPROACH

The NCP requires that a range of remedial alternatives be considered in an FS. "The number and type of alternatives to be analyzed shall be determined at each site, taking into account the scope, characteristics, and complexity of the site problem that is being addressed." (NCP § 300.430(e)(2)).

The NCP requires the development of remedial alternatives that consider the use of treatment options that reduce the toxicity, mobility, or volume of contaminants as a principle element; involve little or no treatment but provide protection of human health and the environment through engineering controls or institutional controls; and include a no-action alternative.

For this FS, the technology process options evaluated, screened, and ultimately retained in Section 4.0 were combined to create a range of remedial alternatives that achieve the RAOs and meet the requirements of the NCP.

5.2 DEVELOPMENT AND INITIAL SCREENING OF REMEDIAL ALTERNATIVES

The remedial alternatives developed for this FS are described in the following subsections. The first alternative is the No Action alternative which is required by the NCP and used as a baseline for comparison to other alternatives. The remaining alternatives, Alternatives 2 through 4, provide increasingly aggressive options for remediation ranging from minor regrading and institutional controls (Alternative 2) to removal of all accessible waste material (Alternative 4).

The primary purpose of the initial screening of remedial alternatives is to refine and to reduce the number of alternatives that will be analyzed in detail. However, CERCLA guidance (USEPA, 1988a) provides that in situations where the number of viable or appropriate alternatives is limited, the screening effort may be minimized or eliminated if unnecessary. Accordingly, the five remedial alternatives developed in this section were not subject to initial screening and were all carried forward for detailed analysis in Section 6.0.

5.2.1 Alternative 1: No Action

Under the No Action alternative, contaminated soils would be left in place with no treatment or controls to prevent human or ecological exposure. The No Action alternative does not mitigate any exposure pathways nor does it reduce the toxicity, mobility, or volume of the contaminated soil.

5.2.2 Alternative 2: Minor Regrading and Institutional Controls

This Alternative would include the improvement of on-site surface drainage by filling and regrading depressions and differentially settled areas in the previously placed landfill cover soils to eliminate surface water ponding. This will help reduce infiltration to the subsurface fill material and improve the usability of the Site for recreation. Six inches of topsoil would be placed over the new fill and disturbed cover soils, which would then be seeded and mulched to protect against erosion and provide stability once vegetation is established.

This Alternative also includes three years of annual perimeter methane monitoring and institutional controls to restrict subsurface activities to prevent contact exposure to contaminated soil and exposure to hazards associated with explosive landfill gas (i.e., methane), and limit future land use (i.e., no residential use).

5.2.3 *Alternative 3: Soil Cap, Localized Shallow Excavation and Off-site Disposal Where Pre-excavation is Required, and Institutional Controls*

This alternative includes the installation of a soil cap to prevent human exposure to contaminated soils and to reduce infiltration of precipitation into the former landfill materials. Within Alternative 3 there are two variations: Alternative 3a - a 12-inch thick soil cap; and Alternative 3b - a RCRA Subtitle D 24-inch thick, low-permeability soil cap. The primary purpose of the soil caps is to achieve the remedial action objective (RAO) of preventing human exposure to PCBs, PAHs, and metals in surface soils (see Section 3.2.1). Either cap would break the exposure pathway for human receptors, particularly Park visitors, to areas of contaminated surface soil. A second purpose of the 24-inch low permeability soil cap (Alternative 3b), which would meet the permeability requirement of a RCRA Subtitle D cap (1 x 10^{-5} cm/s), is to limit infiltration of precipitation through the cap thereby minimizing impacts to groundwater .

Actions required prior to the installation of the cap include minor regrading and filling of low areas as described in Alternative 2, and the shallow excavation of soil around the existing developed features in the vicinity of the former Kenilworth-Parkside Recreation Center (buildings, walkways, paved parking lots, tennis courts, basketball courts, catch basins, etc.) to accommodate the placement of the cap without increasing the ground surface elevation adjacent to these features. At present, it is anticipated that the former Kenilworth-Parkside Recreation Center will be replaced with a new facility in the general vicinity of the former Recreation Center, so the infrastructure in and around that location needs to be preserved. The existing road through KPN and KPS (Deane Avenue) and associated parking areas would be built up a similar height as the adjacent cap, so would not require pre-excavation. Both cap designs include a 6-

inch layer of topsoil to facilitate re-vegetation. The current ground surface at Kenilworth Park Landfill South would be re-graded to level out existing soil piles and depressions to facilitate the installation of a smooth cap. The cap would be seeded and mulched to protect against erosion, to provide stability once vegetation is established, and to conform to NPS-specific ARARs.

Where steep slopes along the Anacostia and adjacent to the Kenilworth Marsh are currently well vegetated with mature bushes and trees, they would be left undisturbed to limit the potential for future erosion and sediment transport. These areas are not conducive to active recreation due to their relatively steep slopes and well developed vegetation and represent a small portion of the total land area of the covered landfills.

However, the long-term expectation for the shoreline area of the Site along the Anacostia River is one of increased visitation as the Anacostia River water and sediment quality improve over time and the shoreline becomes more inviting for recreational activities. For example, D.C. is finalizing plans to build a recreational trail that parallels the Anacostia River through KPN and KPS. Therefore, Alternative 3 includes installation of a soil cap (with pre-excavation to maintain existing topography within the floodway) in shoreline areas along the Anacostia River that exhibit RG exceedances.

This Alternative also includes six rounds of annual perimeter methane monitoring before, during, and after the remedial action.

Institutional controls would be the same as for Alternative 2: controls for subsurface work activities to prevent contact exposure to contaminated soil and exposure to hazards associated with landfill gas (i.e., methane), as well as limits on future land use (i.e., no residential use).

5.2.4 *Alternative 4: Removal of All Accessible Waste Material and Existing Cover Soils, Wetlands Restoration, and Institutional Controls*

All existing cover soil, imported fill, and municipal waste at both KPN and KPS, except in the developed area in the vicinity of the former Kenilworth-Parkside Recreation Center, would be excavated down to native soils and disposed off-site under Alternative 4. It is presently anticipated that the former Kenilworth-Parkside Recreation Center will be replaced in generally the same vicinity, and that the area surrounding it would continue to be utilized for recreational purposes and therefore the existing developed features would need to be retained (sidewalks, parking lots, tennis courts, basketball courts, other buildings, etc.). A stable vegetated slope would be created from the area around the former Kenilworth-Parkside Recreation Center (5 - 8 meters elevation) to the ground surface that pre-existed the landfill activities (approximately sea level). In the area of the former Kenilworth-Parkside Recreation Center, a compacted soil cap with localized shallow excavation as described in Alternative 3 would be used to mitigate risk from contact with the remaining soil.

Institutional controls would include restriction of subsurface work activities in the area of the former Kenilworth-Parkside Recreation Center to prevent contact exposure to contaminated soil and exposure to hazards associated with landfill gases (i.e., methane), and limits on future land use (i.e. no residential use). Because complete removal of contaminated soil and municipal waste/incinerator ash is contemplated for the remaining portions of the Site under this alternative, institutional controls would not be required for the fully excavated and restored areas.

6.0 DETAILED ANALYSIS OF ALTERNATIVES

This section documents the detailed analysis of remedial alternatives for OU1 of the Site. The level of detail describing these alternatives is conceptual. Once an alternative has been selected as the Site remedy by NPS, additional information and data will be collected and/or compiled during the pre-design and design phases to develop the detail necessary to implement that alternative.

6.1 APPROACH

The focus of this FS is the development and evaluation of remedial alternatives to address contaminated soil and soil gas associated with the Site. The purpose of the detailed analysis of remedial alternatives is to provide information to facilitate the evaluation of individual alternatives against each of the nine CERCLA remedy selection criteria and to allow for the comparative analysis of the performance of each alternative against those criteria.

The NCP requires that the detailed analysis of remedial alternatives be conducted using nine evaluation criteria (NCP 300.430(e)(9)(iii)). Table 6-1 presents a summary of the nine evaluation criteria.

The nine evaluation criteria are:

1. overall protection of human health and the environment;
2. compliance with ARARs;
3. long-term effectiveness and permanence;
4. reduction of toxicity, mobility, or volume through treatment;
5. short-term effectiveness;
6. implementability;
7. cost;
8. state acceptance; and
9. community acceptance.

Table 6-1
CERCLA Evaluation Criteria for the Detailed Analysis of Remedial Alternatives[1]

Category	Criteria	General Description	Factors to Consider
Threshold Criteria	Overall Protection of Human Health and the Environment	Describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.	Elimination, reduction or control of site risks posed through each pathway Unacceptable short-term or cross-media impacts
	Compliance with ARARs	Describes how the alternative complies with ARARs, or if a waiver is required and how it is justified.	Compliance with action-specific, location-specific, and chemical-specific ARARs Compliance with other criteria, advisories & guidance
Balancing Criteria	Long-Term Effectiveness & Permanence	Evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after the response objectives have been met.	Magnitude of residual risk Adequacy and reliability of controls
	Reduction of Toxicity, Mobility, and Volume Through Treatment	Evaluates the anticipated performance of the specific treatment technologies that an alternative may incorporate.	Treatment process used and materials treated Amount of hazardous materials destroyed or treated Degree of expected reductions in toxicity, mobility, and volume Degree to which treatment is irreversible Type and quantity of residuals remaining after treatment Degree to which treatment reduces principal threats
	Short-Term Effectiveness	Examines the effectiveness of alternatives in protecting human health and the environment during construction and implementation of a remedy until the response objectives have been achieved.	Protection of the local community during remedial actions Protection of workers during remedial actions Environmental impacts of remedial action activities Time until remedial action objectives are achieved

Table 6-1 **CERCLA Evaluation Criteria for the Detailed Analysis of Remedial Alternatives[1]**			
Category	**Criteria**	**General Description**	**Factors to Consider**
	Implementability	Evaluates the technical and administrative feasibility of alternatives and the availability of services, equipment and skilled manpower.	Ability to construct and operate the technology Reliability of the technology Ease of undertaking additional remedial actions if necessary Ability to monitor effectiveness of remedy Coordination with other agencies Availability of off-site treatment, storage, disposal services & capacity Availability of necessary equipment and specialists Availability of prospective technologies
	Cost	Assesses the capital and operation and maintenance (O&M costs of each alternative.	Capital costs Operating and maintenance costs Present worth cost Accuracy of cost estimates: +50% to -30% Performance period: 30 years
Modifying Criteria	State Acceptance	Assesses the state's or support agency's preferences among or concerns about the alternatives.	To be sought from the District of Columbia
	Community Acceptance	Assesses the community's preferences among or concerns about the alternatives.	To be sought through community involvement, particularly during the public review period of the Proposed Plan (which follows the RI/FS)

1. Sources: NCP 300.430; 55 FR 8849; USEPA. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.* EPA/540/G-89/004. October 1988.

The last two criteria are used to determine whether the preferred alternative is acceptable to a state or support agency and to the local community. Generally, state and community acceptance are assessed during the public comment period after a Proposed Plan is published, and documented in the final decision document (the Record of Decision, or ROD). In the present case, NPS has consulted with the District in the development of the Kenilworth Feasibility Study. The District will have the opportunity to provide formal input, along with the community, following issuance of the Proposed Plan. Accordingly, the detailed analysis of alternatives presented in this FS is based on an evaluation of the first seven criteria.

The NCP and CERCLA guidance outline factors to be considered for each of the nine criteria that facilitate a thorough analysis of the alternatives. Factors for each criterion are summarized in Table 6-1. The costs presented in this FS are based on existing data and knowledge of the Site and will be refined as part of remedial design of the selected alternative. In general, cost estimates consist of two components: (1) capital costs and (2) on-going operation and maintenance (O&M) and administrative costs. Capital costs consist of direct and indirect costs that typically include expenditures initially incurred to develop, construct, and implement the remedial alternative. O&M and administrative costs refer to expenditures associated with activities such as operation and maintenance costs for treatment systems, long-term environmental monitoring, and the cost for five-year reviews. According to CERCLA guidance, the costs are intended to be accurate with a range of -30 to +50 percent of the actual costs. For comparative purposes, the costs for each alternative are estimated for 30 years, regardless of the anticipated time frames beyond 30 years that may be required to meet RAOs.

The following subsections present the detailed analysis of remedial alternatives considered for the Site. For each alternative, a general description of the individual components of the alternative is provided, followed by a detailed evaluation of the alternative against the seven criteria, including compliance with the chemical-specific, location-specific, and action-specific ARARs presented in Table 3-1. A comparative analysis of the alternatives in terms of the evaluation criteria is provided in Section 7.0.

6.2 ALTERNATIVE 1 – NO ACTION

6.2.1 Description

The No Action alternative is required to be considered under CERCLA and the NCP as a baseline against which to compare other remedial alternatives. In a No Action alternative there are no institutional controls, no long term monitoring, and no remedial actions implemented at a site.

6.2.2 Detailed Evaluation

Overall Protection of Human Health and the Environment

A No Action alternative would not be protective of human health since there are currently potential risks to: 1) visitors from exposure to PCBs and PAHs in surface soils; and 2) Site workers from exposure to lead or methane in the subsurface. This alternative would not address these potential risks.

Compliance with ARARS

This alternative would not meet the requirements of RCRA Subtitle D that relate to methane concentrations and exposures – a chemical-specific ARAR for the Site (see Table 3-1) – without institutional controls to manage the potential risks of those exposures by Site workers to subsurface landfill gas. Nor would this alternative allow for unrestricted use of the Site under future use scenarios and therefore fails to comply with the NPS Organic Act.

No action-specific ARARs would be triggered since no active remediation is included in Alternative 1.

Long-Term Effectiveness and Permanence

Alternative 1 does not include institutional controls or remedial actions to prevent human exposure to soil contamination or methane in the subsurface, so those risks would continue to be present in the future. Methane concentrations would be expected to naturally abate over time due to the ultimate biodegradation of the residual organics in the landfill waste materials, but it may take decades for the methane to abate to levels that would not be of concern for subsurface workers. PCBs and PAHs (the compounds that exceed their RGs in surface soil) degrade very slowly over time, and lead not at all, and so would also be expected to be present at the Site for decades. Therefore, Alternative 1 is not considered to be effective in the long term, or permanent.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternative 1 has no active treatment process that would reduce toxicity, mobility or volume.

Short-Term Effectiveness

There are no remedial activities involved in Alternative 1; therefore, there are no short term risks, threats, or adverse impacts posed to the community, workers, or to the environment as a result of this alternative.

Implementability

Alternative 1 would not involve any construction or remedial activities, would not require approvals or coordination with regulatory agencies, and therefore is readily implementable. Equipment, materials, and trained personnel for five-year review reporting are readily available.

Cost

Because there are no remedial activities for Alternative 1, no capital costs (either direct or indirect) would be incurred.

Costs for Alternative 1 would consist only of costs for five-year reviews. No long-term monitoring would be performed for Alternative 1. The estimated total present worth (at five percent interest for 30 years) of costs for the five-year reviews for Alternative 1 is $84,000. Details for this cost estimate are provided in Appendix C.

6.3 ALTERNATIVE 2 – MINOR REGRADING AND INSTITUTIONAL CONTROLS

6.3.1 Description

Minor Regrading

There are several areas at the Site where hummocks remain from prior Site work, or where depressions are present from differential settlement. Some of the depressions collect surface water drainage after precipitation events that contribute to infiltration through the subsurface waste materials to the groundwater beneath. There are also settlement depressions in a parking area at KPN. This alternative includes minor regrading to smooth these areas. These areas are shown on Figure 4-1, and include leveling the hummocks and filling depressions in three areas in KPS using existing soil (shown as green areas on Figure 4-1), importing clean soil to fill in six depressed areas in KPN (shown as purple areas on Figure 4-1), and importing clean gravel backfill to level the grades at a parking area in KPN (shown as the light brown area on Figure 4-1). Topsoil would be used as the top layer in the non-parking regraded areas, and revegetated to match the surrounding areas. The approximate areas shown on Figure 4-1 are based on visual observations and review of aerial photos and are not necessarily inclusive of all depressions. Additional depressions identified during remedial design would be included in the areas addressed by this alternative.

Institutional Controls

This alternative would include implementation of institutional controls to restrict future activities that might otherwise result in health risks or hazards. Institutional controls (ICs) are administrative and/or legal instruments that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use. Both CERCLA and the NCP support the use of ICs as part of the remedial alternative at sites if necessary to protect human health. (CERCLA § 121(d); NCP § 300.430(a); USEPA, 2009a). ICs can be layered (i.e., using different types of ICs at the same time to enhance protectiveness of the remedy) or implemented in series to ensure both the short-term and long-term effectiveness of the remedy. A layered IC approach is recommended in CERCLA guidance as a means of providing overlapping assurances of protection (USEPA, 2000). ICs can be deed notices, health advisories, local ordinances, zoning restrictions, part of site management plans, etc.

Institutional controls under this, and all remaining alternatives described below, would be designed to require the following.

1. Health and safety plans for future construction or utility projects at the Site that involve subsurface excavations should specify a pre-Site work evaluation to identify the potential risks, describe necessary monitoring during the work, and specify worker protection to ensure worker safety. The primary potential risk to Site workers is associated with potentially explosive levels of methane or oxygen-deficient conditions in the subsurface. Lead has also been identified as a potential risk to subsurface workers if they are working in areas with high lead levels for extended periods of time.

2. Residential development on the Site should be restricted, although this is not a contemplated future land use for the Site.

Property Boundary Methane Monitoring

Alternative 2 includes three successive annual rounds of property boundary methane monitoring at 15 soil vapor probes, to confirm the lack of off-site migration of methane documented in the Supplemental Data Collection report (Appendix A). Fifteen soil vapor probes are proposed for this limited duration methane monitoring program. If these monitoring events confirm the continued lack of off-site methane migration, the monitoring program would be discontinued after the third monitoring event.

Five-Year Reviews

CERCLA Section 121(c) requires five-year reviews of remedies at sites where hazardous substances, pollutants, or contaminants will remain on the site at levels that do not allow for “unlimited and unrestricted exposure.” (USEPA, 2001). Accordingly, Alternative 2 would include five-year reviews to assure that human health and the environment are being protected by the remedy.

6.3.2 Detailed Evaluation

Overall Protection of Human Health and the Environment

This alternative is not protective of human health since there are potential risks to visitors from exposure to PCBs and PAHs in surface soils and these contaminants are not addressed by this alternative. Exposure by Site workers to lead or methane in the subsurface is addressed with institutional controls. There are currently no unacceptable risks to the environment; therefore this alternative, as with the others, is protective of the environment.

Compliance with ARARS

This alternative would not allow for unrestricted use of the Site under future use scenarios and therefore fails to comply with the NPS Organic Act. Institutional controls would manage the potential risks of exposure by Site workers to subsurface methane, therefore this alternative would comply with those provisions of RCRA Subtitle D.

Action-specific ARARs associated with the limited active remediation included in this alternative, such as specifications for fill soil and requirements for erosion and sedimentation control, would be relatively easy to meet.

Long-Term Effectiveness and Permanence

Alternative 2 does not include remedial actions to prevent future exposure to surface soil contamination and, as described above, the compounds of concern degrade very slowly and are expected to be present in the surface soils at the Site for many decades. Therefore, those potential risks would continue in the future. Institutional controls should be effective over the long term in managing risks associated with potential worker exposure to methane and lead in the subsurface; however, due to the surface soil risks, Alternative 2 is not considered to be effective in the long term, nor permanent.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternative 2 has no active treatment process that would reduce toxicity, mobility, or volume.

Short-Term Effectiveness

There are few active remedial activities involved in Alternative 2; therefore, there are few short-term risks, threats, or adverse impacts posed to the community, workers, or to the environment from implementation of this alternative.

Implementability

The services, equipment, and trained personnel needed to conduct the activities in Alternative 2 are readily available and, therefore, this alternative would be implementable.

Cost

Capital costs for Alternative 2 are estimated at approximately $1M. Details for the cost estimate are provided in Appendix C.

6.4 ALTERNATIVE 3 – SOIL CAP, LOCALIZED SHALLOW EXCAVATION AND OFF-SITE DISPOSAL WHERE PRE-EXCAVATION IS REQUIRED, AND INSTITUTIONAL CONTROLS

6.4.1 Description

Soil Cap

In order to prevent visitor exposure to contaminants in the surficial soils at the Site, Alternative 3 provides for the installation of a clean soil cap. This cap would be either a total of 12 inches thick for Alternative 3a, or 24 inches thick for Alternative 3b. The soil cap for Alternative 3a would consist of 6 inches of clean fill overlain by 6 inches of topsoil for re-establishment of vegetation. The soil cap for Alternative 3b would be a RCRA Subtitle D cap: 18 inches of compacted clean fill to a permeability of 10^{-5} cm/s overlain by 6 inches of topsoil. Both caps will be protective of human health and the environment and meet the RAOs relative to exposure to contaminants in surface soil. Either soil cap would eliminate exposure to unacceptable levels of contaminants across the surface of the Site by isolating the RG exceedances shown on Figures 3-1 and 3-2 from visitors. The 24-inch cap in Alternative 3b would also provide a low-permeability layer which would promote surface runoff, thereby limiting infiltration that could otherwise impact groundwater quality. Alternative 3b also includes installation of a geogrid beneath the cap in the vicinity of play fields to minimize future subsidence.

At the time of the Site investigations, there were several buildings, asphalt paths and parking areas, tennis courts, basketball courts, etc. in the vicinity of the former Kenilworth-Parkside Recreation Center. Subsequently, the District demolished the Recreation Center, and currently is developing plans to rebuild the Kenilworth-Parkside Recreation Center on approximately the same footprint as the former building. The grades adjacent to these features cannot be increased by a layer of new soil and still maintain the functionality and aesthetics in the area. Therefore, in those areas, existing soil will have to be excavated before the new clean soil is placed to maintain the existing grades. The excavated soil will be removed from the Site and managed and disposed of in accordance with all applicable requirements. The areas where pre-excavation will be required prior to placement of the soil cap are delineated on Figure 4-2. The existing features in the vicinity of the pre-excavation and soil cap placement (walkways, buildings, parking lots, tennis courts, basketball courts, etc.) would be preserved during the excavation and cap placement activities.

The proposed overall extent of the soil cap at KPN, including the area around the former Kenilworth-Parkside Recreation Center where pre-excavation will be required, and at KPS, is shown on Figures 4-3 and 4-4, respectively. The soil cap is not proposed for the sports field area since that area was built up in 2006 with at least 3 feet of imported fill. Additional sampling in this area would be conducted during pre-design activities, however, to confirm that there are no RG exceedances in this imported fill.

The outside limits of placement of the new soil cap shown on Figures 4-3 and 4-4 were derived using the criteria shown in Table 6-2.

Table 6-2
Rationale for Soil Cap Limits – Alternatives 3a & 3b

Soil Cap Limit Criteria	Rationale
Historical limits of placement of landfill waste (as described in the Remedial Investigation reports)	RG exceedances outside of the waste placement area are outside of the Site.
Well-vegetated wooded areas	The vegetation in these areas, which provides wildlife habitat, erosion protection, and a buffer zone that protects surface water from sediment and contaminants in stormwater runoff, would be destroyed in the process of placing a clean soil layer, and would take many decades to re-establish to the current level. The existing vegetation also minimizes the ability for humans to come into physical contact with surface soil,
FEMA Floodway (Watts Branch)	Cap placement in the floodway could impede flood flow or otherwise increase the flood elevation which is not permitted. Excavation prior to cap placement to maintain the existing ground surface elevations would be required to avoid flood impacts.
Existing stormwater management features (KPS)	There are several stormwater drainageways and impoundments that protect receiving waters from water quality impacts from stormwater runoff. These features were designed and constructed as part of Site improvements implemented in 1999, and appear to be functioning well. Attempting to place a soil cap over most of these features could jeopardize their functionality. The stormwater impoundment along the east edge of KPS (along the unnamed tributary to Watts Branch) is an exception, and it is included in the capped area.
Areas of steep slopes	The extensive and relatively steep slopes at KPN and KPS are currently well vegetated, stable, and provide habitat along the Anacostia River. If these areas were included in the soil cap area, the existing mature vegetation would be destroyed and would have to be re-established, which would be difficult given the steep slopes. The existing vegetation provides habitat, minimizes the ability for humans to come into physical contact with surface soil, and prevents erosion and resulting soil transport to the Anacostia River by stabilizing the soil surface.

Although the steep slopes that are adjacent to the Anacostia River at the Site, and along the Watts Branch on KPS, are not included in the areas receiving a soil cap (see table above for the rationale), the portions of the corridors along the shorelines of these water ways that exhibit RG exceedances will be covered under this alternative. These areas are attractive to visitors for recreation (fishing, wading, and walking) and so a cap is required there for a remedy to be protective of human health. Beginning at sample location AR-2 (near the shore of the Anacostia River mid-way along the western edge of KPS – see Figure 3-2), there are occasional RG exceedances along the shoreline corridor north along the Anacostia River and up the Watts Branch to Deane Avenue. Therefore, Alternatives 3a and 3b include pre-excavation where necessary to maintain the existing topography within floodway zones, placement of a clean soil cap, installation of suitable erosion controls where needed, and revegetation along an approximately 1,600-foot long, 50-foot wide corridor between approximately AR-2 and Deane Avenue on KPS (see Figure 4-4). There are few surface soil data along the Anacostia River south of AR-2 in KPS, or along the Anacostia River in KPN. Therefore, surface soil sampling in those areas will be completed as part of pre-design activities.

Localized areas in the central portions of both KPN and KPS (the large majority of the soil cap area) that currently have uneven topography that detracts from the usability and aesthetics of the Site (as described under Alternative 2) would be smoothed and filled as necessary prior to placement of the soil cap to create a smooth finished ground surface. The top layer of the soil cap would be topsoil which would be re-vegetated to match the surrounding areas.

Institutional Controls

Institutional controls would be included in this alternative as described under Alternative 2 above to protect future Site workers from exposure to methane and lead in the subsurface, and to restrict future Site development for residential use.

Property Boundary Methane Monitoring

To confirm the lack of off-site migration of methane previously documented in the Supplemental Data Collection report (Appendix A), and to ensure that the implementation of the remedy does not change methane migration patterns and create a future off-site migration risk, Alternatives 3a and 3b include six rounds of property boundary methane monitoring at fifteen soil vapor probe locations:

1. within a year of completion of the FS;
2. immediately preceding the implementation of the remedial action;
3. during implementation of the remedial action;
4. immediately following completion of the remedial action;
5. one year after completion of the remedial action; and
6. part of the first five-year review.

If these monitoring events confirm the continued lack of off-site methane migration, the monitoring program would be completed after the sixth monitoring event.

Five-Year Reviews

CERCLA Section 121(c) requires five-year reviews of remedies at sites where hazardous substances, pollutants, or contaminants will remain on the site at levels that do not allow for "unlimited and unrestricted exposure." (USEPA, 2001). Accordingly, Alternatives 3a and 3b would include five-year reviews to assure that human health and the environment are being protected by the remedy.

6.4.2 <u>Detailed Evaluation</u>

Overall Protection of Human Health and the Environment

Alternatives 3a and 3b are protective of human health since the soil cap would isolate the PCBs and PAHs in the existing surface soils by creating a new clean soil layer at the surface, thereby preventing visitor exposure to contaminated soil. There are a few RG exeedances outside of the proposed limits of the new soil cap; however, they are in areas that are heavily vegetated where direct contact with contaminated soil is unlikely due to the lack of exposed soil and, therefore, do not represent a significant risk of routine exposure.

Exposure by Site workers to lead or methane in the subsurface is addressed by this alternative with institutional controls as with the other alternatives. There are currently no unacceptable ecological risks; therefore, these alternatives, as with the others, are protective of the environment.

Compliance with ARARS

Alternatives 3a and 3b would comply with the primary location-specific ARAR for the Site, the NPS Organic Act, since contaminants currently accessible to visitors would be isolated with the new soil cap, allowing for unrestricted use of the Site under recreational future use scenarios. For example, the District Department of Transportation and Department of Parks and Recreation have plans for a system of recreational trails in the vicinity of the Anacostia River that potentially include trails across both KPN and KPS. Alternatives 3a and 3b would be protective of human health along likely recreational trail routes. Such trails can be designed not to jeopardize and to be compatible with the proposed soil cap.

Alternatives 3a and 3b involve localized excavation around the location of the former Kenilworth-Parkside Recreation Center and associated recreational features and the associated off-site disposal of excavated soil, as well as earthwork across most of the rest of KPN and KPS. Therefore, compliance with a number of action-specific ARARs would be required. These ARARS are primarily District requirements related to erosion and sediment control and stormwater runoff management. The nature of the majority of the work that would be required (earthwork) is common construction, and control methods are readily available to comply with the action-specific ARARs that would apply. The construction required to install the soil cap along the Anacostia River and Watts Branch corridors would involve other location-specific ARARs associated with wetlands and floodplain protection as well as water quality impacts. Equipment, construction methods, and trained personnel that would be required to comply with these ARARs are readily available, although compliance would be somewhat more challenging than for the ARARs that apply to the interior and uplands portions of the Site. The controls that would be put in place to meet these ARARs would be specified in the Remedial Design and Remedial Action Work Plan documents (including an erosion and sediment control plan).

Alternative 3b includes the design details for meeting the requirements of a RCRA Subtitle D cap, which are relevant and appropriate requirements for remediation of a former municipal solid waste landfill, whereas Alternative 3a does not. Although Alternative 3b contemplates not covering certain limited areas of the former landfill with a new cap, the RCRA Subtitle D requirements, while relevant to those areas, are not appropriate because removing the mature vegetation in order to place additional soils will de-stabilize the existing soil cover over the former landfill contents. Both Alternatives 3a and 3b comply with the relevant and appropriate requirements under RCRA Subtitle D for monitoring of landfill gases. Concentration limits in on-site buildings and in the subsurface at the facility boundary are currently met, and additional methane monitoring is included in the alternatives to confirm these findings over time. Relevant and appropriate requirements under RCRA Subtitle D for monitoring groundwater will be addressed through the additional investigation for OU2 and documented in the associated RI Addendum.

The requirements of the Organic Act and other NPS-specific ARARs and TBCs would be further met by revegetating the capped areas of the Site following its installation.

Long-Term Effectiveness and Permanence

The new soil cap in both Alternatives 3a and 3b would be vegetated and maintained to ensure that it does not erode in the future and monitored over time (through the 5-year reviews) to ensure that it is still intact and functioning as designed.

Institutional controls are expected to be effective over the long term in managing risks associated with potential worker exposure to methane and lead in the subsurface. An Institutional Controls Implementation and Assurance Plan (ICIAP) would be developed during the RD, which would specify the types of ICs that are required and what, if any, long term monitoring would be required to ensure that the ICs remain in place, are enforced, and continue to be effective.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives 3a and 3b include no active treatment process that would reduce toxicity, mobility, or volume.

Short-Term Effectiveness

The remedial activities contemplated by Alternatives 3a and 3b include earthwork with associated large construction equipment; however, the construction methods are conventional and there are readily available methods to protect against short-term risks, threats, or adverse impacts to the community, workers, or to the environment. For example, dust suppression methods are available to minimize dust generation during construction; protective fencing can be installed to secure the construction areas; traffic control officers can be hired to manage truck traffic; and temporary erosion control methods can be implemented to minimize off-site transport of sediment during rain storms. The construction along the Anacostia River and Watts Branch shoreline corridors will require special engineering controls such as silt curtains off- or on-shore and erosion control mats to minimize erosion and sediment transport to the surface water. Temporary erosion control protection methods would have to be employed after construction but before the vegetation becomes fully re-established.

Alternative 3a’s 12-inch variation would be less disruptive in the short-term due to the reduced volumes of imported soil and excavated soils, as well as the reduced overall construction duration.

Implementability

As described above, the construction activities associated with implementing these alternatives involve conventional and well-established construction methods (shallow excavation, backfill, off-site transport and disposal, re-vegetation, and erosion control).

However, the construction of the soil cap along the shoreline areas of the Anacostia River and Watts Branch in KPS would involve somewhat more complex construction techniques and would be more difficult to implement than constructing the soil cap in the upper, flatter portions of the Site. Constructing the soil cap along the banks of the Anacostia River and Watts Branch would involve difficult access for construction equipment, groundwater and surface water management, restricted work areas, and special erosion control and re-vegetation requirements. The equipment and personnel required for performing work in these areas are available, but the work would be more difficult to implement than the rest of the project.

The 24-inch cap (Alternative 3b) would entail greater effort to implement than the 12-inch cap (Alternative 3a) due to the increased thickness of the cap, the more rigorous soil compaction requirements to achieve reduced permeability, and the increased depth for pre-excavation resulting in more material to excavate and ship off-site for disposal, but is nevertheless implementable.

Cost

In general, for any anticipated future recreational facilities to be designed and constructed in areas where the soil cap is to be located, overall project costs and design and construction time frames could be reduced through efficiencies gained by integrating the planning, design, and construction of these future recreational facilities with the remediation. For the purposes of this FS, however, cost estimates developed for this alternative assumed that the soil cap is designed and installed separate from, and independent of, any future recreational facilities

Capital costs for Alternative 3 are estimated at approximately $11 million for the 12-inch cap alternative (Alternative 3a), and $18 million for the 24-inch cap alternative (Alternative 3b). The increased cost for Alternative 3b is due to: 1) additional cap material; 2) additional excavation and disposal (for areas requiring pre-excavation); 3) special soil compaction requirements to achieve the RCRA Subtitle D permeability requirement; and 4) geogrid for playfield areas. Details for the cost estimate are provided in Appendix C.

6.5 ALTERNATIVE 4 – REMOVAL OF ALL ACCESSIBLE WASTE MATERIAL AND EXISTING COVER SOILS, WETLANDS RESTORATION, AND INSTITUTIONAL CONTROLS

6.5.1 Description

Bulk Excavation

Alternative 4 involves removal and off-site disposal of all waste materials and previously placed cover soils (except in the vicinity of the existing recreational facilities and the anticipated rebuilt Kenilworth-Parkside Recreation Center), and re-establishment of the original grades and wetlands habitat that existed before the development of the landfills. This alternative assumes that the existing developed recreational features at and around the Kenilworth-Parkside Recreation Center would be retained for future use as described under Alternative 3. However, the soil and wastes under all of the recreational fields, roads, and parking areas on the rest of KPN and under all of KPS would be excavated and disposed off-site. To provide a transition between existing developed areas along the eastern and southern boundaries of the Site (including the Kenilworth-Parkside Recreation Center area) to the base of the excavated areas, a sloped zone would need to be created that would be covered with clean soil and revegetated for long-term erosion protection.

Soil Cap

To prevent risks associated with contact with contaminants in the soils present in the vicinity of the former Kenilworth-Parkside Recreation Center that would not be removed under this alternative, pre-excavation and installation of a soil cap in those areas as described above under Alternative 3b would be included in this Alternative.

Institutional Controls

To protect future Site workers from exposure to methane and lead in the subsurface soils, and to restrict future Site development for residential use, institutional controls would be included in this alternative to apply to the area in the vicinity of the former Kenilworth-Parkside Recreation Center where contaminated soil and subsurface wastes would remain. These ICs would be the same as described for Alternative 2. Because complete removal of contaminated soil and waste materials is contemplated for the remaining portions of the Site under this alternative, institutional controls would not be required for the fully excavated and restored areas.

Wetlands Restoration

The final elevations at the base of the excavation would be similar to the elevations in the Kenilworth Marsh north of KPN. Groundwater would be close to the ground surface in this area, which would also be subject to inundation from tidal fluctuations and flooding from the Anacostia River. Therefore, this alternative includes creation of new wetlands in this area by placement of highly organic topsoil and wetlands plantings.

Property Boundary Methane Monitoring

Because most of the waste material would be removed under this alternative, property boundary methane monitoring would not be necessary and is therefore not included in this alternative.

Five-Year Reviews

CERCLA Section 121(c) requires five-year reviews of remedies at sites where hazardous substances, pollutants, or contaminants will remain on the site at levels that do not allow for "unlimited and unrestricted exposure." (USEPA, 2001). Although, Alternative 4 entails the removal of most of the existing wastes and soils, to the extent that some would remain in the area of the recreational facilities, this alternative would include five-year reviews to assure that human health and the environment are being protected by the remedy.

6.5.2 <u>Detailed Evaluation</u>

Overall Protection of Human Health and the Environment

This alternative would be protective of human health in the long term since most of the contaminated materials that could potentially create risks would be removed. In the areas where contaminants would remain (i.e., around the former Kenilworth-Parkside Recreation Center area and on the sloped transition areas), the clean soil cap would prevent exposure to contaminants underneath.

Exposure by Site workers to lead or methane in the subsurface is addressed by this alternative by excavating and removing the contaminants over the majority of the Site and in the areas where contaminated soil and wastes remain with institutional controls as described under the other alternatives. There are currently no unacceptable ecological risks; therefore, this alternative, as with the others, is protective of the environment (once the resulting wetlands habitat is established).

Compliance with ARARS

This alternative would comply with the primary location-specific ARAR for the Site: the NPS Organic Act, since contaminant-related Site use constraints would be eliminated in the long term. The values of the Park would shift from active recreational uses to reduced sports and active recreational activities (only those associated with the former Kenilworth-Parkside Recreation Center and its immediate vicinity) to a natural wetlands environment with its associated wildlife habitat value. Institutional controls would manage the potential risks of exposure by Site workers to subsurface methane in the remaining wastes, thereby achieving compliance with the relevant portions of RCRA Subtitle D. The construction along the Anacostia River and Watts Branch would involve action- and location-specific ARARs associated with wetlands and floodplain protection and water quality impacts. Equipment, construction methods, and trained personnel that would be required to comply with those ARARs are available, although compliance would be more difficult than with other alternatives.

This alternative involves extensive excavation throughout the Site and the associated off-site disposal of significant quantities of excavated soil, triggering a number of action-specific ARARs including those related to erosion and sediment control, stormwater runoff management, particulate emissions, and generation, management, transport and off-site disposal of solid wastes, some of which may be considered RCRA hazardous wastes. The nature of the work that would be required (earthwork) is common in the construction industry and therefore control methods are readily available to comply with the action-specific ARARs that apply, although the magnitude of the excavation under this alternative would require more extensive controls and management techniques than for the other alternatives. The controls that would be put in place to meet these ARARs would be specified in the Remedial Design and Remedial Action Work Plan documents (including an erosion and sediment control plan).

Long-Term Effectiveness and Permanence

In the areas of bulk excavation, this alternative would be effective long-term and would be permanent since the majority of the contaminated material would have been removed. In the areas where wastes would remain, a clean soil cap would prevent future exposure to surface soil contamination. The new soil cap would be vegetated and maintained to ensure that it does not erode in the future, and would be monitored as well. These measures will ensure the long-term effectiveness and permanence of the soil cap.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 4 has no active treatment process that would reduce toxicity, mobility, or volume.

Short-Term Effectiveness

This alternative would involve a very large amount of excavation in an area adjoining existing neighborhoods and along surface water bodies and, therefore, there would be adverse short-term impacts to the community including truck traffic, noise, potential dust, and physical hazards. There is also the potential for short-term impacts to adjacent surface water bodies from erosion caused by surface water runoff, high tides, and flooding events since the duration of the excavation would be long, increasing the possibility that intense precipitation events and/or flooding conditions may occur during the construction.

Implementability

This alternative would be difficult to implement due to physical access limitations, conflicts with adjacent land uses, groundwater intrusion into the excavation, proximity to adjacent surface water and wetlands, and locating a licensed landfill with sufficient capacity to take the large volumes of wastes from this project and which is within a reasonable distance from the Site.

Cost

Capital costs for Alternative 4 are estimated to be greater than $400 million. Details for the cost estimate are provided in Appendix C.

7.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section of the FS documents the comparative analysis of remedial alternatives for OU1 of the Site. This analysis evaluates the relative performance of each of the alternatives analyzed in detail (Section 6.0) relative to the same specific evaluation criterion. This provides decision-makers with another tool by which to select an appropriate remedy.

7.1 APPROACH

The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another, focusing on the relative performance of each alternative against the seven evaluation criteria identified above, to aid in the selection of the remedy. The remedy selected for the Site must reflect the scope and purpose of the actions being undertaken and how these actions relate to other actions and the long-term response at the Site. The identification of the preferred alternative and the final remedy selection are based on an evaluation of the more significant trade-offs among the alternatives.

The comparative analysis of alternatives is conducted using the same seven evaluation criteria (the two threshold criteria and the five balancing criteria) used for the detailed analysis of alternatives. A discussion of these criteria was presented earlier in Section 6.1.

7.2 COMPARATIVE ANALYSIS OF ALTERNATIVES BY EVALUATION CRITERIA

7.2.1 Overall Protection of Human Health and the Environment

The results of the Human Health Risk Assessment coupled with the RG exceedances described in Section 3.3 indicate that there are currently unacceptable potential long-term risks at the Site to visitors from exposure to PCBs and PAHs in surficial soil, and for workers from exposure to methane and lead in the subsurface. The Ecological Risk Assessment determined that there are currently no unacceptable risks to ecological receptors at either KPN or KPS.

Neither Alternatives 1 nor 2 is protective of Site visitors from exposure to surface soils since they do not address the risk posed by surface soil RG exceedances on the Site. However, Alternative 2 (along with all of the other alternatives) manages the potential risks for Site workers from exposure to subsurface methane or lead with institutional controls. Alternatives 3 and 4 are protective of Site visitors due to the installation of the soil cap and, in the case of Alternative 4, the extensive removal of waste material. Alternative 3 addresses unacceptable risk despite the fact that some limited RG exceedances exist in areas that will be beyond the extent of the soil cap. Those exceedances are limited and occur in heavily vegetated areas, where direct contact with contaminated soil is unlikely.

7.2.2 Compliance with ARARs

One of the primary location-specific ARARs for the Site is the NPS Organic Act, which, among other things, requires that NPS properties be managed so as to leave them unimpaired for the enjoyment of future generations. Existing PCB and PAH concentrations in surface soils in excess of Site-specific RGs place constraints on current and future Site management. Alternatives 1 and 2 do not eliminate these constraints, thereby failing to attain this ARAR. Alternatives 3a, 3b and 4 comply with the Organic Act; however, Alternative 4 will require significantly more effort than Alternatives 3a or 3b to comply with action-specific ARARs due to the significantly larger excavation proposed in Alternative 4, including excavations adjacent to surface water bodies and wetlands areas. Alternative 3b is compliant with the RCRA Subtitle D cap design requirements (24-inch low permeability cap), whereas Alternative 3a is not.

7.2.3 *Long-Term Effectiveness and Permanence*

Alternative 1 would not be effective or permanent since the risks currently present at the Site are not addressed by this alternative. The risks associated with visitor exposure to surface soil contamination also would not be addressed by Alternative 2, although Alternative 2 (along with all the other alternatives) does address the risks to Site worker exposure to subsurface contaminants through the implementation of institutional controls which are considered effective over the long term. The soil cap and excavation in Alternatives 3 and 4 are considered effective in the long term, and permanent, although the cap in Alternative 3b will be more effective than the 12-inch cap in Alternative 3a in the long-term.

7.2.4 *Reduction of Toxicity, Mobility, or Volume through Treatment*

None of the alternatives will reduce the toxicity, mobility or volume of contaminants through treatment.

7.2.5 *Short-Term Effectiveness*

There would be no short-term impacts associated with Alternative 1 since there is no active remediation, and few short-term impacts with Alternative 2, with its limited active remediation. There will be some short-term impacts to the community, and may be some to workers, and the environment from implementing Alternative 3 due to dust, traffic, noise, and surface water runoff, however there are conventional and readily available methods to protect against many of these impacts. Alternative 3a would be less disruptive to the community in the short-term than Alternative 3b due to the smaller volumes of excavated and imported soils, as well as a shorter overall period of construction. Alternative 4 would have the greatest short-term impacts, as it involves a significantly greater excavation component than the other alternatives, much of which would be adjacent to surface water bodies and wetlands areas. There will be significant short-term impacts with Alternative 4 within and immediately adjacent to the area of excavation, and also a much greater likelihood of short-term off-site impacts that will require management and controls than with the other alternatives.

7.2.6 *Implementability*

Alternatives 1 and 2 are readily implementable since they involve little or no active remediation. Alternative 3 involves extensive active Site-wide remediation (approximately 110 acres of soil cap placement, which will require careful planning for successful implementation. Alternative 4 involves excavation of a very large quantity of material (over 3.5 million cubic yards), much of which is immediately adjacent to the Anacostia River, Watts Branch, and Kenilworth Marsh. Implementation of this alternative, therefore, will be difficult.

7.2.7 *Cost*

Estimated present worth costs for each of the alternatives are summarized as follows:

Alternative 1 (no action): $84,000

Alternative 2 (minor regrading and institutional controls): $1 million

Alternatives 3a and 3b (soil cap, localized shallow excavation and off-site disposal to accommodate soil cap around existing development, and institutional controls): $11 million and $18 million, respectively, for the 12 inch and 24 inch soil cap alternatives.

Alternative 4 (removal of all accessible waste material and existing cover soils, institutional controls to manage risks associated with remaining subsurface wastes in the vicinity of the Kenilworth-Parkside Recreation Center and wetlands restoration) : >$400 million.

7.2.8 *Summary of Comparative Analysis*

A summary of the comparative analysis of alternatives is provided in Table 7-1.

Table 7-1
Comparative Analysis of Alternatives Summary

Criteria and Associated Applicable Factors	Alternative 1	Alternative 2	Alternative 3		Alternative 4
	No Action	**Minor Regrading and Institutional Controls**	**Alternative 3a: 12" Soil Cap, Localized Shallow Excavation and Off-site Disposal Where Pre-excavation is Required, and Institutional Controls**	**Alternative 3b: 24" RCRA Subtitle D Soil Cap, Localized Shallow Excavation and Off-site Disposal Where Pre-excavation is Required, and Institutional Controls**	**Removal of All Accessible Waste Material and Existing Cover Soils, Institutional Controls, and Wetland Restoration**
OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT					
- Human Health Protection					
• Direct contact with surface soil contaminants by visitor	No reduction of current risk to Site visitor from direct contact.	Same as Alternative 1	Reduction of current risk to Site visitor from direct contact.	Same as Alternative 3a	Eliminates risk to Site visitor direct contact
• Site worker exposure to methane and lead in subsurface	No controls for Site-worker exposure.	ICs to manage worker exposure	Same as Alternative 2	Same as Alternative 2	ICs to manage worker exposure to remaining wastes
- Environmental Protection	No current risk to ecological receptors.	No current risk to ecological receptors	No current risk to ecological receptors	No current risk to ecological receptors	No current risk to ecological receptors
COMPLIANCE WITH ARARS					
- Chemical-Specific ARARS	Does not comply with ARARs	Does not comply with ARARs	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.
- Location-Specific ARARs	Does not comply with the Organic Act or relevant and appropriate portions of RCRA Subtitle D	Does not comply with the Organic Act or relevant and appropriate portions of RCRA Subtitle D.	Complies with ARARs.	Complies with ARARs	Complies with ARARs
- Action-Specific ARARS	No action-specific ARARs.	Can be designed to comply with action-specific ARARS that would be triggered.	Does not comply with all relevant and appropriate portions of RCRA Subtitle D.	Same as Alternative 2	Same as Alternative 2 although many more requirements would apply than with other
LONG-TERM EFFECTIVENESS AND PERMANENCE					
- Magnitude of Residual Risk					
• Direct contact with surface soil contaminants by visitor	Residual risk	Residual risk.	Minimal residual risk.	Minimal residual risk.	Negligible residual risk.
• Site worker exposure to methane and lead in subsurface	Residual risk	Minimal residual risk.	Minimal residual risk.	Minimal residual risk.	Negligible residual risk.
- Adequacy and Reliability of Controls	No controls for limiting or eliminating exposure to contaminated surface soil.	No controls for limiting or eliminating exposure to contaminated surface soil. The institutional controls for worker exposure are expected to be adequate and reliable provided they are continually monitored and enforced.	The reliability of soil cap to isolate contaminants from human contact is high Same as Alternative 2	Same as Alternative 3a Same as Alternative 2	The reliability of removing soils and buried waste for off-site disposal to prevent contact with them is high. The institutional controls for worker exposure at the developed portions of KPN are expected to be adequate and reliable provided they are continually monitored and enforced.
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT					
- Treatment Process Used	None.	None	None	None	None
- Reduction of Toxicity, Mobility, or Volume Through Treatment	None.	None	None	None	None
SHORT-TERM EFFECTIVENESS					
- Protection of Community During Remedial Action	Not applicable - no remedial actions.	Limited duration remedial actions - minor impacts.	Construction traffic in neighborhood during soil removal and soil cap placement activities. Perimeter monitoring of fugitive air emissions during soil excavation, and corrective actions if necessary, would be implemented.	Same as Alternative 3a but increased construction traffic and for longer duration due to additional cap material and off-site transport.	Vehicular traffic will likely signifcantly increase during soil and buried waste removal and will be of an extended duration. Perimeter monitoring of fugitive air emissions during soil and buried waste excavation, and corrective actions if necessary, would be implemented.
- Protection of Workers During Remedial Action	Not applicable - no remedial actions.	Training and use of personal protective equipment may be required for workers when existing surface soil is disturbed.	Adherence to health and safety plans, use of protective equipment, and trained personnel should prevent any short-term impacts caused by remedial activities.	Same as Alternative 3a	Same as Alternative 3a
- Environmental Impacts	Not applicable - no remedial actions.	All regrading will be conducted within the property boundaries of the Site. Erosion and storm water management controls would be implemented during regrading activities to prevent surface water runoff from impacting the environment.	All soil cap placement and excavation activities will be conducted within the property boundaries of the Site. Erosion and stormwater management controls would be implemented during these activities to prevent surface water runoff from impacting the environment.	Same as Alternative 3a	All soil/buried waste excavation activities will be conducted within the property boundaries of the Site. Significant erosion and stormwater management controls will be required during these activities to prevent surface water runoff from impacting the environment.

Table 7-1
Comparative Analysis of Alternatives Summary

Criteria and Associated Applicable Factors	Alternative 1	Alternative 2	Alternative 3		Alternative 4
	No Action	**Minor Regrading and Institutional Controls**	**Alternative 3a: 12" Soil Cap, Localized Shallow Excavation and Off-site Disposal Where Pre-excavation is Required, and Institutional Controls**	**Alternative 3b: 24" RCRA Subtitle D Soil Cap, Localized Shallow Excavation and Off-site Disposal Where Pre-excavation is Required, and Institutional Controls**	**Removal of All Accessible Waste Material and Existing Cover Soils, Institutional Controls, and Wetland Restoration**
SHORT-TERM EFFECTIVENESS - continued					
- Time Until Remedial Action Objectives Are Achieved	Indeterminable, many decades	Indeterminable, many decades	Soil cap placement and limited soil excavation and off-site disposal could be accomplished in a 2-3 year timeframe including design and implementation.	The additional soil cap thickness will result in additional time required for implementation for a total 3-4 year timeframe including design and implementation.	Soil and buried waste excavation and off-site disposal placement could be accomplished in a 5-8 year timeframe including design and implementation.
IMPLEMENTABILITY					
- Ability to Construct and Operate	No construction or O&M.	Minor regrading is readily implemented. No O&M following establishment of vegetation.	Placement of soil cap and limited excavation and off-site disposal of soil can be readily implemented. No O&M following establishment of vegetation other than routine cap inspections and periodic cap repair as needed.	Same as Alternative 3a.	Excavation and off-site disposal of soils and buried waste can be implemented, although with greater difficulty than the other alternatives. No O&M following establishment of vegetation other than periodic cap inspections and cap repair in discrete areas where cap installed, as necessary. Upon successful restoration of wetlands, no O&M will be required in those locations and areas containing no current development would be left to return to a natural state.
- Ease of Doing More If Needed	Would not limit further actions.	Would not limit further actions.	Would not limit further actions.	Would not limit further actions.	Would not limit further actions.
- Ability to Monitor Effectiveness	No long-term monitoring to establish the effectiveness of No Action; Five-year review of current Site Status. Limited duration periphery methane monitoring.	Effectiveness readily monitored through periodic cap inspections and five year review of current Site status. Limited duration periphery methane monitoring.	Same as Alternative 2.	Same as Alternative 2.	No monitoring necessary.
- Ability to Obtain Approvals and Coordinate with Other Agencies	No approvals necessary.	Coordination among appropriate legal services, NPS, and the District would be required to implement institutional controls.	Approval by the District may be required for off-site disposal activities. Same as Alternative 2.	Same as Alternative 3a. Same as Alternative 2.	Approval by the District may be required for off-site disposal.
- Availability of Equipment, Materials, Specialists, and Off-Site Support Services	None required.	Equipment, materials, specialists, and off-site support services required to implement all components of this alternative are readily available.	Same as Alternative 2.	Same as Alternative 2.	May be difficult to identify an off-site disposal facility capable of receiving the large quantity of materials that would be excavated.
- Availability of Technologies	None required.	Soil grading/placement is a common technique that is readily implemented.	Soil placement and excavation are common techniques that are readily implemented. Technologies for the transport and off-site disposal of the limited quantities of excavated materials are readily available.	Same as Alternative 3a.	Substantial excavation volumes/depths will require large equipment; heavy construction in and next to surface water bodies will require special equipment methods and controls; locating licensed landfill within a reasonable distance and with sufficient capacity likely will be a challenge; creation of new wetlands requires special expertise.
COST					
- Total Present Worth Cost	$0.1M	$1M	$11M	$18M	>$400M
STATE ACCEPTANCE	NPS will seek the District's input on the Proposed Plan.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
COMMUNITY ACCEPTANCE	Comments received during the public comment period will be incorporated into the ROD in a responsiveness summary.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

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