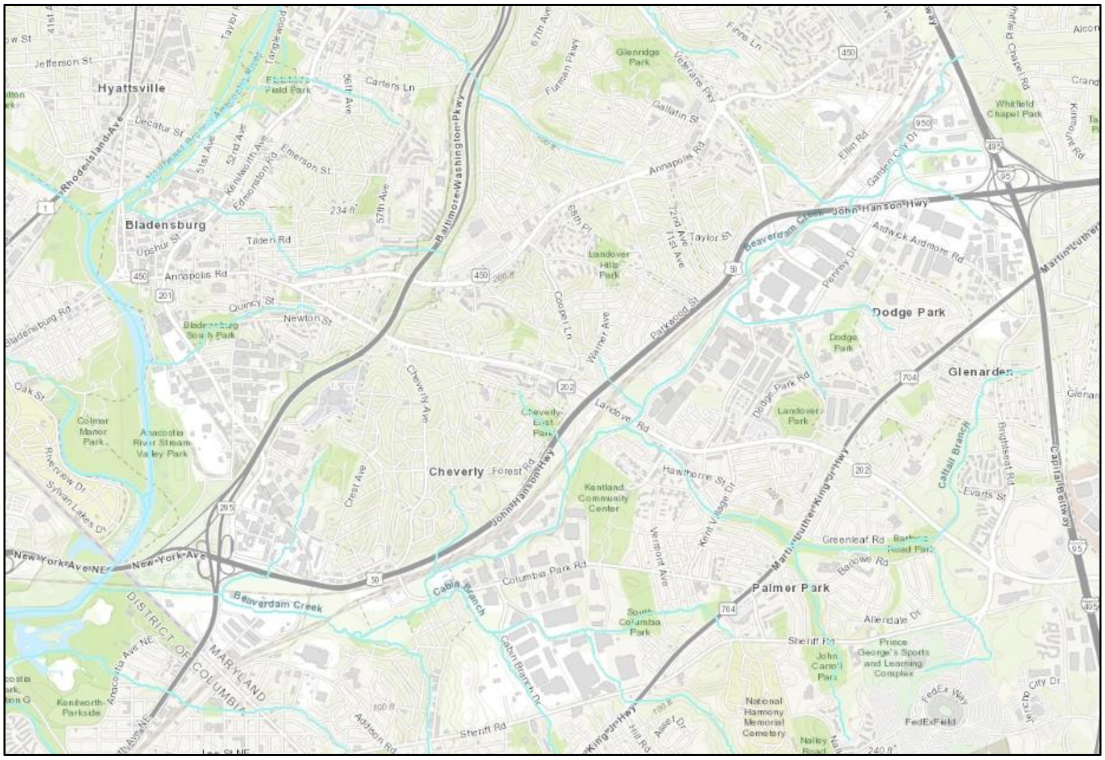
Lower Beaverdam Creek

PCB Investigation

Updated February 2021



Maryland Department of the Environment

Land Restoration Program

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Acronym List

DOEE	Washington D.C.'s Department of Energy and the Environment
EPA	United States Environmental Protection Agency
ESI	Expanded Site Inspection
LBC	Lower Beaverdam Creek
LRP	Land Restoration Program
MDE	Maryland Department of the Environment
mg/kg	milligrams per kilogram
NEB	Northeast Branch
ng/L	nanograms per liter
NPS	National Park Service
NWB	Northwest Branch
PCB	Poly-chlorinated biphenyl
RI	Remedial Investigation
TOC	Total Organic Carbon
µg/kg	micrograms per kilogram
USGS	United States Geological Survey

1. Introduction

The Maryland Department of the Environment's (MDE) Land Restoration Program (LRP) investigated approximately 5 miles of Lower Beaverdam Creek (LBC) from the confluence of the Anacostia River extending into Prince George's County, Maryland. The scope of this investigation included sampling of surface water and sediment to characterize the distribution of poly-chlorinated biphenyls (PCBs) in environmental media within the waterbody. The primary goal of this study is to locate areas of elevated PCBs in sediment or surface water to aid in the identification of potential point sources of PCBs that may impact surface water and sediment quality in LBC.

2. Site Description

The LBC is located in southern Prince George's County, and is a tributary of the tidal Anacostia River. Near the confluence with the Anacostia River, LBC is tidally influenced. The Anacostia River is currently the subject of a Comprehensive Environmental Response, Compensation, and Liability Act-based investigation by Washington D.C.'s Department of Energy and the Environment (DOEE) to address toxics in its sediments. DOEE has collected data in support of a Remedial Investigation (RI) for the Anacostia River sediments over the last several years. Studies completed in support of this RI indicate that LBC may be a continuing source of elevated PCBs to the Anacostia River. However, it is unclear what point-sources within the LBC watershed might be causing these elevated levels of PCBs. The work detailed here will characterize the sediments and surface water to aid in the identification of potential point-sources within the LBC watershed.

The watershed for LBC is 14.8 square miles, which represents ~8% of the total surface area of the Anacostia river watershed. LBC represents 17% of the total flow to the Anacostia River (Warner et al., 1997). LBC is fed by several tributaries, including Cabin Branch and Cattail Branch. The land use within the LBC watershed includes residential, forested, agricultural, commercial and industrial, with approximately 32% impervious cover.

3. Previous Studies

LBC has been the focus of multiple investigations over the past 20 years, many of which suggest that LBC represents a continuing PCB loading source to the tidal Anacostia River. Maryland, Virginia and the District of Columbia developed an inter-jurisdictional Total Maximum Daily Load (TMDL) of PCBs for Tidal Portions of the Potomac and Anacostia Rivers in 2007. The TMDL assigned a load reduction of over 98% to the Maryland portion of the Anacostia watershed including LBC (MDE, 2007). A study published in 2008 (Hwang and Foster) concluded that LBC was a greater source of PCBs to the Anacostia River than either the Northeast Branch (NEB) or the Northwest Branch (NWB). The USGS completed a tributary study in 2018, comparing sediment samples for the five main tributaries of the Anacostia River (NEB, NWB, LBC, Watts Branch, and Hickey Run). LBC was found to be the largest source of PCBs, with the loading primarily due to transport via suspended sediments. The National Park Service also collected samples from these five tributaries as part of an effort to define the anthropogenic background concentration of PCBs in sediments in the Anacostia watershed, and found several locations along LBC where PCB concentrations in sediment were elevated. Based on several different lines of evidence, each of these studies concluded that suspended sediment transport during storm events was the most significant mode of PCB transport to the tidal Anacostia River.

To identify and control sources of PCBs within the LBC watershed, several studies have been conducted by MDE's LRP to pinpoint potential sources for PCBs in LBC sediments, including Rogers Electric, Joseph Smith and Sons, and along the 3300-block of Pennsy Drive. In 1994, a Preliminary Assessment found elevated PCBs in sediment near Kenilworth Avenue, although the source of contamination was not determined. In response to an MDE August 2009 Order, Jack Stone Sign Company performed a removal action for hazardous waste, removing waste and contaminated soil at 3131 Pennsy Drive. An Expanded Site Inspection (ESI) was conducted in 2012 by MDE's Controlled Hazardous Substances Enforcement Division to locate possible sources of PCBs along Pennsy Drive. One of the upgradient sediment samples in LBC for this study was found to have elevated PCBs, and was reported in this ESI (MDE, 2012). However, the source of this upgradient contamination could not be determined at the time. MDE's Water and Science Administration completed several studies along LBC between 2009 and 2011 to locate potential sources in this same area of LBC, but, similar to LRP's efforts, were not able to locate the source.

4. Sampling Effort and Laboratory Analysis

Twenty locations were identified along the entire length of LBC, two of its tributaries (Cabin Branch and Cattail Branch), and reference points in the NEB and NWB for surface water and sediment sampling, in consultation with MDE's Water and Science Administration as well as Prince George's County Department of the Environment. Samples were collected according to the work plan for this effort. Sample locations, rationale, and identification are provided in Table 1. Sample locations are shown on Figure 1. All sampling was conducted on November 20, 2019, by two separate field teams. In the 30 days prior to sampling, there was significant rainfall (5.72 inches at the rain gage near Beltsville, MD). However, most of this occurred at the end of October. Between November 2, 2019 and November 20, 2019, only 0.38 inches of rain was recorded at this station. A moderate rainfall occurred on November 19, the day before sampling, with 0.2 inches of rain recorded at nearby weather stations. However, water velocity and streamflow data from the USGS gage station on LBC indicate that by the time sampling occurred on November 20, LBC had returned to baseflow conditions, with discharge around 7 cubic feet per second (USGS Gage Station data).

Each team was provided a field blank of PCB-free water supplied by the contract laboratory. This water was transported to the field the day of sample collection and transferred to the appropriate sample containers. In addition, each team collected an aqueous equipment rinsate blank prior to the start of sample collection. Duplicate samples were taken at three locations: one from the sampling location in NEB, one from the sampling location in NWB, and one from the SED/SW-18 location within LBC. At each location, water quality parameters were collected, including water temperature, pH, dissolved oxygen, conductivity, salinity, and turbidity (Table 4).

Aqueous samples were collected prior to collection of sediment samples, in a manner that minimized disturbance of sediments. Sediment samples were a composite from three locations at each sampling locale. The three composite locations were selected based on availability of fine-grained substrate. Where possible, the three composite locations were the left bank, mid-stream, and right bank. However, at many sample locations the mid-stream sediments were too sandy, so the third sample was taken from a separate location along either the left or right bank. The sediment from the three locations were thoroughly combined before aliquoting into laboratory-supplied bottles.

All samples were held on ice until being transferred to the courier for the laboratory. Samples were received at the laboratory on November 20, 2019 and analyses were completed by December 20, 2019. Aqueous samples were analyzed for PCB Congeners via United States Environmental Protection Agency (EPA) Method 1668c. Sediment samples were analyzed for PCB Congeners (EPA Method 1668c), for grain size analysis (ASTM D422), and for Total Organic Carbon (TOC) (EPA Method 9060)

4.1. Sediment Sampling Results

The results of TOC and grain size analyses are presented in Table 2. The TOC measured in LBC ranged from non-detect (SED-7) to a high of 18,800 milligrams per kilogram (mg/kg) (SED-18 and SED-3). Grain size is presented as percent fines (represented as % <.075 millimeters), and varied from 2.5% (SED-11) to 85.3% (SED-3).

Total PCB congener concentrations for each sample were calculated by the laboratory and are listed in Table 3 and on Figure 2. The maximum total PCB concentration detected in sediment in this study was 2,450 micrograms per kilogram (µg/kg), in sample SED-4, taken from LBC where it flows near a scrap metal facility near the US-50/I-295 interchange. Elevated total PCBs were found in a second stretch of LBC (SED-13 and SED-14), near Pennsy Drive and the Landover Metro station. The minimum total PCB concentration was measured in sample SED-2 (1.63 µg/kg), taken from the Northeast Branch.

There are 209 unique PCBs, based on position and number of chlorine compounds around the two benzene rings that form the basic structure. PCBs can be grouped according to the number of chlorine atoms present in the compound, resulting in ten "homolog" groups. These homologs (and the associated number of chlorine atoms) is as follows:

- Monochlorobiphenyl (one)
- Dichlorobiphenyl (two)
- Trichlorobiphenyl (three)
- Tetrachlorobiphenyl (four)
- Pentachlorobiphenyl (five)
- Hexachlorobiphenyl (six)
- Heptachlorobiphenyl (seven)
- Octachlorobiphenyl (eight)
- Nonachlorobiphenyl (nine)
- Decachlorobiphenyl (ten)

Figure 4 shows the relative percent of each of these homolog groups for each sample. Moving to the right along the x-axis represents sediment samples further upstream within LBC. The two reference samples (NEB and NWB) are on the left side of the figure, and the two sub-tributaries of LBC (Cattail Branch and Cabin Branch) are on the right side of this figure. Most sediment samples were dominated by tetra-, penta-, and hexa-chlorobiphenyl homologs. The samples with the lowest total PCB concentrations tend to have the highest relative concentrations of the more chlorinated PCBs, specifically hexa- and hepta- chlorobiphenyls. Samples from locations with high total PCBs (e.g. SED-4) tend to show a more significant contribution from trichlorobiphenyls than samples with lower total PCBs. The high concentration of total PCBs in SED-14 compared with the next closest upstream sample (SED-15) suggests the possibility of a nearby, continuing source of PCBs to LBC sediments. In addition, the distribution of homologs in the samples immediately downstream of SED-14 (SED-13 and SED-12) suggest that some down-stream transport of PCB-containing sediments is occurring. However, concentrations attenuate relatively quickly in the sediments. SED-10, which is located approximately 2 km downstream of SED-14, has one of the lowest concentrations of total PCBs in sediment, 17.9 µg/kg.

PCBs and other hydrophobic compounds typically adhere to smaller particles, such as fine-grain sediments and small organic particles. This is the primary reason why sediment samples were preferentially taken from areas with finer grained sediments, rather than the sandy substrate that was often found mid-stream. Regression analyses were completed to determine whether a correlation exists between TOC or grain size and total PCBs at each sampling location. There does not appear to be any correlation between Total PCBs and TOC or grain size. The R-squared value for TOC is 0.0018, and the R-squared value for percent fines is .0397. These results are similar to those found by the DOEE in the tidal Anacostia, as well as those found by the National Park Service (NPS) in its background study (Johnson Co., 2019) of the tributaries of the tidal Anacostia. The NPS states that a lack of correlation suggests that stormwater is likely the main source of sediments to these tributaries.

4.2. Surface Water Results

The results of total PCB congener analyses in surface water are presented in Table 3 and shown on Figure 3. The maximum total PCB concentration detected in surface water in this study was 119 nanograms per liter (ng/L) in sample SW-3, located in LBC just above the confluence with the tidal Anacostia. This sample is located downgradient of two locations with elevated total PCBs in sediment, SED-4 and SED-5. Another surface water sample with elevated total PCBs (SW-13, 73.4 ng/L) was found in the same area as sediment samples with high total PCBs in sediment (SED-12, SED-13, and SED-14). The minimum total PCB concentration was measured in sample SW-1 (reference sample from the Northwest Branch) and SW-20 (Cabin Branch).

As with sediment samples, the relative percent of each homolog group was calculated for surface water samples. The distribution of homologs as well as total PCB concentration for surface water are shown on Figure 5. Overall, surface water samples are comprised of lower chlorinated homologs than the sediment samples. For the most part, LBC samples consist primarily of di-, tri-, and tetra-chlorobiphenyls, which corresponds with the higher solubility of these less-chlorinated homologs. Several of the samples with very low total PCB concentrations have higher percentages of the more chlorinated homologs, such as SW-8, SW-16, and SW-18. The reference samples from NEB and NWB also have higher percentages of the hexa- and hepta-chlorobiphenyls than the majority of the samples from LBC. There is a distinct jump in the percentage of sample composed of dichlorobiphenyl between SW-17 and SW-14, which corresponds with an increased concentration of total PCBs in sediment at SED-14.

5. Findings and Recommendations

Six (6) sediment samples, all within LBC, exceed the EPA's Region III Biological Assistance Technical Group total PCB sediment screening value of 59.8 µg/kg. The sample locations that exceed this screening value are located in close proximity to each other, in two specific stretches of LBC. One area with both elevated surface water and elevated sediment is adjacent to the Landover Metro Station and Pennsy Drive, north of Landover Road. Multiple studies over the past decade have found elevated concentrations of total PCBs in LBC sediments in this area, including the NPS Tributary Study (Johnson Co., 2019), the 2009 PCB Source Tracking Survey conducted by MDE, and the 2012 ESI conducted by MDE. The total PCB sediment concentrations measured as part of this study exceed any of the samples measured in any of the previous studies, indicating a potential source of PCBs within this area of LBC. The second area with elevated total PCBs in sediment is a stretch of LBC near the confluence with the Anacostia River. The creek bisects a large metal recycling facility, and PCB sediment concentrations spike rapidly when LBC enters this segment of the property indicating that there may be legacy contamination on land that is a continuing source of PCBs to LBC.

Six (6) surface water samples exceed Maryland's Numerical Criteria for Toxic Substances in Surface Waters of 14 ng/L total PCBs for protection of aquatic life. Fourteen (14) surface water samples exceed the criteria of 0.64 ng/L total PCBs for human health fish consumption. The surface water values in this study are grab samples taken directly from LBC. Hwang and Foster (2008) measured total PCBs in both stormflow and baseflow at one location in LBC. The LBC sample for the 2008 study was located close to SW/SED-3 of this study. The baseflow concentration measured in 2008 was 11.8 ng/L, and the stormflow concentration was 211 ng/L. The highest surface water concentration measured in the current study (which is considered a baseflow sample) is an order of magnitude higher than the 2008 base flow concentration. Both of these samples were taken in similar locations, in LBC just above the confluence with the Anacostia River. A study completed in 2017 (Ghosh and Pinkney) used passive samplers to estimate water column concentrations in LBC and the Anacostia River. Two locations in LBC were included in this study, one near SW-4 (LBC-1) and one near SW-8 (LBC-2). The passive sampler calculated total PCB concentrations were similar in magnitude and in homolog distribution to the grab samples collected for this study, but not as high as the two elevated surface water samples from SW-3 and SW-13.

The elevated surface water concentrations measured in the current study are in the same stretches of LBC as the sediment samples with high levels of total PCBs discussed above, suggesting two potential point sources that impact sediments and surface water in LBC. One potential point source is located in the vicinity of SED-4 and SED-5. Another potential point source is located near SED-14. Previous work by MDE's LRP in 2012 suggests that there may be another source in the area of SED-17, upstream of SED-14, although the current study found no evidence of an impact to sediments in this area. LRP's future work will be to identify and refine the Conceptual Site Model (CSM) regarding potential PCB sources associated with the two hot spot areas currently found in LBC and collect and assess data within the LBC watershed.

Data from multiple investigations, including this one, suggest that PCB transport occurs during storms via suspended sediment and during base flow conditions. Therefore, in addition to investigating the two potential point sources of PCBs identified in this study, LRP will continue to work cooperatively with MDE's Water and Science Administration and Prince George's County Department of the Environment to identify and mitigate potential sources of PCBs within LBC.

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Table 1: Sample Summary Table

Sample Identification	Sample Type	QA/QC	Sample Location	Rationale
SED-1	Sediment		NWB, just upstream of the Route 1 bridge (38.946610 / -76.949317)	Area reference
SED-1 Dup	Sediment	Duplicate		
SW-1	Aqueous			
SW-1 Dup	Aqueous	Duplicate		
SED-2	Sediment		NEB, Route 410 bridge (38.961439 / -76.925023)	Area reference
SED-2 Dup	Sediment	Duplicate		
SW-2	Aqueous			
SW-2 Dup	Aqueous	Duplicate		
SED-3	Sediment		LBC, near the border with the District of Columbia (38.916434 / -76.937461)	Identify contamination
SW-3	Aqueous			
SED-4	Sediment		LBC, just east of I-295 (38.915607 / -76.930979)	Identify contamination
SW-4	Aqueous			
SED-5	Sediment		LBC, near the end of Olive Street (38.914885, -76.927975)	Identify contamination
SW-5	Aqueous			
SED-6	Sediment		LBC, west of the Metro bridge (38.914959, -76.924700)	Identify contamination
SW-6	Aqueous			
SED-7	Sediment		LBC, near the Jesse Warr Recreation Center on Beaver Dam Park Dr. (38.913551 / -76.917471)	Identify contamination
SW-7	Aqueous			
SED-8	Sediment		LBC, near Trent Street and 61st Avenue (38.915139 / -76.913650)	Identify contamination
SW-8	Aqueous			
SED-9	Sediment		LBC, northeast of the Columbia Park Road bridge (38.917131 / -76.912921)	Identify contamination
SW-9	Aqueous			
SED-10	Sediment		LBC, approximately 1500 ft upstream from SW-9 (38.918942 / -76.907592)	Identify contamination
SW-10	Aqueous			
SED-11	Sediment		LBC, in the 2300 block of Beaver Road (38.920608 / -76.903012)	Identify contamination
SW-11	Aqueous			
SED-12	Sediment		LBC, near the Kentland Community Center (38.927312 / -76.897489)	Identify contamination
SW-12	Aqueous			
SED-13	Sediment		LBC, upstream of the Landover Rd/Route 202 bridge (38.929760 / -76.892905)	Identify contamination
SW-13	Aqueous			
SED-14	Sediment		LBC, near the 3100 block of Pennsy Dr. (38.932173 / -76.889447)	Identify contamination
SW-14	Aqueous			
SED-15	Sediment		LBC, near the 3300 block of Pennsy Dr. (38.936299 / -76.885714)	Identify contamination
SW-15	Aqueous			
SED-16	Sediment		LBC, near the railroad/Metro bridge south of Highway 410 (38.937955 / -76.884277)	Identify contamination
SW-16	Aqueous			
SED-17	Sediment		LBC, near north end of parking area for Landover Metro (38.933369 / -76.888043)	Identify contamination
SW-17	Aqueous			
SED-18	Sediment		LBC, between the New Carrollton Metro East Parking Lot and Pennsy Drive (38.946096 / -76.869767)	Identify contamination
SED-18 DUP	Sediment	Duplicate		
SW-18	Aqueous			
SW-18 DUP	Aqueous	Duplicate		
SED-19	Sediment		Cattail Branch, west of the Pinebrook Avenue bridge 38.928271 / -76.894100)	Identify contamination
SW-19	Aqueous			
SED-20	Sediment			Identify contamination

SW-20	Aqueous		Cabin Branch, south of the Sheriff Road bridge (38.907378 / -76.901721)	
FB-1	Aqueous	Blank	Laboratory-supplied PCB-free water	Field Blank (Team 1)
EB-1	Aqueous	Blank	Laboratory-supplied PCB-free water	Equipment Rinsate Blank (Team 1)
FB-2	Aqueous	Blank	Laboratory-supplied PCB-free water	Field Blank (Team 2)
EB-2	Aqueous	Blank	Laboratory-supplied PCB-free water	Equipment Rinsate Blank (Team 2)

Table 2: Total Organic Carbon and Percent Fines

Sample Location	Total Organic Carbon (mg/kg)	% < 0.75 mm	Total PCBs Sediment (µg/kg)
SED-1 (NWB)	1,400	4.8	1.93
SED-2 (NEB)	750	3.3	1.63
SED-3	18,800	85.3	20.4
SED-4	1,990	11.4	2450
SED-5	7,480	14.5	1390
SED-6	650	73.2	3.54
SED-7	500 (U)	8.6	21
SED-8	1,740	4.9	3.85
SED-9	1,090	4.5	47.9
SED-10	4,620	32.8	17.9
SED-11	1,950	2.5	132
SED-12	8,870	43.1	204
SED-13	4,560	4.5	703
SED-14	5,450	5.9	2330
SED-15	6,960	4.6	22.2
SED-16	5,090	5.3	11
SED-17	5,930	10.9	8.45
SED-18	18,800	29	2.69
SED-19 (CtTBr)	1,000	4.2	2.12
SED-20 (CabBr)	3,780	53.7	5.85

U - Analyte not detected above specified Method Detection Limit (MDL) (shown as a gray tone).

Table 3: Total PCBs measured in surface water and sediment

Sample Location	Total PCBs Surface Water (ng/L)	Total PCBs Sediment (µg/kg)
SW/SED-1 (NWB)	0.21	1.93
SW/SED-2 (NEB)	5.18	1.63
SW/SED-3	119	20.4
SW/SED-4	18.5	2450
SW/SED-5	8.03	1390
SW/SED -6	5.78	3.54
SW/SED-7	8.43	21
SW/SED-8	0.41	3.85
SW/SED-9	11.6	47.9
SW/SED-10	13.1	17.9
SW/SED-11	16.7	132
SW/SED-12	21	204
SW/SED-13	73.4	703
SW/SED-14	43.5	2330
SW/SED-15	2.6	22.2
SW/SED-16	1.74	11
SW/SED-17	0.56	8.45
SW/SED-18	0.43	2.69
SW/SED-19 (CtTBr)	0.4	2.12
SW/SED-20 (CabBr)	0.21	5.85

Table 4: Field Parameters

Sample Location	Water Temp. (deg C)	pH	Diss. Oxygen (mg/L)	Conductivity (Micro siemens / cm)	Salinity (ppt)	Turbidity (NTU)
SW / SED-1	8.7	7.3	10.5	457	0.2	3.5
SW / SED-2	8.3	7.5	10.8	381	0.2	6.9
SW / SED-3	9.9	7.9	10.0	434	0.2	29.2
SW / SED-4	8.6	8.3	10.3	405	0.2	23.2
SW / SED-5	8.6	8.1	10.6	392	0.2	22.6
SW / SED-6	9.1	7.6	10.1	385	0.2	21.0
SW / SED-7	8.8	7.5	9.4	380	0.2	35.9
SW / SED-8	8.7	7.8	10.6	472	0.2	11.9
SW / SED-9	9.1	7.8	9.8	354	0.2	22.1
SW / SED-10	9.2	7.8	9.6	352	0.2	19.9
SW / SED-11	8.8	7.6	9.7	347	0.2	29.2
SW / SED-12	9.5	8.1	11.6	353	0.2	16.0
SW / SED-13	9.6	7.4	8.0	367	0.2	21.0
SW / SED-14	9.6	7.4	8.2	388	0.2	21.0
SW / SED-15	9.9	7.6	10.3	428	0.2	27.4
SW / SED-16	9.7	7.7	10.2	494	0.2	28.2
SW / SED-17	9.5	7.4	8.4	392	0.2	22.0
SW / SED-18	10.9	7.7	8.7	705	0.4	17.5
SW / SED-19	9.9	9.7	16.0	337	0.2	3.5
SW / SED-20	9.3	8.0	12.1	485	0.2	14.9

Figure 1: Sample locations

Lower Beaverdam Creek Sample Locations, 11/20/19

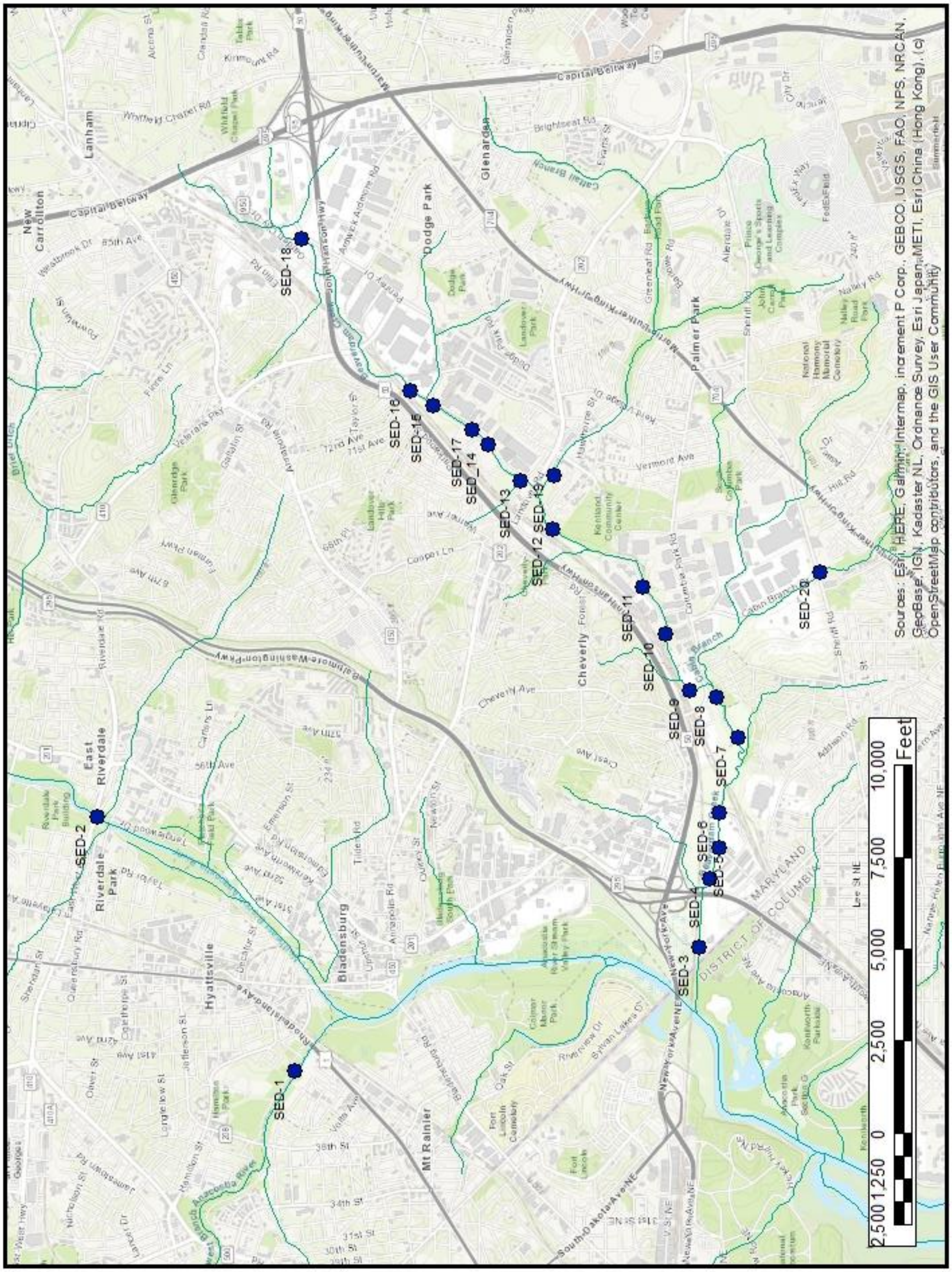

Figure 2: Sediment Results

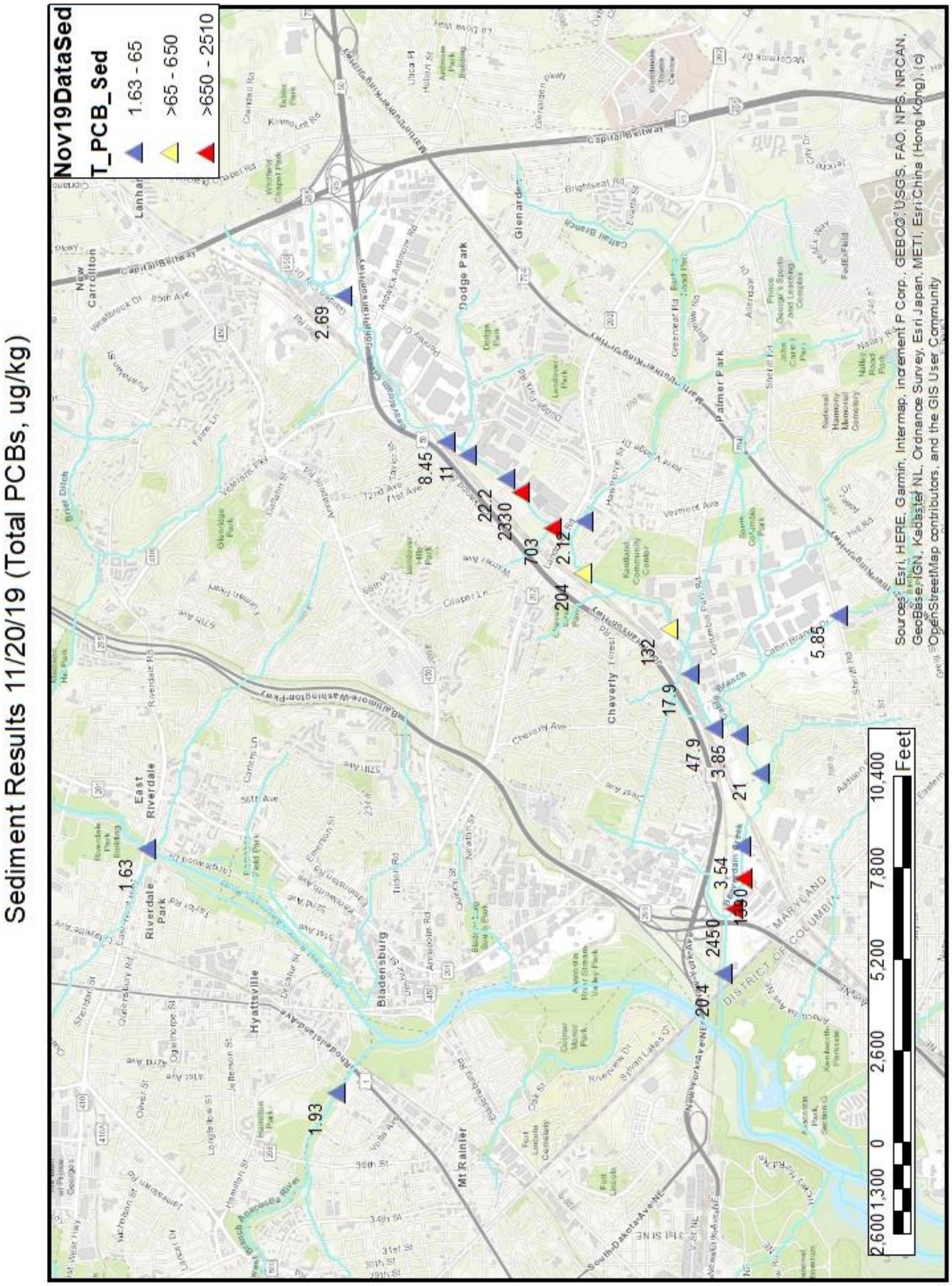

Figure 3: Surface Water Results

Surface Water Results 11/20/19 (Total PCBs, ng/L)

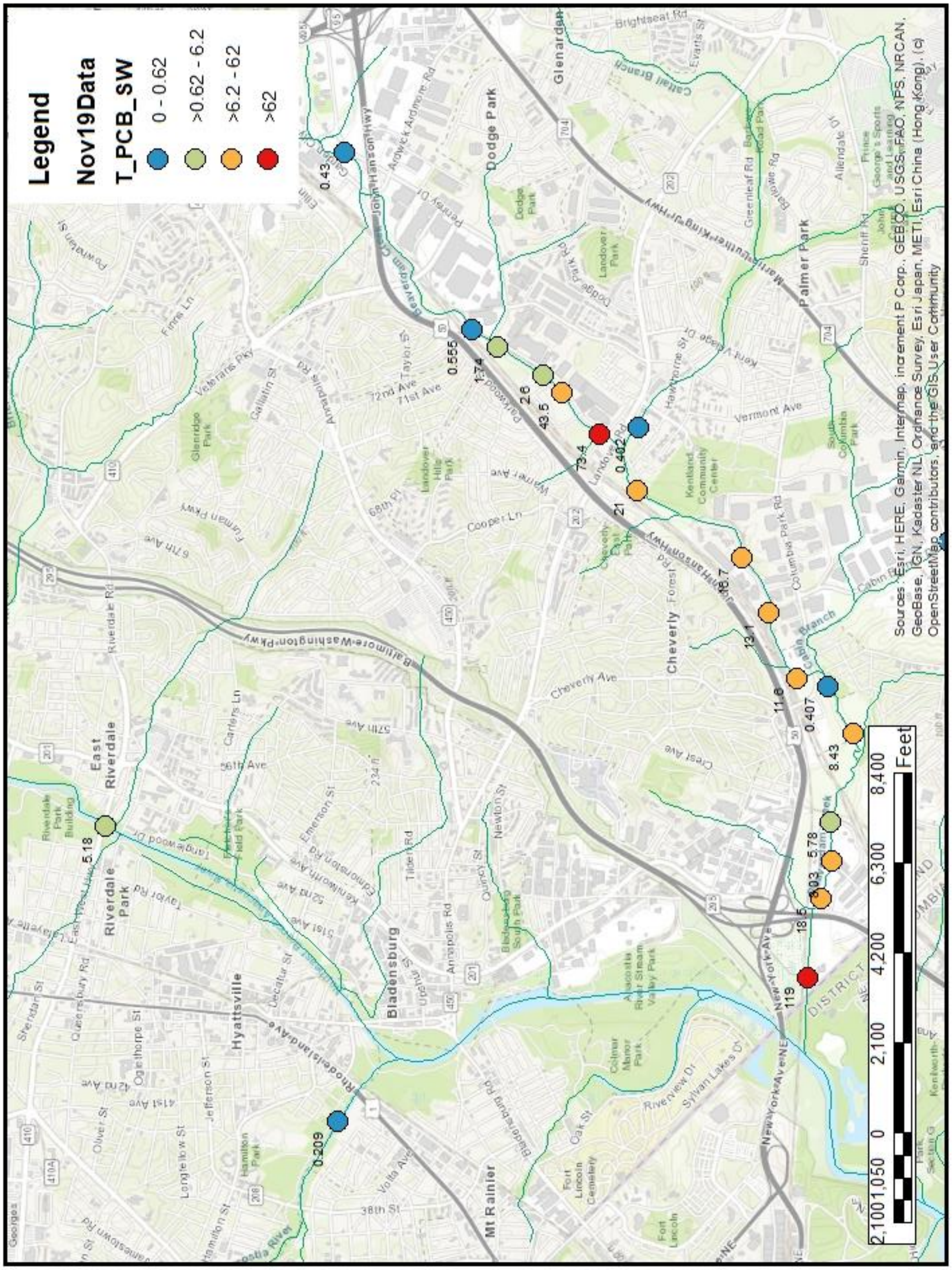

Figure 4: PCB Homolog Distribution and Total PCBs in Sediment

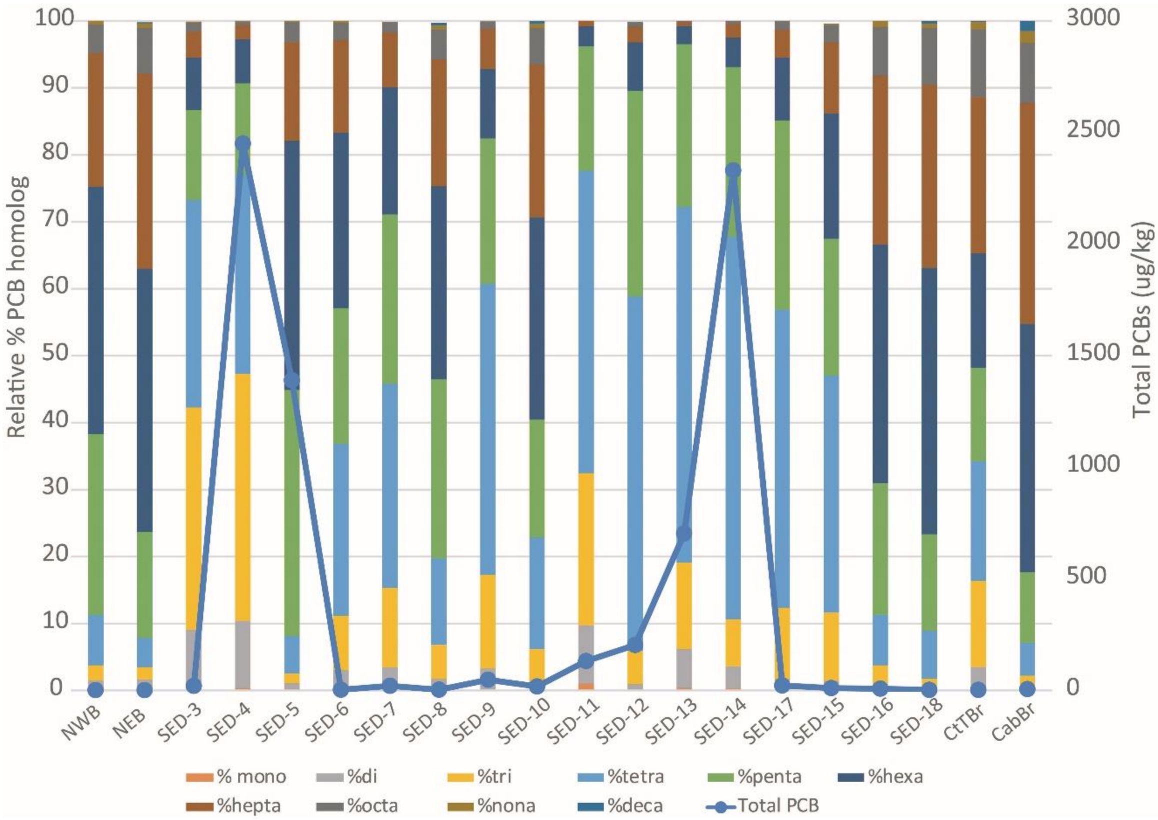

Figure 5: PCB Homolog Distribution and Total PCBs in Surface Water