LANDSIDE (OPERABLE UNIT 1) FEASIBILITY STUDY

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

LANDSIDE OPERABLE UNIT 1 FEASIBILITY STUDY

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

PREPARED FOR:

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An Exelon Company

Tables

Table 2-1: Documented Fuel Spills at Pepco Benning Road Site
3400 Benning Road NE, Washington, DC 20019

Date	Description and Location	Product Type	Amount	Description of Actions Taken	Citation
November 10, 1989	15,000 gallon UST near Unit #13	No. 2 fuel oil	Unknown	230 ton soil excavated after UST removal	Pepco, 1990
July 9, 1993	Generating Station floor and sump	No. 4 fuel oil	~200-300 gallons	Contained and cleaned up	CSM (Pepco, 2016)
August 31, 1993	No. 4 fuel tank	No. 4 fuel oil	~300-500 gallons	Fully recovered	CSM (Pepco, 2016)
September 22, 1993	15,000 gal UST near Building #56	non-PCB mineral oil	~10 gallons	Contained in the pump manhole, not released to the storm drains or soil.	CSM (Pepco, 2016)
October 19, 1993	Fixed fire pump engine fuel tank	diesel fuel	NA	Cleanup completed	CSM (Pepco, 2016)
July 15, 1994	50 gallons leaked from bourdon tube crack onto concrete floor. Location not Specified	No. 2 fuel oil	50 gallons	Contained and cleaned up with speedi-dry. Gauged was replaced. Clean up was completed the same day	Pepco (2022a)
October 19, 1994	20 gallons spilled from strained box. Location not Specified	No. 4 fuel oil	20 gallons	Contained and cleaned up using absorbent material. Clean up was completed the same day	Pepco (2022a)
November 10, 1994	55 gallons spilled from coupling failure AST. Location not Specified	No. 6 fuel oil	55 gallons	Cleanup completed by Clean Harbor from the AST Clean up was completed the same day	Pepco (2022a)
December 20, 1994	Duplex strainer assembly. Location not Specified	No. 4 fuel oil	100 gallons	Oil spilled outside of dike was vacuumed up. Strainer was isolated, drained, then reassembled. Clean up was completed the same day	Pepco (2022a)
December 20, 1994	Diked area near FO#4 Tank	No. 4 fuel oil	~100 gallons	Cleanup completed	CSM (Pepco, 2016)
January 6, 1995	Fuel Oil Tank #1	No. 4 fuel oil	~1,000 gallons	Completely contained by dike and cleaned up	CSM (Pepco, 2016)
January 9, 1995	Line full of oil ahead of flange. Fuel tank #1.	No. 4 fuel oil	15 gallons	Spill was contained and cleaned with Speedi-dry	Pepco (2022a)
February 14, 1995	Package boiler B heater	Fuel oil	20 gallons	Spill contained on floor. Clean up completed on same day. Document does not specify method used for clean up.	Pepco (2022a)
February 17, 1995	Fuel Oil Tank 1	No. 4 fuel oil	~2,000 gallons	Completely contained by dike and cleaned up	CSM (Pepco, 2016)
April 21, 1995	Fuel filter broke. Location not Specified	diesel fuel	35 gallons	Clean up completed on same day. Document does not specify how spill was contained or the method used for clean up.	Pepco (2022a)

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Date	Description and Location	Product Type	Amount	Description of Actions Taken	Citation
May 10, 1995	Leak in fuel line. Location not Specified	No. 4 fuel oil	20 gallons	Spill contained. Clean up completed on same day. Document does not specify method used for clean up.	Pepco (2022a)
July 24, 1995	Equipment failed in plant	No. 4 fuel oil	55 gallons	Spill occurred in the plant. Clean up completed on same day. Document does not specify method used for clean up.	Pepco (2022a)
August 29, 1995	Kenilworth Fuel Island UST	unleaded gasoline	~2,880 gallons	Remeditaion completed 1997 with DDOE closure	CSM (Pepco, 2016)
February 4, 1996	Contractor error valve left open on tanker truck. Location not Specified	No. 2 fuel oil	20 gallons	Trail of spill area was washed down with MIRACHEM 100. The spill was immediately contained with absorbents.	Pepco (2022a)
July 9, 1996	Contractor error - line not empty before cutting fuel line. Location not Specified	No. 4 fuel oil	300 gallons	Spill contained to dike and trench are. Clean up completed next day. Document does not specify method used for clean up.	Pepco (2022a)
May 26, 2004	East of the Generating Station and south of CT #15	No. 2 fuel oil	~50 gallons	Confined to sump in berm, impacted soil excavated	CSM (Pepco, 2016)
April 27, 2005	Leaking delivery truck. Location not Specified	diesel fuel	25 gallons	Contained and excavated	Pepco (2022a)
August 9, 2011	Fuel spill from CW Wright truck	diesel fuel	10 gallons	Spilled contained on roadway. Contaminated material was removed and barrelled for disposal. Double wash and rinse was utilized for cleanup. Clean up completed on 28-Nov-11	Pepco (2022b)
June 11, 2013	Generating Station	No. 4 fuel oil	~10 gallons	Flowed into storm drains and out Outfall 013. 4670 gal oil/water mix recovered.	CSM (Pepco, 2016)

References

Pepco. 2016. Technical Memorandum #1 – Conceptual Site Model.

Pepco, 2022a, Pepco Database Report of Mineral Oil Spills at Benning Site (1990 to 2009), September 2022

Pepco, 2022b, Pepco Database Report of Mineral Oil Spills at Benning Site (2010 to 2016), September 2022

Table 2-2: Documented PCB Releases at Pepco Benning Road Site
3400 Benning Road NE, Washington, DC 20019

Serial Number	Date	Description and Location	Product Type	Amount	Description of Actions Taken	Citation
1	May 1985	Target Area 8: Transformer Shop (then located in current Building 54)	Waste Oil with < 50 ppm PCBs	~ 50 - 100 gallons	~ 45 tons of contaminated material removed from Site for off-site disposal. Due to the precautions taken during the cleanup to avoid exposure to stormwater and the prompt implementation of cleanup, the potential for transport of PCBs to Outfall 013 (and thereby to the Anacostia River) as a result of this release is deemed low.	Pepco (1985); EPA (1997, 2009)
2	May 1988	Target Area 7 (area adjacent to Substation 7)	Electrical Equipment Fluid	Unknown	~ 2,500 cu. ft. of material removed. According to the Site drainage map, stormwater from the pad location would have been discharged to Outfall 005, located on the northeast Site property boundary. Outfall 005 connects to the MS4 and does not discharge to Outfall 013 (which discharges to the Anacostia River).	Pepco (1988)
3	February 1991	Between Building 41 and 61	PCB-containing oil from capacitor	~ 1 gallon	~ 36 sq. ft. of concrete pad, soil up to 3 ft. below concrete pad, and 126 cu. ft. of underlying soils removed from area and backfilled. The potential for release of PCBs to the river from this spill via the storm drains is deemed low in view of the prompt cleanup. EPA (1997) observed that "off-site migration of PCBs as a result of this leak appeared highly unlikely".	Pepco (1991a, 1991b); EPA (1997, 2009)
4	March 6, 1994	Leak from pad mounted transformer. Location not specified.	Mineral Oil with 5 ppm PCBs	~ 1 gallon	A small amount of oil entered a storm drain, but was contained in a catch basin and recovered. The potential for transport of PCBs to Outfall 013 (and thereby to the Anacostia River) as a result of this spill is deemed low in view of the small quantify and reported recovery of the oil.	Pepco (2022b)
5	March 18, 1994	Leak from oil pump on underground storage tank. Location not specified.	Mineral Oil with 10 ppm PCBs	~ 2 gallons	The cleanup was completed the same day as the spill. There is no indication in the spill log entry that any oil entered the storm drain system, i.e. likely that the spill did not reach the Anacostia River.	Pepco (2022c)
6	April 12, 1994	Location not specified in available records	PCB-contaminated oil	35 gallons	Spill log entries indicate that the area of the spill was restored and the cleanup was completed the same day as the spill. There is no indication in the available documentation that any oil entered the storm drain system or was released to the Anacostia River via outfalls.	Pepco (2013, 2022b))
7	April 13, 1994	Leak from an pump for a mineral oil storage tank. Location not specified.	Mineral oil with PCBs < 5 ppm	~ 10 gallons	The cleanup was completed the same day as the spill. There is no indication in the available documentation that any oil entered the storm drain system or was released to the Anacostia River via outfalls.	Pepco (2022c)
8	June 14, 1994	Leak from a tanker due to a defective hose. Location not specified.	Mineral oil with PCBs < 5 ppm	~ 10 gallons	Spill log entry indicates that the spill was contained within a concrete bermed area and the cleanup was completed the day following the spill. There is no indication in the available documentation that any oil entered the storm drain system or was released to the Anacostia River via outfalls.	Pepco (2022b)
9	September 27, 1994	Leak from a failed oil circuit breaker. Location not specified.	Mineral oil with 5 ppm PCBs	~ 200 gallons	Reportedly, all contaminated dirt and bluestone was removed and the cleanup was completed the same day as the spill. There is no indication in the available documentation that any oil entered the storm drain system or was released to the Anacostia River via outfalls.	Pepco (2022b)

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Serial Number	Date	Description and Location	Product Type	Amount	Description of Actions Taken	Citation
10	February 7, 1995	Leak from a transformer that was damaged after sliding off an ice-covered trailer. Location not specified.	Mineral oil with 35 ppm PCBs	~ 1 gallon	Reportedly, the spill was contained to the asphalt roadway, which was double-washed and rinsed. The cleanup was completed the same day as the spill. There is no indication in the available documentation that any oil entered the storm drain system or was released to the Anacostia River via outfalls.	Pepco (2022b)
11	July 27, 1995	Leak from failed O-ring gasket on a regulator. Location not specified in available records	PCB-contaminated oil	Record as "0 PT", presemably indicating a very small quantity	Spill cleaned up the same day using a “double wash and rinse method. The potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the prompt cleanup.	Pepco (2013, 2022b)
12	July 10, 1996	Release from drum that was punctured with a fork lift on a truck bed. Location not specified in available records	PCB-containing oil	~ 2 gallons	The oil reportedly ran onto the ground and into a storm drain, but absorbent materials was placed down immediately and no oil was released to the river. The drain was double washed and rinsed, and the cleanup was reported as completed the following day. The potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the prompt cleanup.	Pepco (2013)
13	August 12, 1996	Leak from failed valve on a network transformer onto a concrete pad. Location not specified in available records	PCB-contaminated oil	1 quart	No indication in the spill log entries that any oil entered the storm drains. The spill was reportedly confined to the concrete area and cleaned up the same day using a “double wash and rinse method.” The potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the prompt cleanup.	Pepco (2013, 2022b)
14	June 26, 1997	Leak onto the ground from failed O-ring gasket on a transformer bushing. Location not specified in available records	PCB-contaminated oil	1 quart	No indication in the spill log entries that any oil entered the storm drains. The spill cleanup was reportedly completed the following day through excavation, within an 3’ x 3’ x 10’ area, of “all visible traces of material.” The potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the small quantity spilled and the prompt cleanup.	Pepco (2013)
15	October 31, 1997	Leak from a transformer inside the power plant	PCB-contaminated oil	~ 10 gallons	Spill cleanup reportedly completed on November 19, 1997, using a “double wash and rinse method." There is no indication in the spill log entries that any oil escaped the plant building or entered the storm drains.	Pepco (2013, 2022b)
16	March 16, 1998	Leak from a failed gasket on a transformer while in transit between transformer test shop and Building 88. Exact location not specified in available records	PCB-contaminated oil	~ 1 gallon	No indication in the spill log entries that any oil entered the storm drains. The spill was reportedly cleaned up the same day using absorbent materials and a “double wash and rinse method.” The potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the prompt cleanup.	Pepco (2013)

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Serial Number	Date	Description and Location	Product Type	Amount	Description of Actions Taken	Citation
17	October 26, 1998	Leak from a loose bushing on a transformer while being moved within the site. Exact location not specified in available records.	Oil containing PCBs	1 gallon	No indication in the spill log entries that any oil entered the storm drains. The spill was reportedly contained in a metal pan and cleaned up the following day using a "double wash and rinse method." The potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the prompt cleanup.	Pepco (2013, 2022b)
18	August 4, 2002	Leak from a voltage transformer in a storage yard when pallet on which it was placed collapsed, causing the transformer to fall over.	Oil with PCB concentration < 5 ppm	78 gallons	The oil leaked onto the ground and entered two storm drains. The drains were equipped with absorbent booms which captured the oil so that no oil was released to the main storm drain leading to Outfall 013.	Pepco (2001, 2013)
19	May 16, 2002	Leak onto asphalt roadway from an oil-containing bushing being transported prior to disposal fell from a fork lift south of southest corner of cooling tower basin #16 and west of fire pump house	Mineral oil. PCBs in waste materials from clean-up reported at 100 ppm and 60 ppm.	~ 2 gallons	The cleanup was completed within two hours following the spill. There is no indication in the spill log entry that any oil entered the storm drains, and the potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the prompt cleanup.	Pepco (2002, 2013, 2022b)
20	February 11, 2004	Leak from scrap transformer at the storage yard outside Building #88	Transformer oil containing 85 ppm PCBs	30 gallons	There is no indication in the available records that any oil entered the storm drains. The cleanup was completed on February 20, 2004, and all of the leaked oil was recovered. The potential for transport of PCBs to Outfall 013 as a result of this spill via subsequent stormwater runoff is deemed low in view of the prompt cleanup.	Pepco (2006, 2008, 2013)
21	November 23, 2004	Leak from a transformer along "transformer row", presumably referring to an area west of the former power plant building, due to deteriorating gaskets.	Transformer oil with PCB concentration reported as 5 ppm	1 gallon	The oil was contained within the secondary containment pit for the transformer. The oil/water mixture was pumped from the pit on February 25, 2005, and treated in the oil/water separator. The blue stone in the pit was cleaned with a degreaser on March 2, 2005. Given the small amount of oil released, the containment provided by the pit, and the cleanup actions, this spill does not appear to have been a source from which PCBs would have migrated to the river.	Pepco (2005a)
22	March 24, 2005	Leak from a loose plug on a portable transformer located within Substation 7	Transformer oil with PCB concentration reported as 5 ppm (Transformer labeled as "non-PCB")	25 gallons	The oil was contained within a bermed secondary containment area and cleaned up the same day using sorbent material which was drummed for off-site disposal. In view of the containment provided by the berm and the prompt cleanup actions, this spill does not appear to have been a source from which PCBs would have migrated to the river.	Pepco (2005b)

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Serial Number	Date	Description and Location	Product Type	Amount	Description of Actions Taken	Citation
23	April 8, 2010	Leak from a transformer located on roof of power plant building due to catastrophic failure believed to have been caused by a lightning strike	Transformer oil with PCBs > 500 ppm	~ 4 quarts	a) Upon discovery of the transformer failure, the lift station and oil-water separator (OWS) were take out of service and the 24-inch diameter pipe was plugged at the manhole near the power plant building and at the other end near the lift station to prevent any further flow of oil from the release into the lift station. b) Water from the dirty water sumps in the basement and flood control sumps (also known as ash sumps) in the auxiliary boiler room was rerouted to the North and South Ash Tanks via hoses and pumps. c) Water in each ash tank was sampled and tested for PCBs. The results were non-detect for PCBs using EPA Method 8082. d) A portable OWS equipped with activated carbon filters was put into operation to treat flows re-routed away from the lift station prior to discharge via internal Outfall 201. e) Water pumped to two frac tanks used in connection with the cleanup was tested and found to be non-detect for PCBs. f) In addition, water samples were collected from two storm drains within the area draining to the lift station and Outfall 201. One sample was non-detect and the other sample showed Aroclor 1242 at 8.1 ppb. g) The failed transformer was removed for disposal and replaced. h) Other electrical components and nonporous surfaces were decontaminated. i) Roofing material contaminated by the PCB oil was replaced. j) Water and oil collected from the containment systems were reportedly sent to an off-site facility for disposal or discharged through via outfall 201 after treatment in the portable OWS and activated carbon filters and confirmatory sampling to ensure that PCBs were non-detect. These containment and cleanup actions appear to have prevented the release of PCBs to the river as result of this incident.	Pepco (2010a, 2010b, 2012)
24	May 20, 2022	Leak from broken bushing in transformer while a potential transformer was being moved around site due to failure of pallet holding the transformer. Oil leaked to the ground surface in the roadway just north of Building 44.	Oil with 1010 ppm PCBs	~ 10 gallons	Cleanup crews were dispatched immediately and the oil was contained and then removed. The affected pavement was cleaned, and the area was cordoned off and closed to traffic. The following day, the pavement in the area of the spill was removed for off-site disposal and the area was covered with plastic to prevent any exposure to stormwater until the area could be repaved. The response actions appear to have prevented any release of PCBs to the river as a result of this spill.	Pepco (2022a, 2022b)

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Serial Number	Date	Description and Location	Product Type	Amount	Description of Actions Taken	Citation

References

EPA. 1997. Multi-Media Inspection Report, Pepco, Benning Road Generating Station, Washington, DC.
EPA. 2009. U.S. EPA, Final Site Inspection Report for the Pepco Benning Road Site, June 30.
Pepco. 1985. Oil Spill Inspection Report, Pepco Environmental Affairs, May 1985 (referenced in AECOM 2016d).
Pepco. 1986. Memo: PCB Transformers -Kick-Off Meeting Minutes. February 5.
Pepco. 1987. In-Plant Printing Offers Much in Serving Pepco, The Pepco Communicator, Vol. 9.
Pepco. 1988. Report of Construction of Parking Area Adjacent to Benning Substation No.7, October.
Pepco. 1989. Volatile Organic Compound (VOC) Emission Inventory for the Potomac electric Power Company (PEPCO) Benning Station Site, prepared by Radian Corporation for Pepco, May 18.
Pepco. 1991a. Benning Generating Station PCB Leaking Capacitor Cleanup Report, April.
Pepco, 1991b. Pepco Letter to EPA re PCB Spill, November 13
Pepco. 1995. Benning Generating Station PCB Cleanup Report, October 24.
Pepco. 2001. Pepco Letter to EPA re Benning Storage Yard Oil Spill, November 1.
Pepco. 2002. Pepco Transmission Spill Report Package, May 16.
Pepco, 2005a. Internal Pepco Email re PCB Testing for February 2004 Transformer Oil Release, May 16.
Pepco, 2005b, Pepco Spill Report Package, Incident Number T0261, March 7.
Pepco, 2005c. Pepco Spill Report Package, Incident Number T0241, April 12.
Pepco, 2006. Spill List from Benning Service Center Integrated Contingency Plan, January.
Pepco, 2008. Report to Pepco Holdings, Inc. by Greenhorne & O'Mara, Inc. Summary Table 4-List of Significant Spills and Leaks, Revised Nov. 2008
Pepco, 2010a, Pepco Email re PCB Testing for Rooftop Transformer Leak, July 6.
Pepco, 2010b, Pepco Email re NRC Report of Rooftop Transformer Leak, August 4.
Pepco, 2012, Pepco Email re Report to EPA Permit Writer of Rooftop Transformer Leak, May 15.
Pepco, 2013, PHI Service Company Release Event Summary and Detail, March 19, 2013
Pepco, 2022a, Pepco Email re Spill from Potential Transformer, May 2022
Pepco, 2022b, Pepco Database Report of Mineral Oil Spills at Benning Site (1990 to 2009), September 2022
Pepco, 2022c, Pepco Database Report of Mineral Oil Spills at Benning Site (2010 to 2016), September 2022
Pepco, 2022d, Pepco Database Report of Mineral Oil Spills at Benning Site (2017 to 202), September 2022

Table 2-3
Potential COCs and Media for Landside Investigation Area
Benning Road Facility FS Project

Chemical	Risk/HI	Future Outdoor Industrial Worker Direct Contact with Surface Soil [a]				Current/Future Construction Worker Direct Contact with Soil [b]		Future Indoor Worker Vapor Intrusion from Groundwater	
		Warehouse and Laydown Area	Salvage Yard and Storage Area	Substation #7	Transformer Shop	Warehouse and Laydown Area	Transformer Shop	Southern Boundary	Northern Boundary (DP-60)
Landside Soil									
2,3,7,8-TCDD-TEQ	Risk	--	4E-06	--	--	--	--	NA	NA
Total PCBs	Risk	5E-06	2E-06	4E-6	2E-03	--	2E-06	NA	NA
	HI	--	--	--	124	--	1.6	NA	NA
Vanadium	HI	--	--	--	--	3	--	NA	NA
Landside Groundwater									
Chloroform	Risk	NA	NA	NA	NA	NA	NA	--	4E-06
Tetrachloroethylene	Risk	NA	NA	NA	NA	NA	NA	7E-06	--
	HI	NA	NA	NA	NA	NA	NA	2	--
Trichloroethylene	Risk	NA	NA	NA	NA	NA	NA	6E-06	--
	HI	NA	NA	NA	NA	NA	NA	2	--
Vinyl Chloride	Risk	NA	NA	NA	NA	NA	NA	2E-06	--

Notes:
NA – Not applicable.
-- Indicates that risk is less than or equal to 10^{-6} and/or HI is less than or equal to 1.
Green highlighting indicates that risk exceeds 10^{-6} but is less than or equal to 10^{-5}.
Yellow highlighting indicates that risk exceeds 10^{-4} or the target endpoint HI exceeds 1.
[a] Assumes the future outdoor industrial worker may be exposed to surface soil (0-1 foot bgs).
[b] Assumes the current/future construction worker may be exposed to surface and subsurface soil (0-16 feet bgs).

Table 2-4
Summary of Potential COCs and Media for the FS Report Benning Road Facility FS Project

	Landside		
	Soil	**Groundwater (Vapor Intrusion)**	**Groundwater (DCMR Groundwater Standards)**
Total PCBs	X [a]		
Vanadium	X [b]		
Perchloroethylene (PCE)		X [c]	X [c]
Trichloroethylene (TCE)		X [c]	X [c]

Notes:
[a] Transformer Shop Area
[b] Warehouse and Laydown Area
[c] Groundwater at Southern Property Boundary

Table 3-1
Applicable or Relevant and Appropriate Requirements (ARARs)
Pepco Benning Road Facility FS Project

Brief Description	Citation	Requirement	Landside - Soil	Landside - Groundwater
Federal Chemical-Specific				
Clean Water Act (CWA), Ambient Water Quality Criteria	33 USC §§ 1251 et seq., 40 CFR Part 131	Surface water criteria established for protection of human health and/or aquatic organisms.	**Applicable** to any disturbance or discharge affecting surface waters.	**Not Applicable** – The CWA does not specifically address contamination of groundwater resources.
National Primary Drinking Water Regulations Maximum Contaminant Levels (MCLs)	Safe Drinking Water Act, 42 USC §§ 300f et seq., 40 CFR Part 141	Human health-based standards, MCLs for public water systems.	**Not Applicable** to soils.	**Relevant and Appropriate** – Groundwater at the site is not currently used as drinking water. However, there are potential (although unlikely) future drinking water sources.
Toxic Substances Control Act (TSCA)	15 USC §§ 2601 et seq., 40 CFR Part 761	PCB remediation and soil disposal requirements.	**Applicable** – PCB-contaminated soil below risk-based thresholds may remain in place after completion of remedy.	**Not Applicable** – No PCB contamination in groundwater.
National Park Service (NPS) Protocol for the Selection and Use of Ecological Screening Values for Non-Radiological Analytes	NPS; updated February 2016	Guidance on selection of ecological screening values for surface water and sediment.	**Not Applicable –** Landside Investigation Area is not under the jurisdiction of NPS.	**Not Applicable –** Landside Investigation Area is not under the jurisdiction of NPS.
National Secondary Drinking Water Regulations, Secondary MCLs	Safe Drinking Water Act, 42 USC §§ 300f et seq., 40 CFR Part 143	Establishes aesthetic standards (secondary MCLs) for public water systems.	**Not Applicable** to soils.	**Relevant and Appropriate** – Groundwater at the site is not currently used as drinking water. However, there are potential (although unlikely) future drinking water sources.
District Chemical -Specific				
District of Columbia Water Quality Standards for Surface Water	D.C. Code §§ 8-103 et seq., 21 DCMR Chapter 11	Water quality standards for surface waters; includes draft Total Maximum Daily Loads for oil and grease, organic chemicals, and metals in the Anacostia River.	**Applicable** to discharges or impacts on surface waters. DC standards contain some constituents not included in federal standards and some criteria, such as for E. coli, are District-specific.	**Not Applicable** to groundwater.
District of Columbia Groundwater Protection and Quality Standards	D.C. Code § 8-103.04, 21 DCMR §§ 1150-1158	Water quality standards specific to District groundwater.	**Not Applicable** to soils.	**Relevant and Appropriate** — Groundwater at the site is not currently used as drinking water. However, groundwater shall be protected for beneficial use, where attainable.
Federal Location-Specific				
Migratory Bird Treaty Act	16 USC § 703	Protects more than 800 species of birds from unregulated taking.	**Applicable** to site remediation to the extent the measures involve activities that could affect migratory birds.	**Applicable** to site remediation to the extent the measures involve activities that could affect migratory birds.
Responsibility of Federal Agencies to Protect Migratory Birds	Executive Order 13186, 66 Fed. Reg. 3853 (Jan. 17, 2001)	Directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act, including supporting the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing adverse impacts on migratory bird resources when conducting agency actions.	**TBC** in designing and implementing site remediation activities that could affect migratory birds.	**TBC** in designing and implementing site remediation activities that could affect migratory birds.
Endangered Species Act	16 USC §§ 1531 – 1544, 50 CFR Part 402	Establishes requirements for protection of federally listed threatened and endangered species and their habitat.	**Not Applicable –** No Critical Habitat within work area.	**Not Applicable –** No Critical Habitat within work area.
CWA, Section 404(b)(1) Guidelines	33 USC § 1344, 40 CFR 230.10	Establishes criteria for evaluating impacts on waters of the US (including wetlands) and sets forth factors for considering mitigation measures.	**Not Applicable** – No waterways present in the LIA.	**Not Applicable** – No waterways present in the LIA.
Solid Waste Disposal in National Parks	54 USC § 100903, 36 CFR Part 6	Prohibits creation of new solid waste disposal units and operation of existing solid waste disposal units within park boundaries, except as specifically provided for in the regulations.	**Not Applicable –** Landside Investigation Area is not under the jurisdiction of NPS.	**Not Applicable –** Landside Investigation Area is not under the jurisdiction of NPS.

Table 3-1 (continued)
Applicable or Relevant and Appropriate Requirements (ARARs)
Pepco Benning Road Facility FS Project

Brief Description	Citation	Requirement	Landside - Soil	Landside - Groundwater
Orders Concerning Floodplains	Executive Order No. 11988 as amended by Executive Order No. 13690, NPS Director's Order No. 77-2: Floodplain Management	Requires consideration of impacts on floodplain areas to reduce flood loss risks; minimize flood impacts on human health, safety, and welfare; and preserve and/or restore floodplain values.	**TBC** in designing and implementing site remediation activities occurring within the 100-year floodplain.	**TBC** in designing and implementing site remediation activities occurring within the 100-year floodplain.
National Historic Preservation Act	54 USC §§ 300101 et seq., 36 CFR Part 800	Establishes requirements for identification and preservation of historic and cultural resources.	**Not Applicable –** Work area not of archaeological or historical significance.	**Not Applicable –** Work area not of archaeological or historical significance.
Archaeological and Historic Preservation Act	54 USC §§ 312501 et seq.	Establishes requirements for protection and preservation of archaeological and historic resources that may be destroyed through alteration of terrain as a result of federal projects.	**Not Applicable –** Work area not of archaeological or historical significance.	**Not Applicable –** Work area not of archaeological or historical significance.
Historic Sites, Buildings, and Antiquities Act	54 USC §§ 320101 et seq.	Requires consideration of existence and location of historic and prehistoric sites, buildings, objects, and properties of historic and archaeological significance when evaluating remedial alternatives.	**Not Applicable –** Work area not of historical significance.	**Not Applicable –** Work area not of historical significance.
Archaeological Resources Protection Act	16 USC §§ 470aa – ii, et seq., 43 CFR Part 7	Provides for protection of archaeological resources located on public lands.	**Not Applicable –** Work area not of archaeological or historical significance.	**Not Applicable –** Work area not of archaeological or historical significance.
Fish and Wildlife Coordination Act	16 USC §§ 661 et seq.	Requires consideration of impacts on wildlife resources resulting from modification of waterways.	**Not Applicable –** Work area does not include rivers or streams.	**Not Applicable –** Work area does not include rivers or streams.
Native American Graves Protection and Repatriation Act (NAGPRA)	25 USC § 3001, 25 USC § 3002(d), 43 CFR Part 10	Establishes requirements for disposition of Native American remains and objects inadvertently discovered on federal or tribal lands. Response activities resulting in discovery of Native American human remains or related objects must stop until NPS and any appropriate Indian tribes are notified. Requires that reasonable efforts be made to protect Native American human remains or related objects (43 CFR § 10.4).	**Not Applicable** – Work area not on federal or tribal lands remains and objects.	**Not Applicable** – Work area not on federal or tribal lands remains and objects.
National Park Service Organic Act General Authorities Act, as amended	54 USC § 100101(a) et seq., 36 CFR Part 1, 54 USC § 100101(b)	Requires that units of the National Park System be managed in such a manner as to conserve the scenery, natural and historic objects, and wildlife, and in such a manner as to leave them unimpaired for the enjoyment of future generations. The General Authorities Act further provides that protection, management, and administration of Park System units shall be conducted in light of the high public value and integrity of the NPS and shall not be exercised in derogation of the values and purposes for which System units have been established.	**Not Applicable –** Work area not within park boundaries.	**Not Applicable –** Work area not within park boundaries.
National Park Resource Protection, Public Use and Recreation	36 CFR Part 2	Prescribes and regulates various activities on lands and waters administered by NPS. For example, Section 2.14 (a) prohibits "(1) Disposing of refuse in other than refuse receptacles …" and "(6) Polluting or contaminating park area waters or water courses."	**Applicable** to any disposal activities that could discharge to the Anacostia River, such as discharge of treated wastewater or handling of general construction debris.	**Applicable** to any disposal activities that could discharge to the Anacostia River, such as discharge of treated wastewater or handling of general construction debris.
National Park Area Nuisance	36 CFR § 5.13	Prohibits creation or maintenance of a nuisance within a park area.	**Not Applicable –** Work area outside of park boundaries.	**Not Applicable** – Work area outside of park boundaries.
Rivers and Harbors Act, Section 10 and Regulations	33 USC § 403, 33 CFR Parts 320–330	Requirements for evaluating excavation activities or placement of structures or fill material within tidal navigable waters.	**Not Applicable –** Work area does not include navigable waters.	**Not Applicable –** Work area does not include navigable waters.
NPS Management Policies 2006	Available at: https://www.nps.gov/policy/mp2006.pdf	Provides policies and guidance governing NPS management of natural and cultural resources in national parks, including revegetation of disturbed land. Provides guidance on returning disturbed areas to the natural conditions and processes characteristic of the ecological zone in which damaged resources are situated. The NPS policy on implementation of the non-impairment mandate is set forth in Section 1.4 of NPS Management Policies 2006.	**Not Applicable** – Work area outside of park boundaries.	**Not Applicable** – Work area outside of park boundaries.

Table 3-1 (continued)
Applicable or Relevant and Appropriate Requirements (ARARs)
Pepco Benning Road Facility FS Project

Brief Description	Citation	Requirement	Landside - Soil	Landside - Groundwater
District Location-Specific				
Establishment of the Comprehensive Park and Playground System of the National Capital Establishment of Anacostia Park	An Act providing for a comprehensive development of the park and playground system of the National Capital, as amended, Pub. L. No. 68-202, 43 Stat. 463 (1924), Pub. L. No. 69-158, 44 Stat. 374 (1926), Capper- Cramton Act, Pub. L. No. 71-284, 46 Stat. 482 (1930), as amended by Pub. L. No. 79-699, 60 Stat. 960 (1946), Pub. L. No. 82-592, 66 Stat. 781, 791 (1952), and Pub. L. No. 85-707, 72 Stat. 705 (1958)	Parks established as a part of this system, including Anacostia Park, are established, in part, "to prevent pollution of... [the] Anacostia River, [and] to preserve forests and natural scenery in and about Washington."	**Not Applicable –** Landside Investigation Area is not under the jurisdiction of NPS.	**Not Applicable –** Landside Investigation Area is not under the jurisdiction of NPS.
General Management Plan for Anacostia Park	Available at: https://parkplanning.nps.gov/parkHome.cfm?parkID=425	The General Management Plan for the Park is the primary guidance document for managing the Park for the next 15 to 20 years. It identifies the preferred vision for the future of the Park and provides the framework for decision making regarding management of the Park's natural and cultural resources.	**Not Applicable** – Work area outside of park boundaries.	**Not Applicable** – Work area outside of park boundaries.
District of Columbia Flood Hazard Control	D.C. Code §§ 6- 501 to 506, 20 DCMR Chapter 31	Regulates placement of fill, grading, excavation, and other disturbances within the defined flood hazard area and/or floodplain of rivers and/or streams.	**Not Applicable** – Work area outside of park boundaries.	**Not Applicable** – Work area outside of park boundaries.
District of Columbia Historic Preservation	10 DCMR Chapter 25	Requires consideration of existence and location of historic and prehistoric sites, buildings, objects, and properties of historic and archaeological significance when evaluating remedial alternatives.	**Not Applicable** – Work area not of historical significance.	**Not Applicable** – Work area not of historical significance.
Chesapeake 2000 Agreement	Chesapeake 2000 Agreement and Chesapeake Executive Council directives: https://www.chesapeakebay.net/channel_files/19193/chesapeake_2000.pdf	Establishes goals, agreements, and directives for protection and restoration of the Chesapeake Bay watershed, including protection and restoration of living resources, vital habitat, and water quality, and stewardship and community engagement.	**TBC** in designing and implementing site remediation activities.	**TBC** in designing and implementing site remediation activities.
Anacostia River Watershed Restoration Agreement	Anacostia River Watershed Restoration Program, 10 DCMR § 405	Establishes goals to reduce pollutant loads to the watershed, restore ecological integrity to encourage aquatic diversity and encourage a quality urban fishery, restore the spawning range of anadromous fish, encourage the natural filtering capacity of the waterbody by increasing acreage and quality of tidal and non-tidal wetlands, expanding forest cover and creating a continuous corridor of forest along the streams and rivers in the watershed, and increasing public awareness and participation in restoration activities.	**TBC** in designing and implementing site remediation activities.	**TBC** in designing and implementing site remediation activities.
Federal Action-Specific				
National Ambient Air Quality Standards, Particulates	42 USC §§ 7409 – 7410, 40 CFR Part 50	Establishes maximum concentrations for specified emissions.	**Applicable** to site remediation activities that generate certain air emissions including dust/particulate emissions.	**Applicable** to site remediation activities that generate certain air emissions including dust/particulate emissions.
CWA Effluent Guidelines and Standards	33 USC §§ 1251 and 1311 et seq., 40 CFR Part 401	Provides requirements for point source discharges of pollutants.	**Applicable** to site remediation activities that result in point source discharge of pollutants to surface water bodies.	**Applicable** to site remediation activities that result in point source discharge of pollutants to surface water bodies.
CWA Stormwater Program	33 USC § 1342, 40 CFR Part 122	Regulates discharge of stormwater from industrial and construction activities. Requires implementation of best management practices, such as use of stormwater fencing and other measures to prevent discharge of sediments to surface waters.	**Applicable** to discharges of stormwater to surface waters from remediation that results in soil/sediment disturbance of more than 1 acre of land.	**Applicable** to land disturbance during remedial activities more than 1 acre.
USDOT Hazardous Materials Transportation Act Regulations	49 USC §§ 5101 et seq., 49 CFR 171-180	Establishes classification, packaging, and labeling requirements for shipments of hazardous materials.	**Applicable** to off-site transportation of hazardous materials.	**Applicable** to off-site transportation of hazardous materials.
Department of Energy and Environment, Well Construction, Maintenance, and Abandonment Standards	21 DCMR Chapter 18	Provides provisions for well construction, maintenance, and abandonment for public health and safety and the environment.	**Not Applicable** to soils.	**Applicable** to site remediation activities that involved installation of wells, such as injection wells used for in situ treatment of groundwater.

Table 3-1 (continued)
Applicable or Relevant and Appropriate Requirements (ARARs)
Pepco Benning Road Facility FS Project

Brief Description	Citation	Requirement	Landside - Soil	Landside - Groundwater
District Action-Specific				
District of Columbia Hazardous Materials Transportation and Motor Carrier Safety Act	18 DCMR § 1403	Designates primary and alternate routes for transportation of hazardous materials in the District of Columbia.	**Applicable** for off-site transportation of hazardous materials within the District of Columbia.	**Applicable** for off-site transportation of hazardous materials within the District of Columbia.
District of Columbia Soil Erosion and Sedimentation Control Act and Stormwater Regulations	21 DCMR Chapter 5	Regulates discharge of stormwater from land-disturbing activities.	**Applicable** to site remediation activities that result in land disturbance.	**Applicable** to site remediation activities that result in land disturbance.
District of Columbia Air Pollution Control Act, Air Quality Regulations	D.C. Code §§ 8-101 et seq., 20 DCMR Chapter 6	Provides requirements applicable to particulate air pollution sources.	**Applicable** to site remediation activities that result in generation and emission of particulate or volatile air pollutants.	**Applicable** to site remediation activities that result in generation and emission of particulate or volatile air pollutants.
District of Columbia Air Pollution Control Act, Engine Idling	D.C. Code §§ 8-101 et seq., 20 DCMR § 900	A vehicle that is parked, stopped, or standing shall not idle for more than three minutes.	**Applicable** to site remediation activities that involve trucks on the site (e.g., for removal of excavated soils for off-site disposal or importation of clean soil).	**Applicable** to site remediation activities that involve trucks on the site (e.g., for removal of excavated soils for off-site disposal or importation of clean soil).
District of Columbia Air Pollution Control Act, Vehicle Exhaust Emissions	D.C. Code §§ 8-101 et seq., 20 DCMR § 901	The engine, power, and exhaust mechanism of each motor vehicle must be equipped, adjusted, and operated to prevent escape of a trail of visible fumes or smoke for more than 10 consecutive seconds.	**Applicable** to site remediation activities that involve trucks or other motorized equipment on the site (e.g., for removal of excavated soils for off-site disposal or importation of clean soil).	**Applicable** to site remediation activities that involve trucks or other motorized equipment on the site (e.g., for removal of excavated soils for off-site disposal or importation of clean soil).
District of Columbia Air Pollution Control Act, Odorous or Other Nuisance Air Pollutants	D.C. Code §§ 8-101 et seq., 20 DCMR § 903	Prohibits an emission into the atmosphere of odorous or other air pollutants from any source in any quantity and of any characteristic, and duration which is, or is likely to be, injurious to the public health or welfare, or which interferes with the reasonable enjoyment of life and property.	**Applicable** to site remediation activities that result in generation and emission of air pollutants.	**Applicable** to site remediation activities that result in generation and emission of air pollutants.
District of Columbia Hazardous Waste Regulations	20 DCMR Chapter 42	Prohibits disposal of any hazardous waste or mixture of hazardous waste and any other constituent into or on any land or water in the District of Columbia, except that hazardous waste management units unable to achieve clean closure shall be considered landfills and subject to the closure and post-closure requirements for landfills as specified in the federal RCRA regulations applicable to the unit in question.	**Applicable** to site remediation activities that involve leaving hazardous wastes on site.	**Applicable** to site remediation activities that involve leaving hazardous wastes on site.

Table 3-2
Identification of Preliminary Remediation Goals (PRGs) for Landside Investigation Area
Pepco Benning Road Facility

Pepco Benning Road – Identification of Landside PRGs								
Media/Receptor	**Chemical**	**Units**	**Risk-Based Target Concentration**		**Background Threshold Value [b]**	**Potential ARAR**	**Selected PRG**	
			RBTC [a]	**Basis**			**PRG**	**Rationale**
Soil								
Surface Soil (0-1 foot bgs) Outdoor Worker	Total PCBs	mg/kg	10.5 [c]	TR=1E-5	0.0151	TSCA 761.6; See note [f]	7	Lower of RBTCs for outdoor worker and construction worker. RBTC is higher than BTV; ARARs not applicable
Surface and Subsurface Soil (0-16 feet bgs) Construction Worker	Total PCBs	mg/kg	7 [d]	THQ=1	0.0151	TSCA 761.6; See note [f]		
	Vanadium	mg/kg	277 [e]	THQ=1	38	NA	277	RBTC is higher than BTV; ARARs not applicable
Groundwater								
Groundwater - Vapor Intrusion	PCE	µg/L	242	TR=1E-5	NA	NA	242	RBTC
	TCE	µg/L	22	TR=1E-5	NA	NA	22	RBTC
Groundwater Restoration	PCE	µg/L	NA	NA	NA	5 [g]	5	ARAR
	TCE	µg/L	NA	NA	NA	5 [g]	5	ARAR
	cis-1,2-DCE	µg/L	NA	NA	NA	70 [g]	70	ARAR
	trans-1,2-DCE	µg/L	NA	NA	NA	100 [g]	100	ARAR
	1,1-DCE	µg/L	NA	NA	NA	7 [g]	7	ARAR
	VC	µg/L	NA	NA	NA	2 [g]	2	ARAR

Acronyms:
BTV - Background Threshold Value
ARAR - Applicable or relevant and appropriate requirement
NA - Not Available
PCB - Polychlorinated Biphenyl
PRG - Preliminary Remediation Goal
RBTC - Risk-Based Target Concentration
THQ - Target Hazard Quotient
TR - Target Risk
PCE - Perchloroethylene
TCE - Trichloroethylene
DCE - Dichloroethylene
VC - Vinyl chloride

Notes:
(a) Lower of RBTCs calculated based on a target cancer risk level of 1E-5 and a target hazard quotient of 1.
(b) Derived in Appendix W of the Final Remedial Investigation Report, February 2020.
(c) to (e) Derived in Appendix C.
(f) RBTCs calculated under the risk-based approach also satisfy the ARAR, TSCA 761.61(c), requirements.
(g) District of Columbia Groundwater Protection and Quality Standards. D.C. Code § 8-103.04, 21 DCMR §§ 1150-1158

Table 3-3
Comparison of Total PCB Concentrations to Surface Soil RBTC for Outdoor Worker- Transformer Shop
Pepco Benning Road Facility FS Project

Location	Depth	Collected	Total PCBs (Aroclors) (mg/kg)	Surface Soil RBTC (a) (mg/kg)	Exceed Surface Soil RBTC?
Surface Soil (0-1 foot)					
SUS21-1A	0 - 1 ft	1/27/2017	0.94	10.5	No
SUS21-1B	0 - 1 ft	1/27/2017	0.098	10.5	No
SUS21-1E	0 - 1 ft	1/27/2017	1.5	10.5	No
SUS21-1F	0 - 1 ft	1/27/2017	0.49	10.5	No
SUS21-1G	0 - 1 ft	1/27/2017	2	10.5	No
SUS21-1H	0 - 1 ft	1/27/2017	0.96	10.5	No
SUS21-2D	0 - 1 ft	3/23/2017	0.3	10.5	No
SUS21-2E	0 - 1 ft	3/23/2017	4	10.5	No
SUS21-2I	0 - 1 ft	3/22/2017	4.5	10.5	No
SUS21-2J	0 - 1 ft	3/22/2017	11	10.5	Yes
SUS21-2L	0 - 1 ft	3/22/2017	1.6	10.5	No
SUS21-2M	0 - 1 ft	3/22/2017	2.7	10.5	No
SUS21-2N	0 - 1 ft	3/22/2017	3	10.5	No
SUSDP21	0 - 1 ft	1/27/2017	0.52	10.5	No
SUSDP21	1 - 1.75 ft	2/7/2013	7.2	10.5	No
SUSDP21-1C	0 - 1 ft	1/27/2017	43	10.5	Yes
SUSDP21-3G	0 - 1 ft	8/28/2017	8800	10.5	Yes
SUSDP21-3M	0 - 1 ft	8/28/2017	130	10.5	Yes
SUSDP21-3Q	0 - 1 ft	8/24/2017	0.066	10.5	No
SUSDP21-5W	0 - 1 ft	1/26/2018	0.025	10.5	No
SUSDP22	0.5 - 1 ft	6/13/2013	0.036	10.5	No
SUSDPGD21-C3	0 - 1 ft	7/2/2018	0.08	10.5	No
SUSDPGD21-C5	0 - 1 ft	5/31/2018	0.05 U	10.5	No
SUSDPGD21-D1	0 - 1 ft	5/30/2018	9.6	10.5	No
SUSDPGD21-E1	0 - 1 ft	5/30/2018	0.036	10.5	No
SUSDPGD21-F1	0 - 1 ft	5/30/2018	0.099	10.5	No
SUSDPGD21-G1	0 - 1 ft	4/4/2018	56	10.5	Yes
SUSDPGD21-G2	0 - 1 ft	4/4/2018	0.068	10.5	No
SUSDPGD21-H1	0 - 1 ft	3/14/2018	0.046	10.5	No
SUSDPGD21-H2	0 - 1 ft	3/14/2018	0.016	10.5	No
SUSDPGD21-I1	0 - 1 ft	2/20/2018	0.013	10.5	No
SUSDPGD21-I2	0 - 1 ft	2/20/2018	0.0083	10.5	No
SUSDPGD21-J1	0 - 1 ft	1/24/2018	0.0062	10.5	No
SUSDPGD21-J2	0 - 1 ft	1/24/2018	0.0079	10.5	No
SUSDPGD21-K1	0 - 1 ft	1/24/2018	0.0088	10.5	No
SUSDPGD21-K1.5	0 - 1 ft	1/26/2018	0.013	10.5	No
SUSDPGD21-K2	0 - 1 ft	1/24/2018	0.0068	10.5	No
SUSDPGD21-L1	0 - 1 ft	2/20/2018	4.1	10.5	No
SUSDPGD21-L2	0 - 1 ft	2/20/2018	0.014	10.5	No
SUSDPGD21-M1	0 - 1 ft	3/14/2018	2.3	10.5	No
SUSDPGD21-M2	0 - 1 ft	3/14/2018	0.03	10.5	No
SUSDPGD21-N1	0 - 1 ft	4/4/2018	0.053	10.5	No
SUSDPGD21-N2	0 - 1 ft	4/4/2018	0.061	10.5	No
SUSDPGD21-P1	0 - 1 ft	5/30/2018	0.002	10.5	No
SUSDPGD21-R1	0 - 1 ft	1/23/2018	0.07	10.5	No
SUSDPGD21-R2	0 - 1 ft	1/23/2018	0.005	10.5	No
SUSDPGD21-S1	0 - 1 ft	1/23/2018	0.091	10.5	No
SUSDPGD21-S2	0 - 1 ft	1/24/2018	0.048	10.5	No

Notes:
PCB - Polychlorinated Biphenyl.
RBTC - Risk-Based Target Concentration.
U - Not detected at specified reporting limit.
Highlighting indicates an exceedance of the RBTC.
(a) Risk-based concentration for an outdoor worker scenario, protective of incidental ingestion, dermal contact, and inhalation of fugitive dust. Based on a target risk of 10^{-5}. Applicable to surface soil (0-1 foot bgs).

Table 3-4
Comparison of Total PCB Concentrations to Combined Soil PRG - Transformer Shop
Pepco Benning Road Facility FS Project

Location	Depth	Collected	Total PCBs (Aroclors) (mg/kg)	Combined Soil PRG (a) (mg/kg)	Exceed Combined Soil PRG?
Surface Soil (0-1 foot)					
SUS21-1A	0 - 1 ft	1/27/2017	0.94	7	No
SUS21-1B	0 - 1 ft	1/27/2017	0.098	7	No
SUS21-1E	0 - 1 ft	1/27/2017	1.5	7	No
SUS21-1F	0 - 1 ft	1/27/2017	0.49	7	No
SUS21-1G	0 - 1 ft	1/27/2017	2	7	No
SUS21-1H	0 - 1 ft	1/27/2017	0.96	7	No
SUS21-2D	0 - 1 ft	3/23/2017	0.3	7	No
SUS21-2E	0 - 1 ft	3/23/2017	4	7	No
SUS21-2I	0 - 1 ft	3/22/2017	4.5	7	No
SUS21-2J	0 - 1 ft	3/22/2017	11	7	Yes
SUS21-2L	0 - 1 ft	3/22/2017	1.6	7	No
SUS21-2M	0 - 1 ft	3/22/2017	2.7	7	No
SUS21-2N	0 - 1 ft	3/22/2017	3	7	No
SUSDP21	0 - 1 ft	1/27/2017	0.52	7	No
SUSDP21	1 - 1.75 ft	2/7/2013	7.2	7	Yes
SUSDP21-1C	0 - 1 ft	1/27/2017	43	7	Yes
SUSDP21-3G	0 - 1 ft	8/28/2017	8800	7	Yes
SUSDP21-3M	0 - 1 ft	8/28/2017	130	7	Yes
SUSDP21-3Q	0 - 1 ft	8/24/2017	0.066	7	No
SUSDP21-5W	0 - 1 ft	1/26/2018	0.025	7	No
SUSDP22	0.5 - 1 ft	6/13/2013	0.036	7	No
SUSDPGD21-C3	0 - 1 ft	7/2/2018	0.08	7	No
SUSDPGD21-C5	0 - 1 ft	5/31/2018	0.05 U	7	No
SUSDPGD21-D1	0 - 1 ft	5/30/2018	9.6	7	Yes
SUSDPGD21-E1	0 - 1 ft	5/30/2018	0.036	7	No
SUSDPGD21-F1	0 - 1 ft	5/30/2018	0.099	7	No
SUSDPGD21-G1	0 - 1 ft	4/4/2018	56	7	Yes
SUSDPGD21-G2	0 - 1 ft	4/4/2018	0.068	7	No
SUSDPGD21-H1	0 - 1 ft	3/14/2018	0.046	7	No
SUSDPGD21-H2	0 - 1 ft	3/14/2018	0.016	7	No
SUSDPGD21-I1	0 - 1 ft	2/20/2018	0.013	7	No
SUSDPGD21-I2	0 - 1 ft	2/20/2018	0.0083	7	No
SUSDPGD21-J1	0 - 1 ft	1/24/2018	0.0062	7	No
SUSDPGD21-J2	0 - 1 ft	1/24/2018	0.0079	7	No
SUSDPGD21-K1	0 - 1 ft	1/24/2018	0.0088	7	No
SUSDPGD21-K1.5	0 - 1 ft	1/26/2018	0.013	7	No
SUSDPGD21-K2	0 - 1 ft	1/24/2018	0.0068	7	No
SUSDPGD21-L1	0 - 1 ft	2/20/2018	4.1	7	No
SUSDPGD21-L2	0 - 1 ft	2/20/2018	0.014	7	No
SUSDPGD21-M1	0 - 1 ft	3/14/2018	2.3	7	No
SUSDPGD21-M2	0 - 1 ft	3/14/2018	0.03	7	No
SUSDPGD21-N1	0 - 1 ft	4/4/2018	0.053	7	No
SUSDPGD21-N2	0 - 1 ft	4/4/2018	0.061	7	No
SUSDPGD21-P1	0 - 1 ft	5/30/2018	0.002	7	No
SUSDPGD21-R1	0 - 1 ft	1/23/2018	0.07	7	No
SUSDPGD21-R2	0 - 1 ft	43123.60417	0.005	7	No
SUSDPGD21-S1	0 - 1 ft	1/23/2018	0.091	7	No
SUSDPGD21-S2	0 - 1 ft	1/24/2018	0.048	7	No

Table 3-4
Comparison of Total PCB Concentrations to Combined Soil PRG - Transformer Shop
Pepco Benning Road Facility FS Project

Location	Depth	Collected	Total PCBs (Aroclors) (mg/kg)	Combined Soil PRG (a) (mg/kg)	Exceed Combined Soil PRG?
Subsurface Soil (1-15 feet)					
DP35	14.5 - 15.5 ft	3/28/2013	0.0049 U	7	No
DP46	14.5 - 15.5 ft	6/5/2013	0.0049 U	7	No
DP46	4.5 - 5.5 ft	5/22/2013	0.0015	7	No
DP46	9.5 - 10.5 ft	6/5/2013	0.0048 U	7	No
DP47	1.5 - 2.5 ft	5/28/2013	0.34	7	No
DP47	14 - 15 ft	6/5/2013	0.0049 U	7	No
DP47	9.5 - 10.5 ft	6/5/2013	0.0046 U	7	No
SUSDP21	1 - 2 ft	1/27/2017	1	7	No
SUSDP21	2 - 5 ft	1/27/2017	0.89	7	No
SUSDP21	5 - 10 ft	2/2/2017	0.0097	7	No
SUSDP21-1C	1 - 2 ft	8/24/2017	17	7	Yes
SUSDP21-1C	2 - 3 ft	8/24/2017	0.32	7	No
SUSDP21-1C	3 - 4 ft	8/24/2017	0.022	7	No
SUSDP21-3A	1 - 2 ft	8/25/2017	1.2	7	No
SUSDP21-3A	2 - 3 ft	8/25/2017	0.86	7	No
SUSDP21-3G	1 - 2 ft	8/28/2017	0.3	7	No
SUSDP21-3G	2 - 3 ft	8/28/2017	0.56	7	No
SUSDP21-3M	1 - 2 ft	8/28/2017	16	7	Yes
SUSDP21-3M	2 - 3 ft	8/28/2017	0.27	7	No
SUSDP21-3T	1 - 2 ft	8/25/2017	2.9	7	No
SUSDP21-3T	2 - 3 ft	8/25/2017	1.8	7	No
SUSDP21-3T	3 - 4 ft	8/25/2017	0.07	7	No
SUSDP21-3V	1 - 2 ft	8/25/2017	0.055	7	No
SUSDP21-5W	1 - 2 ft	1/26/2018	0.43	7	No
SUSDP21-5W	2 - 3 ft	1/26/2018	0.098	7	No
SUSDP22	14.5 - 15.5 ft	6/12/2013	0.078	7	No
SUSDP22	2.5 - 3.5 ft	5/22/2013	0.03	7	No
SUSDP22	9.5 - 10.5 ft	6/12/2013	0.0021	7	No
SUSDPGD21-C3	1 - 2 ft	7/2/2018	0.16	7	No
SUSDPGD21-C3	2 - 3 ft	7/2/2018	0.0039	7	No
SUSDPGD21-C3	3 - 4 ft	7/2/2018	0.001 U	7	No
SUSDPGD21-C5	1 - 2 ft	5/31/2018	0.094	7	No
SUSDPGD21-C5	2 - 3 ft	5/31/2018	0.057 U	7	No
SUSDPGD21-C5	3 - 4 ft	5/31/2018	0.055 U	7	No
SUSDPGD21-C5	4 - 5 ft	5/31/2018	0.057 U	7	No
SUSDPGD21-D1	1 - 2 ft	5/30/2018	11	7	Yes
SUSDPGD21-D1	2 - 3 ft	5/30/2018	7	7	No
SUSDPGD21-D1	3 - 4 ft	5/30/2018	1.6	7	No
SUSDPGD21-D1	4 - 5 ft	5/30/2018	0.059	7	No
SUSDPGD21-E1	1 - 2 ft	5/30/2018	7.7	7	Yes
SUSDPGD21-E1	2 - 3 ft	5/30/2018	0.028	7	No
SUSDPGD21-E1	3 - 4 ft	5/30/2018	0.21	7	No
SUSDPGD21-E1	4 - 5 ft	5/30/2018	0.087	7	No
SUSDPGD21-F1	1 - 2 ft	5/30/2018	52	7	Yes
SUSDPGD21-F1	2 - 3 ft	5/30/2018	0.021	7	No
SUSDPGD21-F1	3 - 4 ft	5/30/2018	0.19	7	No
SUSDPGD21-F1	4 - 5 ft	5/30/2018	0.25	7	No
SUSDPGD21-G1	1 - 2 ft	4/4/2018	450	7	Yes
SUSDPGD21-G1	2 - 3 ft	4/4/2018	77	7	Yes
SUSDPGD21-G1	3 - 4 ft	4/4/2018	180	7	Yes
SUSDPGD21-G1	4 - 5 ft	4/4/2018	23	7	Yes
SUSDPGD21-G1	5 - 6 ft	4/4/2018	0.19	7	No
SUSDPGD21-G2	1 - 2 ft	4/4/2018	5.3	7	No
SUSDPGD21-G2	2 - 3 ft	4/4/2018	1.5	7	No
SUSDPGD21-H1	1 - 2 ft	3/14/2018	1.9	7	No
SUSDPGD21-H1	2 - 3 ft	3/14/2018	0.23	7	No
SUSDPGD21-H2	1 - 2 ft	3/14/2018	2.4	7	No
SUSDPGD21-H2	2 - 3 ft	3/14/2018	0.9	7	No
SUSDPGD21-I1	1 - 2 ft	2/20/2018	24	7	Yes
SUSDPGD21-I1	2 - 3 ft	2/20/2018	0.13	7	No
SUSDPGD21-I2	1 - 2 ft	2/20/2018	14	7	Yes
SUSDPGD21-I2	2 - 3 ft	2/20/2018	4.9	7	No
SUSDPGD21-J1	1 - 2 ft	1/24/2018	9.5	7	Yes

Table 3-4
Comparison of Total PCB Concentrations to Combined Soil PRG - Transformer Shop
Pepco Benning Road Facility FS Project

Location	Depth	Collected	Total PCBs (Aroclors) (mg/kg)	Combined Soil PRG (a) (mg/kg)	Exceed Combined Soil PRG?
SUSDPGD21-J1	2 - 3 ft	1/24/2018	0.05	7	No
SUSDPGD21-J2	1 - 2 ft	1/24/2018	7.7	7	Yes
SUSDPGD21-J2	2 - 3 ft	1/24/2018	0.69	7	No
SUSDPGD21-K1	1 - 2 ft	1/24/2018	42	7	Yes
SUSDPGD21-K1	2 - 3 ft	1/24/2018	0.034	7	No
SUSDPGD21-K1.5	1 - 2 ft	1/26/2018	8.8	7	Yes
SUSDPGD21-K1.5	2 - 3 ft	1/26/2018	0.064	7	No
SUSDPGD21-K2	1 - 2 ft	1/24/2018	42	7	Yes
SUSDPGD21-K2	2 - 3 ft	1/24/2018	0.81	7	No
SUSDPGD21-L1	1 - 2 ft	2/20/2018	9.7	7	Yes
SUSDPGD21-L1	2 - 3 ft	2/20/2018	0.096	7	No
SUSDPGD21-L2	1 - 2 ft	2/20/2018	0.99	7	No
SUSDPGD21-L2	2 - 3 ft	2/20/2018	1.1	7	No
SUSDPGD21-M1	1 - 2 ft	3/14/2018	0.12	7	No
SUSDPGD21-M1	2 - 3 ft	3/14/2018	0.056	7	No
SUSDPGD21-M2	1 - 2 ft	3/14/2018	5.9	7	No
SUSDPGD21-M2	2 - 3 ft	3/14/2018	0.73	7	No
SUSDPGD21-N1	1 - 2 ft	4/4/2018	0.36	7	No
SUSDPGD21-N2	1 - 2 ft	4/4/2018	0.81	7	No
SUSDPGD21-P1	1 - 2 ft	5/30/2018	15	7	Yes
SUSDPGD21-P1	2 - 3 ft	5/30/2018	0.14	7	No
SUSDPGD21-R1	1 - 2 ft	1/23/2018	0.022	7	No
SUSDPGD21-R2	1 - 2 ft	1/23/2018	0.22	7	No
SUSDPGD21-S1	1 - 2 ft	1/23/2018	0.27	7	No
SUSDPGD21-S2	1 - 2 ft	1/24/2018	0.0094 U	7	No

Notes:
PCB - Polychlorinated Biphenyl
PRG - Preliminary Remediation Goal
U - Not detected at specified reporting limit.
Highlighting indicates an exceedance of the PRG.

(a) Risk-based concentration for a construction worker scenario, protective of incidental ingestion, dermal contact, and inhalation of fugitive dust. Based on a hazard quotient of 1. Applicable to combined soil.

Table 3-5
Volume of Soil in Transformer Shop Area with PCBs > 7 mg/kg

Location	PCBs (mg/kg)	Depth Interval	Polygon Area (sq. ft.)	Soil Volume (cu. ft.)
SUS21-2J	11	0-1 ft	595	595
SUSDP21	7.2	1-2 ft	447	447
SUSDP21-1C	43	0-1 ft	340	340
	17	1-2 ft	340	340
SUSDP21-3G	8800	0-1	48	48
SUSDP21-3M	130	0-1 ft	45	45
	16	1-2 ft	45	45
SUSDPGD21-D1	9.6	0-1 ft	89	89
	11	1-2 ft	89	89
	7.0	2-3 ft	89	89
SUSDPGD21-E1	7.7	1-2 ft	98	98
SUSDPGD21-F1	52	1-2 ft	96	96
SUSDPGD21-G1	56	0-1 ft	63	63
	450	1-2 ft	63	63
	77	2-3 ft	63	63
	180	3-4 ft	63	63
	23	4-5 ft	63	63
SUSDPGD21-I1	24	1-2 ft	76	76
SUSDPGD21-I2	14	1-2 ft	64	64
SUSDPGD21-J1	9.5	1-2 ft	72	72
SUSDPGD21-J2	7.7	1-2 ft	44	44
SUSDPGD21-K1	42	1-2 ft	73	73
SUSDPGD21-K1.5	8.8	1-2 ft	46	46
SUSDPGD21-K2	42	1-2 ft	25	25
SUSDPGD21-L1	9.7	1-2 ft	113	113
SUSDPGD21-P1	15	1-2 ft	428	428
Total Volume (cubic feet)				**3577**
Total Volume (cubic yards)				**132**

Table 3-6

Comparison of Vanadium Concentrations to the Construction Worker PRG - Warehouse and Laydown Area
Pepco Benning Road Facility FS Project

Location	Depth	Sample Date	Vanadium Concentration (mg/kg)	PRG (a) (mg/kg)	Exceed PRG?
Surface Soil (0-1 foot)					
SUS08-1A	0 - 1 ft	1/24/2017	44	277	No
SUS08-1B	0 - 1 ft	1/24/2017	35	277	No
SUS08-1B	0 - 1 ft	1/24/2017	64	277	No
SUS08-1C	0 - 1 ft	1/24/2017	23	277	No
SUS08-1D	0 - 1 ft	1/24/2017	900	277	Yes
SUS08-1F	0 - 1 ft	1/24/2017	260	277	No
SUS08-1G	0 - 1 ft	1/24/2017	190	277	No
SUS08-1H	0 - 1 ft	1/24/2017	1,300	277	Yes
SUS08-2F	0 - 1 ft	3/22/2017	23	277	No
SUS08-2H	0 - 1 ft	3/22/2017	59	277	No
SUS08-2J	0 - 1 ft	3/22/2017	1,900	277	Yes
SUS08-2N	0 - 1 ft	3/22/2017	1,400	277	Yes
SUS08-2P	0 - 1 ft	3/22/2017	56	277	No
SUSDP03	0.5 - 1 ft	2/4/2013	10	277	No
SUSDP04	0 - 1 ft	2/4/2013	140	277	No
SUSDP05	0 - 1 ft	2/4/2013	75	277	No
SUSDP06	0 - 1 ft	2/5/2013	20	277	No
SUSDP07	0 - 1 ft	2/5/2013	45	277	No
SUSDP08	0 - 1 ft	2/5/2013	1,700	277	Yes
SUSDP08-1E	0 - 1 ft	1/24/2017	1,500	277	Yes
SUSDP08-2G	0 - 1 ft	3/22/2017	52	277	No
SUSDP11	0 - 1 ft	2/5/2013	78	277	No
SUSDP13	0 - 1 ft	2/5/2013	35	277	No
TA1A1	0 - 1 ft	1/24/2017	290	277	Yes
TA1A3	0 - 1 ft	1/24/2017	180	277	No
TA1A7	0 - 1 ft	1/24/2017	32	277	No
TA1A9	0 - 1 ft	1/24/2017	53	277	No
TA1C1	0 - 1 ft	1/24/2017	470	277	Yes
TA1C3	0 - 1 ft	1/24/2017	41	277	No
TA1C4	0 - 1 ft	1/24/2017	7,000	277	Yes
TA1C5	0 - 1 ft	1/24/2017	3,800	277	Yes
TA1C7	0 - 1 ft	1/24/2017	16	277	No
TA1C9	0 - 1 ft	1/24/2017	200	277	No
TA1E1	0 - 1 ft	1/24/2017	42,000	277	Yes
TA1E10	0 - 1 ft	8/8/2017	3,800	277	Yes
TA1-E11	0 - 1 ft	1/30/2018	180	277	No
TA1E3	0 - 1 ft	1/24/2017	57	277	No
TA1E4	0 - 1 ft	1/24/2017	100	277	No
TA1E5	0 - 1 ft	1/24/2017	190	277	No
TA1E7	0 - 1 ft	1/24/2017	20	277	No
TA1E9	0 - 1 ft	1/24/2017	1,100	277	Yes
TA1F4	0 - 1 ft	1/24/2017	3,800	277	Yes
TA1F5	0 - 1 ft	1/24/2017	610	277	Yes
TA1G1	0 - 1 ft	1/24/2017	68	277	No
TA1G10	0 - 1 ft	8/4/2017	37	277	No
TA1G3	0 - 1 ft	1/24/2017	98	277	No
TA1G5	0 - 1 ft	1/24/2017	330	277	Yes
TA1G7	0 - 1 ft	1/24/2017	190	277	No
TA1G9	0 - 1 ft	1/24/2017	37,000	277	Yes
TA1H9	0 - 1 ft	8/4/2017	450	277	Yes

Table 3-6

Comparison of Vanadium Concentrations to the Construction Worker PRG - Warehouse and Laydown Area
Pepco Benning Road Facility FS Project

Location	Depth	Sample Date	Vanadium Concentration (mg/kg)	PRG (a) (mg/kg)	Exceed PRG?
Subsurface Soil (1-15 feet)					
DP27	6.5 - 7.5 ft	3/26/2013	110	277	No
DP40	2.5 - 3.5 ft	5/20/2013	120	277	No
DP42	14.5 - 15.5 ft	5/29/2013	25	277	No
DP42	9.5 - 10.5 ft	5/29/2013	49	277	No
SUSDP04	2.5 - 3.5 ft	2/4/2013	25	277	No
SUSDP05	4.5 - 5.5 ft	2/4/2013	11	277	No
SUSDP06	4.5 - 5.5 ft	2/5/2013	18	277	No
SUSDP07	14.5 - 15.5 ft	2/5/2013	17	277	No
SUSDP07	4.5 - 5.5 ft	2/5/2013	18	277	No
SUSDP07	9.5 - 10.5 ft	2/5/2013	20	277	No
SUSDP08	14.5 - 15.5 ft	2/5/2013	25	277	No
SUSDP08	2.5 - 3.5 ft	2/5/2013	25	277	No
SUSDP08	9.5 - 10.5 ft	2/5/2013	36	277	No
SUSDP11	4.5 - 5.5 ft	2/5/2013	21	277	No
SUSDP11	9.5 - 10.5 ft	2/5/2013	14	277	No
SUSDP13	4.5 - 5.5 ft	2/5/2013	16	277	No
SUSDP13	9.5 - 10.5 ft	2/5/2013	3	277	No
SUSDP41	14.5 - 15.5 ft	5/24/2013	8	277	No
SUSDP41	2.5 - 3.5 ft	5/24/2013	130	277	No
SUSDP41	9.5 - 10.5 ft	5/24/2013	23	277	No
TA1E0	1 - 2 ft	8/1/2017	670	277	Yes
TA1E0	2 - 3 ft	8/1/2017	630	277	Yes
TA1E0	3 - 4 ft	8/1/2017	420	277	Yes
TA1E1	1 - 2 ft	1/24/2017	200	277	No
TA1E10	1 - 2 ft	8/8/2017	21	277	No
TA1E9	1 - 2 ft	1/24/2017	560	277	Yes
TA1G10	1 - 2 ft	8/4/2017	17	277	No
TA1G9	1 - 2 ft	1/24/2017	1,400	277	Yes
TA1G9	2 - 3 ft	1/24/2017	540	277	Yes
TA1H9	1 - 2 ft	8/4/2017	530	277	Yes

Notes:
PRG - Preliminary Remediation Goal
Highlighting indicates an exceedance of the PRG.

(a) Risk-based concentration for a construction worker scenario, protective of incidental ingestion, dermal contact, and inhalation of fugitive dusts. Based on a hazard quotient of 1. Applicable to subsurface soil.

Table 3-7
Comparison of PCE and TCE Concentrations to Vapor Intrusion PRGs
Groundwater
Pepco Benning Road Facility FS Project

Well Location	Screen Interval/ Sample Interval (ft)	Sample Date	PCE (ug/L)	PRG (ug/L)	Exceeds PRG?	TCE (ug/L)	PRG (ug/L)	Exceeds PRG?
Monitoring Wells								
MW01A	10-35	04/02/21	ND	242	No	ND	22	No
MW02A	8-28	03/24/21	ND	242	No	ND	22	No
MW05A	10-20	03/23/21	1.4	242	No	ND	22	No
MW06A	8-28	11/04/14	0.26	242	No	ND	22	No
MW09A	18-38	03/23/21	390	242	Yes	49	22	Yes
MW10A	10-30	11/04/14	ND	242	No	ND	22	No
Temporary Wells								
TP-01A	22-27	03/24/21	220	242	No	14	22	No
TP-02A	20-25	03/22/21	ND	242	No	ND	22	No
TP-03A	19-24	03/23/21	ND	242	No	ND	22	No
TP-04A	30-35	03/23/21	55	242	No	5.8	22	No
TP-05A	22-27	03/25/21	ND	242	No	ND	22	No
TP-06A	13-18	03/22/21	ND	242	No	ND	22	No
TP-09A	22-27	03/25/21	ND	242	No	ND	22	No
TP-10A	45-50	03/19/21	17	242	No	1.2	22	No
TP-11A	17-22	03/19/21	15	242	No	0.88	22	No
Direct Push Groundwater Samples								
DP28	20-22	04/02/13	ND	242	No	ND	22	No
DP30	27-30	04/03/13	ND	242	No	ND	22	No
DP31	19.5-20.5	04/01/13	ND	242	No	ND	22	No
DP38	15-20	05/23/13	ND	242	No	ND	22	No
DPA1	20-25	04/17/14	ND	242	No	ND	22	No
DPA2	20-25	04/17/14	2.3	242	No	ND	22	No
DPA3	25-30	04/16/14	270	242	Yes	19	22	No
DPA4	25-30	04/16/14	300	242	Yes	26	22	Yes
DPA5	25-30	04/16/14	260	242	Yes	23	22	Yes
DPB10	25-30	04/17/14	25	242	No	0.94	22	No
DPB11	25-30	04/17/14	ND	242	No	ND	22	No
DPB2	20-25	04/17/14	3	242	No	ND	22	No
DPB3	25-30	04/16/14	140	242	No	10	22	No
DPB5	25-30	04/16/14	190	242	No	14	22	No
DPB6	25-30	04/16/14	330	242	Yes	22	22	No
DPB7	30-35	04/16/14	470	242	Yes	26	22	Yes
DPB9	25-30	04/17/14	190	242	No	14	22	No
DPC3	25-30	04/16/14	0.99	242	No	ND	22	No
DPC4	25-30	04/16/14	53	242	No	4.1	22	No
DPC5	25-30	04/16/14	69	242	No	4.2	22	No

Table 3-7 (continued)
Comparison of PCE and TCE Concentrations to Vapor Intrusion PRGs
Groundwater
Pepco Benning Road Facility FS Project

Well Location	Screen Interval/ Sample Interval (ft)	Sample Date	PCE (ug/L)	PRG (ug/L)	Exceeds PRG?	TCE (ug/L)	PRG (ug/L)	Exceeds PRG?
DPC7	30-35	04/17/14	88	242	No	6.9	22	No
DPC8	30-35	04/17/14	ND	242	No	ND	22	No
DPC9	30-35	04/18/14	0.96	242	No	ND	22	No
DPD5	25-30	04/18/14	24	242	No	ND	22	No
DPD6	30-35	04/17/14	4.9	242	No	ND	22	No
DPD7	30-35	04/17/14	ND	242	No	ND	22	No
SUSDP01	9.5-10.5	06/13/13	ND	242	No	ND	22	No
SUSDP03	9.5-10.5	06/11/13	ND	242	No	ND	22	No
SUSDP09	25-30	06/11/13	160	242	No	12	22	No
SUSDP12	0-1	01/26/17	ND	242	No	ND	22	No
SUSDP14	9.5-10.5	06/06/13	ND	242	No	ND	22	No
SUSDP15	3.5-4.5	05/21/13	ND	242	No	ND	22	No
SUSDP15	9.5-10.5	06/06/13	ND	242	No	ND	22	No
SUSDP37	13-18	05/23/13	ND	242	No	ND	22	No
SUSDP37	25-30	05/23/13	ND	242	No	ND	22	No
SUSDP39	13-18	05/22/13	ND	242	No	ND	22	No
SUSDP43	15-20	06/06/13	ND	242	No	ND	22	No
TPA19A1	15-20	03/20/17	ND	242	No	ND	22	No
TPA19A2	15-20	03/20/17	ND	242	No	ND	22	No
TPA19A3	15-20	03/20/17	2.2	242	No	ND	22	No
TPA19B3	15-20	02/07/17	0.24 J	242	No	ND	22	No
TA19C1	15-20	02/08/17	30	242	No	3.2	22	No
TA19C2	15-20	02/07/17	18	242	No	5.9	22	No
TA19C3	15-20	02/07/17	6.7	242	No	0.23 J	22	No
TA19D1	15-20	03/03/17	ND	242	No	ND	22	No
TA19D3	15-20	03/08/17	ND	242	No	ND	22	No
TA19E1	15-20	02/07/17	ND	242	No	ND	22	No
TA19E2	15-20	02/07/17	0.52 J	242	No	ND	22	No

Notes:

ft - feet

ND - not detected

PCE -tetrachloroethylene

PRG - Preliminary Remediation Goal

TCE - trichloroethene

ug/L - micrograms per liter

Highlighting indicates an exceedance of the PRG.

Table 3-8
Comparison of PCE and TCE Concentrations to Groundwater Restoration PRGs
Groundwater
Pepco Benning Road Facility FS Project

Well Location	Screen Interval/ Sample Interval (ft)	Sample Date	PCE (ug/L)	PRG (ug/L)	Exceeds PRG?	TCE (ug/L)	PRG (ug/L)	Exceeds PRG?
Monitoring Wells								
MW01A	10-35	04/02/21	ND	5	No	ND	5	No
MW02A	8-28	03/24/21	ND	5	No	ND	5	No
MW05A	10-20	03/23/21	1.4	5	No	ND	5	No
MW06A	8-28	11/04/14	0.26	5	No	ND	5	No
MW09A	18-38	03/23/21	390	5	Yes	49	5	Yes
MW10A	10-30	11/04/14	ND	5	Yes	ND	No	No
Temporary Wells								
TP-01A	22-27	03/24/21	220	5	Yes	14	5	Yes
TP-02A	20-25	03/22/21	ND	5	No	ND	5	No
TP-03A	19-24	03/23/21	ND	5	No	ND	5	No
TP-04A	30-35	03/23/21	55	5	Yes	5.8	5	Yes
TP-05A	22-27	03/25/21	ND	5	No	ND	5	No
TP-06A	13-18	03/22/21	ND	5	No	ND	5	No
TP-09A	22-27	03/25/21	ND	5	No	ND	5	No
TP-10A	45-50	03/19/21	17	5	Yes	1.2	5	No
TP-11A	17-22	03/19/21	15	5	Yes	0.88	5	No
Direct Push Groundwater Samples								
DP28	20-22	04/02/13	ND	5	No	ND	5	No
DP30	27-30	04/03/13	ND	5	No	ND	5	No
DP31	19.5-20.5	04/01/13	ND	5	No	ND	5	No
DP38	15-20	05/23/13	ND	5	No	ND	5	No
DPA1	20-25	04/17/14	ND	5	No	ND	5	No
DPA2	20-25	04/17/14	2.3	5	No	ND	5	No
DPA3	25-30	04/16/14	270	5	Yes	19	5	Yes
DPA4	25-30	04/16/14	300	5	Yes	26	5	Yes
DPA5	25-30	04/16/14	260	5	Yes	23	5	Yes
DPB10	25-30	04/17/14	25	5	Yes	0.94	5	No
DPB11	25-30	04/17/14	ND	5	No	ND	5	No
DPB2	20-25	04/17/14	3	5	No	ND	5	No
DPB3	25-30	04/16/14	140	5	Yes	10	5	Yes
DPB5	25-30	04/16/14	190	5	Yes	14	5	Yes
DPB6	25-30	04/16/14	330	5	Yes	22	5	Yes
DPB7	30-35	04/16/14	470	5	Yes	26	5	Yes
DPB9	25-30	04/17/14	190	5	Yes	14	5	Yes
DPC3	25-30	04/16/14	0.99	5	No	ND	5	No
DPC4	25-30	04/16/14	53	5	Yes	4.1	5	No
DPC5	25-30	04/16/14	69	5	Yes	4.2	5	No

Table 3-8 (continued)
Comparison of PCE and TCE Concentrations to Groundwater Restoration PRGs
Groundwater
Pepco Benning Road Facility FS Project

Well Location	Screen Interval/ Sample Interval (ft)	Sample Date	PCE (ug/L)	PRG (ug/L)	Exceeds PRG?	TCE (ug/L)	PRG (ug/L)	Exceeds PRG?
DPC7	30-35	04/17/14	88	5	Yes	6.9	5	Yes
DPC8	30-35	04/17/14	ND	5	No	ND	5	No
DPC9	30-35	04/18/14	0.96	5	No	ND	5	No
DPD5	25-30	04/18/14	24	5	Yes	ND	5	No
DPD6	30-35	04/17/14	4.9	5	No	ND	5	No
DPD7	30-35	04/17/14	ND	5	No	ND	5	No
SUSDP01	9.5-10.5	06/13/13	ND	5	No	ND	5	No
SUSDP03	9.5-10.5	06/11/13	ND	5	No	ND	5	No
SUSDP09	25-30	06/11/13	160	5	Yes	12	5	Yes
SUSDP12	0-1	01/26/17	ND	5	No	ND	5	No
SUSDP14	9.5-10.5	06/06/13	ND	5	No	ND	5	No
SUSDP15	3.5-4.5	05/21/13	ND	5	No	ND	5	No
SUSDP15	9.5-10.5	06/06/13	ND	5	No	ND	5	No
SUSDP37	13-18	05/23/13	ND	5	No	ND	5	No
SUSDP37	25-30	05/23/13	ND	5	No	ND	5	No
SUSDP39	13-18	05/22/13	ND	5	No	ND	5	No
SUSDP43	15-20	06/06/13	ND	5	No	ND	5	No
TPA19A1	15-20	03/20/17	ND	5	No	ND	5	No
TPA19A2	15-20	03/20/17	ND	5	No	ND	5	No
TPA19A3	15-20	03/20/17	2.2	5	No	ND	5	No
TPA19B3	15-20	02/07/17	0.24 J	5	No	ND	5	No
TA19C1	15-20	02/08/17	30	5	Yes	3.2	5	No
TA19C2	15-20	02/07/17	18	5	Yes	5.9	5	Yes
TA19C3	15-20	02/07/17	6.7	5	Yes	0.23 J	5	No
TA19D1	15-20	03/03/17	ND	5	No	ND	5	No
TA19D3	15-20	03/08/17	ND	5	No	ND	5	No
TA19E1	15-20	02/07/17	ND	5	No	ND	5	No
TA19E2	15-20	02/07/17	0.52 J	5	No	ND	5	No

Notes:

ft - feet

ND - not detected

PCE -tetrachloroethylene

PRG - Preliminary Remediation Goal

TCE - trichloroethene

ug/L - micrograms per liter

Highlighting indicates an exceedance of the PRG.

Table 3-9
Concentrations of Individual and Total Chlorinated VOCs and Their Comparison with Groundwater Standards
Pepco Benning Road Facility FS Project

			PCE (µg/L)	TCE (µg/L)	cis-1,2-DCE (µg/L)	trans-1,2-DCE (µg/L)	1,1-DCE (µg/L)	VC (µg/L)	Total Chlorinated VOCs (µg/L)
DC Groundwater Standard (µg/L)			5	5	70	100	7	2	N/A
Well Location	Screen Interval / Sample Interval	Sample Date							
Monitoring Wells									
MW01A	10 - 35 ft	11/5/2014	4.4	0.43 J	0.92 J	< 1.0 U	< 1.0 U	< 1.0 U	5.8
MW01A	10 - 35 ft	12/22/2016	5.4 J-	1.2	0.83 J	< 1.0 U	< 1.0 U	< 1.0 U	7.4
MW01A	10 - 35 ft	12/22/2016	5.5	1.1	0.77 J	< 1.0 U	< 1.0 U	< 1.0 U	7.4
MW01A	10 - 35 ft	4/2/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
MW02A	8 - 28 ft	11/5/2014	2.3	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	2.3
MW02A	8 - 28 ft	12/22/2016	1.8	0.22 J	0.34 J	< 1.0 U	< 1.0 U	< 1.0 U	2.4
MW02A	8 - 28 ft	3/24/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
MW02A	8 - 28 ft	3/24/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
MW03A	10 - 25 ft	11/4/2014	0.32 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.32
MW04A	6 - 26 ft	11/4/2014	0.25 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.25
MW05A	10 - 20 ft	11/4/2014	2.2	0.23 J	0.38 J	< 1.0 U	< 1.0 U	< 1.0 U	2.8
MW05A	10 - 20 ft	12/21/2016	15	2.3	3.6	< 1.0 U	< 1.0 U	< 1.0 U	21
MW05A	10 - 20 ft	3/23/2021	1.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.4
MW06A	8 - 28 ft	11/4/2014	0.25 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.25
MW06A	8 - 28 ft	11/4/2014	0.26 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.26
MW07A	8 - 28 ft	11/5/2014	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW08A	10 - 25 ft	11/10/2014	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW09A	18 - 38 ft	11/3/2014	130	15	7.2	< 1.0 U	< 1.0 U	< 1.0 U	150
MW09A	18 - 38 ft	12/21/2016	320	41	18	0.22 J	0.72 J	5.3	390
MW09A	18 - 38 ft	3/23/2021	390	49	18	< 10	< 10	< 10	460
MW10A	10 - 30 ft	11/4/2014	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW11A	27 - 42 ft	11/4/2014	0.18 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.18
MW11A	27 - 42 ft	12/22/2016	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW12A	9 - 29 ft	11/3/2014	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW13A	8 - 20 ft	11/3/2014	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW13A	8 - 20 ft	12/20/2016	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW14A	7 - 27 ft	11/3/2014	0.96 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.96
MW14A	7 - 27 ft	12/20/2016	0.73 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.73
MW15A	28 - 38 ft	11/3/2014	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
MW15A	28 - 38 ft	12/21/2016	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
Temporary Wells									
TP-01A	22-27 ft	3/24/2021	220	14	< 10	< 10	< 10	< 10	230
TP-02A	20-25 ft	3/22/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
TP-03A	19-24 ft	3/23/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
TP-04A	30-35 ft	3/23/2021	55	5.8	9.0	< 5.0	< 5.0	< 5.0	70
TP-05A	22-27 ft	3/25/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
TP-06A	13-18 ft	3/22/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
TP-09A	22-27 ft	3/25/2021	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1 U
TP-10A	45-50 ft	3/19/2021	17	1.2	< 1.0	< 1.0	< 1.0	< 1.0	18
TP-11A	17-22 ft	3/19/2021	15	0.88	< 1.0	< 1.0	< 1.0	< 1.0	16
Direct Push Groundwater Samples									
DP54	15 - 20 ft	2/2/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DP55	15 - 20 ft	2/2/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DP55	15 - 20 ft	2/2/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DP56	15 - 20 ft	2/3/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DP57	15 - 20 ft	2/3/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DP57	15 - 20 ft	2/3/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DP58	15 - 20 ft	2/6/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DP59	15 - 20 ft	2/3/2017	0.30 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.30
DP60	15 - 20 ft	2/6/2017	0.44 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.44
DP61	15 - 20 ft	2/6/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 1.0 U	< 1 U
DP62	15 - 20 ft	2/6/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 1.0 U	< 1 U
DP62	15 - 20 ft	2/6/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 UJ	< 1.0 U	< 1 U
DP63	15 - 20 ft	2/6/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
DPA1	20 - 25 ft	4/17/2014	< 1	< 1	< 1	< 1	< 1	< 1	< 1 U

Table 3-9
Concentrations of Individual and Total Chlorinated VOCs and Their Comparison with Groundwater Standards
Pepco Benning Road Facility FS Project

			PCE (μg/L)	TCE (μg/L)	cis-1,2-DCE (μg/L)	trans-1,2-DCE (μg/L)	1,1-DCE (μg/L)	VC (μg/L)	Total Chlorinated VOCs (μg/L)
DC Groundwater Standard (μg/L)			5	5	70	100	7	2	N/A
Well Location	Screen Interval / Sample Interval	Sample Date							
DPA2	20 - 25 ft	4/17/2014	2.3	< 1	< 1	< 1	< 1	< 1	2.3
DPA2	20 - 25 ft	4/17/2014	2.1	< 1	< 1	< 1	< 1	< 1	2.1
DPA3	25 - 30 ft	4/16/2014	270	19	11	< 1	< 1	< 1	300
DPA4	25 - 30 ft	4/16/2014	300	26	15	< 1	< 1	< 1	340
DPA5	25 - 30 ft	4/16/2014	240	22	12	< 1	< 1	< 1	270
DPA5	25 - 30 ft	4/16/2014	260	23	13	< 1	< 1	< 1	300
DPB10	25 - 30 ft	4/17/2014	25	0.94	1.5	< 1	< 1	< 1	27
DPB11	25 - 30 ft	4/17/2014	< 1	< 1	< 1	< 1	< 1	< 1	< 1 U
DPB12	25 - 30 ft	4/17/2014	< 1	< 1	< 1	< 1	< 1	< 1	< 1 U
DPB2	20 - 25 ft	4/17/2014	3	< 1	< 1	< 1	< 1	< 1	3
DPB3	25 - 30 ft	4/16/2014	140	10	5	< 1	< 1	< 1	160
DPB5	25 - 30 ft	4/16/2014	190	14	7	< 1	< 1	< 1	210
DPB6	25 - 30 ft	4/16/2014	330	22	14	< 1	< 1	< 1	370
DPB7	30 - 35 ft	4/16/2014	470	26	23	< 1	< 1	< 1	520
DPB9	25 - 30 ft	4/17/2014	190	14	20	< 1	< 1	< 1	220
DPC3	25 - 30 ft	4/16/2014	0.99	< 1	< 1	< 1	< 1	< 1	0.99
DPC4	25 - 30 ft	4/16/2014	53	4.1	1.6	< 1	< 1	< 1	59
DPC5	25 - 30 ft	4/16/2014	69	4.2	4.7	< 1	< 1	< 1	78
DPC7	30 - 35 ft	4/17/2014	88	6.9	0.5	< 1	< 1	< 1	95
DPC8	30 - 35 ft	4/17/2014	< 1	< 1	< 1	< 1	< 1	< 1	< 1 U
DPC9	30 - 35 ft	4/18/2014	0.96	< 1	< 1	< 1	< 1	< 1	0.96
DPD5	25 - 30 ft	4/18/2014	24	< 1	< 1	< 1	< 1	< 1	24
DPD6	30 - 35 ft	4/17/2014	4.9	< 1	< 1	< 1	< 1	< 1	4.9
DPD7	30 - 35 ft	4/17/2014	< 1	< 1	< 1	< 1	< 1	< 1	< 1 U
SUSDP52	15 - 20 ft	2/3/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
TA19A1	15 - 20 ft	3/20/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
TA19A2	15 - 20 ft	3/20/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
TA19A3	15 - 20 ft	3/20/2017	2.2	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	2.2
TA19B3	15 - 20 ft	2/7/2017	0.24 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.24
TA19C1	15 - 20 ft	2/8/2017	30	3.2	1.2	< 1.0 U	< 1.0 U	< 1.0 U	34
TA19C2	15 - 20 ft	2/7/2017	18	5.9	6.2	< 1.0 U	< 1.0 U	< 1.0 U	30
TA19C3	15 - 20 ft	2/7/2017	6.7	0.23 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	6.9
TA19D1	15 - 20 ft	3/3/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
TA19D3	15 - 20 ft	3/8/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
TA19E1	15 - 20 ft	2/7/2017	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1 U
TA19E2	15 - 20 ft	2/7/2017	0.80 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.80

Notes:
ft: feet
U: Below Detection Limit
PCE: Tetrachloroethylene
TCE: Trichloroethene
cis-1,2-DCE: cis-1,2-dichloroethylene
trans-1,2-DCE:trans-1,2-dichloroethylene
1,1-DCE: 1,1-dichloroethylene
VC: Vinyl Chloride
μg/L - micrograms per liter
Highlighting indicates an exceedance of the respective groundwater standard

Table 4-1
General Response Action (GRA) Screening for PCB-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
No Action	No action or monitoring implemented	N/A	N/A	N/A	Not Effective	Not Effective	None	None	None	None	Retained as baseline case
Institutional Controls	Methods of minimizing potential human exposure to potential COCs or of protecting an implemented remedy through use restriction. Often used in conjunction with other actions.	**Engineering Controls**	Fencing and site security to prevent use of areas impacted by potential COCs by target populations.	• Areas where site access is controlled • Areas where impacts from potential COCs are unlikely to lead to ecological risks • Areas where potential COCs are unlikely to migrate	Effective - Site access is controlled by perimeter fence and guarded entrances, so engineering controls can be effectively implemented with respect to the target population. - PCBs remain in place.	Effective - Engineering controls will remain effective as long as they remain implemented and enforced. - Not effective if the site is no longer controlled. - PCBs remain in place.	Easy	Easy	Low	Low	Retained to be used in conjunction with institutional controls to limit access to and use of the property. Retained for consideration in conjunction with other remedial approaches.
		Administrative Controls	Signage to identify risks and soil management plan to inform target populations on use of areas impacted by potential COCs.		Effective - Prevents current worker exposure when controls are communicated and followed. - Efficacy is increased when site access is controlled, and enforcement mechanisms are available. - PCBs remain in place.	Effective - Administrative controls will remain effective as long as they remain communicated and followed. - PCBs remain in place.	Easy	Easy	Low	Low	Retained to be used in conjunction with engineering controls to limit access to and use of the property. Retained for consideration in conjunction with other remedial approaches.
		Legal Controls	Land use restrictions, permit limits, and deed notices to restrict use of site. Efficacy is increased when site access is controlled, and enforcement mechanisms are available.		Effective - Prevents current worker risk when controls are communicated and enforced. - Efficacy is increased when site access is controlled, and enforcement mechanisms are available. - PCBs remain in place.	Effective - Legal controls will remain effective as long as they remain implemented and enforced. - PCBs remain in place.	Easy	Easy	Low	Low	Retained to be used in conjunction with administrative controls to limit access to and use of the property. Retained for consideration in conjunction with other remedial approaches.

Table 4-1 (continued)
General Response Action (GRA) Screening for PCB-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Containment	Installation of a cap over soils impacted with potential COCs to prevent direct human contact with underlying impacted soils.	Single-layer cap	**Soil Cap:** Placing a cap of clean soil over impacted areas to prevent contact with potential COCs.	• Areas where the potential for migration of potential COCs is low. • Areas where subsurface disturbance due to future construction activities is minimal. • Areas where treatment or removal are difficult or impractical.	Highly Effective - Limits exposure pathways to PCB-impacted soils through physical separation.	Effective - Provided that erosion control measures are implemented. - Provided that a soil management plan is in place to protect workers and construction activities that have the potential to disturb the cap.	Difficult	Moderate	Moderate	Moderate	Eliminated because a soil cap is not a permanent containment measure and would impede movement of equipment and vehicles. An asphalt cap covering the impacted areas already exists at the site and a soil cap would not provide any additional protection.
			Geomembrane Capping: Lining the impacted areas with a geomembrane to prevent contact with potential COCs in soil and prevent potential contaminant migration due to infiltration through the surface.		Highly Effective - Limits exposure pathways to PCB-impacted soils through physical separation.	Effective - Provided regular inspections and O&M measures are implemented. - Provided a soil management plan is in place to protect workers and construction activities that have the potential to disturb the cap.	Difficult	Moderate	Moderate	Moderate	Eliminated because a geomembrane lining by itself may not be a permanent containment measure and would impede movement of equipment and vehicles. An asphalt cap covering the impacted areas already exists at the site and a geomembrane cap would not provide any additional protection.
			Asphalt Cap: Placing an asphalt cap over the impacted areas to prevent contact with potential COCs in soil and prevent potential contaminant migration due to infiltration through the surface.		Highly Effective - Limits exposure pathways to PCB-impacted soils through physical separation.	Highly Effective - Effective provided the cap is properly maintained and a soil management plan is in place to protect workers and construction activities that have the possibility of disturbing the cap.	Easy	Easy	Moderate	Moderate	Retained to be used in conjunction with Institutional Controls. An asphalt cap already exists at the site over the PCB-containing soils. Integrity of the existing cap to be evaluated and enhanced as needed.
			Concrete Cap: Placing a concrete cap over the impacted areas to prevent contact with potential COCs in soil and prevent potential contaminant migration due to infiltration through the surface.		Highly Effective - Limits exposure pathways to PCB-impacted soils through physical separation.	Highly Effective - Effective provided the cap is properly maintained and a soil management plan is in place to protect workers and construction activities that have the possibility of disturbing the cap.	Difficult	Moderate	Moderate to High	Moderate	Eliminated because an asphalt cap already exists at the site, covering the PCB-containing soils. A concrete cap would not provide any additional protection.
		Multi-layer cap	**Geomembrane + Soil Cap:** Covering of impacted soils with a geomembrane, followed by placement of a soil cap.		Highly Effective - Limits exposure pathways to PCB-impacted soils through physical separation.	Effective - Provided that erosion control measures are implemented. - Provided that a soil management plan is in place to protect workers and construction activities that have the potential to disturb the cap. - Provided regular inspections and O&M measures are implemented.	Difficult	Moderate	High	Moderate	Eliminated because an asphalt cap covering the impacted areas already exists at the site. A geomembrane + soil cap would not provide any additional protection.

Table 4-1 (continued)
General Response Action (GRA) Screening for PCB-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Treatment	Treatment of soils in place or ex-situ	**In situ treatment**	**Immobilization / Stabilization:** Treatment of impacted soils so that they are physically bound or enclosed within a stabilized mass (solidification), or the soils are treated chemically with a stabilizing agent to reduce contaminant mobility.	• Areas where removal of potential COCs is not practical. • Areas containing subsurface impacts (no surface impacts). • Areas where subsurface utilities and other structures are not present or will not impede soil mixing. • Areas where subsurface conditions are conducive to treatment.	Potentially Effective - PCBs are generally readily solidified, but site-specific leaching tests are needed to confirm.	Potentially Effective - The uniform reliability of the solidified/stabilized matrix can be difficult to assess when evaluating long-term effectiveness. - Certain parameters, such as moisture content and temperature, can impact the treatment process, such that bonding, stability, and strength may be affected, which can lead to the release PCBs over time. - PCBs remain on site with no chemical modification; therefore, the toxicity associated with exposure to future workers is not eliminated.	Moderate	Moderate	Moderate to High	Low	Eliminated because direct exposure to treated soil has the potential to pose risk. Also, areas on site where PCBs are elevated are near/immediately adjacent to structures and utilities, which would limit application of treatment.
			Chemical Dechlorination Using Zero Valent Iron (ZVI): Dechlorination of potential COCs in situ using ZVI particles.		Potentially Effective - PCBs are rendered less toxic or inert through chemical reaction. Chemical treatment is typically fast acting. However, bench-scale testing could be conducted during the design phase to optimize treatment. - ZVI may not treat all PCB congeners, and this process is sensitive to the presence of co-contaminants. - Limited effectiveness in unsaturated soils.	Potentially Effective - PCB source areas can be targeted. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required. - Parameters such as soil moisture content, particle size, clay content etc. can impact effectiveness.	Difficult	Moderate	High	Moderate	Eliminated due to limited effectiveness in unsaturated soils, high cost, and short reactive life span of ZVI. Also, areas on site where PCBs are elevated are near/immediately adjacent to structures and utilities, which would limit application of treatment.
			Thermal Desorption with Off-Gas Controls: Heating of soil at temperatures high enough to volatilize potential COCs, followed by destruction of potential COCs in off-gas.		Effective - PCBs are volatilized at high temperature. - Additional technology / processes are needed to destroy PCBs in off-gas.	Effective - PCBs are volatilized at high temperature. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required.	Difficult	Moderate to Difficult	High	Moderate	Eliminated because few full-scale applications of in situ thermal desorption for PCB-contaminated soils have been demonstrated. Cost of mobilizing thermal treatment system for a small quantity of soil outweighs benefits of the treatment.
			Bioremediation: The degradation of potential COCs in situ via aerobic or anaerobic means through the stimulation of either native or introduced microbial populations. Typically, a food source is introduced to catalyze the direct consumption of potential COCs or produce a geochemically beneficial environment as the byproduct of microbial stimulation.		Potentially Effective - Treatment begins immediately following introduction of the treatment. - However, bioattenuation can take months or years to occur and may not be effective to meet PRGs.	Potentially Effective - If treatment is successful in meeting PRGs, long-term maintenance or monitoring is typically reduced or not required.	Moderate to Difficult	Moderate to Difficult	Moderate to High	Moderate	Eliminated because PCBs are not generally amenable to biological degradation.

Table 4-1 (continued)
General Response Action (GRA) Screening for PCB-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Treatment	Treatment of soils in place or ex-situ	**Ex situ treatment following excavation of soil**	**Incineration (off-site):** High-temperature volatilization and combustion of potential COCs in soil at off-site incinerator.	• Areas where removal of potential COCs is practical. • Areas where subsurface utilities and other structures are not present. • Where volume of soil to be treated is small.	Highly Effective - PCBs are volatilized and destroyed at high temperature.	Highly Effective - PCBs are volatilized and destroyed at high temperature. - Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required.	Moderate	Moderate to Difficult	Moderate to High	Low	Retained for soils with PCB concentrations that would be classified as Principal Threat Waste.
			Thermal Desorption with Off-Gas Controls (on-site): Heating of soil at temperatures high enough to volatilize potential COCs, followed by destruction of potential COCs in off-gas.		Highly Effective - PCBs are volatilized at high temperature. - Additional treatment steps are needed to destroy PCBs in off-gas.	Highly Effective - PCBs are volatilized from the matrix at high temperature. - Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required.	Moderate to Difficult	Moderate to Difficult	Moderate to High	Low	Eliminated because cost of mobilizing thermal treatment system for a small quantity of soil outweighs benefits of the treatment.
			Soil Washing (on-site): Mechanical mixing, rinsing, and washing of soil with water and/or surfactants to remove potential COCs.		Potentially Effective - PCBs are removed from the soil. - Hydrophobic potential COCs such as PCBs can be difficult to separate from soil particles using aqueous washing fluid.	Potentially Effective - PCBs are removed from the soil. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required. - Hydrophobic chemicals such as PCBs can be difficult to separate from soil particles using aqueous washing fluid.	Moderate to Difficult	Moderate to Difficult	Moderate to High	Low	Eliminated because PCBs are difficult to separate from soil using aqueous washing fluid. While surfactants can be added to improve removal efficiencies, this can result in large volume of washing fluid needed. Soil washing has been applied at a limited number of sites.
			Immobilization/Stabilization: Treatment of impacted soils so that they are physically bound or enclosed within a stabilized mass (solidification), or the soils are treated chemically with a stabilizing agent to reduce contaminant mobility.		Potentially Effective - PCBs are generally readily solidified, but site-specific leaching tests are needed to confirm.	Potentially Effective - The uniform reliability of the solidified/stabilized matrix can be difficult to assess when evaluating long-term effectiveness. - Certain parameters, like moisture content and temperature, can impact the treatment process, such that bonding, stability, and strength may be affected, which can release PCB over time.	Moderate	Moderate	Moderate to High	Low	Eliminated because technology does not treat or destroy PCBs and thus would not be applicable for soils classified as Principal Threat Waste.
			Dehalogenation: Use of chemical reagents and reduction processes to destroy or chemically alter potential COCs (such as PCBs) to a less toxic form.		Potentially Effective - PCBs are destroyed or converted to less toxic forms. - Dehalogenation is effective at treating PCBs. Bench-scale studies using site-specific soils are needed to confirm effectiveness.	Potentially Effective - Dehalogenation is effective at treating PCBs. - However, high moisture content, particle size, clay content, presence of co-contaminants may impact effectiveness.	Moderate	Moderate	High	Low	Eliminated because technology is not proven to treat all PCB congeners.
			Solvent Extraction with Spent Solvent Destruction: Use of chemical solvents under controlled pressure and temperature conditions to separate potential COCs from soil, followed by destruction of PCBs in spent solvent. Reduces the overall volume of the hazardous waste to be treated.		Potentially Effective - PCBs are separated from the soil. - Effective for PCB-containing soils. - Treatability tests are needed to confirm if mass transfer or equilibrium partitioning is the rate-controlling step. - Additional treatment steps are needed to destroy PCBs in the spent solvent.	Effective - Solvent extraction is effective at removing PCBs from soil. PCBs are not degraded or destroyed. - High moisture content, particle size, clay content, and the presence of co-contaminants may impact effectiveness.	Moderate	Moderate	High	Low	Eliminated because solvent residuals in treated material may introduce additional toxicity. Geotechnical data from borings show high clay content and >15% fines at several locations, which is likely to reduce effectiveness of remedy.

Table 4-1 (continued)
General Response Action (GRA) Screening for PCB-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Removal and Disposal/ Reuse	Removal of soils with potential COC concentrations exceeding PRG and on-site reuse or off-site disposal of excavated soils	**Excavation and on-site reuse or off-site disposal**	**On-site reuse:** Re-use of excavated soils (as backfill) on site. This process option is applicable for soils that have COC concentrations below the PRGs or have been treated to reduce potential COC concentrations below PRG using treatment process options.	• Areas where appropriate on-site or off-site facilities are available for safe disposal of excavated soil.	Effective - Soils with PCB concentration above PRG are removed from site, treated, and re-used on site. - Toxicity of contaminated soils on site is reduced. - Full removal typically results in immediate unrestricted use of the property.	Effective - Soils with PCB concentration above PRG are removed from site, treated, and re-used or disposed of on site. - Toxicity of contaminated soils on site is reduced. - Some PCBs may remain in treated soils on site. - Full removal typically results in immediate unrestricted use of the property.	Moderate to Difficult	Moderate	Moderate	Moderate	Retained for excavated soils with PCBs < 1 mg/kg.
			Off-site disposal: Disposal of excavated soils at off-site facilities such as permitted landfills. This process option is applicable for both treated and untreated soils. For soils with PCB concentrations exceeding 50 mg/kg, disposal would be in TSCA-approved landfills.		Highly Effective - Soils with PCB concentration above PRG are removed from site. - Volume and toxicity of contaminated soils on site is reduced. - Full removal typically results in immediate unrestricted use of the property.	Highly Effective - Soils with PCB concentration above PRG are removed from site. - Volume and toxicity of contaminated soils on site is reduced. - Full removal typically results in immediate unrestricted use of the property.	Moderate	Moderate	Moderate	None	Retained

Table 4-2
General Response Action (GRA) Screening for Vanadium-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
No Action	No action or monitoring implemented	N/A	N/A	N/A	Not Effective	Not Effective	None	None	None	None	Retained as baseline case
Institutional Controls	Methods of minimizing potential human exposure to potential COCs or of protecting an implemented remedy through use restriction. Often used in conjunction with other actions. .	**Engineering Controls**	Fencing and site security to prevent use of areas impacted by potential COCs by target populations.	• Areas where site access is controlled • Areas where impacts from potential COCs are unlikely to lead to ecological risks • Areas where potential COCs are unlikely to migrate	Effective - Site access is controlled by perimeter fence and guarded entrances, so engineering controls can be effectively disseminated to the target population. - Vanadium remains in place.	Effective - Engineering Controls will remain effective as long as they remain implemented and enforced. Not effective if the site is no longer controlled or controls are not communicated to the target population.	Easy	Easy	Low	Low	Retained to be used in conjunction with institutional controls to limit access to and use of the property. Retained for consideration in conjunction with other remedial approaches.
		Administrative Controls	Signage to identify risks and soil management plan to inform target populations on use of areas impacted by potential COCs.		- Prevents current worker exposure. - Vanadium remains in place.	Effective - Administrative Controls will remain effective as long as they remain implemented and enforced. Not effective if the site is no longer controlled or controls are not communicated to the target population. - Vanadium remains in place.	Easy	Easy	Low	Low	Retained to be used in conjunction with engineering controls to limit access to and use of the property. Retained for consideration in conjunction with other remedial approaches.
		Legal Controls	Land use restrictions, permit limits, and deed notices to restrict use of site. Efficacy is increased when site access is controlled, and enforcement mechanisms are available.		Effective - Site is access controlled, communicated, and enforced. - Prevents current worker risk. - Vanadium remains in place.	Effective - Effective provided the site will continue in its current capacity, with no work exposing impacted soils.	Easy	Easy	Low	Low	Retained to be used in conjunction with administrative controls to limit access to and use of the property. Retained for consideration in conjunction with other remedial approaches.

Table 4-2 (continued)
General Response Action (GRA) Screening for Vanadium-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Effectiveness		Cost		Retained/Eliminated
					Short -erm	Long-Term	Technical	Administrative	Capital	O&M	
Containment	Installation of a cap over soils impacted with potential COCs to prevent direct human contact with underlying impacted soils.	**Single-layer cap**	**Gravel Cover:** Use of gravel over impacted soils. For new installation, this option includes placement of a geotextile to separate gravel from underlying contaminated soil.	• Areas where the potential for migration of potential COCs is low. • Areas where subsurface disturbance due to future construction activities is minimal. • Areas that are difficult or impractical to implement removal.	Highly Effective - Limits exposure pathways to impacted soils through physical separation.	Effective - Provided that dust control measures are implemented, and a soil management plan is in place to protect workers and construction activities that have the potential to disturb the cover.	Easy	Easy	Low	Low	Retained to be used in conjunction with administrative and/or legal controls. A gravel cover over the impacted areas is already in place. Adequacy of existing gravel cover to be evaluated and enhanced as needed.
			Soil Cap: Placing a cap of clean soil over impacted areas.		Highly Effective - Limits exposure pathways to impacted soils through physical separation.	Effective - Provided that erosion control measures are implemented, and a soil management plan is in place to protect workers and construction activities that have the potential to disturb the cap.	Moderate	Easy	Moderate	Moderate	Eliminated because a soil cap is not a permanent containment measure. A gravel cover over the impacted areas is already in place and a soil cap does not offer any additional advantages.
			Geomembrane Capping: Lining the impacted areas with a geomembrane to prevent contact with potential COCs in soil and prevent potential contaminant migration due to infiltration through the surface.		Highly Effective - Limits exposure pathways to impacted soils through physical separation.	Effective - Provided regular inspections and O&M measures are implemented and a soil management plan is in place to protect workers and construction activities that have the potential to disturb the cap.	Moderate	Easy	Moderate	Moderate	Eliminated because a geomembrane lining by itself may not be a permanent containment measure. A gravel cover over the impacted areas is already in place and a geomembrane cap does not offer any additional advantages.
			Asphalt Cap: Placing an asphalt cap over the impacted areas to prevent contact with potential COCs in soil and prevent potential contaminant migration due to infiltration through the surface.		Highly Effective - Limits exposure pathways to impacted soils through physical separation.	Highly Effective - Effective provided the cap is properly maintained and soil management plan is in place to protect workers and construction activities that have the possibility of disturbing the cap.	Moderate to Difficult	Moderate	Moderate	Moderate	Eliminated because a gravel cover over the impacted areas is already in place. Paving the area with asphalt will create additional stormwater runoff, requiring additional stormwater control measures.
			Concrete Cap: Placing a concrete cap over the impacted areas to prevent contact with potential COCs in soil and prevent potential contaminant migration due to infiltration through the surface.		Highly Effective - Limits exposure pathways to impacted soils through physical separation.	Highly Effective - Effective provided the cap is properly maintained and soil management plan is in place to protect workers and construction activities that have the possibility of disturbing the cap.	Moderate to Difficult	Moderate	Moderate	Moderate	Eliminated because a gravel cover over the impacted areas is already in place. Paving the area with concrete will create additional stormwater runoff, requiring additional stormwater control measures.

Table 4-2 (continued)
General Response Action (GRA) Screening for Vanadium-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Treatment	Treatment of soils in place or ex-situ	**In situ treatment**	**Immobilization / Stabilization:** Treatment of impacted soils so that they are physically bound or enclosed within a stabilized mass (solidification), or the soils are treated chemically with a stabilizing agent to reduce contaminant mobility.	• Areas where removal of potential COCs is not practical. • Areas containing subsurface impacts (no surface impacts). • Areas where subsurface utilities and other structures are not present or have the potential to impede soil mixing.	Potentially Effective - Vanadium is generally readily solidified, but site-specific leaching tests are needed to confirm.	Potentially Effective - The uniform reliability of the solidified/stabilized matrix can be difficult to assess when evaluating long-term effectiveness. - Certain parameters, like moisture content and temperature, can impact the treatment process, such that bonding, stability, and strength may be affected, which can release vanadium over time. - Vanadium remains on site with no chemical modification; therefore, the toxicity associated with exposure to future workers is not eliminated.	Moderate	Moderate	Moderate to High	Low	Eliminated because direct exposure to treated soil has the potential to continue to pose risk. Also, areas on site where vanadium concentrations are elevated are near/immediately adjacent to structures and utilities, which would limit application of treatment.
			Soil Flushing: Extraction of potential COCs from soil using water, possibly combined with other suitable amendments such as a surfactant, cosolvent, acid, or base. Flushing fluid is introduced via a series of injection wells and recovered via wells downgradient of the injection points. potential COCs in used flushing fluid are removed/destroyed.		Potentially Effective - Vanadium is extracted from soils and the flushing fluid is recovered and treated to destroy the potential COCs. However, bench-scale testing could be conducted during the design phase to optimize treatment.	Potentially Effective - Vanadium source areas can be targeted. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required. - Parameters such as soil moisture content, particle size, clay content, silt content etc. can impact effectiveness.	Difficult	Moderate	High	Moderate	Eliminated because acidic/basic flushing solution may be needed for vanadium. Flushing solution and residual washing solution may remain adhered to soil particles and/or dissolved in groundwater, which can solubilize and facilitate migration of vanadium. Presence of several above-ground structures and underground utilities would limit application of treatment. Regulatory requirements pertaining to the introduction of fluids into the aquifer must be considered.
		Ex situ treatment following excavation of soil	**Immobilization / Stabilization:** Treatment of impacted soils so that they are physically bound or enclosed within a stabilized mass (solidification), or the soils are treated chemically with a stabilizing agent to reduce contaminant mobility.	• Areas where removal of potential COCs is practical. • Areas where subsurface utilities and other structures are not present. • Where volume of soil to be treated is small.	Potentially Effective - Vanadium is generally readily solidified, though site-specific leaching tests are needed to confirm.	Potentially Effective - The uniform reliability of the solidified/stabilized matrix can be difficult to assess when evaluating long-term effectiveness. - Certain parameters, like moisture content and temperature, can impact the treatment process, such that bonding, stability, and strength may be affected, which can release vanadium over time.	Moderate	Moderate	Moderate to High	Low	Eliminated as there are limited opportunities for on-site re-use of treated soil and treatment after removal would not provide any additional benefits.
			Soil Washing: Mechanical mixing, rinsing, and washing of soil with water and/or surfactants to remove contaminants.		Potentially Effective - Vanadium is removed from the matrices. - Bench-scale testing using on-site soils is needed to confirm effectiveness.	Potentially Effective - Vanadium is removed from the matrices. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required.	Moderate to Difficult	Moderate to Difficult	Moderate to High	Low	Eliminated. Process relies on separation of fines from the rest of the soils (as metals are generally sorbed to fines). However, vanadium-impacted soil primarily consists of sand and gravel and soil washing is not anticipated to be effective. The process would generate complex waste streams requiring further treatment prior to safe disposal. Furthermore, as excavation is being performed as part of building construction, opportunities for re-use of treated soil on site are limited.

Table 4-2 (continued)
General Response Action (GRA) Screening for Vanadium-Contaminated Soil

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Removal and Disposal/ Reuse	Removal of soils with potential COC concentrations exceeding PRG (or a shallower depth if determined that access below that depth by population at risk is not a concern) and on-site or off-site disposal of excavated soils	**Excavation and on-site reuse or off-site disposal**	**On-site disposal:** Disposal of excavated soils on site. This process option is applicable for soils that have been treated to reduce concentrations of potential COCs below PRG using treatment process options. Disposal options include on-site landfills or reuse as backfill.	• Areas where appropriate on-site or off-site facilities are available for safe disposal of excavated soil.	Effective - Soils with vanadium concentration above PRG are removed from site, treated, and re-used or disposed on site. - Toxicity of contaminated soils on site is reduced. - Full removal typically results in immediate unrestricted use of the property.	Effective - Soils with vanadium concentration above PRG are removed from site, treated, and re-used or disposed on site. - Toxicity of contaminated soils on site is reduced. - Some vanadium may remain in treated soils on site. - Full removal typically results in immediate unrestricted use of the property.	Moderate to Difficult	Moderate	Moderate	Moderate	Eliminated as there are limited opportunities for on-site re-use of excavated soil.
			Off-site disposal: Disposal of excavated soils at off-site facilities such as permitted landfills. This process option is applicable for both treated and untreated soils.		Highly Effective - Soils with vanadium concentration above PRG are removed from site. - Volume and toxicity of contaminated soils on site is reduced. - Full removal typically results in immediate unrestricted use of the property.	Highly Effective - Soils with vanadium concentration above PRG are removed from site. - Volume and toxicity of contaminated soils on site is reduced. - Full removal typically results in immediate unrestricted use of the property.	Moderate	Moderate	Moderate	None	Retained

Table 4-3
General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Vapor Intrusion RAOs Only

Remedial Approach	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
No Action	No action or monitoring implemented	N/A	N/A	N/A	Not Effective	Not Effective	None	None	None	None	Retained as baseline case.
Institutional Controls	Methods of minimizing potential human exposure to potential COCs or of protecting an implemented remedy through use restriction. Often used in conjunction with other actions.	**Engineering Controls**	Use of existing site security and fencing for protection of any implemented remedy.	• Areas where site access is controlled • Areas where impacts from potential COCs impacts are unlikely to lead to ecological risks • Areas where potential COCs are unlikely to migrate	Effective - Site access is controlled by perimeter fence and round-the-clock security that restrict access to unauthorized persons. - PCE remains in place.	Effective - Engineering controls will remain effective as long as they remain implemented and enforced. - Not effective if the site is no longer controlled or controls are not communicated to the target population. - PCE remains in place.	Easy	Easy	Low	Easy	Retained to be used in conjunction with other remedial approaches.
		Administrative Controls	Signage identifying potential COCs in groundwater and any restrictions on use of groundwater as documented in deed restrictions. Designation of the PCE plume area as Classification Exception Areas (CEA)/Well Restriction Area (WRA), which is an administrative control that alerts the public as well as governmental organizations that the groundwater contained within the footprint is unfit for human consumption and not to be used for potable purposes.		Effective - Site access is controlled by perimeter fence and guarded entrances, so administrative controls can be effectively implemented. - Prevents exposure via potable use. - PCE remains in place.	Effective - Administrative Controls will remain effective as long as they remain implemented and enforced. - Not effective if the site is no longer controlled or controls are not communicated to the target population. - PCE remains in place.	Easy	Easy	Low	Low	Retained to be used in conjunction with other remedial approaches.
		Legal Controls	General land use restrictions and deed restrictions to prohibit potable use of affected groundwater.		Effective - Site access is controlled by perimeter fence and guarded entrances, so legal controls can be effectively implemented and enforced. - Prevents exposure via potable use. - PCE remains in place.	Effective - Legal Controls will remain effective as long as they remain implemented and enforced. - PCE remains in place.	Easy	Easy	Low	Low	Retained to be used in conjunction with other remedial approaches.

Table 4-3 (continued)

General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Vapor Intrusion RAOs Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Monitored Natural Attenuation (MNA)	Term used to describe reduction of toxicity, volume, concentration, or mobility of potential COCs by naturally occurring processes. Examples of these processes include reduction of potential COC concentrations through natural physical processes (e.g., dilution, dispersion, etc.), natural biological degradation, and/or reduction of potential COC concentrations through abiotic chemical degradation.	**Attenuation with physical, biological, or chemical processes**	**Reduction of Potential COC Concentrations Through Physical Processes:** Concentrations of potential COCs in groundwater are reduced through natural physical processes such as dispersion, dilution, and diffusion through advective transport. **Reduction of Potential COC Concentrations Through Biological Degradation:** Native microorganisms present in the groundwater degrade potential COCs and break them down into non-toxic byproducts. **Reduction of Potential COC Concentrations Through Chemical Degradation:** Potential COCs are degraded through chemical reactions within the groundwater and break them down into non-toxic byproducts.	Sites where: • Natural attenuation processes are demonstrated and expected to continue at existing rates. • Human exposure is limited or can be limited by institutional controls. • Potential COC exposures to the ecosystem are already approaching remedial cleanup levels. • Groundwater plume is stable and likely to remain stable after remedial actions are completed.	Potentially Effective - PCE and TCE do degrade under natural conditions. However, due to the slow and incomplete degradation and possible formation of toxic byproducts, MNA is most effective when implemented in conjunction with treatment in order to meet PRGs within the desired timeframe and to limit the formation of toxic byproducts.	Potentially Effective - MNA alone could take many years to achieve PRGs. So long-term maintenance or monitoring is typically required.	Moderate to Difficult	Moderate	Low	Moderate to High	Retained. MNA through biological and chemical degradation pathways is limited at this site and MNA would rely mostly on physical degradation processes.

Table 4-3 (continued)

General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Vapor Intrusion RAOs Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Containment	Isolation of groundwater impacted with potential COCs or manipulation of groundwater vapor pathway through the placement of engineered material and/or vapor control systems	**Horizontal Containment with Sub-Slab Venting System** Non-permeable barriers installed horizontally to prevent vapor intrusion from impacted groundwater into occupied buildings. Typically combined with sub-slab venting systems.	**Asphalt latex membranes (ALMs):** A continuous seamless layer of spray-on asphalt latex, typically used in combination with a geotextile base layer and geotextile protective layer. ALMs can be applied at a specified thickness.	Areas where occupied buildings are planned in the area of the contaminated groundwater plume (there are currently no buildings located within the contaminant plume area).	Effective - ALMs have very low permeability, protect against both diffusive and advective vapor flow, and thus reduce human exposure to indoor vapors resulting from underlying impacted groundwater. - PCE and TCE remain in groundwater. - Implementation of ICs would be required, which improves short-term efficacy.	Effective - Vapor barriers are effective in the long term provided they are properly maintained. - Monitoring of the indoor air space is essential to verify that the remedy remains effective over time. - PCE and TCE remain in groundwater. - Implementation of ICs would be required, which improves long-term efficacy.	Moderate	Moderate	Moderate	Moderate	Retained as a contingency measure for implementation in future buildings constructed over the PCE plume until groundwater RAOs are achieved.
			Thermoplastic membranes (TMs): Minimum 40-mil thick membranes made of LLDPE, PVC, or HDPE.		Effective - Reduces human exposure to indoor vapors resulting from underlying impacted groundwater. - PCE and TCE remain in groundwater. - Implementation of ICs would be required, which improves short-term efficacy.	Effective - Vapor barriers are effective in the long term provided they are properly maintained. - Monitoring of the indoor air space is essential to verify that the remedy remains effective over time. - PCE and TCE remain in groundwater. - Implementation of ICs would be required, which improves long-term efficacy.	Moderate	Moderate	Moderate	Moderate	Retained as a contingency measure for implementation in future buildings constructed over the PCE plume until groundwater RAOs are achieved.
			Composite membrane barriers: Composite barriers consisting of multiple layers of polymers or geotextiles. Examples of composite membranes include: a) Ethyl vinyl alcohol (EVOH) sheet membrane, polymer-modified asphalt, and HDPE b) Multiple HDPE sheets and polymer-modified asphalt membrane		Effective - Reduces human exposure to indoor vapors resulting from underlying impacted groundwater. - PCE and TCE remain in groundwater. - Implementation of ICs would be required, which improves short-term efficacy.	Effective - Vapor barriers are effective in the long term provided they are properly maintained. - Monitoring of the indoor air space is essential to verify that the remedy remains effective over time. - PCE and TCE remain in groundwater. - Implementation of ICs would be required, which improves long-term efficacy.	Moderate	Moderate to Difficult	Moderate	Moderate	Retained as a contingency measure for implementation in future buildings constructed over the PCE plume until groundwater RAOs are achieved.

Table 4-3 (continued)

General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Vapor Intrusion RAOs Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Containment	Isolation of groundwater impacted with potential COCs or manipulation of groundwater vapor pathway through the placement of engineered material and/or vapor control systems	**Horizontal Containment with Sub-Slab Venting System** Non-permeable barriers installed horizontally to prevent vapor intrusion from impacted groundwater into occupied buildings. Typically combined with sub-slab venting systems.	**Passive Venting System:** A type of sub-slab venting system that relies on convective flow of warmed air upward in a vent pipe to draw air and vapor-phase potential COCs from beneath the slab, thus preventing their intrusion into a building. Used in conjunction with vapor barriers.	Areas where occupied buildings are planned in the area of the contaminated groundwater plume (there are currently no buildings located within the contaminant plume area).	Effective - When used in combination with vapor barriers, prevents intrusion of sub-slab air into the building - Effective for low to moderate levels of potential COCs in groundwater. - Performance of system can vary depending upon weather conditions. - Performance of system can be improved by using wind-driven turbines in roof stacks to supplement the convective flow. - PCE and TCE remain in groundwater.	Effective - When used in combination with vapor barriers, prevents intrusion of sub-slab air into the building. - Performance of system can vary depending upon weather conditions. - Can be easily converted into an active venting system if required. - PCE and TCE remain in groundwater.	Easy to Moderate	Easy to Moderate	Low	Low	Retained to implementation in conjunction with vapor barriers as a contingency measure in future buildings constructed within the PCE plume footprint until groundwater RAOs are achieved.
			Active Venting System: Sub-slab venting system consisting of vent pipes installed through the slab and connected to a vacuum pump to extract air and vapor-phase potential COCs from beneath the slab, thus preventing their intrusion into a building. Used in conjunction with vapor barriers.		Highly Effective - When used in combination with vapor barriers, prevents intrusion of sub-slab air into the building. - System performance not impacted by weather conditions. - PCE and TCE remain in groundwater.	Highly Effective - When used in combination with vapor barriers, prevents intrusion of sub-slab air into the building. - PCE and TCE remain in groundwater.	Moderate	Easy to Moderate	Low to Moderate	Moderate	Eliminated as vapor intrusion risks from the relatively low levels of PCE and TCE in on-site groundwater can be mitigated via vapor barriers with passive venting systems. A passive venting system can be easily converted to an active venting system if required based on indoor air monitoring results

Table 4-3 (continued)

General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Vapor Intrusion RAOs Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Containment	Isolation of groundwater impacted with potential COCs or manipulation of groundwater flow through the placement of engineered material to prevent migration of the containment plume	**Vertical Containment** Vertical barriers used to contain contaminated groundwater, divert contaminated groundwater, and/or provide a barrier for the groundwater treatment system.	**Slurry Walls:** Barriers constructed underground to impede groundwater flow above and below the groundwater table.	• Areas where the contaminant plume is present in unconsolidated media (such as gravel, sand, silt) that allows for installation • Areas where consolidated media (e.g., bedrock) is present below the unconsolidated layer that allows for the walls to be "keyed in"	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Slurry walls do not prevent vapor migration.	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not address vapor migration risks and do not achieve groundwater RAOs.
			Grout Curtains: Thin, vertical walls installed in the ground, constructed by pressure-injecting grout directly into soil at closely spaced intervals.		Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Grout curtains do not prevent vapor migration.	Not effective - The PCE plume is stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not address vapor migration risks and do not achieve groundwater RAOs.
			Diaphragm Walls: Sub-surface reinforced concrete structures that serve as a barrier to groundwater flow.		Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Diaphragm walls do not prevent vapor migration.	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not address vapor migration risks and do not achieve groundwater RAOs.
			Sheet Pile Walls: Walls constructed by driving sheet piles into the ground to provide a barrier to groundwater flow.		Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Sheet pile walls do not prevent vapor migration.	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not address vapor migration risks and do not achieve groundwater RAOs.

Table 4-4
General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Groundwater Restoration RAO Only

<table>
<tr><th rowspan="2">General Response Action</th><th rowspan="2">General Description</th><th rowspan="2">Technology</th><th rowspan="2">Process Option</th><th rowspan="2">Site Conditions Favoring</th><th colspan="2">Effectiveness</th><th colspan="2">Implementability</th><th colspan="2">Cost</th><th rowspan="2">Retained/Eliminated</th></tr>
<tr><th>Short-Term</th><th>Long-Term</th><th>Technical</th><th>Administrative</th><th>Capital</th><th>O&M</th></tr>
<tr><td>No Action</td><td>No action or monitoring implemented</td><td>N/A</td><td>N/A</td><td>• N/A</td><td>Not Effective</td><td>Not Effective</td><td>None</td><td>None</td><td>None</td><td>None</td><td>Retained as baseline case.</td></tr>
<tr><td rowspan="3">Institutional Controls</td><td rowspan="3">Methods of minimizing potential human exposure to potential COCs or of protecting an implemented remedy through use restriction. Often used in conjunction with other actions.</td><td>Engineering Controls</td><td>Use of existing site security and fencing for protection of any implemented remedy.</td><td rowspan="3">• Areas where site access is controlled
• Areas where impacts from potential COCs impacts are unlikely to lead to ecological risks
• Areas where potential COCs are unlikely to migrate</td><td>Effective
- Site access is controlled by perimeter fence and round-the-clock security that restrict access to unauthorized persons.

- PCE remains in place.</td><td>Effective
- Engineering controls will remain effective as long as they remain implemented and enforced.
- Not effective if the site is no longer controlled or controls are not communicated to the target population.
- PCE remains in place.</td><td>Easy</td><td>Easy</td><td>Low</td><td>Easy</td><td>Retained to be used in conjunction with other remedial approaches.</td></tr>
<tr><td>Administrative Controls</td><td>Signage identifying potential COCs in groundwater and any restrictions on use of groundwater as documented in deed restrictions.

Designation of the PCE plume area as Classification Exception Areas (CEA)/Well Restriction Area (WRA), which is an administrative control that alerts the public as well as governmental organizations that the groundwater contained within the footprint is unfit for human consumption and not to be used for potable purposes.</td><td>Effective
- Site access is controlled by perimeter fence and guarded entrances, so administrative controls can be effectively implemented.
- Prevents exposure via potable use.
- PCE remains in place.</td><td>Effective
- Administrative Controls will remain effective as long as they remain implemented and enforced.
- Not effective if the site is no longer controlled or controls are not communicated to the target population.
- PCE remains in place.</td><td>Easy</td><td>Easy</td><td>Low</td><td>Low</td><td>Retained to be used in conjunction with other remedial approaches.</td></tr>
<tr><td>Legal Controls</td><td>General land use restrictions and deed restrictions to prohibit potable use of affected groundwater.</td><td>Effective
- Site access is controlled by perimeter fence and guarded entrances, so legal controls can be effectively implemented and enforced.
- Prevents exposure via potable use.
- PCE remains in place.</td><td>Effective
- Legal Controls will remain effective as long as they remain implemented and enforced.
- PCE remains in place.</td><td>Easy</td><td>Easy</td><td>Low</td><td>Low</td><td>Retained to be used in conjunction with other remedial approaches.</td></tr>
</table>

Table 4-4 (continued)
General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Groundwater Restoration RAO Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Monitored Natural Attenuation (MNA)	Term used to describe reduction of toxicity, volume, concentration, or mobility of potential COCs by naturally occurring processes. Examples of these processes include reduction of potential COC concentrations through natural physical processes (e.g., dilution, dispersion, etc.), natural biological degradation, and/or reduction of potential COC concentrations through abiotic chemical degradation.	**Attenuation with physical, biological, or chemical processes**	**Reduction of Potential COC Concentrations Through Physical Processes:** Concentrations of potential COCs in groundwater are reduced through natural physical processes such as dispersion, dilution, and diffusion through advective transport. **Reduction of Potential COC Concentrations Through Biological Degradation:** Native microorganisms present in the groundwater degrade potential COCs and break them down into non-toxic byproducts. **Reduction of Potential COC Concentrations Through Chemical Degradation:** Potential COCs are degraded through chemical reactions within the groundwater and break them down into non-toxic byproducts.	Sites where: • Natural attenuation processes are demonstrated and expected to continue at existing rates. • Human exposure is limited or can be limited by institutional controls. • Potential COC exposures to the ecosystem are already approaching remedial cleanup levels. • Groundwater plume is stable and likely to remain stable after remedial actions are completed.	Potentially Effective - PCE and TCE do degrade under natural conditions. However, due to the slow and incomplete degradation and possible formation of toxic byproducts, MNA is most effective when implemented in conjunction with treatment in order to meet PRGs within the desired timeframe and to limit the formation of toxic byproducts.	Potentially Effective - MNA alone could take many years to achieve PRGs. So long-term maintenance or monitoring is typically required.	Moderate to Difficult	Moderate	Low	Moderate to High	Retained. MNA through biological and chemical degradation pathways is limited at this site and MNA would rely mostly on physical degradation processes.

Table 4-4 (continued)
General Response Action (GRA) Screening for PCE and TCE in Groundwater
Applicable to LIA Groundwater for Groundwater Restoration RAO Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Containment	Isolation of groundwater impacted with potential COCs or manipulation of groundwater flow through the placement of engineered material to prevent migration of the containment plume	**Vertical Containment** Vertical barriers used to contain contaminated groundwater, divert contaminated groundwater, and/or provide a barrier for the groundwater treatment system.	**Slurry Walls:** Barriers constructed underground to impede groundwater flow above and below the groundwater table.	• Areas where the contaminant plume is present in unconsolidated media (such as gravel, sand, silt) that allows for installation • Areas where consolidated media (e.g., bedrock) is present below the unconsolidated layer that allows for the walls to be "keyed in"	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Slurry walls do not prevent vapor migration.	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not achieve groundwater RAOs.
			Grout Curtains: Thin, vertical walls installed in the ground, constructed by pressure-injecting grout directly into soil at closely spaced intervals.		Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Grout curtains do not prevent vapor migration.	Not effective - The PCE plume is stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not achieve groundwater RAOs.
			Diaphragm Walls: Sub-surface reinforced concrete structures that serve as a barrier to groundwater flow.		Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Diaphragm walls do not prevent vapor migration.	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not achieve groundwater RAOs.
			Sheet Pile Walls: Walls constructed by driving sheet piles into the ground to provide a barrier to groundwater flow.		Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Sheet pile walls do not prevent vapor migration.	Not effective - The PCE plume is currently stabilized and migration to the River is not a concern. Site risks are related to vapor migration. Vertical walls do not prevent vapor migration.	Moderate	Moderate	High	Moderate	Eliminated because vertical barriers do not achieve groundwater RAOs.

Table 4-4 (continued)
General Response Action (GRA) Screening for PCE in Groundwater
Applicable to LIA Groundwater for Groundwater Restoration RAO Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Collection and Discharge	Collection of groundwater on site, followed by on-site or off-site discharge.	**Collection Using Subsurface Drains or Extraction Wells**	**Interceptor trenches with off-site disposal:** Collection of contaminated groundwater using perforated pipe in trenches backfilled with porous media. Disposal of extracted groundwater to publicly owned treatment works (POTW) or MS4 system under permit.	• Sites where the contaminant plume and volume are small.	Potentially effective - Volume of contaminated groundwater at the site is reduced.	Less effective - Volume of contaminated groundwater at the site is reduced. - Unless the source of contamination is addressed, collection and discharge may take years to achieve RAOs or may not be sufficient to achieve the RAOs. - In addition, this may risk drawing unknown off-site contaminants onto the Site.	Moderate	Moderate	Moderate	Moderate	Eliminated because the alternative does not treat groundwater, is not likely to be permitted, and may not achieve RAOs.
			Extraction wells with off-site disposal: Installation of a series of wells to extract contaminated groundwater. Disposal of extracted groundwater to publicly owned treatment works (POTW) or MS4 system under permit.	• Sites where the contaminant source has been controlled or eliminated.	Potentially effective - Volume of contaminated groundwater at the site is reduced.	Less effective - Volume of contaminated groundwater at the site is reduced. - Unless the source of contamination is addressed, collection and discharge may take years to achieve RAOs or may not be sufficient to achieve the RAOs. - In addition, this may risk drawing unknown off-site contaminants onto the Site.	Moderate	Moderate	Moderate	Moderate	Eliminated because the alternative does not treat groundwater, is not likely to be permitted, and may not achieve RAOs.

Table 4-4 (continued)
General Response Action (GRA) Screening for PCE in Groundwater
Applicable to LIA Groundwater for Groundwater Restoration RAO Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Treatment	The treatment of potential COCs to reduce toxicity, volume, or mobility.	**In Situ Treatment**	**Chemical oxidation via permanganate injection:** Degradation of potential COCs via injection of permanganate, a chemical oxidant that can oxidize PCE/TCE to harmless end products.	Areas where delivery of chemical oxidant to contaminant target areas is feasible.	Effective - Chemical oxidation treatment can take a few months or years to complete depending on site conditions and treatment design. - Short-term effectiveness can vary depending on soil oxygen demand (SOD) and would need bench- and pilot-scale evaluations to optimize treatment. - Use of permanganate can impart a purple color to the groundwater. - Permanganate injection can impact the existing redox conditions the sub-surface. - Mobilization of metals such as chromium and nickel due to oxidation by permanganate has been observed under field conditions.	Highly Effective - PCE plume exceeding PRGs can be targeted. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required. However, post-treatment monitoring is often required initially to verify "rebounding" is not occurring. - Permanganate is long-lasting in the aquifer and can persist and react with potential COCs several months after injections are complete	Moderate	Moderate	Moderate to High	Low	Retained
			Chemical oxidation via Fenton's Reagent: Degradation of potential COCs via injection of Fenton's Reagent, a chemical oxidant that can oxidize PCE/TCE to harmless end products.		Effective - Chemical oxidation treatment can take a few months or years to complete depending on site conditions and treatment design. - Short-term effectiveness can vary depending on SOD and would need bench- and pilot-scale evaluations to optimize treatment. - Fenton's Reagent is a strong oxidant that requires a higher level of safe handling and storage procedures. - The reaction of this oxidant with potential COCs and background soil can create safety issues due to elevated localized temperatures and formation of steam.	Effective - PCE plume exceeding PRGs can be targeted. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required. However, post-treatment monitoring is often required initially to verify "rebounding" is not occurring. - Due to its very high reactivity, Fenton's Reagent lasts for only a short duration in the sub-surface.	Difficult	Difficult	Moderate to High	Low	Eliminated because acid injection into the UWZ may be required to reduce groundwater pH to below 5 and due to safety issues from possible elevated localized temperatures (>200 °C) and formation of steam.
			Zero Valent Iron (ZVI) injection: Injection of a slurry of ZVI can enhance reductive dechlorination of PCE and TCE abiotically and render them innocuous.	Areas where delivery of amendments and/or microbial populations to contaminant target areas is feasible and where geochemical conditions are favorable for dechlorination.	Effective - Enhanced bioattenuation treatment can take a few months or years to complete depending on site conditions and treatment design. - Additionally, degradation of PCE can lead to the production of harmful byproducts in the short term if sub-surface conditions are not optimal, which are degraded over time as treatment progresses. Short-term efficacy can be improved if implemented in conjunction with a properly designed monitoring program to limit the production of harmful byproducts. Bench-scale testing can be conducted during the design phase to optimize treatment.	Highly Effective - PCE plume exceeding PRGs can be targeted. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required.	Moderate	Moderate	Moderate to High	Low	Retained

Table 4-4 (continued)
General Response Action (GRA) Screening for PCE in Groundwater
Applicable to LIA Groundwater for Groundwater Restoration RAO Only

General Response Action	General Description	Technology	Process Option	Site Conditions Favoring	Effectiveness		Implementability		Cost		Retained/Eliminated
					Short-Term	Long-Term	Technical	Administrative	Capital	O&M	
Treatment	The treatment of potential COCs to reduce toxicity, volume, or mobility.	**In Situ Treatment**	**In situ enhanced bioremediation:** Application of substrates, nutrients, and/or microbes to improve natural biodegradation via reductive dechlorination. Application can be performed either using injection wells or mixing into extracted treated water prior to re-injection. In situ degradation can be further enhanced by injecting carbon-containing reactive media such as BOS 100® (Remediation Products, Inc.) or PlumeStop™ (REGENESIS).	Areas where delivery of amendments and/or microbial populations to contaminant target areas is feasible and where geochemical conditions are favorable for dechlorination.	Effective - Enhanced bioremediation treatment can take a few months or years to complete depending on site conditions and treatment design. Additionally, degradation of PCE can lead to the production of harmful byproducts in the short term, which are degraded over time as treatment progresses. Short term efficacy can be improved if implemented in conjunction with a properly designed monitoring program to limit the production of harmful byproducts. Bench-scale testing can be conducted during the design phase to optimize treatment.	Highly Effective - PCE plume exceeding PRGs can be targeted. Once treatment is complete and PRGs are met, long-term maintenance or monitoring is typically not required.	Moderate	Moderate	Moderate to High	Low	Retained
Collection, Treatment, and Discharge	The treatment of potential COCs to reduce toxicity, volume, or mobility and off-site disposal via authorized discharge to POTW or MS4. This GRA differs from the "Collection and Discharge" GRA in the "Treatment" aspect. The extraction systems used in both GRA are similar but this GRA includes above-ground treatment of the extracted groundwater prior to discharge to POTW or MS4.	**Extraction and Ex -situ Treatment**	**Groundwater extraction, treatment via adsorption on Granular Activated Carbon (GAC), and discharge:** Extraction of groundwater via a series of wells. PCE and TCE can be removed from extracted groundwater via direct adsorption on GAC filters. Treated groundwater is then discharged to POTW or MS4 system under permit.	Areas where groundwater discharge to surface water or off-site migration is a concern.	Potentially Effective - GAC can effectively treat PCE and TCE in groundwater - Rate of PCE reduction by pump and treat is very slow and achieving RAOs could take many years. - Certain areas within the UWZ may not produce sufficient water to allow sustained operation of the system.	Potentially Effective - Many years of pumping may be needed to achieve RAOs in groundwater. - In addition, pumping creates risk drawing unknown off-site contaminants onto the Site.	Moderate	Moderate	Moderate	High	Retained

Table 5-1
Description and Screening of Assembled Remedial Alternatives for PCB-Contaminated Soil

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
LSS-PCB-1: No Action	No remedial activities or institutional controls are implemented to address risks from PCB-contaminated soil	**Not Effective**	**Easy**	None	Retained as a baseline measure
LSS-PCB-2: Removal with Off-Site Treatment and Disposal of PTSM, and ICs	- Excavation and off-site incineration of 1.8 CY of PTSM. - Excavated areas backfilled with clean soil. - Asphalt pavement over the excavated area would be restored for operational and personnel safety and would isolate remaining soil from human receptors. - Implementation of ICs including engineering, administrative, and legal controls.	**Effective** - Removal and treatment of 1.8 CY of PTSM expected to reduce surface soil EPC to below the PRG and reduce excess lifetime cancer risk to 1E-05 for outdoor worker - PTSM removal expected to reduce combined soil EPC for construction worker by 40% compared to current EPC.	**Moderate** - Only a small volume of soil to be excavated and treated. - Incineration is a well-established technology. - Materials and methods necessary are generally readily available. - ICs would be easy to implement. - Excavation and handling of PTSM and TSCA-level soil in tight spaces would be challenging.	Low	Retained
LSS-PCB-3: Removal with Off-Site Treatment/Disposal of PTSM, Surface Soils with PCBs > 7 mg/kg, and Select Sub-Surface Soils (1-4 ft.), and ICs	- Excavation and off-site incineration of 1.8 CY of PTSM. - Excavation and off-site disposal of 42 CY of surface soil with PCBs > 7 mg/kg. - Excavation and off-site disposal of 7 CY of sub-surface soil with PCBs > 100 mg/kg. - Disposal of excavated soil with PCBs > 50 mg/kg at TSCA-approved landfill. - Disposal of excavated soil with PCBs < 50 mg/kg at permitted or Subtitle D landfill. - Excavated areas backfilled with clean soil. - Asphalt pavement over the excavated area would be restored for operational and personnel safety. - Implementation of ICs including engineering, administrative, and legal controls.	**Effective** - Removal and treatment/disposal of 51 CY of soil with PCBs > 7 mg/kg expected to reduce the surface soil EPC to below the PRG as well as reduce the excess lifetime cancer risks below 1E-05 for outdoor worker. - Removal and treatment/disposal expected to reduce combined soil EPC for construction worker by 83% compared to current EPC.	**Difficult** - Incineration is a well-established technology. - Materials and methods necessary are generally readily available. - ICs would be easy to implement. - Excavation and handling of PTSM and TSCA-level soil in tight spaces would be challenging. - Sub-surface excavation (up to 4 ft. bgs) would be required next to the Kenilworth Avenue retaining wall which is likely to require consultation with DDOT and measures to support foundation of the wall during excavation activities to preserve integrity of the retaining wall. - Various sub-surface utilities are present within the excavation area which are also expected to pose implementation challenges.	High	Eliminated
LSS-PCB-4: Removal with Off-Site Treatment/Disposal of PTSM, Surface Soils with PCBs > 7 mg/kg, and Select Sub-Surface Soils (1-2 ft.), and ICs	- Excavation and off-site incineration of 1.8 CY of PTSM. - Excavation and off-site disposal of 42 CY of surface soil with PCBs > 7 mg/kg. - Excavation and off-site disposal of 31 CY of sub-surface soil with PCBs > 7 mg/kg. - Disposal of excavated soil with PCBs > 50 mg/kg at TSCA-approved landfill. - Disposal of excavated soil with PCBs < 50 mg/kg at permitted or Subtitle D landfill. - Excavated areas backfilled with clean soil. - Asphalt pavement over the excavated area would be restored for operational and personnel safety. - Implementation of ICs including engineering, administrative, and legal controls.	**Effective** - Removal and treatment/disposal of 75 CY of soil with PCBs > 7 mg/kg expected to reduce the surface soil EPC to below the PRG as well as reduce the excess lifetime cancer risks below 1E-05 for outdoor worker. - Removal and treatment of 75 CY of soil with PCBs > 7 mg/kg expected to reduce combined soil EPC for construction worker by 77% compared to current EPC.	**Moderate** - Incineration is a well-established technology. - Materials and methods necessary are generally readily available. - ICs would be easy to implement. - Excavation and handling of PTSM and TSCA-level soil in tight spaces would be challenging. - Sub-surface excavation would be required next to the Kenilworth Avenue retaining wall which is expected to pose moderate implementation challenges. - Various sub-surface utilities are present within the excavation area which are also expected to pose implementation challenges.	Moderate	Retained

Table 5-1 (continued)
Description and Screening of Assembled Remedial Alternatives for PCB-Contaminated Soil

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
LSS-PCB-5: Removal with Off-Site Treatment/Disposal of PTSM and Soils (0-2 ft.) with PCBs > 7 mg/kg, and ICs	- Excavation and off-site incineration of 1.8 CY of PTSM. - Excavation and off-site disposal of 125 CY of soil with PCBs > 7 mg/kg in the 02-ft. interval. - Disposal of excavated soil with PCBs > 50 mg/kg at TSCA-approved landfill. - Disposal of excavated soil with PCBs < 50 mg/kg at permitted or Subtitle D landfill. - Excavated areas backfilled with clean soil. - Asphalt pavement over the excavated area would be restored for operational and personnel safety. - Implementation of ICs including engineering, administrative, and legal controls.	**Effective** - Removal and treatment of 126 CY of soil with PCBs > 7 mg/kg expected to reduce the surface soil EPC to below the PRG as well as reduce the excess lifetime cancer risks below 1E-05 for outdoor worker. - Removal and treatment of 126 CY of soil with PCBs > 7 mg/kg expected to reduce combined soil EPC for construction worker by 94% compared to current EPC. - Reduces EPC associated with combined soils to 7.1 mg/kg, close to the PRG of 7 mg/kg.	**Difficult** - Incineration is a well-established technology. - Materials and methods necessary are generally readily available. - ICs would be easy to implement. - Excavation and handling of large quantity of soil, with PTSM and TSCA-level PCBs, in tight spaces would be difficult. - Sub-surface excavation (up to 2 ft. bgs) would be required next to the Kenilworth Avenue retaining wall which is likely to require consultation with DDOT and measures to support foundation of the wall during excavation activities to preserve integrity of the retaining wall. - Various sub-surface utilities are present within the excavation area which are also expected to pose implementation challenges.	Very High	Retained

Table 5-2
Description and Screening of Assembled Remedial Alternatives for Vanadium-Contaminated Soil

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
LSS-V-1: No Action	No remedial activities or institutional controls are implemented to address risks from vanadium-contaminated soil.	**Not Effective**	**Easy**	None	Retained as a baseline measure
LSS-V-2: ICs	- Implementation of ICs including engineering, administrative, and legal controls. - ICs include preparation and implementation of an SMP, implementation of appropriate health and safety measures, signage, and deed restrictions.	**Effective** - Implementation of institutional controls to help manage any residual impacts and reduce human exposure to impacted soil.	**Easy** - ICs would be easy to implement.	Low	Retained
LSS-V-3 Excavation with Off-Site Disposal, and ICs	- Excavation and off-site disposal of 1530 CY of soil with vanadium concentrations exceeding PRG from the Warehouse and Laydown area. - Excavated soil disposed of at a permitted landfill. - Excavated areas backfilled with clean soil. - Implementation of ICs including engineering, administrative, and legal controls.	**Effective** - Excavation of the soils in the polygons included in this alternative predicted to reduce the EPC 258 mg/kg, which is lower than the PRG of 277 mg/kg. - Implementation of institutional controls to help manage any residual impacts and reduce human exposure to impacted soil.	**Moderate** - Excavation of impacted soil in certain areas may be challenging due to presence of above-ground structures and underground utilities. - ICs would be easy to implement.	High	Retained

Table 5-3
Description and Screening of Assembled Alternatives for Reducing Vapor Intrusion Risks in Future Buildings from PCE and TCE in Groundwater

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
LGW-VB-1: No Action	No remedial activities or institutional controls are implemented to address vapor intrusion risks in future buildings due to PCE- and TCE-impacted groundwater plume.	**Not Effective**	**Easy**	None	Retained as a baseline measure.
LGW-VB-2: Asphalt Latex Membrane Vapor Barriers with Passive Venting System	- Application of spray-on asphalt latex to a base geotextile layer to create a vapor barrier. - Used in combination with passive venting system in future building construction.	**Effective** - ALM vapor barriers in combination with a passive venting system would be effective in achieving the RAOs by reducing intrusion of PCE and TCE vapors from impacted groundwater plume into indoor air. - ALMs exhibit lower chemical resistance and higher permeability to VOCs as compared to thermoplastic materials such as HDPE.	**Moderate** - Can be easily incorporated into new building construction. - Easier to install than thermoplastic and composite membrane vapor barriers. - Requires additional geotextile layer. - Multiple applications needed to achieve minimum thickness. - Harder to patch or repair.	Moderate	Eliminated due to lower effectiveness compared to other alternatives and issues with implementability.
LGW-VB-3: Thermoplastic Membrane Vapor Barriers with Passive Venting System	- Use of membranes made from materials such as HDPE, LLDPE, and PCV as vapor barriers. - Used in combination with passive venting system in future building construction.	**Highly Effective** - TM vapor barriers in combination with a passive venting system would be effective in achieving the RAOs by reducing intrusion of PCE and TCE vapors from impacted groundwater plume into indoor air. - Excellent chemical resistance and very low permeability for VOCs.	**Easy to moderate** - Can be easily incorporated into new building construction. - Highly resistant to puncture and less prone to being damaged during construction. - Higher installation costs than ALMs. - Thicker membranes may be difficult to install.	Moderate	Retained for implementation in future buildings constructed within plume footprint.
LGW-VB-4: Composite Membrane Vapor Barriers with Passive Venting System	- Use of composite membranes (CMs) vapor barriers that incorporate multiple layers of passive barriers to improve chemical resistance, constructability, and durability. - Examples include ethylene vinyl alcohol embedded between layers of HDPE, ALMs embedded within HDPE (Geo-Seal®-100), metallized films or foils embedded between polyester layers (ZEROPERM®). - Used in combination with passive venting system in future building construction.	**Effective** - CM vapor barriers in combination with a passive venting system would be effective in achieving the RAOs by reducing intrusion of PCE and TCE vapors from impacted groundwater plume into indoor air. - Improved chemical resistance, constructability, and durability over TM membranes - Low permeability to VOCs.	**Easy to moderate** - Can be easily incorporated into new building construction. - Highly resistant to puncture and less prone to being damaged during construction. - Higher installation costs than ALMs. - Smooth CMs may have difficulty in adhering to concrete surfaces. - Thicker membranes may be difficult to install. - May need regulatory approval for some commercially available products less than 30-40 mil thickness.	Moderate	Eliminated because on-site groundwater concentrations of PCE and TCE can be effectively handled by TMs. Use of CMs would not provide any additional benefits over TMs.

Table 5-4
Description and Screening of Assembled Alternatives for Groundwater Restoration

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
LGW-GR-1: No Action	No remedial activities or institutional controls are implemented to restore groundwater quality.	**Not Effective**	**Easy**	None	Retained as a baseline measure
LGW-GR-2: MNA, Groundwater Monitoring, and ICs	- Long-term groundwater monitoring program to confirm absence of on-site PCE source, verify stability of plume or quantify reduction in plume size, and evaluate if MNA is occurring or if conditions for MNA exist on-site. - Implementation of ICs such as signage, security, fencing, groundwater use restrictions, and general land use and deed restrictions	**Moderately Effective** - Groundwater in DC and on-site not used for drinking purposes. - Groundwater unlikely to be used as a drinking water source in the future. - No ecological risks identified in LIA. - On-site plume is stable and data does not show presence of on-site sources. - Groundwater modeling study predicts no impact to biota in surface sediments of the Anacostia River from discharge of on-site groundwater to the River.	**Easy** - Both ICs and long-term groundwater monitoring program would be easy to implement.	Low	Retained
LGW-GR-3: Treatment via Permanganate Injection, with MNA and ICs	- Use of permanganate ion as an oxidant to degrade PCE in groundwater to carbon dioxide and water. - Involves injecting aqueous solution of either $KMnO_4$ or $NaMnO_4$ into the aquifer via injection wells or direct-push methods. - Involves monitoring groundwater for PCE and reaction products. - Implementation of ICs including engineering, administrative, and legal controls.	**Highly Effective** - Effective for degradation of PCE and daughter products. - High persistence in sub-surface post-injection. - Bench-scale studies are needed to evaluate effectiveness for on-site groundwater. - Background (soil) oxygen demand can potentially impact effectiveness.	**Moderate to Difficult** - Well-developed technology that has been applied successfully at several sites for PCE-impacted groundwater. - Materials, methods, and services are readily available. - Sub-surface geology is somewhat conducive to injection of permanganate solution. - High background oxygen demand anticipated. - Groundwater pH is suitable for application. - Avoids formation of DCE, VC, and other toxic intermediates. - Utilities and transit infrastructure in the plume area would pose challenges to successful implementation. - Reaction byproduct, MnO_2, is an insoluble precipitate and can reduce the permeability of the aquifer in the long term. - May impart purple color to groundwater, which can show up in connected surface water bodies.	High	Eliminated due to high anticipated background oxygen demand that would potentially reduce effectiveness of the remedy.
LGW-GR-4: Treatment via ZVI Injection, with MNA and ICs	- Use of ZVI for abiotic dechlorination of PCE to ethene and ethane - Commercially available ZVI delivered to the MW-09 Treatment Zone groundwater plume as a slurry via direct-push methods. - ZVI curtains created downgradient of MW-09 Treatment Zone via direct push ZVI injections along transects. - Involves monitoring groundwater for PCE and any reaction by-products. - I Implementation of ICs including engineering, administrative, and legal controls.	**Highly Effective** - ZVI is effective for degradation of PCE and daughter products. - Bench-scale studies are needed to evaluate effectiveness for on-site groundwater.	**Moderate** - Well-developed technology that has been applied successfully at several sites for PCE-impacted groundwater. - Materials, methods, and services are readily available. - Sub-surface geology is somewhat conducive to injection of ZVI slurry. - Groundwater pH is suitable for application. - Limited formation of DCE, VC, and other toxic intermediates. - Utilities and transit infrastructure in the plume area would pose challenges to successful implementation.	Moderate	Retained

Table 5-4 (continued)
Description and Screening of Assembled Alternatives for Groundwater Restoration

General Response Action	Description	Effectiveness	Implementability	Cost	Retained/Eliminated
LGW-GR-5: Treatment Via Biowalls and ZVI Injection, with MNA and ICs	- Groundwater treatment via a combination of enhanced bioremediation and abiotic dechlorination using ZVI. - Involves construction of 3 underground biowall trenches, filled with limestone (for pH adjustment) and mulch, along the length of the plume, for anaerobic dechlorination of PCE and daughter products. - Emulsified vegetable oil (EVO) used as substrate and injected into biowalls to stimulate microbial activity. - Bioaugmentation may be necessary in absence of a sufficiently active native population of halorespirers. - Sequential dechlorination of PCE to TCE, cis-1,2-DCE, vinyl chloride to the final degradation product, ethene by native or introduced microbial population of halorespirers. - ZVI curtains created downgradient of the biowalls via direct push ZVI injections along transects. - Abiotic dechlorination of PCE to ethene and ethane via ZVI. - Implementation of ICs including engineering, administrative, and legal controls.	**Highly Effective** - Effective for degradation of PCE and daughter products. - Bench-scale studies are needed to evaluate effectiveness for on-site groundwater.	**Difficult** - Well-developed technologies that have been applied. successfully at several sites for PCE-impacted groundwater. - Materials, methods, and services are readily available. - Sub-surface geology is somewhat conducive to injection of substrates, nutrients, and micro-organisms. - Groundwater pH would need to be raised to provide conditions suitable for dechlorinating bacteria. - Possible accumulation of DCE, VC, and other toxic intermediates in groundwater in the short-term or with incomplete treatment. - Utilities and transit infrastructure in the plume area would pose challenges to construction of underground trenches and successful implementation of the remedy.	Moderate to High	Retained
LGW-GR-6: Groundwater Extraction and Treatment Using GAC, with MNA and ICs	- Extraction of groundwater via 5 extraction wells installed within the plume footprint. - - Extracted groundwater treated via liquid-phase GAC to remove PCE and daughter products. - - Treated water discharged to MS4 or s under permit. - - Implementation of ICs including engineering, administrative, and legal controls.	**Highly Effective** - GAC is effective in removing PCE and daughter products from groundwater. - Bench-scale studies are needed to evaluate effectiveness for on-site groundwater and for selection of suitable GAC product.	**Moderate to Difficult** - Well-developed technology that has been applied successfully at several sites for PCE-impacted groundwater. - Materials, methods, and services are readily available. - Rate of PCE and daughter production reduction by pump and treat can be slow and achieving RAOs could take many years. - Certain areas within the UWZ may not produce sufficient water to allow sustained operation of the system. - In addition, pumping creates risk of drawing unknown off-site contaminants onto the Site.	Moderate to High	Retained

Table 6-1 Cost Estimates for LSS-PCB-2

Remedy Components:

1. Implementation of ICs
2. Excavation and Incineration of PTSM (1.8 CY or 2.7 tons)
3. Backfilling of Excavated Areas
4. Replacement of Asphalt Cap Over Backfilled Areas for Operational and Personnel Safety
5. Periodic Maintenance of Asphalt Pavement (assumes 10% of asphalt-paved area requires maintenance every 5 years)

Capital Cost					
	Direct Capital Cost	**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Mobilization/Demobilization	*LS*	$5,330	1.0	$5,300
2	Contractor Plans and Submittals	*LS*	$10,000	1.0	$10,000
3	PTSM Excavation and Management	*Day*	$10,000	1.0	$10,000
4	Excavation and Management of Non-PTSM Soil	*CY*	$15	0.0	$0
5	PTSM Transportation (as Hazardous Waste) to Incineration Facility	*Load*	$11,000	1.0	$11,000
6	PTSM Incineration	*CY*	$1,200	1.8	$2,200
7	Transportation of Soil with PCBs > 50 mg/kg to TSCA Landfill	*Load*	$4,000	0.0	$0
8	Disposal of Soil with PCBs > 50 mg/kg at TSCA Landfill	*Ton*	$500	0.0	$0
9	Transportation and Disposal of Soil with PCBs < 50 mg/kg at Permitted/Industrial Landfill	*Ton*	$200	0.0	$0
10	Removal and replacement of asphalt cap	*DAY*	$10,000	1.0	$10,000
11	Back-fill supply and placement	*Ton*	$35	2.7	$100
12	Topographic Survey	*LS*	$10,000	1.0	$10,000
		Direct Capital Cost Subtotal			**$58,600**
13	Contingency	percent		30%	$17,600
		Direct Capital Cost Total			**$77,000**
	Indirect Capital Cost				
14	Deed Notice (associated permitting)	LS	$10,000	1.0	$10,000
15	Soil Management Plan	LS	$15,000	1.0	$15,000
16	Project Management	percent		10%	$5,900
17	Remedial Design	percent		20%	$11,700
18	Construction Management & QA Support	percent		10%	$5,900
19	Agency Review & Oversight	percent		10%	$5,900
		Indirect Capital Cost Subtotal			**$54,400**
		Total Capital Cost			**$132,000**
	Periodic Costs				
20	5 Year Reviews	Event	$10,000	6.0	$60,000
21	Asphalt Pavement Maintenance	Event	$15,000	6.0	$90,000
		Periodic Costs Total			**$150,000**
22	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$92,300
23	Contingency	percent		30%	$28,000
		Periodic Costs Total			**$121,000**
	TOTAL PRESENT WORTH COST				**$253,000**

Table 6-2 Cost Estimates for LSS-PCB-4

Remedy Components:

1. Implementation of ICs
2. Excavation and Incineration of PTSM (1.8 CY or 2.7 tons)
3. Excavation and Disposal of Non-PTSM Soil (75 CY or 113 tons)
4. Disposal of Non-PTSM Soil at TSCA and Permitted Landfills
5. Backfilling of Excavated Areas
6. Replacement of Asphalt Cap Over Backfilled Areas for Operational and Personnel Safety

Capital Cost					
Direct Capital Cost		**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Mobilization/Demobilization	*LS*	$21,620	1.0	$21,600
2	Contractor Plans and Submittals	*LS*	$10,000	1.0	$10,000
3	Underground Utility Line Management	*Day*	$5,000	2.0	$10,000
4	PTSM Excavation and Management	*Day*	$10,000	1.0	$10,000
5	Excavation and Management of Non-PTSM Soil	*Day*	$10,000	7.0	$70,000
6	PTSM Transportation (as Hazardous Waste) to Incineration Facility	*Load*	$11,000	1.0	$11,000
7	PTSM Incineration	*CY*	$1,200	1.8	$2,200
8	Transportation of Soil with PCBs > 50 mg/kg to TSCA Landfill	*Load*	$4,000	1.0	$4,000
9	Disposal of Soil with PCBs > 50 mg/kg at TSCA Landfill	*Ton*	$500	9.5	$4,800
10	Transportation and Disposal of Soil with PCBs < 50 mg/kg at Permitted/Industrial Landfill	*Ton*	$200	101	$20,200
11	Removal and replacement of asphalt cap	*DAY*	$10,000	6.0	$60,000
12	Back-fill supply and placement	*Ton*	$35	113	$4,000
13	Topographic Survey	*LS*	$10,000	1.0	$10,000
			Direct Capital Cost Subtotal		**$237,800**
14	Contingency	*percent*		30%	$71,300
			Direct Capital Cost Total		**$310,000**
Indirect Capital Cost					
15	Deed Notice (associated permitting)	*LS*	$10,000	1.0	$10,000
16	Soil Management Plan	*LS*	$15,000	1.0	$15,000
17	Project Management	*percent*		10%	$23,800
18	Remedial Design	*percent*		20%	$47,600
19	Construction Management & QA Support	*percent*		10%	$23,800
20	Agency Review & Oversight	*percent*		10%	$23,800
			Indirect Capital Cost Subtotal		**$144,000**
			Total Capital Cost		**$454,000**
Periodic Costs					
21	5 Year Reviews	*Event*	$10,000	6.0	$60,000
			Periodic Costs Total		**$60,000**
22	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$37,000
23	Contingency	*percent*		30%	$11,000
			Periodic Costs Total		**$48,000**
	TOTAL PRESENT WORTH COST				**$502,000**

Table 6-3 Cost Estimates for LSS-PCB-5

Remedy Components:

1. Implementation of ICs
2. Excavation and Incineration of PTSM (1.8 CY or 2.7 tons)
3. Excavation and Disposal of Non-PTSM Soil (126 CY or 189 tons)
4. Disposal of Non-PTSM Soil at TSCA and Permitted Landfills
5. Backfilling of Excavated Areas
6. Replacement of Asphalt Cap Over Backfilled Areas for Operational and Personnel Safety

Capital Cost					
Direct Capital Cost		**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Mobilization/Demobilization	*LS*	$45,580	1.0	$45,600
2	Contractor Plans and Submittals	*LS*	$10,000	1.0	$10,000
3	Retaining Wall Foundation Shoring	*LS*	$150,000	1	$150,000
4	PTSM Excavation and Management	*Day*	$10,000	1.0	$10,000
5	Underground Utility Line Management	*Day*	$5,000	2.0	$10,000
6	Excavation and Management of Non-PTSM Soil	*Day*	$10,000	15.0	$150,000
7	PTSM Transportation (as Hazardous Waste) to Incineration Facility	*Load*	$11,000	1.0	$11,000
8	PTSM Incineration	*CY*	$1,200	1.8	$2,200
9	Transportation of Soil with PCBs > 50 mg/kg to TSCA Landfill	*Load*	$4,000	1.0	$4,000
10	Disposal of Soil with PCBs > 50 mg/kg at TSCA Landfill	*Ton*	$500	15	$7,500
11	Transportation and Disposal of Soil with PCBs < 50 mg/kg at Permitted/Industrial Landfill	*Ton*	$200	172	$34,400
12	Removal and replacement of asphalt cap	*DAY*	$10,000	5.0	$50,000
13	Back-fill supply and placement	*Ton*	$35	190	$6,700
14	Topographic Survey	*LS*	$10,000	1.0	$10,000
		Direct Capital Cost Subtotal			**$501,000**
15	Contingency	*percent*		30%	$150,300
		Direct Capital Cost Total			**$652,000**
Indirect Capital Cost					
16	Deed Notice (associated permitting)	*LS*	$10,000	1.0	$10,000
17	Soil Management Plan	*LS*	$15,000	1.0	$15,000
18	Project Management	*percent*		10%	$50,100
19	Remedial Design	*percent*		20%	$100,200
20	Construction Management & QA Support	*percent*		10%	$50,100
21	Agency Review & Oversight	*percent*		10%	$50,100
		Indirect Capital Cost Subtotal			**$275,500**
		Total Capital Cost			**$928,000**
Periodic Costs					
22	5 Year Reviews	*Event*	$10,000	6.0	$60,000
		Periodic Costs Total			**$60,000**
23	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$37,000
24	Contingency	*percent*		30%	$11,000
		Periodic Costs Total			**$48,000**
	TOTAL PRESENT WORTH COST				**$976,000**

Table 6-4
Comparative Evaluation of Remedial Alternatives for PCB-Contaminated Soil

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LSS-PCB-1: No Action	No remedial activities or institutional controls are implemented to address risks from PCB-contaminated soil.	N/A	N/A	N/A	N/A	N/A	N/A	None
LSS-PCB-2: Removal with Off-Site Treatment and Disposal of PTSM, and ICs	- Excavation and off-site incineration of 1.8 CY of PTSM. - Excavated areas backfilled with clean soil. - Asphalt pavement over the excavated area would be restored for operational and personnel safety, and would isolate human receptors from remaining impacted soil. - Implementation of Institutional Controls including engineering, administrative, and legal controls.	**Protective of human health and environment.** - Removal and treatment of 1.8 CY of PTSM expected to reduce surface soil EPC to below the PRG and reduce excess lifetime cancer risk to 1E-05 for outdoor worker. - PTSM removal expected to reduce combined soil EPC for construction worker by 40% compared to current EPC. - Implemented ICs would inform target populations about risks, limit use of impacted areas, and include protocols for excavation or construction activities for reducing exposure to soil. - No ecological risks identified for the LIA.	**Complies with ARARs.** - Alternative implemented pursuant to the risk-based option under TSCA. - Meets EPA expectation of treatment of PTSM.	**Provides long-term effectiveness and permanence.** - Permanent removal of PCBs in PTSM via incineration. - Asphalt pavement would provide long-term effectiveness and permanence. - Routine maintenance, implementation of ICs and SMP is expected to provide continued effectiveness and permanence.	**Substantial reduction in toxicity and minor reduction in volume of contaminated soil.** - Removal and treatment of 1.8 CY of PTSM expected to reduce surface soil EPC to below the PRG and reduce excess lifetime cancer risk to 1E-05 for outdoor worker - Minor reduction in volume of contaminated soil through removal of 1.8 CY of PTSM.	**Provides short-term effectiveness.** - Removal and treatment of 1.8 CY of PTSM expected to substantially reduce toxicity of remaining soils and can be achieved in a short timeframe. - The asphalt pavement over the excavation area would need to be removed but can be re-installed in a short timeframe. - ICs can be implemented in a relatively short timeframe. - Short-term risks to community, workers, and environment possible during pavement removal and replacement, and excavation activities. - Mitigation of short-term risks via dust suppression and site control measures, use of PPE, soil erosion control measures, SMP, and OSHA-compliant air monitoring. - Minimal impact to surrounding community from traffic and movement of trucks anticipated due to small excavation volume.	**Moderate** - Only a small volume of soil to be excavated and treated - Technologies and methods are well-established. - Equipment, materials, and services needed are readily available. - Site conditions favorable for remedy implementation, as work areas are already cleared. - Excavation and handling of PTSM and TSCA-level soil in tight spaces would be challenging. - No additional time required for negotiating ICs, as Pepco is the property owner. - Alternative parking areas and/or building access/egress points could be established during construction.	$253,000

Table 6-4 (continued)
Comparative Evaluation of Remedial Alternatives for PCB-Contaminated Soil

Remedial Action Alternative	- Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LSS-PCB-4: Removal with Off-Site Treatment/Disposal of PTSM, Surface Soils with PCBs > 7 mg/kg, and Select Sub-Surface Soils (1-2 ft.), and ICs	- Excavation and off-site incineration of 1.8 CY of PTSM. - Excavation and off-site disposal of 42 CY of surface soil with PCBs > 7 mg/kg. - Excavation and off-site disposal of 31 CY of sub-surface soil with PCBs > 7 mg/kg. - Disposal of excavated soil with PCBs > 50 mg/kg at TSCA-approved landfill. - Disposal of excavated soil with PCBs < 50 mg/kg at permitted or Subtitle D landfill. - Excavated areas backfilled with clean soil. - Asphalt pavement over the excavated area would be restored for operational and personnel safety. - Implementation of ICs including engineering, administrative, and legal controls.	**Protective of human health and environment.** - Removal and treatment/disposal of 75 CY of soil with PCBs > 7 mg/kg expected to reduce the surface soil EPC to below the PRG as well as reduce the excess lifetime cancer risks below 1E-05 for outdoor worker. - Removal and treatment of 75 CY of soil with PCBs > 7 mg/kg expected to reduce combined soil EPC for construction worker by 77% compared to current EPC. - Implemented ICs would inform target populations about risks, limit use of impacted areas, and include protocols for excavation or construction activities for reducing exposure to soil. - No ecological risks identified for the LIA.	**Complies with ARARs.** - Alternative implemented pursuant to the risk-based option under TSCA. - Meets EPA expectation of treatment of PTSM.	**Provides long-term effectiveness and permanence.** - Permanent removal from site of 75 CY of soils with PCBs > 7 mg/kg. - Routine maintenance, implementation of ICs and SMP is expected to provide continued effectiveness and permanence.	**Large reduction in toxicity and moderate reduction in volume of contaminated soil.** - Permanent removal of 75 CY of soil expected to reduce cancer risk to < 1E-05 for surface soils and reduce combined soil EPC by 77%. - Moderate reduction in volume through removal of 75 CY of soil with PCBs > 7 mg/kg.	**Provides short-term effectiveness.** - Implementation timeframe of 6-8 months. - The asphalt pavement over the excavation area would need to be removed but can be re-installed in a short timeframe. - ICs can be implemented in a relatively short timeframe. - Short-term but temporary risks to community, workers, and environment possible during excavation of soil and from movement of trucks and machinery. - Mitigation of short-term risks via dust suppression and site control measures, use of PPE, soil erosion control measures, SMP, and OSHA-compliant air monitoring. - Temporary impact on surrounding community from traffic and movement of trucks.	**Moderate** - Equipment, materials, and services needed are readily available. - Technologies and methods are well-established. - Site conditions favorable for remedy implementation, as work areas are already cleared. - Excavation and handling of 75 CY of soil PTSM and TSCA-level soil in tight spaces would be challenging. - Presence of a major underground sewer line owned by DC Water and Sewer south of Building 57 may present challenges to sub-surface excavation. - Excavation near retaining wall may need specific techniques and foundation shoring to preserve structural integrity of the wall. - No additional time required for negotiating ICs, as Pepco is the property owner. - Alternative parking areas and/or building access/egress points could be established during construction.	$502,000
LSS-PCB-5: Removal with Off-Site Treatment/Disposal of PTSM and Soils (0-2 ft.) with PCBs > 7 mg/kg, and ICs	- Excavation and off-site incineration of 1.8 CY of PTSM. - Excavation and off-site disposal of 125 CY of soil with PCBs > 7 mg/kg in the 02- ft. interval. - Disposal of excavated soil with PCBs > 50 mg/kg at TSCA-approved landfill. - Disposal of excavated soil with PCBs < 50 mg/kg at permitted or Subtitle D landfill. - Excavated areas backfilled with clean soil. - Asphalt pavement over the excavated area would be restored for operational and personnel safety. - Implementation of ICs including engineering, administrative, and legal controls.	**Protective of human health and environment.** - Removal and treatment of 126 CY of soil with PCBs > 7 mg/kg expected to reduce the surface soil EPC to below the PRG as well as reduce the excess lifetime cancer risks below 1E-05 for outdoor worker. - Removal and treatment of 126 CY of soil with PCBs > 7 mg/kg expected to reduce combined soil EPC for construction worker by 94% compared to current EPC. - Reduces EPC associated with combined soils to 7.1 mg/kg, close to the PRG of 7 mg/kg. - Implemented ICs would inform target populations about risks, limit use of impacted areas, and include protocols for excavation or construction activities for reducing exposure to soil. - No ecological risks identified for the LIA.	**Complies with ARARs.** - Alternative implemented pursuant to the risk-based option under TSCA. - Meets EPA expectation of treatment of PTSM.	**Provides long-term effectiveness and permanence.** - Permanent removal from site of 126 CY of soils with PCBs > 7 mg/kg. - Routine maintenance, implementation of ICs and SMP is expected to provide continued effectiveness and permanence.	**Large reduction in toxicity and moderate reduction in volume of contaminated soil.** - Permanent removal of 126 CY of soil expected to reduce cancer risk to < 1E-05 for surface soils and reduce combined soil EPC by 94%. - Moderate reduction in volume through removal of 126 CY of soil with PCBs > 7 mg/kg.	**Provides short-term effectiveness.** - Implementation timeframe of 10-12 months. - The asphalt pavement over the excavation area would need to be removed but can be re-installed in a short timeframe. - ICs can be implemented in a relatively short timeframe. - Short-term but temporary risks to community, workers, and environment possible during excavation of soil and from movement of trucks and machinery. - Mitigation of short-term risks via dust suppression and site control measures, use of PPE, soil erosion control measures, SMP, and OSHA-compliant air monitoring. - Temporary impact on surrounding community from traffic and movement of trucks.	**Difficult** - Equipment, materials, and services needed are readily available. - Technologies and methods are well-established. - Site conditions favorable for remedy implementation, as work areas are already cleared. - Excavation and handling of 126 CY of soil PTSM and TSCA-level soil in tight spaces would be challenging. - Presence of several underground utilities in excavation area may pose implementation challenges for sub-surface excavation. - Sub-surface excavation along the retaining wall likely to require consultation and permission from DDOT, specific excavation techniques, and shoring of wall foundation to preserve structural integrity of the wall. - No additional time required for negotiating ICs, as Pepco is the property owner. - Alternative parking areas and/or building access/egress points could be established.	$976,000

Table 6-5 Cost Estimates for LSS-V-2

Remedy Components:

1. Implementation of ICs

Capital Cost					
Direct Capital Cost		**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Mobilization/Demobilization	*LS*	$0	0	$0
2	Contractor Plans and Submittals	*LS*	$10,000	0	$0
3	Soil Excavation and Management	*CY*	$15	0.0	$0
4	Transportation and Disposal of excavated soil at Permitted/Industrial Landfill	*Ton*	$80	0.0	$0
5	Topographic Survey	*LS*	$10,000	0.0	$0
		Direct Capital Cost Subtotal			**$0**
6	Contingency	*percent*		30%	$0
		Direct Capital Cost Total			**$0**
Indirect Capital Cost					
7	Deed Notice (associated permitting)	*LS*	$10,000	1.0	$10,000
8	Soil Management Plan	*LS*	$15,000	1.0	$15,000
9	Project Management	*percent*		10%	$2,500
10	Remedial Design	*percent*		0%	$0
11	Construction Management & QA Support	*percent*		0%	$0
12	Agency Review & Oversight	*percent*		10%	$2,500
		Indirect Capital Cost Subtotal			**$30,000**
		Total Capital Cost			**$30,000**
Periodic Costs					
13	5 Year Reviews	*Event*	$10,000	6.0	$60,000
		Periodic Costs Total			**$60,000**
14	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$36,900
15	Contingency	*percent*		30%	$11,100
		Periodic Costs Total			**$48,000**
	TOTAL PRESENT WORTH COST				**$80,000**

Table 6-6 Cost Estimates for LSS-V-3

Remedy Components:

1. Implementation of ICs
2. Excavation of 1530 CY (2300 tons) of surface soils (up to 1 ft bgs)
3. Disposal of excavated soil as non-hazardous waste at permitted landfill
4. Backfilling of excavated areas to grade

Capital Cost					
Direct Capital Cost		**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Mobilization/Demobilization	*LS*	$30,250	1.0	$30,300
2	Contractor Plans and Submittals	*LS*	$5,000	1.0	$5,000
3	Soil Excavation and Management	*CY*	$15	1530	$23,000
4	Transportation and Disposal of excavated soil at Permitted/Industrial Landfill	*Ton*	$80	2300	$184,000
5	Backfilling of Excavated Areas	*Ton*	$35	2300	$80,500
6	Topographic Survey	*LS*	$10,000	1.0	$10,000
		Direct Capital Cost Subtotal			**$333,000**
7	Contingency	*percent*		30%	$100,000
		Direct Capital Cost Total			**$433,000**
Indirect Capital Cost					
8	Deed Notice (associated permitting)	*LS*	$10,000	1.0	$10,000
9	Soil Management Plan	*LS*	$15,000	1.0	$15,000
10	Project Management	*percent*		10%	$33,000
11	Remedial Design	*percent*		20%	$67,000
12	Construction Management & QA Support	*percent*		10%	$33,000
13	Agency Review & Oversight	*percent*		10%	$33,000
		Indirect Capital Cost Subtotal			**$191,000**
		Total Capital Cost			**$620,000**
Periodic Costs					
14	5 Year Reviews	*Event*	$10,000	6.0	$60,000
		Periodic Costs Total			**$60,000**
15	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$37,000
16	Contingency	*percent*		30%	$11,000
		Periodic Costs Total			**$48,000**
	TOTAL PRESENT WORTH COST				**$670,000**

Table 6-7
Comparative Evaluation of Remedial Alternatives for Vanadium-Contaminated Soil

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LSS-V-1: No Action	No remedial activities or institutional controls are implemented to address risks from vanadium-contaminated soil	N/A	N/A	N/A	N/A	N/A	N/A	None
LSS-V-2: ICs	- Implementation of ICs such as SMP, signage, and deed restrictions engineering to reduce vanadium exposure to current or future construction workers.	**Protective of human health and environment.** - Implemented ICs would inform target populations about risks, limit use of impacted areas, and reduce exposure to vanadium-contaminated soil during construction or maintenance activities.	**Complies with ARARs.** - All activities under this alternative would be implemented in accordance with relevant ARARs.	**Provides long-term effectiveness and permanence.** - Routine maintenance, implementation of ICs, and SMP is expected to provide continued effectiveness and permanence.	**No reduction in toxicity, mobility, or volume through treatment.** - Remedy does not include any treatment of soils with vanadium concentrations exceeding PRGs. Thus, no reduction in toxicity, mobility, or volume is expected from implementation of this remedy.	**Provides short-term effectiveness.** - ICs can be implemented in relatively short timeframe. - No short-term risks to the community, workers, and the environment are expected during the implementation of this alternative.	**Easy** - ICs would be easy to implement - No additional time is required for negotiating ICs, as Pepco is the property owner.	$80,000
LSS-V-3: Excavation with Off-Site Disposal, and ICs	- Partial excavation and disposal of 1530 CY of surface soil (0-1 ft.) exceeding vanadium PRG. - Excavated areas backfilled - Implementation of ICs such as SMP, signage, and deed restrictions engineering to reduce vanadium exposure to current or future construction workers.	**Protective of human health and environment.** - Excavation and disposal of 1530 CY of soil predicted to combined soil EPC (for current/future construction worker) to 258 mg/kg, which is below the PRG of 277 mg/kg. - Implemented ICs would inform target populations about risks, limit use of impacted areas, and reduce vanadium exposure to current or future construction workers.	**Complies with ARARs.** - All actions planned under this alternative will be designed to comply with applicable ARARs.	**Provides long-term effectiveness and permanence.** - Permanent removal of 1530 CY of soil with vanadium concentration exceeding PRG. - Routine maintenance, implementation of ICs, and SMP is expected to provide continued effectiveness and permanence.	**Substantial reduction in toxicity, mobility, or volume through treatment.** - Risk assessment calculations predict reduction in Hazard Index to 0.9 (from current Hazard Index of 16) after removal of 1530 CY of soil. - Remedy does not include any treatment of soils with vanadium concentrations exceeding PRGs. - However, substantial reduction in volume of potential COCs on site via removal and disposal of 1530 CY of soil.	**Provides short-term effectiveness.** - Risk assessment calculations show 94% reduction in Hazard Index after removal of 1530 CY of soil. - Timeframe of 10-12 months for excavation of soil. - ICs can be implemented in relatively short timeframe. - Short-term risks to community, workers, and environment possible during excavation and transport of soil - Mitigation of short-term risks via dust suppression and site control measures, use of PPE, soil erosion control measures, SMP, and OSHA-compliant air monitoring. - Temporary impact to surrounding community from traffic and movement of trucks anticipated.	**Moderate** - Technologies and methods are well-established. - Equipment, materials, and services needed are readily available. - Some excavation areas overlap with above ground structures and underground utilities. - No additional time is required for negotiating ICs, as Pepco is the property owner. - Alternative parking areas and/or building access/egress points could be established if required. - Alternative routes for movement of vehicles and machinery could be established if required.	$670,000

Table 6-8 Cost Estimates for LGW-VB-3

Remedy Components:

1. Incorporation of thermoplastic membrane vapor barriers with passive venting system in future building construction
2. Periodic Indoor Air Monitoring

		Unit	Unit Cost	Quantity	Total Cost
Capital Costs					
Direct Capital Costs		**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Thermoplastic Membrane Vapor Barrier	*Sq. Ft.*	$8	20570	$165,000
2	Passive Venting System	*LS*	$100,000	1.0	$100,000
		Direct Capital Cost Subtotal			**$265,000**
3	Contingency	*percent*		30%	$79,500
		Direct Capital Cost Total			**$345,000**
Indirect Capital Costs					
4	Institutional Controls	*LS*	$15,000	1.0	$15,000
5	Project Management	*percent*		10%	$26,500
6	Remedial Design	*percent*		20%	$53,000
7	Construction Management & QA Support	*percent*		10%	$26,500
8	Agency Review & Oversight	*percent*		10%	$26,500
		Indirect Capital Cost Total			**$148,000**
		Total Capital Cost			**$490,000**
Periodic Costs					
9	Operation and maintenance costs for vapor barrier and passive venting system	Event	$3,000	30.0	$90,000
10	Indoor Air Monitoring	Event	$2,000	35.0	$70,000
11	5 Year Reviews	Event	$10,000	6.0	$60,000
		Periodic Costs Subtotal			**$220,000**
12	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$144,080
13	Contingency	*percent*		30%	$43,224
		Periodic Costs Total			**$188,000**
	TOTAL PRESENT WORTH COST				**$680,000**

Table 6-9
Comparative Evaluation of Remedial Alternatives for Addressing Vapor Intrusion Risks from PCE and TCE in Groundwater

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LGW-VB-1: No Action	No remedial activities or institutional controls are implemented to address vapor intrusion risks from PCE and TCE in hypothetical future building constructed over the groundwater plume.	N/A	N/A	N/A	N/A	N/A	N/A	None
LGW-VB-3: Thermoplastic Membrane Vapor Barriers with Passive Venting System, MNA, and ICs	- Installation of thermoplastic membrane vapor barriers in hypothetical future building constructed within the PCE plume footprint to reduce vapor intrusion risks to occupants - Used in conjunction with a passive venting system - Implementation of ICs such as groundwater use restrictions and deed restrictions requiring installation of vapor barriers and passive venting system for any building constructed within the area of the PCE plume prior to achieving the PRGs for vapor intrusion.	**Protective of human health and environment.** - Thermoplastic vapor barriers, passive venting system, and ICs would be implemented to reduce human exposure to vapor intrusion risks from impacted groundwater and to prevent groundwater use. - No ecological risk was identified during the RI.	**Complies with ARARs.** - This alternative would be implemented pursuant to the risk-based option under TSCA. All actions planned under this alternative will be designed to comply with applicable ARARs.	**Provides long-term effectiveness and permanence.** - Properly installed vapor barriers can have longevity in excess of 30 years. - TM vapor barriers are highly durable, chemically-resistant, and exhibit very low permeability for VOCs. - Continued active management and enforcement of implemented ICs would provide long-term effectiveness.	**No reduction in toxicity, mobility, or volume through treatment.** - No reduction of toxicity, mobility, or volume of contamination would be achieved other than what results from MNA.	**Provides short-term effectiveness.** - ICs can be implemented in relatively short timeframe. - Short-term risks to surrounding community, workers or the environment during installation of liners and monitoring wells would be low. - Engineering and health and safety controls can be implemented during construction phase to minimize short-term risks.	Easy - ICs would be easy to implement. - Equipment, materials, and services for installation of TMs are readily available. - TMs can be easily incorporated into new construction as they exhibit higher puncture resistance and are less prone to being damaged during the construction process. - Use of qualified contractors can address issues associated with installation of thicker membranes and need for labor-intensive methods for sealing and fastening ot TMs.	$680,000

Table 6-10 Cost Estimates for LGW-GR-2

Remedy Components:

1. Implement ICs
2. Installation of 6 additional monitoring wells
3. Implement monitoring for PCE, daughter products, degradation products, and other MNA analytical parameters

Direct Capital Costs		Unit	Unit Cost	Quantity	Total Cost
1	Contractor Plans and Submittals	*LS*	$50,000	0.0	$0
2	Bench-Scale Study	*LS*	$35,000	0.0	$0
3	Utility Screening	*LS*	$3,000	1.0	$3,000
4	Installation of 6 additional monitoring wells	*Each*	$5,000	6.0	$30,000
5	As-Built Survey	*Each*	$10,000	1.0	$10,000
		Direct Capital Cost Subtotal			**$43,000**
6	Contingency	*percent*		30%	$12,900
		Direct Capital Cost Total			**$56,000**
Indirect Capital Costs					
7	Institutional Controls	*LS*	$15,000	1.0	$15,000
8	Long-term GW Monitoring Plan	*LS*	$25,000	1.0	$25,000
9	Permits	*LS*	$25,000	1.0	$25,000
10	Project Management	*percent*		10%	$4,300
11	Remedial Design	*percent*		20%	$8,600
12	Construction Management & QA Support	*percent*		10%	$4,300
13	Agency Review & Oversight	*percent*		10%	$4,300
		Indirect Capital Cost Total			**$87,000**
		Total Capital Cost			**$143,000**
Periodic Costs for Groundwater Monitoring					
14	5 Year Reviews	Event	$10,000	6.0	$60,000
15	Groundwater Monitoring Analytical Costs	Sample	$1,000	144	$144,000
16	Sampling Labor Costs	Day	$2,500	60	$150,000
17	Periodic Reporting	Event	$10,000	12	$120,000
		Periodic Costs Subtotal			**$474,000**
18	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$341,000
19	Contingency	*percent*		30%	$102,000
		Periodic Costs Total			**$443,000**
	TOTAL PRESENT WORTH COST				**$586,000**

Table 6-11 Cost Estimates for LGW-GR-4

Remedy Components:

1. Implementation of ICs
2. In-Situ abiotic dechlorination using Zero Valent Iron (ZVI)
3. Implementation of monitoring for PCE, daughter products, and degradation products

Capital Costs					
Direct Capital Costs		**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Contractor Plans and Submittals	*LS*	$50,000	1.0	$50,000
2	Bench-Scale Study	*LS*	$35,000	1.0	$35,000
3	Pilot Test	*LS*	$150,000	1.0	$150,000
4	Utility Screening	*Day*	$3,000	3.0	$9,000
5	Mobilization/Demobilization for 1st injection	*LS*	$50,000	1.0	$50,000
	MW-09 Treatment Area				
6	Material cost (ZVI, viscosifier, and enzymatic breaker) - 1st Mobilization for Hot Spot	*LS*	$150,000	1.0	$150,000
7	Direct injections - 1st Mobilization for Hot Spot	*Each*	$3,000	58	$174,000
8	Material cost (ZVI, viscosifier, and enzymatic breaker) - 2nd Mobilization	*LS*	$75,000	1.0	$75,000
9	Direct injections - 2nd Mobilization for Hot Spot	*Each*	$3,000	29	$87,000
	ZVI Curtain				
10	Material cost (ZVI, viscosifier, and enzymatic breaker) - Curtain	*LS*	$23,000	1.0	$23,000
11	Direct injections for ZVI curtain	*Each*	$3,000	19	$57,000
12	Installation of 6 Additional Monitoring Wells	*Each*	$5,000	6.0	$30,000
13	As-Built Survey	*Each*	$10,000	1.0	$10,000
		Direct Capital Cost Subtotal			**$900,000**
14	Contingency	*percent*		30%	$270,000
		Direct Capital Cost Total			**$1,170,000**
Indirect Capital Costs					
15	Institutional Controls	*LS*	$15,000	1.0	$15,000
16	Long-term GW Monitoring Plan	*LS*	$25,000	1.0	$25,000
17	Permits	*LS*	$25,000	1.0	$25,000
18	Project Management	*percent*		10%	$90,000
19	Remedial Design	*percent*		20%	$180,000
20	Construction Management & QA Support	*percent*		10%	$90,000
21	Agency Review & Oversight	*percent*		10%	$90,000
		Indirect Capital Cost Total			**$515,000**
		Total Capital Cost			**$1,690,000**
Periodic Costs					
22	5 Year Reviews	Event	$10,000	6.0	$60,000
23	Ground Water Sampling Event	Event	$15,000	10	$150,000
		Periodic Costs Subtotal			**$210,000**
24	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$148,100
25	Contingency	*percent*		30%	$44,400
		Periodic Costs Total			**$193,000**
	TOTAL PRESENT WORTH COST				**$1,880,000**

Table 6-12 Cost Estimates for LGW-GR-5

Remedy Components:

1. Implementation of ICs
2. Groundwater treatment via enhanced bioremediation and ZVI
3. Implementation of monitoring for PCE, daughter products, and degradation products

		Unit	Unit Cost	Quantity	Total Cost
Capital Costs					
Direct Capital Costs		**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Contractor Plans and Submittals	*LS*	$50,000	1.0	$50,000
2	Bench-Scale Study	*LS*	$35,000	1.0	$35,000
3	Pilot Test	*LS*	$150,000	1.0	$150,000
4	Utility Screening	*Day*	$3,000	3.0	$9,000
	Biobarrier				
5	Trenching cost including mobilization/demobilization, excavation and trench construction, mixing, and back-filling	*Each*	$250,000	3.0	$750,000
6	Material cost for mulch	*CY*	$40	455	$18,200
7	Material cost for limestone	*Ton*	$40	570	$22,800
8	Material cost for initial EVO dose	*gal*	$20	1275	$25,300
	ZVI Curtain				
9	Material cost (ZVI, viscosifier, and enzymatic breaker)	*LS*	$25,400	1.0	$25,400
10	Direct Injections for ZVI curtain	*Each*	$3,000	27	$81,000
11	Installation of 6 additional monitoring wells	*Each*	$5,000	6.0	$30,000
12	Transportation and disposal of excavated soil as non-hazardous waste	*Ton*	$80	1135	$90,800
13	As-Built Survey	*Each*	$10,000	1.0	$10,000
		Direct Capital Cost Subtotal			**$1,297,500**
14	Contingency	*percent*		30%	$389,250
		Direct Capital Cost Total			**$1,687,000**
Indirect Capital Costs					
15	Deed Notice (associated permitting)	*LS*	$15,000	1.0	$15,000
16	Long-term GW Monitoring Plan	*LS*	$25,000	1.0	$25,000
17	Permits	*LS*	$25,000	1.0	$25,000
18	Project Management	*percent*		10%	$130,000
19	Remedial Design	*percent*		20%	$260,000
20	Construction Management & QA Support	*percent*		10%	$130,000
21	Agency Review & Oversight	*percent*		10%	$130,000
		Indirect Capital Cost Total			**$715,000**
		Total Capital Cost			**$2,400,000**
Periodic Costs					
22	5 Year Reviews	Event	$10,000	6.0	$60,000
23	Annual Groundwater Monitoring and Reporting	Event	$15,000	10	$150,000
24	EVO dosing in one trench each year	Event	$8,000	29	$232,000
		Periodic Costs Subtotal			**$442,000**
25	Net Present Value Periodic Costs (30 years at a discount rate of 3%)				$297,089
26	Contingency	*percent*		30%	$89,127
		Periodic Costs Total			**$387,000**
	TOTAL PRESENT WORTH COST				**$2,790,000**

Table 6-13 Cost Estimates for LGW-GR-6

Remedy Components:

1. Implement ICs
2. Groundwater extraction and treatment using granular activated carbon (GAC)
3. Implement monitoring for PCE, daughter products, and degradation products

Capital Costs						
	Direct Capital Costs	**Unit**	**Unit Cost**	**Quantity**	**Total Cost**
1	Contractor Plans and Submittals	*LS*	$50,000	1.0	$50,000
2	Bench-Scale Study	*LS*	$35,000	1.0	$35,000
3	Aquifer Pump Tests	*LS*	$60,000	1.0	$60,000
4	Installation of 6 additional monitoring wells	*Each*	$5,000	6.0	$30,000
5	Utility Screening	*Day*	$3,000	3.0	$9,000
6	Groundwater extraction system (including utility screening, 5 extraction wells, pumps, and piping)	*LS*	$95,000	1.0	$95,000
7	Groundwater treatment system (including treatment building, bag filters, 2 x 1000-lb liquid phase GAC units, pumps, piping, electrical equipment, instrumentation and PLC, and monitoring system)	*Each*	$230,000	1	$230,000
8	As-Built Survey	*Each*	$10,000	1.0	$10,000
		Direct Capital Cost Subtotal			**$519,000**
9	Contingency	*percent*		30%	$155,700
		Direct Capital Cost Total			**$675,000**
	Indirect Capital Costs				
10	Institutional Controls	*LS*	$15,000	1.0	$15,000
11	Long-term GW Monitoring Plan	*LS*	$25,000	1.0	$25,000
12	Permits	*LS*	$25,000	1.0	$25,000
13	Project Management	*percent*		10%	$51,900
14	Remedial Design	*percent*		20%	$103,800
15	Construction Management & QA Support	*percent*		10%	$51,900
16	Agency Review & Oversight	*percent*		10%	$51,900
		Indirect Capital Cost Total			**$325,000**
		Total Capital Cost			**$1,000,000**
	Periodic Costs for Groundwater Monitoring				
17	5 Year Reviews	Event	$10,000	6.0	$60,000
18	Ground Water Sampling Event	Event	$15,000	10	$150,000
		Periodic Costs Subtotal			**$210,000**
	Annual Periodic O&M Costs for Treatment System				
19	Carbon Changeout	*Event*	$16,000	1	$16,000
20	Effluent monitoring	*Event*	$800	4	$3,200
21	System Operator	*hr*	$80	416	$33,280
22	Annual Reporting	*Event*	$10,000	1	$10,000
23	Project Management	*percent*		10%	$6,248
		Periodic Costs Subtotal			**$69,000**
24	Net Present Value of Periodic Costs (Over 30 years at a discount rate of 3%)				$1,500,483
25	Contingency	*percent*		30%	$450,145
		Periodic Costs Total			**$1,951,000**
	TOTAL PRESENT WORTH COST				**$2,950,000**

Table 6-14
Comparative Evaluation of Remedial Alternatives for PCE-Contaminated Groundwater

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LGW- GR-1: No Action	- No remedial activities or institutional controls are implemented to address groundwater protection and restoration RAO - Some natural attenuation may take place but is not monitored	N/A	N/A	N/A	N/A	N/A	N/A	None
LGW-GR-2: MNA, Groundwater Monitoring, and ICs	- This alternative does not include any remedial action. - Installation of 6 additional monitoring wells. - Implementation of groundwater monitoring program to evaluate plume stability, trends in concentration of PCE and daughter products, and evaluate/quantify potential for MNA on-site. - Groundwater not currently used for drinking purposes in DC and on-site. - ICs such as fencing, security, and land use and deed restrictions to prevent use of on-site groundwater via land use and deed restrictions. - Signage to inform target population of presence of potential COCs in groundwater.	**Protective of Human Health and Environment** - No current risks to human health as the groundwater on-site and within DC is not used as drinking water, and as no public supply wells or drinking water intakes are present in the vicinity of the site. - Groundwater in UWZ unlikely to be used as a groundwater resource in the future due to low yields. - No ecological risks from groundwater identified. - ARSP groundwater modeling study predicts no impact to biota in the surface sediment of the Anacostia River from discharge of PCE-containing groundwater from the site to the River. - ICs are implemented to prevent groundwater use and to require vapor barriers and passive venting systems in any building constructed within the area of the plume until the PRG is achieved for vapor intrusion.	**Complies with ARARs.** - Groundwater is classified as Class G1 aquifer but is not used as drinking water - ICs would be implemented to prevent use of on-site groundwater as drinking water until RAOs are achieved - All actions planned under this alternative will be designed to comply with applicable ARARs.	**Provides long-term effectiveness and permanence.** - Enforcement of implemented ICs would provide long-term effectiveness for this alternative. - Groundwater in the UWZ at the site is not a viable water resource and is unlikely to be developed as a drinking water resource in the future.	**No reduction through treatment** - There would no reduction in toxicity, mobility, or volume through treatment under this alternative. - Some reduction is possible through natural attenuation via physical and biological degradation processes as evidenced by decreasing concentrations of PCE and daughter products in several on-site wells, stable plume, and likely presence of a depleted off-site PCE source.	**Provides Short-Term Effectiveness** - ICs, groundwater monitoring plan, and groundwater sampling events can be implemented in a relatively short timeframe of 6-12 months. - Short-term risks to the community, workers, and the environment possible during well installation - Mitigation of short-term risks via site control measures and use of PPE. - No impacts on workers or surrounding community anticipated from other components of this alternative.	**Easy** - ICs, groundwater monitoring plan, and groundwater sampling events can be implemented easily. - Since Pepco is the property owner, additional time would not be required for negotiations regarding property restrictions with property owners.	$586,000

Table 6-14 (continued)
Comparative Evaluation of Remedial Alternatives for PCE-Contaminated Groundwater

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LGW-GR-4: Treatment via ZVI Injection, with MNA and ICs	- Use of ZVI for abiotic dechlorination of PCE to ethene and ethane. - Commercially available ZVI delivered to MW-09 Treatment Zone as a slurry via direct-push methods. - ZVI curtain created downgradient of MW-09 Treatment Zone via direct push ZVI injections along a transect. - Multiple injections may be needed depending on sub-surface conditions, extent of distribution, and progress toward RAO. - Periodic groundwater monitoring to assess effectiveness of both active remediation and natural attenuation. - Implementation of ICs including engineering, administrative, and legal controls.	**Protective of human health and environment.** - Abiotic reductive dechlorination using ZVI would be targeted to reduce PCE and daughter product concentrations to groundwater standards. - Bench-scale studies are needed to estimate ZVI dose necessary to meet groundwater standards. - ICs are implemented to prevent groundwater use and to require vapor barriers and passive venting systems in any building constructed within the area of the plume until the PRG is achieved for vapor intrusion. - No ecological exposure to impacted groundwater identified during RI.	**Complies with ARARs.** - Abiotic reductive dechlorination using ZVI would be targeted to reduce PCE and daughter product concentrations to groundwater standards. - Groundwater is classified as Class G1 aquifer but is not used as drinking water. - ICs would be implemented to prevent use of on-site groundwater as drinking water until RAOs are achieved. - All actions planned under this alternative will be designed to comply with applicable ARARs.	**Provides long-term effectiveness and permanence.** - Effectiveness of ZVI for PCE and daughter product degradation is well demonstrated. - Bench-scale studies are needed to evaluate effectiveness for meeting groundwater standards for potential COCs. - Nano- and micro-sized ZVI have higher reactivity but a relatively short lifespan. - Multiple injections may be needed depending on sub-surface conditions, extent of distribution of ZVI, and progress toward RAO. - Estimated timeframe of 15-30 years for achieving PRGs. - ICs could be eliminated after completion of treatment.	**Significant reduction in toxicity, mobility, and volume through treatment.** - Achieved through active treatment of PCE and daughter products in groundwater through in situ abiotic reductive dechlorination with ZVI.	**Provides short-term effectiveness.** - Design and construction timeframe of 2-3 years. - Treatment is expected to begin immediately once appropriate conditions such as a strongly reducing environment with ORP < -400 mV are achieved in the sub-surface. - Conditions not sufficiently conducive for abiotic reductive dechlorination may result in formation of toxic intermediation such as TCE, DCE, and VC. - Short-term risks to community, workers, and environment during installation of injection wells and during handling of treatment chemicals. - Mitigation of short-term risks via site control measures, use of PPE, and OSHA-compliant air monitoring.	**Moderate** - Technologies and methods are well-established. - Equipment, materials, and services needed are readily available. - Sub-surface geology is somewhat conducive to injection of ZVI slurry. - Sub-surface conditions are somewhat suitable for reductive dechlorination but may be enhanced by addition of ZVI. - Groundwater pH is suitable for application. - Formation of toxic intermediates can be avoided under appropriate sub-surface conditions. - Utilities and transit infrastructure in the plume area would pose challenges to successful implementation. - Since Pepco is the property owner, additional time would not be required for negotiations regarding property restrictions with property owners.	$1,880,000

Table 6-14 (continued)
Comparative Evaluation of Remedial Alternatives for PCE-Contaminated Groundwater

Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LGW-GR-5: Treatment Via Biowalls and ZVI, with MNA and ICs	- Groundwater treatment via a combination of enhanced bioremediation and abiotic dechlorination using ZVI. - Involves construction of 3 underground biowall trenches, filled with limestone (for pH adjustment) and mulch, along the length of the plume, for biotic anaerobic dechlorination of PCE and daughter products. - Emulsified vegetable oil (EVO) used as substrate and injected into biowalls to stimulate microbial activity. - Bioaugmentation may be necessary in absence of a sufficiently active native population of halorespirers. - Sequential dechlorination of PCE to TCE, cis-1,2-DCE, vinyl chloride to the final degradation product, ethene by native or introduced microbial population of halorespirers. - ZVI curtain created downgradient of the biowalls via direct push ZVI injections along transect. - Abiotic dechlorination of PCE to ethene and ethane via ZVI. - Periodic groundwater monitoring to assess effectiveness of both active remediation and natural attenuation. - Implementation of ICs including engineering, administrative, and legal controls.	**Protective of human health and environment.** - Enhanced bioremediation and ZVI would be targeted to reduce PCE and daughter product concentrations to groundwater standards. - Bench scale studies needed to estimate substrate and ZVI dose, and bioaugmentation necessary to meet groundwater standards. - ICs are implemented to prevent groundwater use and to require vapor barriers and passive venting systems in any building constructed within the area of the plume until the PRG is achieved for vapor intrusion. - No ecological exposure to impacted groundwater identified during RI.	**Complies with ARARs.** - Enhanced bioremediation and ZVI would be targeted to achieve respective groundwater standards for PCE and associated daughter products. - Groundwater is classified as Class G1 aquifer but is not used as drinking water. - ICs would be implemented to prevent use of on-site groundwater as drinking water until RAOs are achieved. - All actions planned under this alternative will be designed to comply with applicable ARARs.	**Provides long-term effectiveness and permanence.** - Effectiveness of enhanced bioremediation and ZVI for PCE and daughter product degradation is well demonstrated. - Bench-scale studies are needed to evaluate effectiveness for meeting groundwater standards for potential COCs. - Multiple injections may be needed depending on sub-surface conditions, extent of distribution of substrates and micro-organisms, and progress toward RAO. - Estimated timeframe of 15-30 years for achieving PRGs. - ICs could be eliminated after completion of treatment.	**Significant reduction in toxicity, mobility, and volume through treatment.** - Achieved through active treatment of PCE and daughter products in groundwater through enhanced bioremediation and ZVI treatment.	**Provides short-term effectiveness.** - Design and construction timeframe of 2-3 years. - Treatment is expected to begin immediately once appropriate conditions such as a strongly reducing environment with ORP < -200 mV are achieved in the sub-surface. - Reactions may result in accumulation of toxic intermediation such as TCE, DCE, and VC in the short-term but are expected to degrade to ethene with continued treatment. - Short-term risks to community, workers, and environment during installation of injection wells and during handling of treatment chemicals. - Mitigation of short-term risks via site control measures, use of PPE, and OSHA-compliant air monitoring.	**Difficult to implement.** - Technologies and methods are well-established. - Equipment, materials, and services needed are readily available. - Sub-surface geology is somewhat conducive to injection of substrates, ZVI, nutrients, and micro-organisms. - Sub-surface conditions are somewhat suitable for reductive dechlorination but may be enhanced by addition of appropriate substrate. - Incomplete treatment may result in accumulation of toxic intermediates - Groundwater pH is not suitable for bioremediation and would need to be raised. However, groundwater pH > 8.1 would reduce effectiveness of ZVI treatment. Controlling pH within a narrow range that is suitable for both bioremediation and ZVI would be challenging. - Utilities and transit infrastructure in the plume area would pose challenges to installation of underground biowalls. - Since Pepco is the property owner, additional time would not be required for negotiations regarding property restrictions with property owners.	$2,790,000

Table 6-14 (continued)
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Remedial Action Alternative	Remedial Action Alternative Components	Protection of Human Health and Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability	Cost
LGW-GR-6: Groundwater Extraction and Treatment Using GAC, with MNA and ICs	- Extraction of groundwater via 4 extraction wells located along the length of the plume. - Average extraction rate of 7.2 gallons per minute for each well. - Extracted groundwater treated to remove PCE and daughter products via presumptive technology such as liquid-phase GAC. - Treated water discharged to MS4 or POTW under permit. - Periodic groundwater monitoring to assess effectiveness of both active remediation and natural attenuation. - Implementation of ICs including engineering, administrative, and legal controls.	**Protective of human health and environment.** - Pump and treat system would be targeted to reduce PCE and daughter product concentrations to groundwater standards. - Bench-scale studies are needed to estimate GAC volumes and type necessary to meet groundwater standards. - ICs are implemented to prevent groundwater use and to require vapor barriers and passive venting systems in any building constructed within the area of the plume until the PRG is achieved for vapor intrusion. - No ecological exposure to impacted groundwater identified during RI.	**Complies with ARARs.** - Pump and treat system using GAC would be targeted to reduce PCE and daughter product concentrations to groundwater standards. - Groundwater is classified as Class G1 aquifer but is not used as drinking water. - ICs would be implemented to prevent use of on-site groundwater as drinking water until RAOs are achieved. - All actions planned under this alternative will be designed to comply with applicable ARARs.	**Provides long-term effectiveness and permanence.** - Effectiveness of GAC for removal of PCE and daughter product from groundwater is well demonstrated. - Bench-scale studies are needed to evaluate effectiveness for meeting groundwater standards for potential COCs. - Estimated timeframe of 3-30 years for achieving PRGs. - ICs could be eliminated after completion of treatment.	**Significant reduction in toxicity, mobility, and volume through treatment.** - Achieved through active treatment of PCE and daughter products in groundwater via adsorption on GAC.	**Provides short-term effectiveness.** - Design and construction timeframe of 2-3 years. - Treatment effectiveness in the short-term is dependent upon the extraction rates that can be supported by the aquifer. However, pump and treat systems generally need to be operated for several years to achieve the PRGs. - GAC is effective in removing PCE and daughter products from groundwater. - Bench-scale studies are needed to evaluate effectiveness for on-site groundwater and for selection of suitable GAC product.	**Moderate to Difficult** - Well-developed technology that has been applied successfully at several sites for PCE-impacted groundwater. - Materials, methods, and services are readily available. - Rate of PCE and daughter production reduction by pump and treat can be slow and achieving RAOs could take many years. - Certain areas within the UWZ may not produce sufficient water to allow sustained operation of the system. - In addition, pumping creates risk drawing unknown off-site contaminants onto the Site and into the treatment train, which may impact effectiveness of the treatment. - Some construction and implementation challenges are anticipated due to the presence of several underground utilities within the plume area.	$2,950,000