Tables

Table 1
Historical Removal Actions and Investigations
Benning Road Facility RI/FS Project
3400 Benning Road, NE
Washington, DC 20019

Date	Incident / Investigation	Location	Activities
May-85	**PCB Cleanup**: Underground pipe leaked waste transformer oil containing PCBs.	Underground pipe leading from Kenilworth Transformer Shop (Current Building 56)	Removal of aboveground storage tank, associated piping, and excavation of PCB-contaminated material >5 ppm (approximately 288 cu ft)
Sep-88	**PCB Cleanup**: Soil contamination detected under concrete pad used to prepare off-line PCB capacitor banks for disposal in area formerly used to store used electrical equipment.	Parking lot located in the northeast portion of facility.	Removal of approximately 2500 cu ft (389 tons) of PCB-contaminated material (>5 ppm), including concrete slab.
1989-91	**UST Removals**: A total of 6 USTs were removed/closed in place during this period	550-gal #4 (south of bulk tank #1) 4,000-gal diesel (fuel island) 15K-gal #2 (est of Units 13 and 14) 2,000-gal used oil (Fleet Main.) 250-gal #4 10K-gal Diesel (Fuel Island)	All UST removals were inspected and approved for closure by the District.
Mar-91	**PCB Cleanup**: PCB capacitor leaked approximately 8 pounds onto concrete surface and seeped through expansion joints.	Concrete covered area located between Buildings 42 and 61	Approximately 126 cu ft PCB contaminated soil (>25 ppm PCBs) were removed and backfilled. Concrete replaced.
Apr-95	**PCB Cleanup**: PCB containing caulk and joint filler located inside cooling tower structures were found to be impacting the cooling tower concrete basins, sludge and water inside the basins, and soil adjacent to the basin's wall expansion joints. Pre-cleanup sediment sampling results from cooling tower blowdown discharge location upstream of Outfall 013 indicated no PCBs above 1 ppm.	Unit 15 and 16 cooling tower basins and surrounding soil	Approximately 185 cu ft of soil (>1-3 ppm) PCB was excavated. Old joint filler and caulk were removed and the expansion joints and basin were double washed and rinsed. The basin was encapsulated with concrete sealant after all rinse water was removed.
Sep-96 to Mar-97	**Intake Dredging**: Dredging of Station Intake for creation of wetlands	Generating station intake and points up- and downstream	Intake area in the Anacostia River was dredged and the dredge spoils were used to construct wetlands. Pre- and post-dredge sediment samples exhibited total PCBs of 119-934 ppb.
Apr-97	**USEPA Multi-media Inspection**: NPDES, RCRA and TSCA compliance inspection conducted by USEPA.	Entire facility	No compliance problems noted. PCBs at 0.25-3.13 ppm detected in residue samples from storm sewers inlets and outfalls. Elevated concentrations of heavy metals were also detected.
Dec-99	**Phase I Environmental Site Assessment**: conducted by PHI in anticipation of property transaction.	Entire facility	Recognized environmental concerns noted oil staining at two #4 and #2 fuel oil recirculation ASTs located east of the generating station. No concrete bottom noted in the containment areas.
Nov-03	**Salvage Yard Investigation**: Soil investigation was completed in area formerly used for storing used electrical equipment.	Salvage yard located west of Buildings 75 and 88	Approximately 296 cu ft of PCB contaminated material (>1 ppm) was removed from the site. TPH-DRO was detected, but were below DCDOH requirements upon final excavation.
Jun-09	**USEPA Site Inspection**: Site Inspection conducted during 2008 to determine further actions under CERCLA.	Former sludge dewatering area and the Anacostia River water and sediments	Metals, PAHs and PCBs were detected in the former sludge dewatering area and in Anacostia River sediments at concentrations exceeding the screening levels. USEPA links the historical discharges at the site to contamination found in river sediments.
Jan-10	**Phase I ESA**: conducted in connection with substation expansion.	18.5-acre area in the eastern and southern portions of the site that will be impacted by the substation expansion.	Conclusions noted potential for petroleum, metals and PCB impacts of subsurface soils and recommended sampling to develop proper health and safety and soils management procedures during construction.

Table 2
Landside Data Quality Objectives
Benning Road Facility
3400 Benning Road, N.E.
Washington, DC

DQO Step	Site-Specific Information
Step 1: State the Problems	Based on limited sediment sampling, PCBs, PAHs, and metals were detected at elevated levels in the Anacostia River in the vicinity of the Benning Road facility (the Site). Additional environmental assessment including soil and groundwater sampling is necessary at the Site to characterize environmental conditions, refine the CSM and to determine whether past or current conditions at the Site have caused or contributed to contamination of the river. This data is also needed to evaluate the potential for risk to human health and evaluate potential remedial alternatives.
Step 2: Identify the Decisions	1) Has the nature and extent of soil and groundwater contamination been adequately delineated? 2) Are potential target chemical concentrations detected in soil, groundwater or storm drain impacting the river currently or in the past? 3) Is the site-specific hydrogeology and volumetric flux of groundwater to the Anacostia River well understood in the context of the CSM? 4) Is the storm drain system and associated discharge to the Anacostia River at various outfalls well understood in the context of the CSM? 5) Are the target chemical concentrations in soil and groundwater at the Site greater than background concentrations? 6) Are the target chemical concentrations in soil or groundwater present at levels that indicate the potential for risk to human health or the environment?
Step 3: Identify Inputs to the Decision	The key inputs for making the required decisions are briefly summarized as follows: 1) Historical hydrogeological information, geotechnical information, analytical data and Site use/operations documentation. 2) Potential surface soil impacts will be evaluated by collecting 20 surface soil samples for PID and XRF instrument field screening. 3) Potential current or historic discharges from the storm drain system will be evaluated by sampling 5 sediment/residue and 5 water samples. Forensic analysis will be performed on up to 2 samples. 4) Five (5) HSA geotechnical soil borings and ERI will be performed to verify existing data and better characterize Site lithology and potential impacts, respectively. 5) 40 DPT soil borings with XRF field instrument screening and TPH/PCB aroclor analysis using on-site mobile laboratory will be performed to evaluate potential subsurface impacts. Discrete groundwater sampling at DPT locations will be performed to evaluate potential groundwater impacts. 6) HSA-installed monitoring wells, groundwater sampling, and aquifer testing will be performed following site-wide assessment to evaluate potential groundwater impacts and Site-specific hydrogeology. 7) A comprehensive analysis for VOCs, SVOCs, Metals, PCBs, Pesticides, Dioxin, and Furans will be performed selectively in the various media sampled to evaluate for these potential impacts.

Table 2
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DQO Step	Site-Specific Information
Step 4: Define the Study Boundaries	The Landside investigation includes Target Areas identified within the 77-acre Site (i.e. Benning Road Facility located at 3400 Benning Road, Northeast in Washington, DC). The Site is bordered by a DC Solid Waste Transfer Station to the north, Kenilworth Maintenance Yard (owned by the National Park Service, NPS) to the northwest, the Anacostia Avenue and Anacostia River to the west, Benning Road to the south and residential areas to the east and south (across Benning Road).
Step 5: Develop a Decision Rule	1) Historical information will be reviewed to identify potential sources of target chemicals and contamination at the Site. Past or current sources at the Site will then be evaluated using ERI followed by confirmatory soil and groundwater samples at target zones to delineate potential zones of impact and identify any continuing sources of contamination. 2) An evaluation will be performed which compares the analytical results to background to see if the concentrations are consistent with background concentrations. Should concentrations be less than or consistent with background concentrations, then this suggests no unacceptable risk attributable to the Site. 3) If the groundwater and soil concentrations of target chemicals are at or below the conservative human health screening values, then the potential source area will be recommended for no further evaluation. 4) If the soil or groundwater concentrations are above the screening values at a potential source area, the Site data will be further evaluated, including a fate and transport analysis of the target chemicals to characterize the potential impacts to the river.
Step 6: Specify Tolerable Limits of Decision Errors	The data quality indicators for screening and definitive data are defined in terms of the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. The assessment of the data quality indicators is necessary to determine data usability and involves the evaluation of the PARCC parameters. To ensure the quality and integrity of the project data, the precision and accuracy of the analysis, the representativeness of the results the completeness of the data, and the comparability of the data to existing data will be evaluated. Data that meet the DQOs and fulfill project goals will be deemed acceptable. Data that do not meet objectives and goals will be reviewed on a case-by-case basis to ascertain its usefulness. To limit errors made based upon analytical data, the reporting limits (practical quantitation limits) for target analytes have been established at a level at least three times less than the action limit whenever technically feasible. In general, statistical analysis will not be used to determine decision error tolerance limits. Generally each sample will be used to make a decision.

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DQO Step	Site-Specific Information
Step 7: Optimize the Design	The sampling design incorporates a progressive elimination approach using screening parameters to help focus the sampling and analysis for target chemical concentrations over the Site. The variability of data will have an effect on the sampling design. If necessary, the sample frequency and the analytical procedures may undergo changes to optimize the design. The design options, such as sample collection design, sample size and analytical procedures will be evaluated based on cost and ability to meet the DQOs.

Table 3
Waterside Data Quality Objectives
Benning Road Facility
3400 Benning Road, N.E.
Washington, DC

DQO Step	Site-Specific Information
Step 1: State the Problems	Based on limited sediment sampling, PCBs, PAHs, and metals were detected at elevated levels in the Anacostia River in the vicinity of the Benning Road facility (the Site). Additional sediment and surface water sampling is necessary to identify potential Site-related, near-Site and far-Site sources of COPCs in sediment and surface water and evaluate the potential for risk to human health and the environment.
Step 2: Identify the Decisions	1) Has the nature and extent of sediment contamination been adequately delineated? 2) Are the target chemical concentrations in surface sediments adjacent to the Site greater than upstream from the Site? 3) Are the target chemical concentrations in sub-surface sediments adjacent to the Site greater than upstream from the Site? 4) Are the target chemical concentrations in surface water adjacent to the Site greater than upstream from the Site? 5) Are detected concentrations in surface water or sediment present at levels that indicate the potential for risk to human health or the environment? 6) Is sedimentation in the portion of the Anacostia River in Study Area well understood in the context of the CSM? 7) Are the target chemical concentrations in sediment or surface water present at levels that indicate the potential for risk to human health or the environment?
Step 3: Identify Inputs to the Decision	The key inputs for making the required decisions are briefly summarized as follows: 1) PCBs and PAHs within the Anacostia River will be evaluated by sampling surface water and sediment (surface and sub-surface) from within the Waterside Investigation Area and background locations for laboratory analysis. 2) Inorganics within the Anacostia River will be evaluated by sampling surface water and surface sediment from within the Waterside Investigation Area and background locations for laboratory analysis of inorganics, hardness (water only), grain size (sediment only), TOC (sediment only), and SEM/AVS (sediment only). 3) VOCs, SVOCs, Pesticides, Dioxins, and Furans within the Anacostia River will be evaluated by sampling a sub-set of surface water and sediment (surface) samples from within the Waterside Investigation Area and background locations for laboratory analysis. 4) A sub-set of sediment samples will be collected and submitted for forensic laboratory analysis of PCBs and PAHs to differentiate between Site-related, near-Site and far-Site sources of COPCs.
Step 4: Define the Study Boundaries	The Benning Road facility is located at 3400 Benning Road, Northeast in Washington, DC. The Waterside investigation will primarily address sediment conditions within an area of the Anacostia River approximately 10 to 15 acres in size including approximately 2,500 linear feet to the south (approximately 700 feet south of the Benning Road Bridge) and 1,000 linear feet to the north of the Site's main storm water outfall area.

Table 3
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3400 Benning Road, N.E.
Washington, DC

DQO Step	Site-Specific Information
Step 5: Develop a Decision Rule	1) A benchmark comparison will be conducted to determine whether the sediment and surface water concentrations of organic and inorganic constituents adjacent to the site are above human health and ecological benchmarks, indicating the potential for risk. a. If the benchmark comparison indicates that adjacent concentrations are below human health and/or ecological benchmarks, then this suggests no unacceptable risk attributable to the site. b. If the benchmark comparison indicates that adjacent concentrations are above human health and/or ecological benchmarks, then additional investigation may be necessary. If the constituent concentrations are less than the sediment quality benchmarks, then those contaminants are not expected to contribute to total site risk. If the contaminant concentrations are greater than the sediment quality benchmarks, then further evaluation may be required. 2) A statistical evaluation will be conducted to determine whether the sediment and surface water concentrations of organic and inorganic constituents adjacent to the site are consistent with upstream conditions. a. If the statistical evaluation indicates that adjacent concentrations are less than or consistent with upstream concentrations, then this suggests no unacceptable risk attributable to the site. b. If the statistical evaluation indicates that adjacent concentrations are greater than upstream concentrations, then additional investigation may be necessary.
Step 6: Specify Tolerable Limits of Decision Errors	The data quality indicators for screening and definitive data are defined in terms of the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. The assessment of the data quality indicators is necessary to determine data usability and involves the evaluation of the PARCC parameters. To ensure the quality and integrity of the project data, the precision and accuracy of the analysis, the representativeness of the results the completeness of the data, and the comparability of the data to existing data will be evaluated. Data that meet the DQOs and fulfill project goals will be deemed acceptable. Data that do not meet objectives and goals will be reviewed on a case-by-case basis to ascertain its usefulness. To limit errors made based upon analytical data, the reporting limits (practical quantitation limits) for target analytes have been established at a level at least three times less than the action limit whenever technically feasible. In general, statistical analysis will not be used to determine decision error tolerance limits. Generally each sample will be used to make a decision.

Table 4: Landside Data Collection Program
Benning Road Facility RI/FS Project
3400 Benning Rd, N.E.

Data Type	Data Use	Approximate Quantity	Methods
Surface Soil Samples (Phase I)			
Chemical analysis	Evaluation of surface soil quality	25 locations	TPH (8015), VOC (8260), PCB (8082), Metals, EPA 16 PAHs (8270)
		Up to 10 locations	VOCs (8260), SVOCs (8270), Pesticides, and Dioxins/furans
Forensic analysis	Evaluation of PCB and PAH origin and contribution	Up to 5 locations	PCB 680 Homologs and/or PCB 1668 Congeners, PAH fingerprinting
Storm Drain System (leading to Outfall 013) Sampling (Phase I)			
Water	Surface water discharge pathway	5 locations	PCBs (8082), PCB (608), EPA 16 PAHs (8270), dissolved and total Metals, VOCs (8260), TPH (8015), Pesticides
Sediment	Surface water discharge pathway	5 locations	PCBs (8082), PCB (608), EPA 16 PAHs (8270), Metals, VOCs (8260), TPH (8015), Pesticides
Forensic samples	PCB and PAH origin, site reference, surface water pathway	Up to 2 locations	PCB 680 Homologs, PCB 1668 B Congeners, PAH fingerprinting, dioxins/furans
Surface Geophysics (Phase I)			
Electrical Resistive Imaging (ERI)	Evaluation of subsurface geology, obstructions, NAPL plumes and optimization of soil boring and monitoring well placement	Up to 8 transects of 300-500 ft long	Geo Trax™ Survey
Soil Borings to 100 ft below grade (Phase I)			
Lithology	Subsurface geology	Continuous	Visual identification
PID Reading	Screening for VOCs	Continuous	Field methods
Geotechnical	Subsurface geology	25 samples (5 locations, and up to 5 samples per location)	ASTM Grain size and Atterberg limits
Geotechnical	Subsurface geology	10 Shelby tubes (5 locations and two samples per boring)	ASTM Permeability
Subsurface Soil and Groundwater Samples (Phase II)			
Direct Push (Geoprobe™) Borings to 5 ft below groundwater	Subsurface geology, identification of free phase oils	40 locations	Visual identification
VOC Vapor Screen	Rapid characterization, flexibility to field adjust sampling grid	Continuous	Photoionization Detector (PID) field instrument
Metals screen	Subsurface soil quality, rapid characterization, flexibility to field adjust sampling grid	120 samples (three depths at 40 locations)	X-Ray Fluorescence (XRF) field instrument
Soil chemical	Rapid characterization, flexibility to field adjust sampling grid	120 samples (three depths at 40 locations)	Mobile lab TPH (8015) and PCBs (8082)
Soil chemical	Metals confirmation/correlation	24 samples (20% of 120)	Metals (fixed lab)
Soil chemcial	Evaluation of subsurface soil quality	Up to 40 samples	VOCs (8260), PAHs (8270)
Soil chemical	Evaluation of subsurface soil quality	Up to 10 samples	Pesticides, SVOC (8270), dioxins/furans
Groundwater chemical	Evaluation of groundwater quality	40 locations	Mobile lab TPH (8015) and PCBs (8082)
Groundwater chemical	Evaluation of groundwater quality	40 locations	VOCs (8260), EPA 16 PAHs (8270), total and dissolved metals

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Groundwater chemical	Evaluation of groundwater quality	Up to 10 samples	Pesticides, SVOC (8270), dioxins/furans
Forensic analysis	Evaluation of PCB and PAH origin and contribution	Up to 5 soil/groundwater samples	PCB 680 Homologs, PCB 1668 Congeners, PAH fingerprinting
Monitoring Wells to the top of Arundel Clay (Phase III) *			
GW elevation monitoring	Determine depth to groundwater and groundwater gradient	TBD	Gauging
Aquifer testing	Evaluation of aquifer characteristics	TBD	Slug Testing
Chemical analysis	Evaluation of groundwater quality	TBD	VOC (8260), PCB (8082), dissolved and total Metals, EPA 16 PAHs (8270), SVOC (8270), pesticides
Chemical analysis	Evaluation of groundwater quality	TBD	Pesticides, dioxins/furans
Forensic analysis	Evaluation of PCB and PAH origin and contribution	TBD	PCB 680 Homologs and/or PCB 1668 Congeners, PAH fingerprinting
Civil Surveying			
Horizontal and vertical surveys	To locate all sampling points	All locations sampled in Phases I, II and III	GPS surveys

* Number and location of monitoring wells to be determined following evaluation of results from Phase I and Phase II.

Table 5: Waterside Data Collection Program
Benning Road Facility RI/FS Project
3400 Benning Rd, N.E.

Data Type	Data Use	Approximate Quantity	Methods
River Bottom Surveys (Phase I)			
Bathymetric survey	Understanding of depth of the water column and configuration of river bottom	Investigation area and background locations	USACE Hydrographic survey methods (Differential Geographic Positioning System, DGPS)
Utility Survey	Confirm utilities and other underwater obstructions	Investigation area and background locations	Side scan sonar
Surface Water Samples (Phase II)			
General chemistry	Evaluation of surface water quality near sediment-water interface	20 locations (10 transects + up to 10 background)	Field methods for measuring temperature, pH, turbidity, dissolved oxygen and conductivity
Chemical analysis	Surface water impacts	20 locations (10 transects + up to 10 background)	PCBs (8082), EPA 16 PAHs (8270), and Total and dissolved phase Metals (including hardness)
		Up to 10 locations	VOCs (8260), SVOCs (8270), Pesticides, and Dioxins/furans
Surface Sediment Samples (Phase II)			
Chemical analysis	Evaluation of surface sediment quality and background surface sediment quality	55 samples (45 near the site + up to 10 background)	PCBs (8082), Metals, EPA 16 PAHs (8270), AVS/SEM
		Up to 20 samples	VOCs (8260), SVOC (8270), Pesticides, and Dioxins/furans
Sediment characteristics	Evaluation of surface sediment quality and background surface sediment quality	55 samples (45 near the site + up to 10 background)	Total Organic Carbon (TOC), ASTM grain size
Forensic analysis	Evaluation of PCB and PAH origin and contribution	Up to 8 samples	PCB 680 Homologs and/or PCB 1668 Congeners, PAH fingerprinting
Subsurface Sediment Samples (phase II)			
Vibracore Borings (8 to 10 ft deep depending on refusal)	Sediment physical characteristics	55 samples (45 near the site + up to 10 background)	Visual identification
Chemical analysis	Evaluation of subsurface sediment quality and background surface sediment quality	165 samples (3 depths at 55 locations)	PCB (8082) and PAH16 (8270)
Forensic analysis	Evaluation of PCB and PAH origin and contribution	Up to 7 samples	PCB 680 Homologs and/or PCB 1668 Congeners, PAH fingerprinting
Geotech	Evaluation of subsurface sediment physical characteristics	Up to 20 samples	ASTM Grain size and TOC

Table 6
Summary of Calibration Frequency and Criterion for Field Instruments
Benning Road Facility
3400 Benning Road, N.E.
Washington, DC

Instrument	Calibration Frequency	Calibration Standards	Acceptance Criteria
pH meter	Initial: Each time instrument is turned on or upon erratic results	Two reference buffers which bracket expected sample values	Within ≤0.1 pH unit of true value
	Check: Every 15 samples and at the end of the day	pH 7 reference buffer	Within ≤0.1 pH unit of true value or instrument will be recalibrated
Specific conductivity meter	Initial: Each time instrument is turned on or upon erratic results	Two reference standards	Within 10% of true value
	Check: Every 15 samples and at the end of the day	Initial reference standard	Within 10% of true value or instrument will be recalibrated
DO meter	Initial: Each time the instrument is turned on or upon erratic results	Moist air	Within 5% of true value (based on altitude and temperature)
	Check: Every 15 samples and at the end of the day	Moist air	Within 5% of true value or instrument will be recalibrated
ORP meter	Initial: Each time instrument is turned on or upon erratic results	Two reference standards	Within 10% of true value
	Check: Every 15 samples and at the end of the day	Initial reference standard	Within 10% of true value or instrument will be recalibrated
Turbidity meter	Initial: Each time the instrument is turned on or upon erratic results	Two standards	Within 10% of true value
	Check: Every 15 samples or upon erratic results	Higher of initial reference standards	Within 10% of true value or instrument will be recalibrated
Temperature meter	Initial: Factory calibrated annually; no field calibration required.	NA	NA
	Check: Prior to use in field	Mercury bulb thermometer	Within 0.5°C of bulb thermometer or instrument will be replaced
Water Level Tape	Beginning, middle, and end of field program	Check against a manual water level measurement (steel tape)	Within 0.1 ft
PID	Initial: Each time the instrument is turned on or upon erratic results	Clean ambient air and compressed gas standard (isobutylene at 100ppm)	Within 5% of true value
	Check: Mid and end of the day	Compressed gas standard (isobutylene at 100 ppm)	Within 5% of true value
XRF	Initial: Each time the instrument is turned on or upon erratic results.	Use of certified reference standards/samples.	Within 2% of true value
	Check: Mid and end of the day	Initial reference standard	Within 2% of true value