US Army Corps
of Engineers
Buffalo District

ERDC
Engineer Research and Development Center

Eighteenmile Creek
Great Lakes Area of Concern (AOC)

Evaluation of Bioavailable PCBs Using Semi-Permeable Membrane Devices (SPMD)

Report to U.S. Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO)

December 2021

Great Lakes
RESTORATION

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EXECUTIVE SUMMARY

Previous evaluations of the Eighteenmile Creek Area of Concern (AOC) identified bioavailable PCBs being transported through the water column from upstream sources as the primary contaminant of concern (COC) continuing to drive beneficial use impairments (BUIs). To further quantify the bioavailable fraction of PCBs within the water column as a source for fish bioaccumulation, water column sampling, including the use of passive water samplers, was conducted within the AOC, the upstream source area, and reference areas in Oak Orchard Creek and Lake Ontario.

To evaluate bioavailable PCB concentrations within the water column, semipermeable membrane devices (SPMD) and paired whole water grab samples were collected from the upstream Burt Dam pool and downstream AOC, and from reference areas in Oak Orchard Creek and Lake Ontario during a baseflow period in August 2020 and a high flow period during March 2021. Accumulation of total PCBs in the SPMD in the upstream Burt Dam pool ranged from 1,609 to 4,032 ng, compared to a range of 1,137 to 2,813 ng in the downstream AOC, reflecting, on average, greater concentrations of bioavailable PCBs in the water column closer to the source upstream of the AOC. SPMD total PCB accumulation within Oak Orchard Creek and Lake Ontario ranged from 21 to 64 ng, which are less than that of the AOC and upstream areas by a factor of about 50. SPMD total PCB concentrations showed a linear correlation (R^2=0.99, $P < 0.001$) to total organic carbon (TOC)-normalized total PCB concentrations in paired whole water grab samples. Although total PCB concentrations were relatively consistent between the baseflow and high flow periods, TOC concentrations were higher during the high flow period, resulting in correspondingly lower PCB bioavailability within both Eighteenmile Creek and Oak Orchard Creek. Substantial uncertainties were noted in the estimated dissolved total PCB concentrations from the SPMD results as the loss rates of performance refence compounds (PRCs) used to estimate the site sampling rate were usually less than the minimally acceptable threshold of 20% and thus not significantly different from analytical variability. To address this, dissolved concentrations were re-estimated using only PRCs with a greater than 20% loss rate. Additionally, to verify these results, dissolved concentrations were estimated without using PRCs, by using an unadjusted experimentally determined sampling rate for comparison. The re-estimated dissolved concentrations provided an improved estimate of dissolved concentrations that had a better correlation to the paired whole water concentrations. Based on the re-estimated dissolved concentrations, bioconcentration of total PCBs by fish were estimated to range from 0.5 mg/kg to 2.1 mg/kg mg/kg within the AOC, and from 0.7 mg/kg to 3.1 mg/kg within the upstream Burt Dam pool.

The estimated concentrations in fish exceed thresholds for determining a specific fish consumption advisory (1 mg/kg) and a “do not eat” advisory (2 mg/kg), indicating that fish bioconcentration of PCBs from the water column represents a significant source of PCBs with respect to impairments in the AOC. These results support the conclusion that PCBs being transported through the water column represent a driving source of PCB bioaccumulation in fish within the AOC.

INTRODUCTION

The Eighteenmile Creek Area of Concern (AOC) in the Town of Newfane, Niagara County, New York, is located along the south shore of Lake Ontario at the mouth of Eighteenmile Creek, about 18 miles east of the mouth of the Niagara River. It is one of 43 Great Lakes AOCs designated by the International Joint Commission (IJC) under the 1987 Great Lakes Water Quality Agreement (IJC 1987). The AOC boundary encompasses the creek's outlet at Olcott Harbor and its main stem upstream approximately two miles to Burt Dam and its approximately 58,056-acre watershed (U.S. Environmental Protection Agency [USEPA] 2019).

The main stem of Eighteenmile Creek upstream of the New York State (NYS) Route 18 Bridge is largely undisturbed and designated Significant Coastal Fish and Wildlife Habitat area (New York State Department of State [NYSDOS] 1987). Downstream of the dam, the creek flows north through a wooded, steeply sloped gorge, and contains large beds of submergent and emergent aquatic vegetation. The creek channel is meandering and warmwater, offering low gradient, lower velocity pools with a mixture of mud and gravel-bottom substrates. These conditions collectively provide high quality habitat to a variety of fish and wildlife species. Downstream of the NYS Route 18 Bridge, the creek is largely developed for recreational purposes where marinas and Olcott Harbor are adjacent to Lake Ontario. Olcott Harbor is a shallow draft federal navigation project maintained by the U.S. Army Corps of Engineers (USACE) and is a designated Harbor of Refuge. Land use within the AOC watershed is mostly agricultural in nature, with areas of rural residential and commercial development. The main stem portion of Eighteenmile Creek is a heavily used for recreational and sport fishing during fall salmonid spawning.

The Eighteenmile Creek AOC has a total of four outstanding beneficial use impairments (BUIs): (1) Restrictions on Fish and Wildlife Consumption; (2) Degradation of Fish and Wildlife Populations; (3) Bird/Animal Deformities or Reproductive Problems; and (4) Degradation of Benthos. The USACE Buffalo District and U.S. Army Engineer Research and Development Center (USAERDC) were previously tasked with assessing the potential for COCs to inhibit BUI removal efforts on the Eighteenmile Creek AOC and providing associated recommendations, including needs for management action (Pickard et al. 2020). It was concluded that bioavailable polychlorinated biphenyls (PCBs) being transported from upstream sources through the water column were the primary COC that was driving BUIs in the AOC. Despite relatively low total PCB concentrations within AOC sediments, fish tissue concentrations remain elevated compared to fish consumption advisory limits and reference conditions. Consequently, passive water sampling was recommended to further quantify bioavailable PCBs within the water column as a source for fish tissue bioaccumulation.

In follow-up to the recommendation in Pickard et al. (2020), this investigation employed passive sampling devices for dissolved phase water column PCBs with analysis, and PCB analysis of paired whole water grab samples collected within and upstream of the AOC, and at reference locations within Lake Ontario and Oak Orchard Creek. This was accomplished during baseflow conditions in late Summer 2020 as well as high flow conditions in early Spring 2021. The primary objectives were to (1) provide additional information on the current loading of PCBs from the watershed upstream of Burt Dam into the AOC; and (2) evaluate analytical PCB data to further support the current hypothesis that the primary source of PCBs to fish within the AOC is from the water column.

METHODS

Semipermeable Membrane Devices (SPMDs), one of the most common passive sampler technologies used to monitor legacy neutral organic pollutants, were a key tool used to collect dissolved phase PCBs from the water column in this investigation. SMPDs accumulate organic compounds similar to organismal exposure, such as bioaccumulation from the water column by fish. These instruments provide large volume composites of water through time that would otherwise be difficult to sample. SPMDs are constructed of non-porous polyethylene membranes containing a lipid known as triolein, a simplified triglyceride also known as a symmetrical glycerol trioleate. Canisters containing the membranes were constructed by USGS, Columbia Environmental Research Center laboratory (CERC).

Sampling Locations and Field Procedures

Water quality monitoring at a total of five locations commenced in Summer 2020 and continued into Spring of 2021 (Table 1, Figure 1) following USGS Techniques and Methods: *Guidelines for the Use of the Semipermeable Membrane Device (SPMD) and the Polar Organic Chemical Integrative Sampler (POCIS) in Environmental Monitoring Studies* (Alvarez, 2010a). All sampling locations are mapped in Figure 1. The Eighteenmile Creek sampling locations were behind the Burt Dam spillway within the pool upstream of the AOC (18M-T1) and a location approximately one mile downstream within the AOC (18M-T2), both in Newfane, NY. The reference location was in Oak Orchard Creek below the Waterport Dam near Waterport, NY (OAK-T1). Two locations in Lake Ontario, both at the furthest westerly point of the embayment sea wall, were selected to evaluate ambient Lake concentrations (18M-L1 and OAK-L1) in the vicinity of the creek mouths (Figure 1, Table 1). Global Positioning System (GPS) equipment was used to locate sample points. When returning to sample a tributary for subsequent sampling events, the GPS equipment and location directions are utilized to navigate to the previously identified sampling point. Sampling locations may have been adjusted in the field in order to avoid hazardous conditions and obstacles; however, all locations were repeated for both sampling periods.

For the collection of dissolved phase PCBs from the water column, SPMD were deployed as follows: August 11th - September 22nd, 2020, for a total of 42 days; and March 15th - April 28th, 2021, for a total of 44 days. SPMD deployment followed Alvarez (2010a). The SPMD canisters were strapped to large concrete blocks and placed into the centroid of flow behind natural streambed controls consisting of braided cobble and gravel, and bed rock. A stainless-steel chain was linked to small trees, a hand-driven fence post or other man-made structures located along the left or right banks for each location. The locations were camouflaged with cobble and stream bed stone brought from downstream of the installations as not to disturb sediment to avoid sample bias. Once the samplers were carefully placed within the stream and lake setting a field form was filled out to record information on deployment. At both lake locations the SPMD canisters were attached to substructures built into the sea wall and sunk to the bottom substrate on concrete blocks.

At each SPMD deployment location, paired whole water grab samples were collected August 10-11, 2020, and March 15-16, 2021. Samples were collected near the centroid of flow using pre-cleaned sample bottles from ALS Global Laboratory. Samples were collected directly from the stream by reaching an arm’s length into the column of water, removing the cap, and slowly pulling the bottle upward through the column of water. A small air space was left in the bottle and the cap was tightened before the bottle reached the surface. The samples were labeled and placed on ice. Another sample at each location was collected and filtered through a 0.45-micron capsule filter on location for dissolved organic carbon (DOC), labeled and placed on ice. Sampling at the lake locations followed the same methods.

Analytical Procedures

The SPMDs were analyzed for 141 PCB congeners at the US Geological Survey's Columbia Environmental Research Center laboratory (CERC) in Columbia, MO. SPMD analysis consisted of dialysis to extract chemicals from the SPMD, size exclusion chromatography (SEC) to isolate the PCBs from potential interferences, successive cleanup and fractionation of the extracts using Florisil gravity-flow chromatography columns followed by Silica Gel gravity-flow chromatography column fraction (Alvarez et al., 2008). Congener PCBs were determined using a dual column gas chromatography analysis with electron capture detection. The analysis used multi-point calibration and internal standards (PCB-30 and 207) for peak identification and quantitation. A primary column was used, in most cases, for peak identification and quantitation while the second column was used for confirmation (SOPs P.673 and P.674). Total PCBs were determined using a single column gas chromatography analysis with electron capture detection. The analysis used multi-point calibration and internal standards (PCB-30 and 207) for peak identification and quantitation (SOP P.003).

Whole water grab samples were analyzed for 209 PCB congeners, TOC, dissolved oxygen (DO), and total suspended solids (TSS) at ALS Global laboratory in Middletown, PA using EPA method 1668A for PCB congeners (detection limits are listed in the Appendix), EPA methods SM 2540D (5 MRL) for TSS and 9060A (0.5 MRL) for TOC and DOC.

In addition to the environmental samples, quality assurance samples were collected for whole water and SPMDs. Two whole water samples were collected for each constituent as replicate field collections and four replicates for SPMDs. The SPMDs environmental and replicate samples at 18M-L1 (Table 1), during the August deployment, were lost due to tampering in the field. The replicates samples are collected at the same time as the environmental sample to assess field and laboratory variability. Whole water blanks were collected using organic free blank water provided by ALS Global Laboratory. USGS provided a SPMD media blank which was stored in a small stainless-steel canister and opened to the field location atmosphere, both during deployment and retrieval, then resealed.

RESULTS AND DISCUSSION

Water Analysis and Chemical Concentrations

Field notes and laboratory reports were compared for completeness and accuracy for this report. Analytical chemistry results from the laboratories were checked and found to be within acceptable criteria for laboratory quality assurance and control. Total PCB concentrations were determined as the sum of all detected congener concentrations in a SPMD or whole water sample. In the summations, censored data were valued at zero. Whole water total PCB concentrations were also summed as the 141 congeners analyzed in SPMD to evaluate the potential difference compared to the sum of 209 congeners. The percent difference between the two sums was minimal, ranging from less than 1% to 12%, and averaging 5%. Creek discharge and water chemistry data, and estimated fish bioconcentration (passive uptake from the water column) relative to all Eighteenmile Creek, Oak Orchard Creek, and Lake Ontario samples are presented and discussed below.

Discharge

Total discharge and watershed area at Oak Orchard Creek is larger than that of Eighteenmile Creek. The 10-yr annual average discharge at Eighteenmile Creek below Burt Dam ranges between 113 to 186 cubic feet per second (cfs). In 2020 and 2021, the annual mean discharge was lower than the 10-yr average. Discharge during the summer period of SPMD deployment were representative of baseflow conditions with an average discharge of 43.5 cfs at Eighteenmile Creek (ranging 37 to 57 cfs for the period of deployment). The 10-yr annual average discharge at Oak Orchard Creek near Kenyonville above Waterport Dam ranges between 238 to 460 cfs. At the sampling location below Waterport Dam, there was considerably less flow (ranges estimated at 1 to 2 cfs) in the bypass channel which may affect SPMD uptake (Alvarez, 2010a). Most flow at Waterport Dam, passes through power production turbines. The SPMD sample location could not be deployed in the main channel, and thus was placed in the bypass channel. This location was assumed to have less variability in flow from power operations and be more representative of baseflow conditions.

Discharge during the spring period were representative of Spring higher flow conditions with an average discharge of 91.5 cfs at Eighteenmile Creek (ranging 47.6 to 221 cfs for the period of deployment). At Oak Orchard Creek below the Waterport Dam, at the sampling location, there is considerably less flow in the bypass channel (ranges estimated at 1 to 10 cfs). Overall discharge at Oak Orchard Creek near Kenyonville above Waterport Dam, average discharge was 277 cfs (USGS, 2021).

Lake levels during the sample periods were normal and had only minor effects from seiche within the embayment's. It is safe to assume the SPMD concentrations were not affected by dissolution from lake water during the deployment.

Whole Water TSS and DOC

TSS and DOC concentrations are shown in Table 2. TSS concentrations across the sampling locations were mainly non-detectable during the baseflow period at a reporting limit of 5 mg/L, with the exception of Oak Orchard Creek, which had a detected concentration of 6 mg/L. TSS concentrations were similar during the high flow period, ranging up to 6 mg/L within Eighteenmile Creek and Oak Orchard Creek, and 9 mg/L within Lake Ontario. DOC concentrations in most cases were greater than the TOC concentration, preventing the calculation of particulate organic carbon (POC) concentrations. The larger DOC concentrations from the filtered samples compared to the whole water TOC concentrations indicates that the filters likely leached carbon to the samples, making the DOC data unusable. Because PCBs partition to both POC and DOC, PCB bioavailability was assessed through TOC concentrations as described below.

Whole Water Total PCBs

Whole water total PCB concentrations are shown in Table 2. During the baseflow sample period, the total PCB concentration within the Burt Dam pool was 34 ng/L. The downstream AOC location was similar, with total PCB concentrations ranging from 25 to 30 ng/L and averaging 27 ng/L. Near the mouth of Eighteenmile Creek, within Lake Ontario, the total PCB concentration was 0.72 ng/L. The results for Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek were 0.34 ng/L and 0.25 ng/L, respectively, about 100 times less than the Eighteenmile Creek results. During the high flow sample period, the total PCB concentrations within the Burt Dam pool and downstream AOC location were 29 ng/L and 28 ng/L, respectively, both similar to the baseflow concentrations. However, the Lake Ontario concentration at the mouth of Eighteenmile Creek was elevated during the high flow period, with a concentration of 4.4 ng/L. This may be due to a larger discharge plume from Eighteenmile Creek from the higher flow rate. Oak Orchard Creek and Lake Ontario total PCB concentrations at high flow were also similar to the baseflow concentrations at 0.36 ng/L and 0.32 ng/L, respectively. Figure 2 presents the whole water total PCB concentrations across the baseflow and high flow periods for the Burt Dam pool and AOC in Eighteenmile Creek, Oak Orchard Creek, and Lake Ontario.

Whole Water TOC

Whole water TOC concentrations are shown in Table 2. During the baseflow sample period, TOC concentrations were similar between the Burt Dam pool and downstream AOC location, ranging from 3.6 mg/L to 3.8 mg/L respectively. Near the mouth of Eighteenmile Creek within Lake Ontario, the TOC concentration was 4.2 mg/L. Results for Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek were 5.0 mg/L and 2.3 mg/L, respectively. During the high flow sample period, TOC concentrations within the Burt Dam pool and downstream AOC location were almost double the baseflow concentrations at 6.7 mg/L and 6.6 mg/L, respectively. The Lake Ontario concentration near the mouth of Eighteenmile Creek was similar to the baseflow condition at 3.4 mg/L. TOC concentrations for Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek were 11 mg/L and 9 mg/L, respectively, more than double the baseflow conditions. Figure 3 presents the whole water TOC concentrations across the baseflow and high flow periods for the Burt Dam pool and AOC in Eighteenmile Creek, Oak Orchard Creek, and Lake Ontario.

The proportion of PCBs that are within the dissolved phase, and thus bioavailable, is a function of the concentration of POC and DOC (USEPA 1995). Because the TOC concentration includes both the POC and DOC phases, whole water PCB concentrations were normalized to the TOC concentration to compare the relative bioavailability of PCBs among locations across the baseflow and high flow periods. TOC-normalized total PCB concentrations are shown in Table 2. TOC-normalized total PCB concentrations during the baseflow period were 9.58 mg/kg-TOC in the Burt Dam pool and ranged from 6.61 to 8.21 mg/kg-TOC within the downstream AOC location. The Lake Ontario concentration at the mouth of Eighteenmile Creek was 0.17 mg/kg-TOC. Concentrations within Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek were 0.07 mg/kg-TOC and 0.11 mg/kg-TOC respectively, which are less than that of Eighteenmile Creek by a factor of about 90. During the high flow period, TOC-normalized total PCB concentrations in the Burt Dam pool and the downstream AOC location were 4.34 and 4.30 mg/kg-TOC, respectively, about half of the baseflow concentrations. The Lake Ontario concentration at the mouth of Eighteenmile Creek was 1.28 mg/kg-TOC, about eight times higher than the baseflow concentration. This is likely due to a larger discharge plume from Eighteenmile Creek during the higher flow conditions. Concentrations within Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek were 0.03 and 0.04 mg/kg-TOC, two to three times less than the baseflow conditions. These results indicate that although whole water total PCB concentrations at individual sampling locations are similar during baseflow and high flow periods, the concentration of bioavailable PCBs in the water column were higher during the baseflow period, as there is less particulate and dissolved organic carbon available for PCB partitioning. Figure 4 presents the whole water TOC-normalized total PCB concentrations across the baseflow and high flow periods for the Burt Dam pool and AOC in Eighteenmile Creek, Oak Orchard Creek, and Lake Ontario.

SPMD Total PCBs

The mass of total PCBs accumulated within SPMD are shown in Table 3. During the baseflow period, total PCB accumulation within SPMD in the Burt dam pool ranged from 3,222 to 4,032 ng, with an average of 3,627 ng. The downstream AOC SPMD accumulated about 30% less than the upstream dam pool SPMD at 2,813 ng of total PCBs. Results for SPMD within Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek were 64 ng and 48 ng, respectively, about 50 times less than the two Eighteenmile Creek results. During the high flow sample period, the mass of PCBs accumulated in the SPMD in the Burt Dam pool was 1,609 ng, about 40% of the baseflow accumulated mass. The accumulated mass in the downstream AOC SPMD ranged from 1,137 to 1,296 ng and averaged 1,217 ng, again about 30% less than the Burt Dam pool result and about 40% of the baseflow accumulated mass. Similarly, the Oak Orchard Creek results ranged from 21 to 28 ng and averaged 25 ng, about 40% of the baseflow result and about 50 times less than that of Eighteenmile Creek. Figure 5 presents the SPMD results across the baseflow and high flow periods for the Burt Dam pool and AOC in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario.

These SPMD accumulated PCB mass data demonstrate an ongoing presence of dissolved phase PCBs in the water column at the Eighteenmile Creek sampling locations, including the AOC, that is far greater than those present at the reference sites in Oak Orchard Creek and Lake Ontario. These results are highly consistent with the TOC-normalized total PCB concentration data on the paired whole water samples. In addition, the higher PCB accumulation in SPMDs during the baseflow period compared to the high flow period is consistent with the higher TOC-normalized total PCB whole water concentrations observed during the baseflow period. The accumulation of total PCBs in SPMDs showed a strong linear correlation to TOC-normalized PCB concentration in whole water grab samples (R^2=0.99, P<0.001) as shown in Figure 6. Compared to the baseflow condition, higher TOC concentrations within the water column observed during the high flow period appear to be lowering the amount of dissolved phase PCBs in the water column.

Estimated Dissolved Total PCBs

Huckins et al. (2006) describes in detail the theoretical aspects of the model methods for determining average dissolved water concentrations from SPMD. To simplify the process of performing these calculations, a set of Microsoft Excel spreadsheets were created to calculate ambient water concentrations from site specific data (Alvarez, 2010b; 2010c). The uptake of PCBs into passive samplers follows integrative, curvilinear and equilibrium phases during exposure to the water column. Estimated dissolved concentrations may be determined using performance reference compounds (PRCs) (Estimated Water Concentration Calculator from SPMD Data When Using PRCs v5-2), which provide a site-specific determination of the sampling rate, or absent PRCs, using experimentally determined sampling rates (Estimated Water Concentration Calculator From SPMD Data When Not Using PRCs v4-1). PRCs are added to the SPMD during fabrication. The measured loss rate of the PRCs during field deployment provides an estimate of the site-specific sampling rate of the SPMD (Alvarez 2010a). However, for PRC data to be useful, the loss of PRCs from the SPMD should be greater than 20% and less than 80% to be significantly different from analytical variability (Alvarez 2010a).

Estimated dissolved concentrations and PRC loss percentages are summarized in Table 3. Most of the PRC results did not have a loss greater than 20%, and in some instances showed an increase. Huckins et al. (2002) notes that detecting losses of PRCs with log K_{OW}s > 5.5 are often difficult unless exposures are of extended duration in warm and highly turbulent environments. The PCB congeners used as PRCs are PCB-14, PCB-29, and PCB-50, which have estimated log K_{OW}s of 5.28, 5.60, and 5.63 respectively (Hawker and Connell 1988). Most PCBs have log K_{OW}s that are > 5.5, indicating that using PRCs to estimate dissolved PCB concentrations from SPMD can be challenging unless certain environmental conditions are met that promote the dissipation rate of the PRCs, such as areas with higher flow velocities. The low loss rates for some of the PRCs indicates the potential for significant uncertainty in the estimated dissolved concentrations unrelated to differences in the site sampling rate. This uncertainty is noted in the relatively elevated dissolved concentrations estimated for Oak Orchard Creek of up to 5 ng/L during the high flow period and the large differences between the percent of the whole water total PCB concentration that is estimated to be dissolved between sample locations. Based on the PRC-derived values, the percent of total PCBs estimated to be dissolved within Eighteenmile Creek and Oak Orchard Creek ranged from 7% to 93% and 87% to 1,365%, respectively (Table 3). The magnitude and variability in these estimated dissolved concentrations are inconsistent with the paired whole water data. Major discrepancies with the data include the estimated dissolved concentration for Oak Orchard Creek being an order of magnitude greater than the paired whole water sample and the estimated dissolved concentrations within the Burt Dam pool being 3- to 5-times greater than the downstream AOC location, despite similar whole water total PCB and TOC concentrations between the two locations. Previously, the fraction of total PCBs that are dissolved within the AOC was estimated to be 25%, based on a DOC of 3.4 mg/L and POC of 0.5 mg/L (Pickard et al. 2020). These conditions closely approximate the TOC concentrations measured during the baseflow period (3.7 mg/L) and are lower than those during the high flow period (6.6 mg/L), indicating that the estimated PRC-derived dissolved concentrations are likely biased high, as they would be expected to be about 25% or less of the whole water concentration. The estimated dissolved concentrations showed a weaker linear correlation ($R^2 = 0.72$, $P = 0.015$) to the TOC-normalized whole water concentrations compared to the SPMD accumulated mass results as shown in Figure 7.

Because the PRC-derived estimates included the use of PRCs with unacceptable loss rates, they are not considered to be reliable. Therefore, dissolved concentrations were re-estimated using only the PRCs with an acceptable loss rate (i.e. > 20%). These results are presented in Table 3 as the adjusted-PRC concentrations. The adjusted-PRC values estimated that the percent of the whole water total PCB concentration that was dissolved ranged from 21% to 35% within Eighteenmile Creek during the baseflow period and 7 to 14% during the high flow period. For Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek, the percent dissolved ranged from 102% to 63%, respectively, during the baseflow period. No estimates could be made for the Oak Orchard Creek high flow period as all of the PRC loss rates were less than 20%. These results were less variable across sample sites and are more consistent with the paired whole water concentrations. The adjusted-PRC estimates showed a stronger linear correlation with the paired TOC-normalized whole water concentrations ($R^2 = 0.95$, $P = 0.001$) compared to the un-adjusted PRC estimates as shown in Figure 8.

To verify the adjusted-PRC estimates and provide estimated dissolved concentrations for the Oak Orchard Creek high flow period samples, dissolved total PCB concentrations were also estimated without using PRCs, by using an unadjusted experimentally determined sampling rate (Alvarez 2010c). These results are also presented in Table 3 as the non-PRC concentrations. The non-PRC corrected results estimated that the percent of the whole water total PCB concentration that was dissolved ranged from 17% to 22% within Eighteenmile Creek during the baseflow period and 7 to 10% during the high flow period. For Oak Orchard Creek, the percent dissolved ranged from 10% to 14% during the high flow period to 35% during the baseflow period. The closest match between the PRC derived results and the non-PRC derived results were for the downstream AOC samples during the high flow period, both of which were the only samples where all PRC loss percentages were greater than 20% (Table 3). The non-PRC estimates are generally similar to the adjusted-PRC results and show a slightly stronger linear correlation to the whole water TOC-normalized whole water concentrations ($R^2 = 0.99$, $P < 0.001$) compared to the adjusted PRC-corrected values (Figure 9). Collectively, this information indicates that estimates of dissolved phase PCBs in the water column derived from the adjusted-PRC calculations and non-PRC calculations provide the best estimate of dissolved total PCB concentrations. The non-PRC estimated dissolved concentrations across the baseflow and high flow periods for the Burt Dam pool and AOC in Eighteenmile Creek, and Oak Orchard Creek and Lake Ontario are presented in Figure 10.

Estimated Bioconcentration of PCBs by Fish

Fish bioconcentration of PCBs were estimated from the adjusted PRC and non-PRC estimated dissolved concentrations based on Equations 14 and 21 from Appendix C of USEPA (1995). These results are presented in Table 3. To convert estimated dissolved water concentrations from passive water samplers to organism lipid-based concentrations, Smedes (2019) provides the following relationship for lipid-water partition coefficients ($K_{lip/w}$) and K_{ow}:

$$log\, K_{lip/w} = 1.075(log K_{ow}) + 0.06$$

Using a log K_{ow} for total PCBs of 6.4 (Alvarez 2010c) and an assumed lipid content of 3% for fish, fish bioconcentration within Eighteenmile Creek would be estimated to range from 0.5 mg/kg during the high flow period to 2.0 mg/kg during the baseflow period for the non-PRC estimated dissolved concentrations. Within Oak Orchard Creek fish bioconcentration would range from 0.01 mg/kg during the high flow period to 0.03 mg/kg during the baseflow period for the non-PRC estimated dissolved concentrations. Using the adjusted-PRC estimated dissolved concentrations, fish bioconcentration within Eighteenmile Creek would be estimated to range from 0.5 mg/kg during the high flow period to 3.1 mg/kg during the baseflow period. Within Oak Orchard Creek and Lake Ontario near the mouth of Oak Orchard Creek, fish bioconcentration of total PCBs would be estimated to be 0.09 mg/kg and 0.04 mg/kg, respectively. The magnitudes of difference (MODs) between the Eighteenmile Creek and Oak Orchard Creek values were 50 and 64 for the baseflow and high flow periods, respectively. The non-PRC estimated fish tissue concentrations across the baseflow and high flow periods for the Burt Dam pool and AOC in Eighteenmile Creek, and Oak Orchard Creek and Lake Ontario are presented in Figure 11.

Fish bioconcentration of total PCBs within the AOC is estimated to exceed fish consumption limits used to establish a specific advisory (1 mg/kg) and to establish a “do not eat advisory” (2 mg/kg), indicating that PCBs within the water column represent a substantial source of PCB bioaccumulation with respect to impairment within the AOC.

CONCLUSIONS

To evaluate bioavailable PCB concentrations within the water column, SPMD and paired whole water grab samples were collected from Eighteenmile Creek in the upstream Burt Dam pool and downstream AOC, and from reference areas in Oak Orchard Creek and Lake Ontario during a baseflow period in August 2020 and high flow period during March 2021. Accumulation of total PCBs in the SPMD in the upstream Burt Dam pool ranged from 1,609 to 4,032 ng, compared to a range of 1,137 to 2,813 ng in the AOC, reflecting, on average, greater concentrations of bioavailable PCBs in the water column closer to the source upstream of the AOC. Accumulation within Oak Orchard Creek and Lake Ontario ranged from 21 to 64 ng and about 50 times less than that at the two Eighteenmile Creek sampling locations. SPMD PCB concentrations were linearly correlated ($R^2 = 0.99$, $P < 0.001$) to TOC-normalized total PCB concentrations in paired whole water grab samples. Although total PCB concentrations were relatively consistent between the baseflow and high flow periods, TOC concentrations were higher during the high flow period, resulting in correspondingly lower PCB bioavailability within both Eighteenmile Creek and Oak Orchard Creek. Substantial uncertainties were encountered in estimating dissolved total PCB concentrations from the SPMD results as the loss rates of PRCs used to estimate the site sampling rate were usually less than 20% and thus not significantly different from analytical variability. To address this, dissolved concentrations were re-estimated using only PRCs with a greater than 20% loss rate. Additionally, to verify these results, dissolved concentrations were estimated without using PRCs, by using an unadjusted experimentally determined sampling rate for comparison. The re-estimated dissolved concentrations provided an improved estimate of dissolved concentrations that had a better correlation to whole water concentrations. Based on the re-estimated dissolved concentrations, bioconcentration of total PCBs by fish were estimated to range from 0.5 mg/kg to 2.1 mg/kg mg/kg within the AOC, and from 0.7 mg/kg to 3.1 mg/kg within the upstream Burt Dam pool. These concentrations exceed thresholds used to establish a specific fish consumption advisory (1 mg/kg) and to establish a “do not eat advisory” (2 mg/kg), indicating that PCBs within the water column represent a substantial source of PCB bioaccumulation with respect to impairment within the AOC. These results support the conclusion that PCBs being transported through the water column represent a driving source of PCB bioaccumulation in fish within the AOC.

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FIGURES

Figure 1. Sampling locations at locations in Eighteenmile Creek, Oak orchard Creek and Lake Ontario, New York, 2020-21.

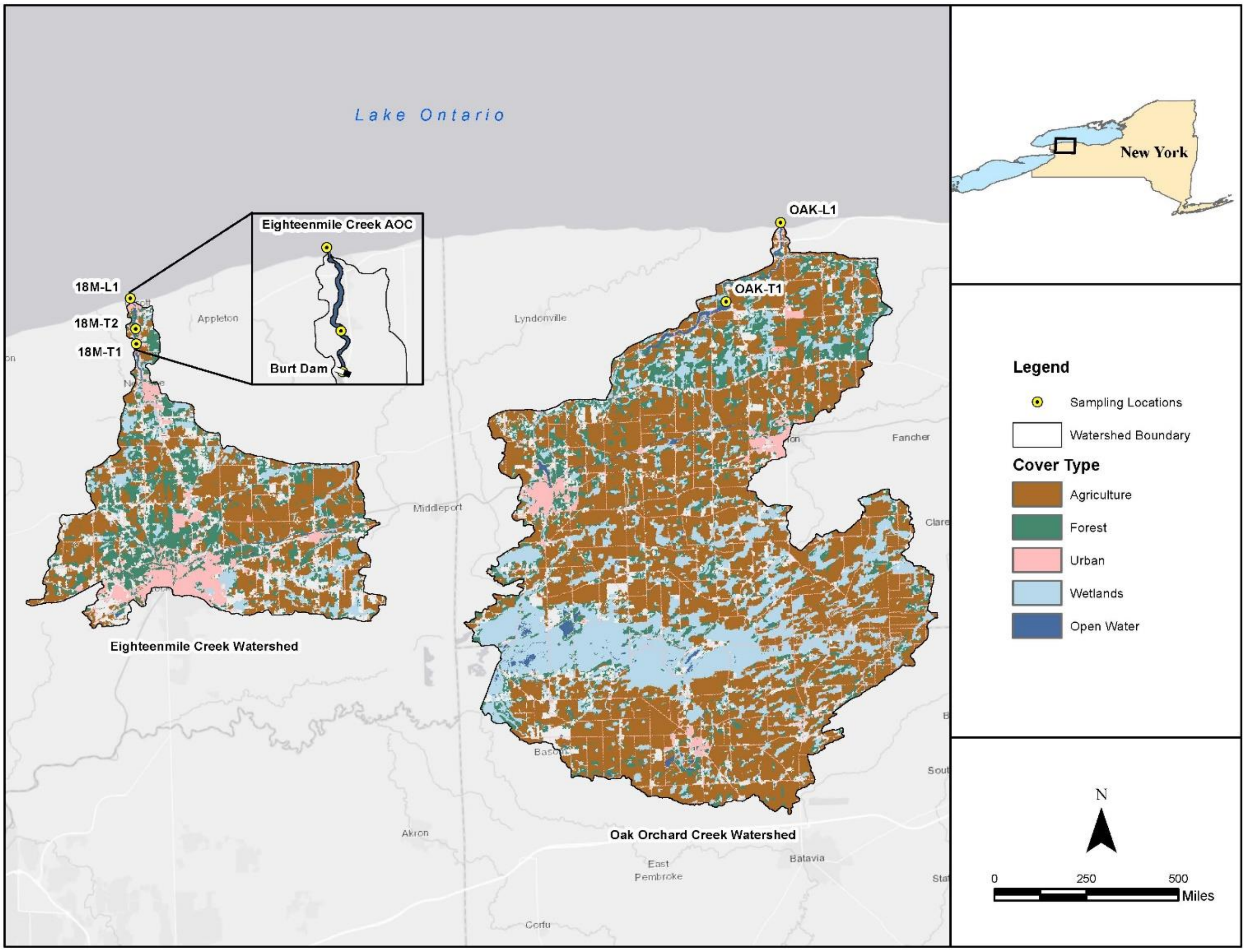


Figure 2. Whole water total PCB concentrations during baseflow and high flow periods at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

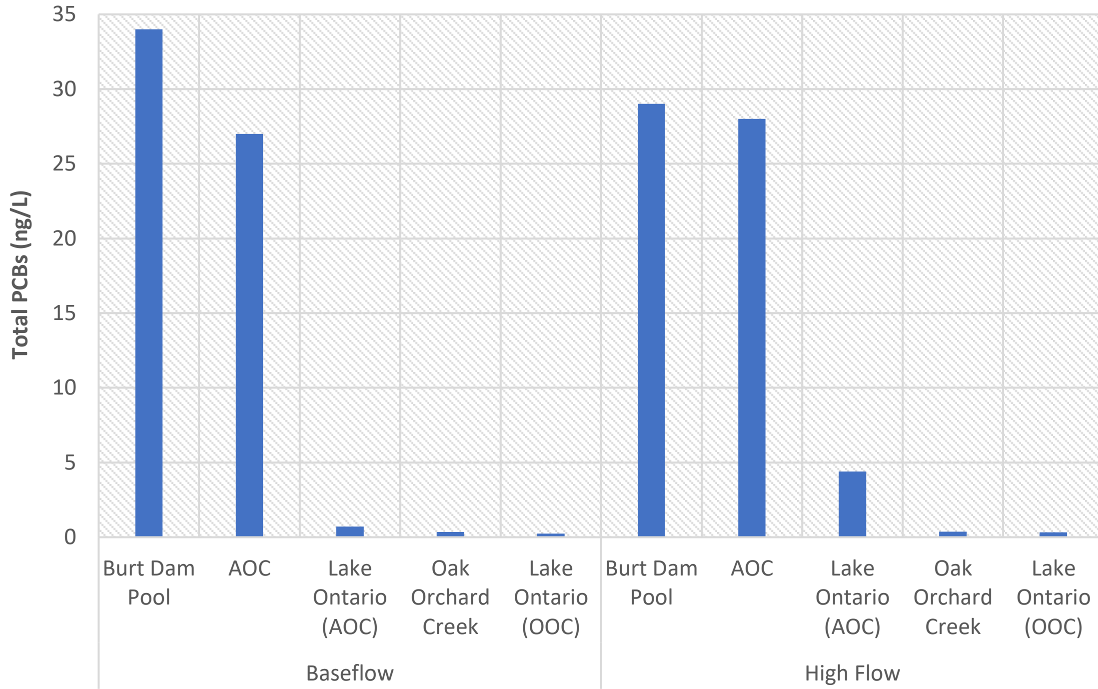


Figure 3. Whole water total organic carbon (TOC) concentrations during baseflow and high flow periods at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

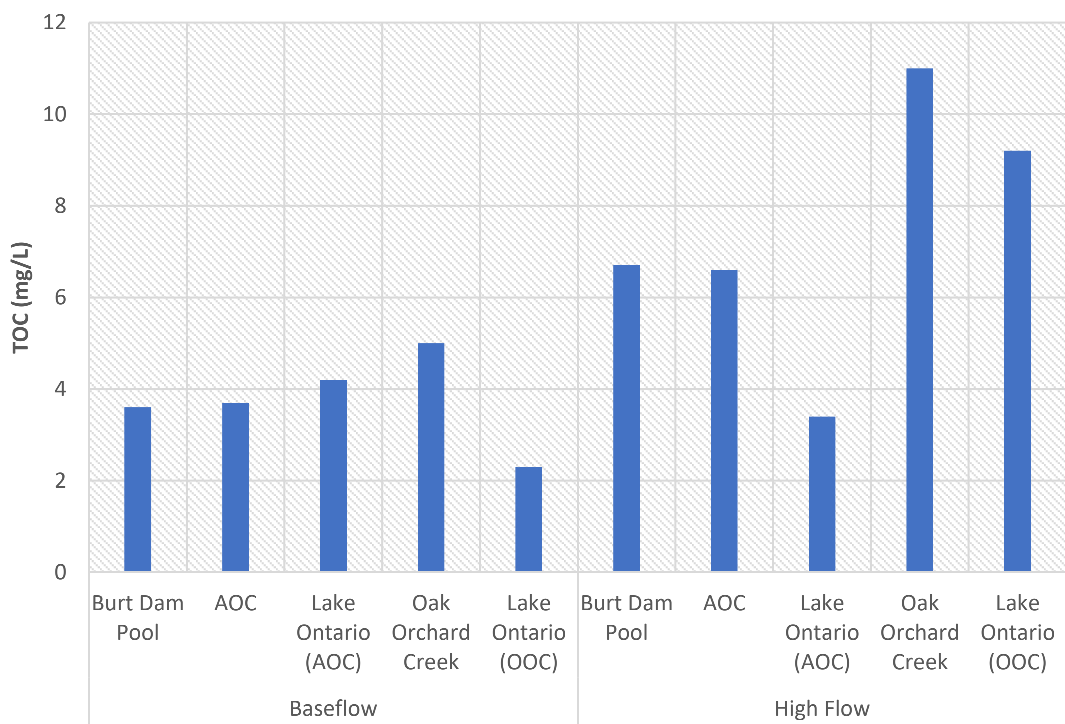


Figure 4. Whole water TOC-normalized total PCB concentrations during baseflow and high flow periods at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

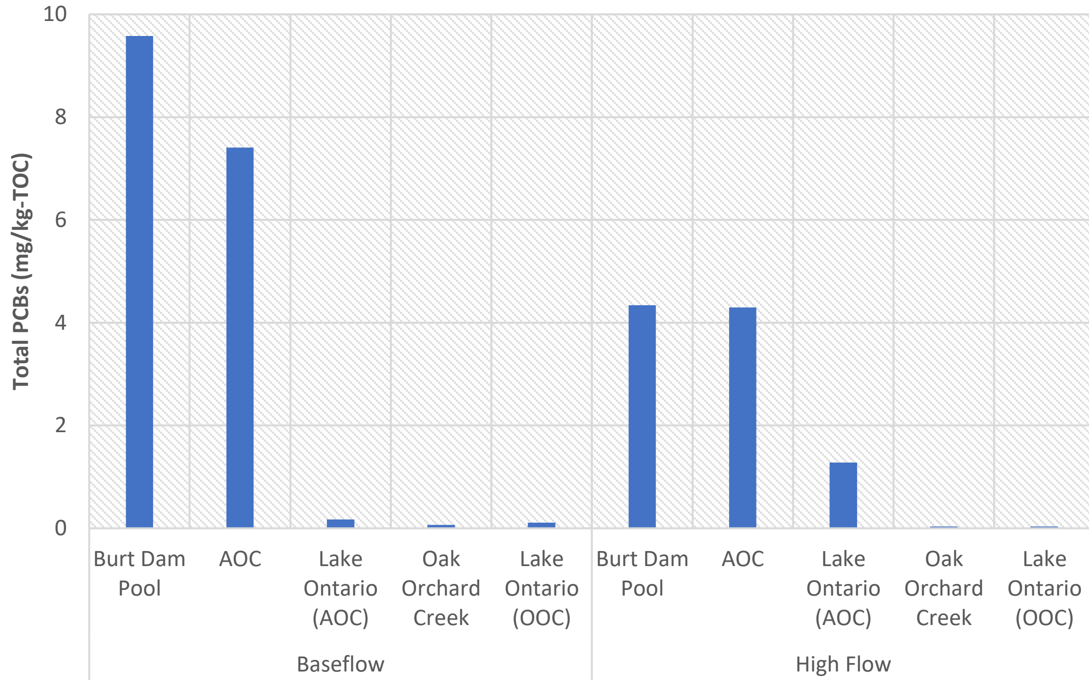


Figure 5. SPMD total accumulated PCB mass during baseflow and high flow periods at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

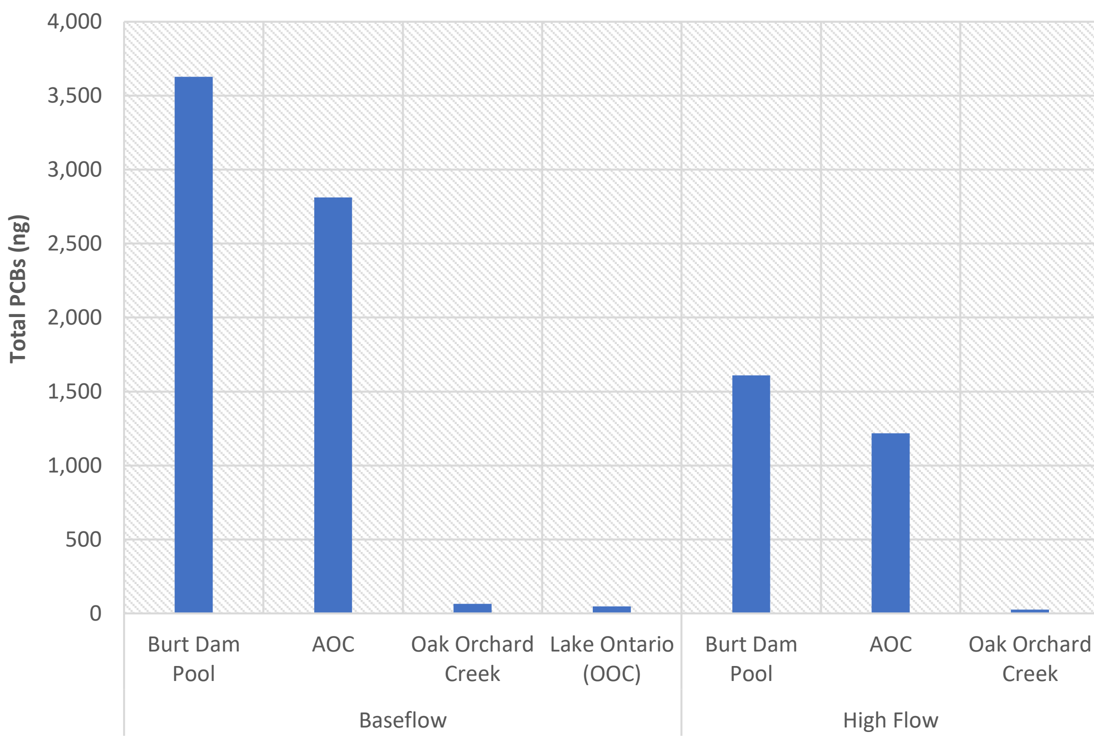


Figure 6. Total PCB concentrations in paired SPMD and TOC-normalized whole water grab samples at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

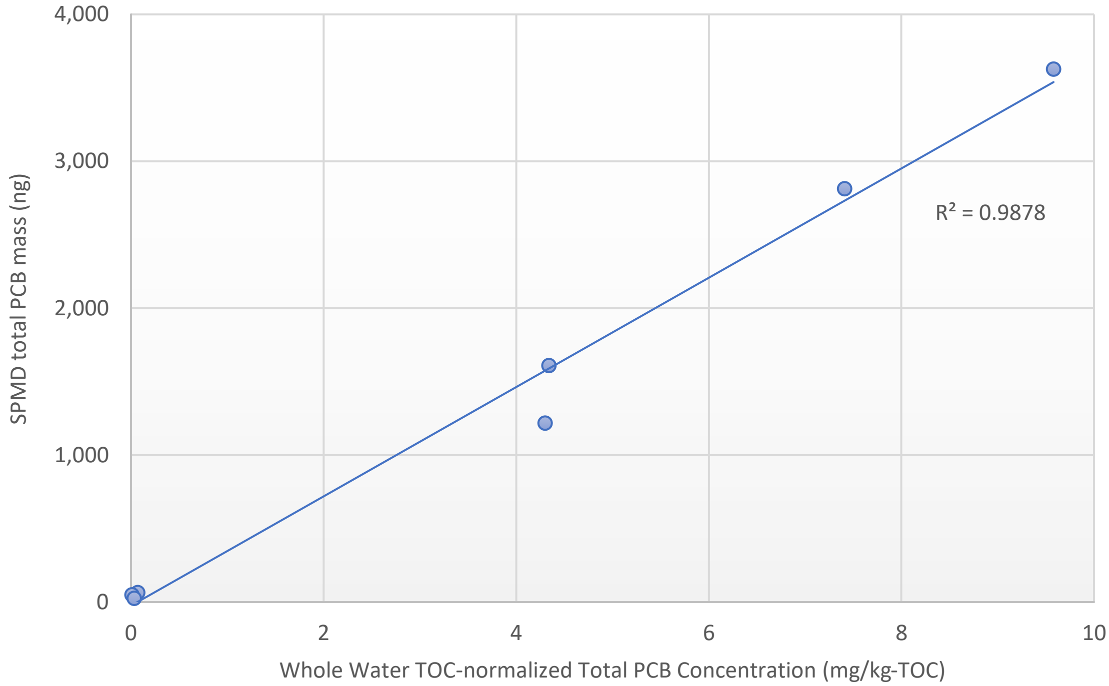


Figure 7. Estimated dissolved total PCB concentrations (PRC) compared to paired TOC-normalized whole water total PCB concentrations at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

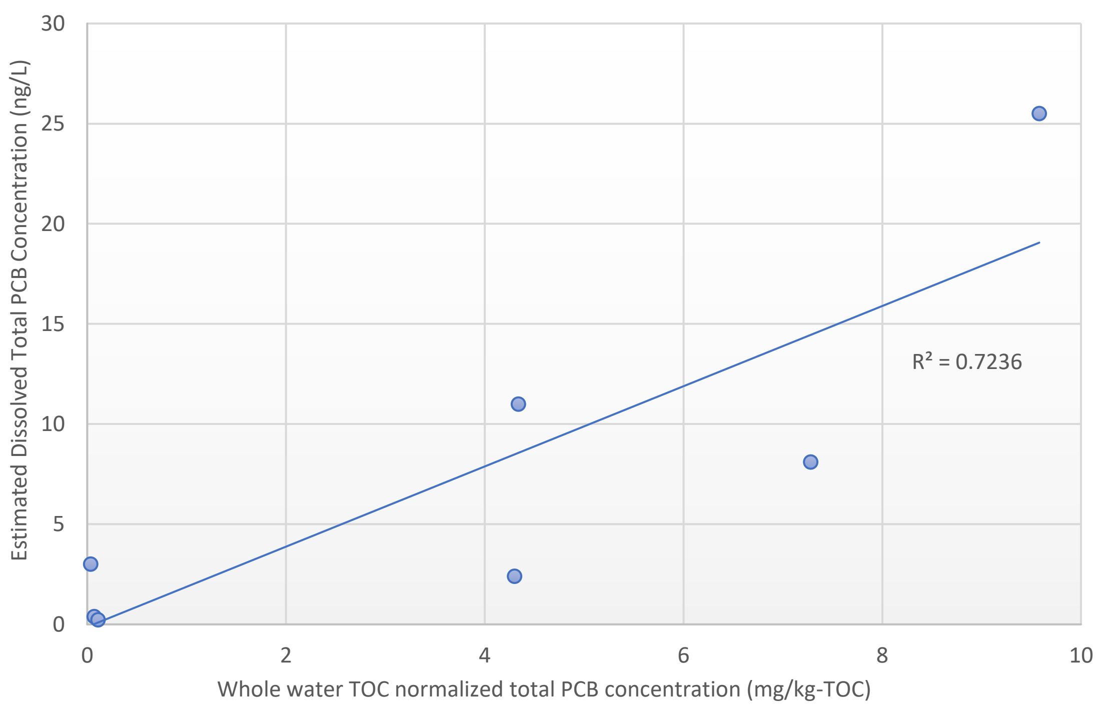


Figure 8. Estimated dissolved total PCB concentrations (adjusted-PRC) compared to paired TOC-normalized whole water total PCB concentrations at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

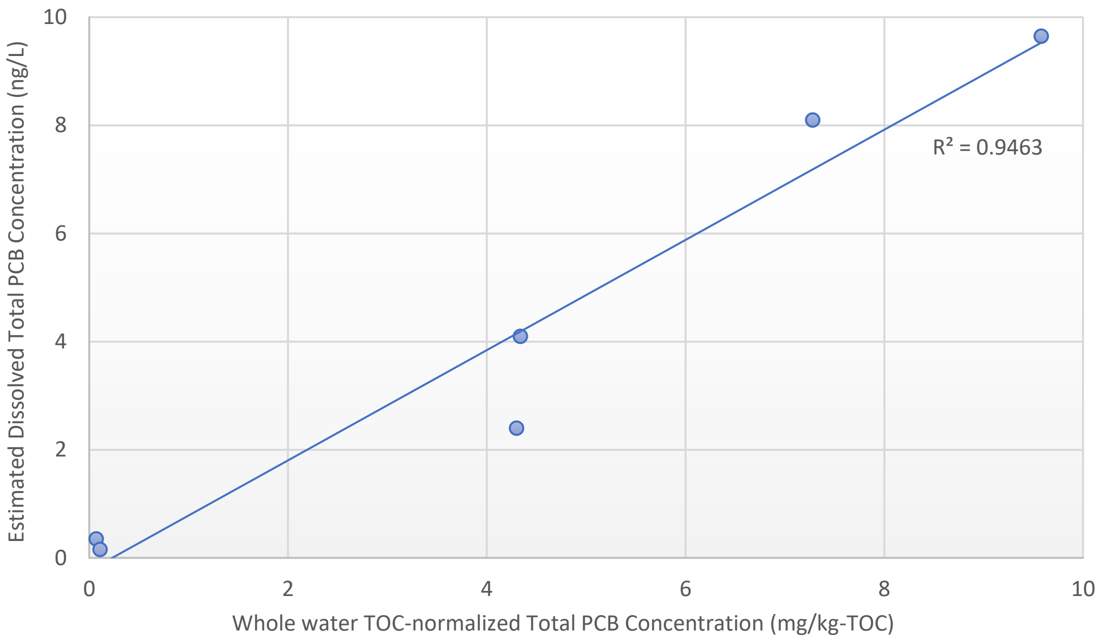


Figure 9. Estimated dissolved total PCB concentrations (non-PRC) compared to paired TOC-normalized whole water total PCB concentrations at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

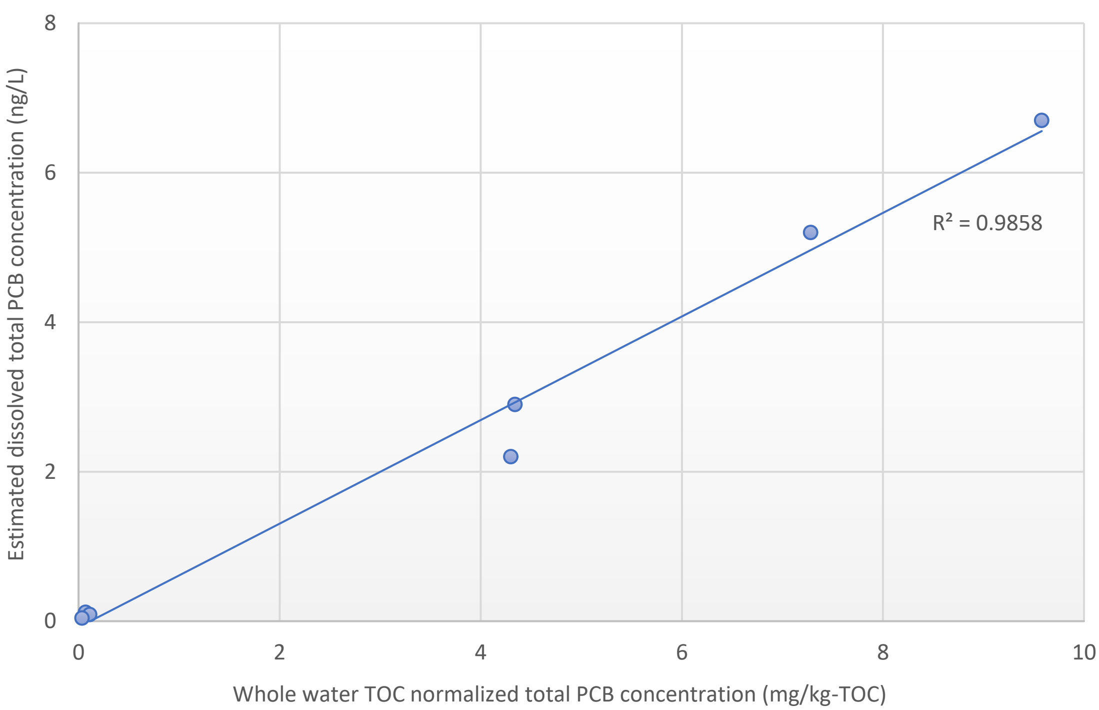


Figure 10. Estimated dissolved total PCB concentrations (non-PRC) in the water column during baseflow and high flow periods at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.

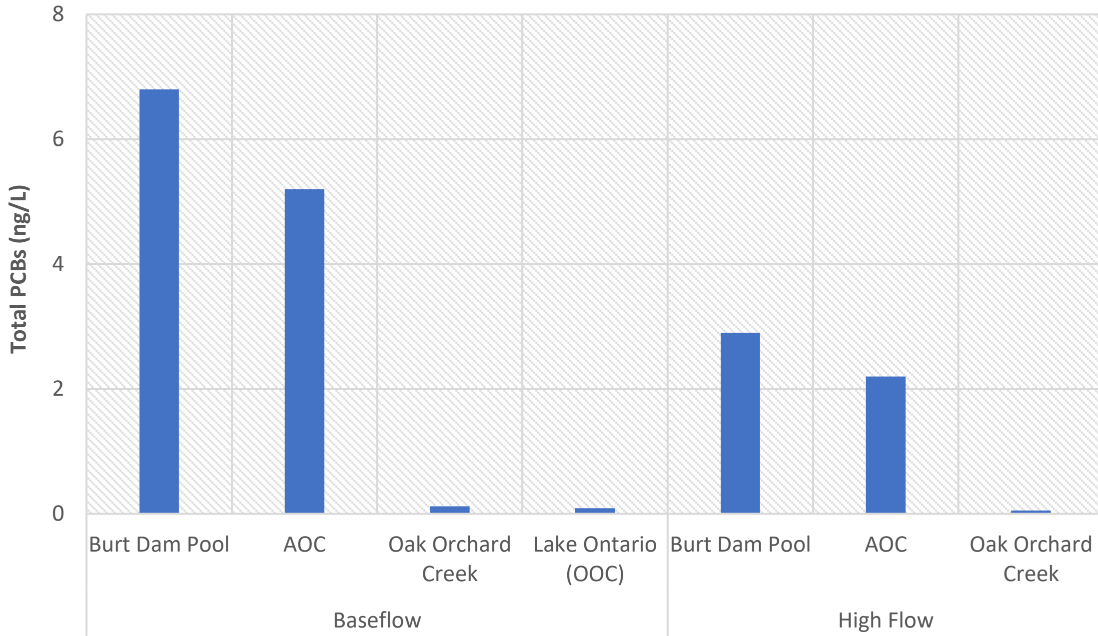
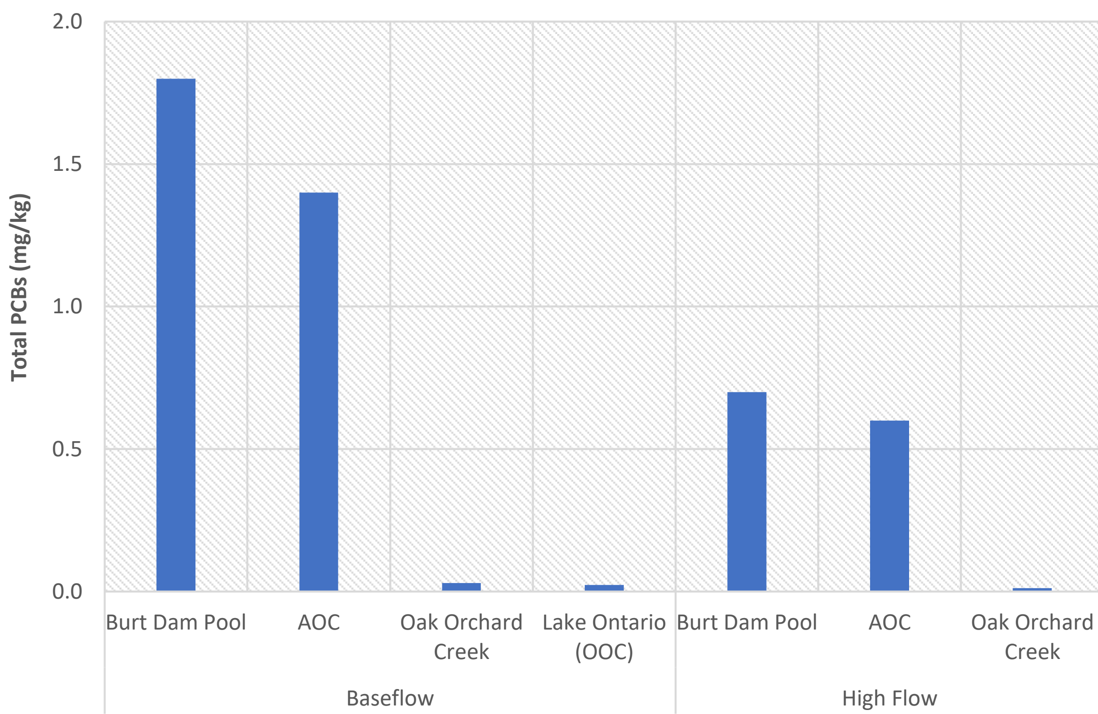


Figure 11. Estimated bioconcentration of total PCBs by fish during baseflow and high flow periods at sampling locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21.



TABLES

Table 1. Sampling distribution at Eighteenmile Creek, Oak Orchard Creek, and Lake Ontario, New York, 2020-21. [**R**; Sample Replication, **B**; Sample Blank]

Identification	Station name	Latitude	Longitude	Passive Sample		Water Sample	
				Aug-Sept	Mar-Apr	Aug-Sept	Mar-Apr
Eighteenmile Creek watershed							
18M-T1	Eighteenmile Creek at Burt (Spillway), NY	43.31381	-78.71581	3(R,B)	1	1	1
18M-T2	Eighteenmile Creek above Olcott (Below Bend), NY	43.32263	-78.71598	1	2(R)	3(R,B)	1
Oak Orchard Creek watershed							
OAK-T1	Oak Orchard Creek below Dam near Waterport, NY	43.32811	-78.23866	1	3(R,B)	1	3(R,B)
Lake Ontario							
18M-L1	Eighteenmile Creek at Lake Ontario West Sea Wall, NY	43.34076	-78.71953	2(R)[1]	1[1]	1	1
OAK-L1	Oak Orchard Creek at Lake Ontario West Sea Wall, NY	43.37367	-78.19241	1	1[1]	1	1
			TOTALS	8	8	7	7

[1] SPMD sampler device was not recovered.

Table 2. Chemical concentrations at locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, 2020-21. [Chemical concentrations are the average of laboratory duplicate values. **pg/L**, picograms per liter; **mg/L**, milligrams per liter; **<**, less than; **REP**, Field replicate; **--**, no data]

Season	Identification	Dissolved Organic Carbon[2] (mg/L)	Total Organic Carbon (mg/L)	Total Suspended Solids (mg/L)	Whole-Water Total PCB (ng/L)	Whole-Water Total PCB (mg/kg-TOC)
Summer[1] (baseflow)	18M-T1	5.23	3.58	< 5	34.3	9.58
	18M-T1-REP	--	--	--	--	
	18M-T2	6.98	3.63	< 5	29.8	8.21
	18M-T2-REP	7.38	3.78	< 5	25.0	6.61
	18M-L1	1.8	4.18	< 5	0.722	0.173
	Oak-T1	7.5	4.98	6	0.344	0.069
	Oak-L1	3.08	2.28	< 5	0.252	0.111
Spring [1] (high flow)	18M-T1	6.7	6.7	< 5	29.1	4.34
	18M-T2	8.2	6.6	6	28.4	4.30
	18M-T2-REP	--	--	--	--	
	18M-L1	4	3.4	9	4.35	1.28
	Oak-T1	10.70	10.9	6	0.364	0.033
	Oak-T1-REP	10.80	11.2	5	0.365	0.033
	Oak-L1	14.7	9.2	< 5	0.321	0.035

[1] Season represents a 40-day SPMD deployment for dissolved PCBs, all other chemical concentrations are discrete samples. Discrete samples were on August 10-11, 2020 and March 15-16, 2021.
[2] Dissolved Organic Carbon concentrations are likely impacted by carbon leaching from the filter material.

Table 3. Whole water and SPMD sampling results at locations in Eighteenmile Creek, Oak Orchard Creek and Lake Ontario, New York, during August 2020 and March 2021. [**(PRC)** – Estimate includes PRCs with unacceptable loss rates, **(adjusted-PRC)** – Only utilizes PRCs with acceptable loss rates (> 20%), **(non-PRC)** – PRCs not used]

Total PCB Concentrations		Eighteenmile Creek						Oak Orchard Creek			
		Baseflow (August)			High flow (March)			Baseflow (August)		High flow (March)	
		Burt Dam pool		AOC	Burt Dam pool	AOC		Creek	Lake Ontario	Creek	
		Test	DUP	Test	Test	Test	DUP	Ref	Ref	Ref	DUP
SPMD	(ng)	4,032	3,222	2,813	1,609	1,137	1,296	64	48	28	21
Whole Water Concentrations											
Total PCBs	(ng/L)	34	34	27	29	28	28	0.34	0.25	0.36	0.37
TOC	(mg/L)	3.6	3.6	3.7	6.7	6.6	6.6	5.0	2.3	10.9	11.2
Total PCBs TOC-normalized	(mg/kg-TOC)	9.6	9.6	7.3	4.3	4.3	4.3	0.07	0.11	0.03	0.03
Estimated Dissolved Concentrations											
(USGS V5-2) (PRC)	(ng/L)	32	19	8.1	11	1.9	2.9	0.39	0.22	5.0	0.96
(USGS V5-2) (adjusted-PRC)	(ng/L)	12	7.3	8.1	4.1	1.9	2.9	0.35	0.16	NA	NA
(USGS V4-1) (non-PRC)	(ng/L)	7.5	6.0	5.2	2.9	2.0	2.3	0.12	0.09	0.05	0.04
Dissolved/whole water (PRC)		93%	55%	30%	38%	7%	10%	113%	87%	1,365%	263%
Dissolved/whole water (adjusted-PRC)		35%	21%	30%	14%	7%	10%	102%	63%	NA	NA
Dissolved/whole water (non-PRC)		22%	17%	19%	10%	7%	8%	34%	35%	14%	10%
Estimated Fish Bioconcentration											
Fish tissue (adjusted-PRC)	(mg/kg)	3.1	1.9	2.1	1.1	0.5	0.8	0.09	0.04	NA	NA
Fish tissue (non-PRC)	(mg/kg)	2.0	1.6	1.4	0.7	0.5	0.6	0.03	0.02	0.01	0.01
Performance Reference Compounds (PRC)											
% loss compared to blanks	PCB-14	-17	-15	1	-20	-67	-56	-32	-50	-1	-7
	PCB-29	-8	-18	5	-9	-52	-36	-17	-32	20	13
	PCB-50	-38	-46	-38	-41	-74	-71	-19	-15	7	-2

APPENDIX

Concentrations of total and congener polychlorinated biphenyls (PCBs) measured in SPMDs from the Eighteenmile Creek 2020 sampling Project

[SPMD, semipermeable membrane device; ng/SPMD, nanograms of chemical measured in a SPMD, ng/SPMD values are used for the estimation of the time-weighted average water concentrations]

PCB Congener number [a]	CERC Site # Field ID	Site 1 18M-T1 ng/SPMD	Site 1 REP 18M-T1 ng/SPMD	Site 2 18M-T2 ng/SPMD	Site 3 OAK-T1 ng/SPMD	Site 5 OAK-L1 ng/SPMD
1		0.00	0.00	0.00	0.00	0.00
2		0.00	0.00	0.00	0.00	0.00
3		0.00	0.00	0.00	0.67	0.00
004/010		0.00	0.00	0.00	0.00	0.00
5		0.11	0.06	0.16	0.00	0.00
6		24.73	20.12	15.64	0.00	0.00
007/009		2.50	1.89	1.01	0.00	0.00
8		40.90	33.33	24.87	0.22	0.13
12		2.12	2.38	1.72	0.96	0.01
13		31.47	25.29	22.67	7.83	0.85
15		126.93	122.76	62.58	0.84	0.59
16		18.51	11.05	5.93	0.05	0.00
17		185.70	160.29	120.89	1.56	0.87
18		149.07	105.83	124.62	2.05	0.90
19		1.33	1.14	0.10	0.00	0.00

020/033	40.95	34.43	27.30	0.40	0.32
22	35.65	28.70	22.04	0.36	0.26
024/027	70.78	57.08	43.69	0.62	0.34
25	125.60	82.80	79.78	0.92	0.62
26	231.56	152.70	154.77	1.87	1.08
28	226.23	157.55	145.14	2.05	1.58
31	319.97	282.42	205.12	2.87	2.29
32	63.62	56.20	33.13	0.39	0.29
34	6.19	5.81	4.41	0.00	0.13
35	0.00	0.00	0.00	0.00	0.00
037/059	26.47	20.02	18.63	0.29	0.24
40	18.03	13.23	10.69	0.17	0.08
041/064	108.16	89.88	73.58	4.01	1.32
42	88.68	62.91	77.48	1.11	0.67
44	0.32	0.43	0.78	0.00	0.17
45	16.48	11.76	9.95	0.00	0.00
46	9.82	7.53	6.19	0.08	0.00
47	168.75	151.36	121.13	1.99	1.37
048/075	26.81	23.71	18.25	0.26	0.21
49	277.71	202.59	207.13	3.47	2.62
51	38.09	34.28	21.70	0.26	0.15
52	329.84	269.48	238.53	4.13	3.52
53	100.12	71.53	58.08	0.90	0.57
54	3.24	2.61	1.44	0.00	0.00
056/060	50.07	40.94	33.52	0.84	0.71
63	11.84	9.95	8.18	0.13	0.04
66	111.32	96.48	85.63	1.87	1.53
67	3.71	4.43	3.77	0.04	0.05

69	1.82	1.50	1.13	0.00	0.00
70	122.83	90.72	91.81	1.94	2.07
71	79.92	57.33	68.50	2.13	0.41
73	6.51	5.69	4.76	0.43	0.73
74	64.11	49.93	40.21	1.06	0.80
77	3.53	3.01	2.74	0.00	0.07
81	1.07	0.97	0.78	0.00	0.00
82	8.81	7.21	6.41	0.14	0.15
83	8.45	7.08	6.27	0.13	0.19
84	28.47	22.50	20.45	0.56	0.51
85	10.93	10.87	7.95	0.02	0.03
87	24.51	21.98	18.49	0.66	0.90
90	18.04	15.70	13.63	0.38	0.51
91	19.22	17.70	15.16	0.31	0.32
92	21.03	18.28	16.10	0.51	0.57
93	8.13	5.47	0.37	0.70	0.25
95	116.19	91.47	99.91	2.19	2.45
97	27.83	23.35	20.29	0.57	0.71
99	35.65	30.81	27.89	0.87	0.97
100	3.03	2.81	1.69	0.00	0.00
101	53.51	47.00	45.17	1.43	1.96
103	1.99	1.85	1.49	0.00	0.00
104	0.74	0.94	1.59	0.00	0.00
105	15.56	13.44	11.95	0.37	0.53
107	4.26	3.45	3.44	0.05	0.10
110	86.62	73.80	59.85	1.79	2.04
114	1.40	1.20	1.02	0.00	0.01
115	0.70	0.67	1.14	0.00	0.00

117	4.79	4.00	3.55	0.00	0.00
118	41.99	35.17	32.30	1.32	1.55
119	3.94	3.39	3.04	0.01	0.00
122	0.75	0.57	0.48	0.00	0.00
123	0.88	0.71	0.64	0.00	0.00
124/135	5.74	4.92	4.50	0.03	0.16
128	3.13	2.80	2.63	0.06	0.13
129	1.01	0.83	0.80	0.00	0.00
130	1.54	1.30	1.26	0.00	0.03
131	0.29	0.27	0.22	0.00	0.00
132	6.92	6.20	6.09	0.17	0.33
134	1.94	1.64	1.53	0.00	0.04
136	4.14	3.55	3.32	0.09	0.19
137	1.01	0.91	0.82	0.02	0.00
138/163/164	17.65	15.50	14.82	0.60	1.28
141	2.77	2.45	2.29	0.06	0.18
144	1.60	1.51	1.30	0.00	0.03
146	3.41	2.95	3.05	0.11	0.23
147	0.68	0.59	0.52	0.00	0.00
149	16.36	14.21	13.15	0.62	1.06
151	5.13	4.50	4.22	0.11	0.31
153	13.63	11.72	11.65	0.58	1.20
154	0.62	0.53	0.48	0.00	0.00
156	1.40	1.21	1.12	0.03	0.05
157	0.31	0.26	0.23	0.00	0.00
158	1.80	1.52	1.46	0.02	0.07
165	0.00	0.01	0.00	0.00	0.00
167	0.59	0.49	0.51	0.00	0.00

170	1.26	1.11	0.99	0.01	0.06
171	0.39	0.34	0.41	0.00	0.00
172	0.29	0.24	0.22	0.00	0.00
173	0.00	0.00	0.00	0.00	0.00
174	1.84	1.59	1.49	0.01	0.08
175	0.05	0.03	0.02	0.00	0.00
176	0.17	0.11	0.08	0.00	0.00
177	1.11	0.97	0.86	0.00	0.02
178	0.77	0.63	0.56	0.00	0.00
179	1.33	1.14	0.98	0.00	0.05
180	3.11	2.70	2.45	0.11	0.21
183	1.05	0.89	0.83	0.00	0.05
185	0.21	0.18	0.16	0.00	0.00
187	3.27	2.77	2.65	0.09	0.32
189	0.01	0.00	0.00	0.00	0.00
190	0.25	0.22	0.18	0.00	0.00
191	0.01	0.00	0.00	0.00	0.00
193	0.14	0.12	0.10	0.00	0.00
194	0.48	0.38	0.32	0.00	0.00
195	0.14	0.12	0.08	0.00	0.00
196/203	0.82	0.68	0.62	0.00	0.00
197	0.00	0.00	0.00	0.00	0.00
199	0.99	0.81	0.83	0.00	0.00
200	0.10	0.08	0.10	0.00	0.00
201	0.08	0.04	0.04	0.00	0.00
202	0.33	0.25	0.29	0.00	0.00
205	0.00	0.00	0.00	0.00	0.00
206	0.40	0.32	0.58	0.00	0.00

208		0.22	0.17	0.35	0.00	0.00
209		0.83	0.74	1.07	0.40	0.44
Total PCBs [b]		4032	3222	2813	64	48

[a] combined congener numbers (XX/YY) represent 2 or more PCB congeners that could not be resolved during analysis.
[b] Total PCBs values are from a separate analysis from the congener PCB analyses. Total PCB values were previously reported.

Estimated time-weighted average water concentrations of total and congener polychlorinated biphenyls (PCBs) sampled by SPMDs from the Eighteenmile Creek 2020 sampling Project.

[SPMD, semipermeable membrane device; MDL, method detection limit; MQL, method quantitation limit; pg/L, picograms per liter of water; <, less than the MDL; NR, little to no recovery in QC sample; E, estimated value between the MDL and MQL]

PCB Congener number [a]	MDL pg/L	MQL pg/L	CERC Site # Field ID	Site 1 18M-T1	pg/L	Site 1 REP 18M-T1	pg/L	Site 2 18M-T2	pg/L	Site 3 OAK-T1	pg/L	Site 5 OAK-L1	pg/L
1	0.18	0.88		<, NR	0.18	<, NR	0.18	<, NR	0.18	<, NR	0.18	<, NR	0.18
2	0.14	0.70		<, NR	0.14	<, NR	0.14	<, NR	0.14	<, NR	0.14	<, NR	0.14
3	0.14	0.70		<, NR	0.14	<, NR	0.14	<, NR	0.14	NR	4.5	<, NR	0.14
004/010	0.13	0.66		<, NR	0.13	<, NR	0.13	<, NR	0.13	<, NR	0.13	<, NR	0.13
5	0.12	0.58		NR	0.77	E, NR	0.31	E, NR	0.52	<, NR	0.12	<, NR	0.12
6	0.11	0.56			170		100		49	<	0.11	<	0.11
007/009	0.11	0.56			17		9.7		3.1	<	0.11	<	0.11
8	0.11	0.56			280		170		77		1.2	E	0.55
12	0.11	0.53		NR	14	NR	12	NR	4.8	NR	49	<, NR	0.11

13	0.10	0.52		200		120		62		40		3.3
15	0.10	0.52		820		590		170		4.2		2.3
16	0.11	0.54		120		55		17	E	0.25	<	0.11
17	0.53	1.6		1200		780		340		8.0		3.4
18	0.42	1.3		970		510		350		11		3.5
19	0.11	0.57	NR	9.1		6.0	E, NR	0.33	<, NR	0.11	<, NR	0.11
020/033	0.10	0.51		260		160		69		2.0		1.2
22	0.10	0.51		230		130		56		1.8		0.97
024/027	0.10	0.52		450		270		110		3.1		1.3
25	0.10	0.52		810		390		200		4.6		2.3
26	0.10	0.52		1500		720		390		9.3		4.1
28	0.93	2.9		1500		740		360		10		5.9
31	1.6	4.8		2100		1300		510		14		8.6
32	0.10	0.51		410		260		86		1.9		1.1
34	0.10	0.52		40		27		11	<	0.10	E	0.49
35	0.11	0.53	<, NR	0.11	<, NR	0.11	<, NR	0.11	<, NR	0.11	<, NR	0.11
037/059	0.11	0.56		190		100		48		1.6		0.93
40	0.10	0.52		120		62		27		0.84	E	0.30
041/064	1.2	3.5		720		430		180		21		5.0
42	0.10	0.52		580		300		190		5.6		2.5
44	2.4	7.3	<, NR	2.4	<, NR	2.4	<, NR	2.4	<, NR	2.4	<, NR	2.4
45	0.10	0.51		110		55		25	<	0.10	<	0.10
46	0.10	0.51		63		35		16	E	0.40	<	0.10
47	0.85	2.6		1100		730		300		10		5.2
048/075	0.11	0.54		180		120		46		1.4		0.83
49	1.7	5.1		1900		980		520		18		10
51	0.10	0.51		240		160		54		1.3		0.54
52	6.4	18		2200		1300		600		21	E	13

53	0.10	0.51		640		340		150		4.5		2.1
54	0.11	0.53		21		13		4.1	<	0.11	<	0.11
056/060	0.11	0.57		360		210		88		4.7		2.9
63	0.12	0.58		87		53		22		0.73	E	0.15
66	1.1	3.1		830		520		230		11		6.4
67	0.12	0.59		28		24		10	E	0.21	E	0.21
69	0.11	0.56	NR	13	NR	7.6	NR	2.9	<, NR	0.11	<, NR	0.11
70	4.6	13		920		490		250		11	E	8.7
71	0.11	0.55		550		290		180		11		1.6
73	0.11	0.56		46		29		12		2.4		2.9
74	0.59	1.8		480		270		110		6.0		3.4
77	0.13	0.63		28		17		7.8	<	0.13	E	0.32
81	0.13	0.63		8.5		5.6		2.2	<	0.13	<	0.13
82	0.35	1.1		66		39		17	E	0.79	E	0.65
83	0.18	0.61		65		39		17		0.79		0.80
84	2.2	6.7		200		110		53	E	3.0	<	2.2
85	1.2	3.5		85		61		22	<	1.2	<	1.2
87	4.9	14		190		120		51	<	4.9	<	4.9
90	1.9	5.6		140		90		39	E	2.4	E	2.3
91	1.3	3.7		140		93		40	E	1.8	E	1.3
92	2.0	5.9		170		100		46	E	3.1	E	2.5
93	0.11	0.56		57		28		0.96		3.8		0.99
95	13	39		840		480		260	E	12	<	13
97	3.3	9.2		220		130		56	E	3.4	<	3.3
99	4.7	13		290		180		81	E	5.4	<	4.7
100	0.12	0.60		23		15		4.6	<	0.12	<	0.12
101	13	37		430		270		130	<	13	<	13
103	0.12	0.60		15		10		4.1	<	0.12	<	0.12

104	0.11	0.53	4.9	4.5	4.0	<	0.11	<	0.11
105	1.6	4.3	140	89	39	E	2.6	E	2.7
107	0.15	0.76	41	24	12	E	0.36	E	0.54
110	10	29	730	450	180	E	12	E	10
114	0.15	0.73	13	7.9	3.3	<	0.15	<	0.15
115	0.13	0.67	6.0	4.1	3.4	<	0.13	<	0.13
117	0.13	0.66	40	24	11	<	0.13	<	0.13
118	6.9	18	410	240	110	E	9.8	E	8.4
119	0.14	0.70	35	22	9.5	<	0.14	<	0.14
122	0.15	0.73	6.9	3.8	1.6	<	0.15	<	0.15
123	0.15	0.77	8.6	5.0	2.2	<	0.15	<	0.15
124/135	0.30	1.5	54	33	15	<	0.30	E	0.84
128	0.15	0.77	31	19	9.0	E	0.44	E	0.70
129	0.15	0.76	9.8	5.7	2.7	<	0.15	<	0.15
130	0.16	0.80	16	9.4	4.4	<	0.16	<	0.16
131	0.14	0.70	2.6	1.7	0.71	<	0.14	<	0.14
132	1.7	4.9	62	40	19	<	1.7	E	1.7
134	0.14	0.69	17	10	4.7	<	0.14	E	0.18
136	0.48	1.5	31	19	9.0	E	0.54	E	0.79
137	0.16	0.81	10	6.7	3.0	<	0.16	<	0.16
138/163/164	3.8	10	200	120	57	E	5.0	E	7.9
141	0.40	1.1	28	18	8.2	E	0.50	E	1.0
144	0.15	0.74	15	10	4.3	<	0.15	E	0.18
146	0.17	0.84	36	22	11		0.90		1.4
147	0.15	0.73	6.3	3.9	1.7	<	0.15	<	0.15
149	4.9	14	150	95	43	<	4.9	E	5.5
151	0.65	2.0	47	30	14	E	0.76	E	1.6
153	3.8	10	150	91	44	E	4.8	E	7.2

154	0.16	0.78		6.1		3.7		1.7	<	0.16	<	0.16
156	0.20	1.0		18		11		5.0	E	0.25	E	0.33
157	0.20	1.0		3.9		2.4		1.0	<	0.2	<	0.2
158	0.18	0.91		21		13		5.9	E	0.18	E	0.43
165	0.19	0.93	<, NR	0.19	<, NR	0.19	<, NR	0.19	<, NR	0.19	<, NR	0.19
167	0.22	1.1		8.1		4.8		2.4	<	0.22	<	0.22
170	0.22	1.1		17		11		4.7	<	0.22	E	0.45
171	0.19	0.97		4.8		3.0		1.7	<	0.19	<	0.19
172	0.23	1.1		4.2		2.5		1.1	<	0.23	<	0.23
173	0.18	0.91	<	0.18	<	0.18	<	0.18	<	0.18	<	0.18
174	0.19	0.97		23		14		6.3	<	0.19	E	0.56
175	0.20	1.0	E	0.59	E	0.29	<	0.20	<	0.20	<	0.20
176	0.16	0.78		1.7	E	0.75	E	0.28	<	0.16	<	0.16
177	0.19	0.95		13		8.3		3.6	<	0.19	<	0.19
178	0.20	0.99		9.7		5.6		2.4	<	0.20	<	0.20
179	0.15	0.76		13		7.9		3.3	<	0.15	E	0.28
180	0.23	1.2		46		28		12	E	1.2		1.7
183	0.21	1.0		14		8.3		3.7	<	0.21	E	0.34
185	0.19	0.97		2.6		1.5	E	0.67	<	0.19	<	0.19
187	0.20	1.0		42		25		12	E	0.85		2.2
189	0.30	1.5	<	0.30	<	0.30	<	0.30	<	0.30	<	0.30
190	0.25	1.2		4.0		2.4	E	1.0	<	0.25	<	0.25
191	0.26	1.3	<	0.26	<	0.26	<	0.26	<	0.26	<	0.26
193	0.26	1.3		2.4		1.4	E	0.56	<	0.26	<	0.26
194	0.32	1.6		9.7		5.6		2.2	<	0.32	<	0.32
195	0.27	1.3		2.3		1.4	E	0.49	<	0.27	<	0.27
196/203	0.28	1.4		15		8.7		3.9	<	0.28	<	0.28
197	0.22	1.1	<	0.22	<	0.22	<	0.22	<	0.22	<	0.22

199	0.21	1.0		13		7.6		3.8	<	0.21	<	0.21
200	0.22	1.1		1.4	E	0.75	E	0.46	<	0.22	<	0.22
201	0.28	1.4		1.4	E	0.54	<	0.28	<	0.28	<	0.28
202	0.21	1.1		4.4		2.4		1.4	<	0.21	<	0.21
205	0.37	1.9	<	0.37	<	0.37	<	0.37	<	0.37	<	0.37
206	0.40	2.0		10		5.8		5.1	<	0.40	<	0.40
208	0.30	1.5		4.2		2.2		2.3	<	0.30	<	0.30
209	9.6	11		23		14	E	10	<	9.6	<	9.6
Total PCBs [b]	98	270		32000		19000		8100		390		220

[a] combined congener numbers (XX/YY) represent 2 or more PCB congeners that could not be resolved during analysis.

[b] Total PCBs values are from a separate analysis from the congener PCB analyses. Total PCB values were previously reported.

Eighteenmile Creek 2020 (Deployment 1) - PRC Data

reordered to put congeners in order

units of ng/mL = ng/SPMD

	PCB-14 ng/SPMD	PCB-29 ng/SPMD	PCB-50 ng/SPMD
FAB Blank SG1	7.7728	7.9641	12.4898
Field Blank #1 SG1	11.1542	11.6939	16.464
Field Blank #2 SG1	10.7136	11.6665	15.3896
Blank ave	**9.8802**	**10.4415**	**14.78113**

	PCB-14 ng/SPMD	PCB-29 ng/SPMD	PCB-50 ng/SPMD

Site 1 18M T1 SG1	8.2241	9.6443	9.2131
Site 2 18M T2 SG1	9.9815	10.9436	9.1862
Site 3 OAK T1 SG1	6.6728	8.646	11.9146
Site 5 OAK L1 SG1	4.9159	7.0831	12.6203
Site 1 18M T1 REP SG1	8.4422	8.5381	7.9724
Field Ave	**7.6473**	**8.97102**	**10.18132**

Concentrations of total and congener polychlorinated biphenyls (PCBs) measured in SPMDs from the Eighteenmile Creek 2021 sampling

[SPMD, semipermeable membrane device; ng/SPMD, nanograms of chemical measured in a SPMD, ng/SPMD values are used for the estimation of the time-weighted average water concentrations]

PCB Congener number [a]	CERC Site # Field ID	Site 1 18M-T1 ng/SPMD	Site 2 18M-T2 ng/SPMD	Site 2 Rep 18M-T2 ng/SPMD	Site 3 OAK-T1 ng/SPMD	Site 3 Rep OAK-L1 ng/SPMD
1		0.00	0.00	0.00	0.00	0.00
2		0.00	0.00	0.00	0.00	0.00
3		0.00	0.00	0.00	0.00	0.00
004/010		0.00	0.00	0.00	0.00	0.00
5		0.20	0.00	0.04	0.00	0.00
6		13.84	5.03	6.57	0.00	0.09
007/009		1.20	0.61	0.91	0.00	0.00
8		21.97	8.18	11.32	0.19	0.10
12		0.32	1.01	0.97	0.05	0.03
13		17.80	18.54	23.29	3.52	4.09

15	31.81	21.08	20.73	0.74	0.30
16	11.95	7.56	9.15	0.05	0.02
17	62.02	41.39	48.99	0.69	0.28
18	46.76	31.63	46.18	0.71	0.50
19	0.60	0.53	1.12	0.00	0.00
020/033	16.11	7.71	8.64	0.13	0.07
22	13.00	11.99	14.73	0.28	0.21
024/027	39.04	15.85	19.60	0.27	0.12
25	53.63	25.11	26.06	0.25	0.08
26	54.77	41.73	50.53	0.30	0.00
28	43.12	41.72	44.43	0.67	0.59
31	67.50	53.43	63.70	1.54	1.06
32	48.11	17.56	19.25	0.36	0.41
34	3.15	2.12	2.21	0.00	0.00
35	0.00	0.00	0.00	0.00	0.00
037/059	10.75	10.53	10.87	0.04	0.03
40	8.98	4.09	5.74	0.02	0.07
041/064	48.79	32.80	49.17	1.61	0.39
42	39.60	36.42	43.90	0.23	0.11
44	0.41	0.00	0.00	0.00	0.00
45	7.47	2.62	4.12	0.00	0.00
46	6.18	2.94	3.67	0.00	0.02
47	53.99	45.06	46.52	0.67	0.47
048/075	13.70	6.81	7.20	0.06	0.07
49	81.85	69.60	82.50	1.23	0.71
51	28.40	23.38	26.23	0.07	0.00
52	91.58	76.22	90.23	1.55	0.94
53	50.59	21.19	23.23	0.30	0.15

54	1.74	0.94	1.20	0.06	0.00
056/060	23.64	13.28	13.85	0.20	0.12
63	5.53	3.04	3.12	0.00	0.00
66	50.66	27.93	29.02	0.62	0.47
67	2.50	1.26	1.28	0.02	0.00
69	0.89	0.72	0.91	0.00	0.00
70	55.61	29.90	30.86	0.81	0.59
71	42.27	25.40	35.93	0.77	0.06
73	5.31	2.70	2.82	0.36	0.39
74	25.17	15.01	15.55	0.36	0.30
77	2.41	1.22	1.27	0.01	0.00
81	0.76	0.35	0.39	0.00	0.00
82	5.89	2.98	3.28	0.08	0.06
83	5.38	2.76	2.99	0.06	0.04
84	18.42	18.02	22.26	0.23	0.18
85	8.18	5.14	5.28	0.03	0.00
87	15.00	16.07	17.97	0.31	0.22
90	12.96	3.99	7.43	0.21	0.21
91	13.86	7.04	7.24	0.13	0.06
92	13.23	14.29	16.02	0.25	0.21
93	4.94	35.14	42.99	0.06	0.02
95	51.61	53.27	42.24	1.25	1.06
97	16.91	9.01	9.23	0.31	0.27
99	22.78	13.08	13.56	0.48	0.48
100	2.57	1.23	1.03	0.00	0.00
101	30.23	20.86	17.33	0.90	0.75
103	1.50	0.72	0.75	0.00	0.00
104	0.00	0.00	0.00	0.00	0.00

105	10.45	5.74	5.93	0.26	0.23
107	2.16	1.20	1.22	0.03	0.02
110	51.96	27.65	28.63	1.05	0.87
114	0.86	0.91	1.02	0.00	0.00
115	0.46	0.25	0.28	0.00	0.00
117	2.98	3.79	4.19	0.00	0.00
118	27.72	31.24	35.70	0.88	0.73
119	2.46	1.34	1.47	0.00	0.00
122	0.41	0.21	0.23	0.00	0.00
123	0.70	0.36	0.39	0.00	0.00
124/135	3.80	2.12	2.23	0.05	0.03
128	2.40	1.33	1.39	0.07	0.06
129	0.71	0.38	0.43	0.00	0.00
130	1.02	0.55	0.58	0.00	0.00
131	0.15	0.11	0.11	0.00	0.00
132	5.61	2.96	3.06	0.16	0.14
134	1.37	1.37	1.57	0.00	0.00
136	2.89	3.07	3.57	0.03	0.01
137	0.78	0.40	0.43	0.00	0.00
138/163/164	13.31	7.45	7.73	0.66	0.66
141	2.13	1.14	1.22	0.07	0.07
144	1.29	0.72	0.77	0.00	0.00
146	2.39	2.81	3.28	0.11	0.12
147	0.50	0.29	0.31	0.00	0.00
149	11.90	12.88	14.38	0.55	0.50
151	3.57	1.95	2.06	0.10	0.09
153	9.86	5.71	5.88	0.63	0.69
154	0.37	0.18	0.19	0.00	0.00

156	1.00	0.57	0.61	0.00	0.00
157	0.21	0.11	0.11	0.00	0.00
158	1.42	0.76	0.78	0.04	0.03
165	0.00	0.00	0.00	0.00	0.00
167	0.37	0.18	0.28	0.00	0.00
170	0.90	0.49	0.53	0.02	0.04
171	0.28	0.16	0.21	0.00	0.00
172	0.18	0.13	0.22	0.00	0.00
173	0.00	0.00	0.00	0.00	0.00
174	1.31	0.72	0.77	0.03	0.01
175	0.01	0.01	0.00	0.00	0.00
176	0.15	0.15	0.17	0.00	0.00
177	0.78	0.41	0.44	0.00	0.00
178	0.46	0.24	0.25	0.00	0.00
179	0.83	0.40	0.44	0.00	0.00
180	2.31	1.28	1.50	0.12	0.13
183	0.78	0.41	0.42	0.00	0.00
185	0.15	0.06	0.07	0.00	0.00
187	2.20	1.25	1.31	0.17	0.21
189	0.00	0.00	0.00	0.00	0.00
190	0.18	0.09	0.10	0.00	0.00
191	0.00	0.00	0.01	0.00	0.00
193	0.09	0.07	0.10	0.00	0.00
194	0.27	0.14	0.16	0.00	0.00
195	0.09	0.04	0.05	0.00	0.00
196/203	0.51	0.26	0.30	0.00	0.00
197	0.00	0.00	0.00	0.00	0.00
199	0.55	0.32	0.37	0.00	0.00

200	0.05	0.02	0.02	0.00	0.00
201	0.03	0.00	0.02	0.00	0.00
202	0.15	0.07	0.05	0.00	0.00
205	0.00	0.00	0.00	0.00	0.00
206	0.20	0.17	0.21	0.00	0.00
208	0.11	0.08	0.11	0.00	0.00
209	0.62	0.39	0.42	0.43	0.44
Total PCBs [b]	1609	1137	1296	28	21

[a] combined congener numbers (XX/YY) represent 2 or more PCB congeners that could not be resolved during analysis.

[b] Total PCBs values are the summation of individual congener measurements.

Estimated time-weighted average water concentrations of total and congener polychlorinated biphenyls (PCBs) sampled by SPMDs from the Eighteenmile Creek 2021 sampling

[SPMD, semipermeable membrane device; MDL, method detection limit; MQL, method quantitation limit; pg/L, picograms per liter of water; <, less than the MDL; NR, little (<10%) to no recovery in QC sample; E, estimated value between the MDL and MQL]

PCB Congener number [a]	MDL pg/L	MQL pg/L	CERC Site # Field ID	Site 1 18M-T1 pg/L		Site 2 18M-T2 pg/L		Site 2 Rep 18M-T2 pg/L		Site 3 OAK-T1 pg/L		Site 3 Rep OAK-T1 pg/L	
1	0.16	0.82		<,NR	0.16	<,NR	0.16	<,NR	0.16	<,NR	0.16	<,NR	0.16
2	0.13	0.64		<,NR	0.13	<,NR	0.13	<,NR	0.13	<,NR	0.13	<,NR	0.13
3	0.13	0.64		<,NR	0.13	<,NR	0.13	<,NR	0.13	<,NR	0.13	<,NR	0.13
004/010	0.24	1.2		<,NR	0.24	<,NR	0.24	<,NR	0.24	<,NR	0.24	<,NR	0.24

5	0.10	0.52		1.3	<	0.10	<	0.12	<	0.10	<	0.10
6	0.10	0.50		83		12		18	<	0.10		3.1
007/009	0.20	0.99	NR	7.2	NR	1.4	NR	2.4	<,NR	0.20	<,NR	0.20
8	0.10	0.50		130		19		30		24		3.5
12	0.09	0.47	NR	1.8	NR	2.1	NR	2.3		6.5		0.85
13	0.09	0.46		100		36		53		450		140
15	0.09	0.46		180		41		47		94		9.9
16	0.10	0.48	NR	69	NR	16	NR	23		6.6		0.60
17	0.09	0.47		350		83		110		88		9.3
18	0.09	0.47		270		64		110		91		16
19	0.10	0.51	NR	3.6	NR	1.3	NR	3.1	<,NR	0.10	<,NR	0.10
020/033	0.18	0.90		89		13		18		17		2.5
22	0.09	0.45		72		20		30		36		7.1
024/027	0.18	0.91		220		29		42		34		3.9
25	0.09	0.45		300		41		52		33		2.6
26	0.09	0.45		301		68		100		41	<	0.09
28	0.09	0.45		240		68		89		90		20
31	0.68	2.1		380		86		130		210		37
32	0.09	0.45		270		31		41		46		14
34	0.09	0.45		18		3.4		4.4	<	0.09	<	0.09
35	0.09	0.16	<,NR	0.09	<,NR	0.09	<,NR	0.09	<,NR	0.09	<,NR	0.09
037/059	0.19	0.97		65		17		22		5.6		1.1
40	0.09	0.45		50		6.6		11		2.5		2.4
041/064	0.19	0.93		280		52		97		230		14
42	0.09	0.46		220		58		87		31		3.9
44	0.09	0.46	NR	2.3	<,NR	0.09	<,NR	0.09	<,NR	0.09	<,NR	0.09
45	0.09	0.45		41		4.4		8.5	<	0.09	<	0.09
46	0.09	0.45		34		5.0		7.5	<	0.09		0.59

47	0.09	0.47		310		71		92		95		17
048/075	0.19	0.95		80		11		14		8.5		2.4
49	0.09	0.47		470		110		160		170		26
51	0.09	0.45		160		38		53		9.4	<	0.09
52	0.47	1.4		530		120		180		220		34
53	0.09	0.45		280		35		47		40		5.2
54	0.09	0.47		9.9		2.0		2.9		7.1	<	0.09
056/060	0.20	1.0		150		22		28		32		4.9
63	0.10	0.51		35		4.9		6.5	E	0.28	<	0.10
66	0.26	0.77		320		45		61		99		20
67	0.10	0.52		16		2.0		2.7		2.8	<	0.10
69	0.10	0.49	NR	5.4	NR	1.1	NR	1.8	<,NR	0.10	<,NR	0.10
70	1.6	4.5		360		48		64		130		24
71	0.10	0.48		250		40		72		110		2.3
73	0.10	0.49		32		4.3		5.7		54		15
74	0.10	0.52		160		24		32		58		12
77	0.11	0.55		17		2.1		2.8		0.93	<	0.11
81	0.11	0.55		5.2		0.59		0.85	<	0.11	<	0.11
82	0.10	0.52		38		4.8		6.8		12		2.6
83	0.11	0.53		35		4.5		6.4		10		1.9
84	0.39	1.2		110		28		45		35		7.0
85	0.48	1.6		55		8.5		11		4.3	<	0.48
87	1.2	3.7		100		26		39		52		9.5
90	0.28	0.83		89		6.7		16		36		9.5
91	0.10	0.50		87		11		15		21		2.3
92	0.71	2.1		90		24		35		43		9.2
93	0.10	0.49		30		56		87		8.8		0.68
95	4.5	13		320		85		87		190		42

97	1.3	3.7		120		15		20		52		11
99	2.1	6.1		160		22		30		85		21
100	0.10	0.52		17		2.0		2.2	<	0.10	<	0.10
101	5.3	14		210		35		38		160		34
103	0.10	0.52		9.7		1.2		1.6	<	0.10	<	0.10
104	0.09	0.46	<,NR	0.09	<,NR	0.09	<,NR	0.09	<,NR	0.09	<,NR	0.09
105	0.70	1.6		83		11		15		52		12
107	0.13	0.66		18		2.3		3.1		5.9		1.2
110	4.2	12		380		49		66		190		41
114	0.13	0.64		6.8		1.7		2.5	<	0.13	<	0.13
115	0.12	0.59		3.4	E	0.43		0.64	<	0.12	<	0.12
117	0.12	0.58		21		6.6		9.6	<	0.12	<	0.12
118	3.3	8.7		230		62		93		190		40
119	0.12	0.62		19		2.5		3.5	<	0.12	<	0.12
122	0.13	0.63		3.2	E	0.40	E	0.58	<	0.13	<	0.13
123	0.13	0.67		5.9		0.71		1.0	<	0.13	<	0.13
124/135	0.26	1.3		31		4.1		5.6		9.3		1.7
128	0.13	0.67		20		2.6		3.6		15		3.3
129	0.13	0.67		5.9		0.75		1.1	<	0.13	<	0.13
130	0.14	0.69		8.8		1.1		1.6	<	0.14	<	0.14
131	0.12	0.61		1.1	E	0.20	E	0.28	<	0.12	<	0.12
132	0.61	1.7		43		5.4		7.3		31		7.7
134	0.12	0.60		10		2.5		3.7	<	0.12	<	0.12
136	0.10	0.52		19		5.0		7.5		4.3	E	0.22
137	0.14	0.71		6.9		0.84		1.2	<	0.14	<	0.14
138/163/164	1.4	3.9		130		16		23		160		41
141	0.14	0.70		19		2.3		3.3		16		4.0
144	0.13	0.64		10		1.4		1.9	<	0.13	<	0.13

146	0.15	0.73		22		6.0		9.3		25		7.1
147	0.13	0.63		4.0		0.54		0.77	<	0.13	<	0.13
149	2.1	6.1		96		25		36		110		26
151	0.13	0.63		28		3.7		5.1		21		4.9
153	1.5	3.9		92		12		17		150		42
154	0.14	0.68		3.1	E	0.35	E	0.50	<	0.14	<	0.14
156	0.18	0.88		11		1.4		2.1	<	0.18	<	0.18
157	0.18	0.88		2.3	E	0.28	E	0.36	<	0.18	<	0.18
158	0.16	0.79		14		1.7		2.4		9.2		2.2
165	0.16	0.81	<,NR	0.16	<,NR	0.16	<,NR	0.16	<,NR	0.16	<,NR	0.16
167	0.19	0.94		4.3	E	0.49		1.0	<	0.19	<	0.19
170	0.19	0.94		11		1.3		1.9		7.5		2.8
171	0.17	0.84		3.0	E	0.39	E	0.68	<	0.19	<	0.19
172	0.20	0.98		2.2	E	0.37	E	0.84	<	0.17	<	0.17
173	0.16	0.79	<	0.16	<	0.16	<	0.16	<	0.16	<	0.16
174	0.17	0.84		14		1.8		2.5		7.5	E	0.76
175	0.18	0.88	<	0.18	<	0.18	<	0.18	<	0.18	<	0.18
176	0.14	0.68		1.2	E	0.29	E	0.45	<	0.14	<	0.14
177	0.17	0.83		8.0		0.98		1.4	<	0.17	<	0.17
178	0.17	0.86		4.9	E	0.60	E	0.83	<	0.17	<	0.17
179	0.13	0.67		6.9		0.79		1.1	<	0.13	<	0.13
180	0.20	1.0		29		3.7		5.7		38		11
183	0.18	0.89		8.8		1.0		1.4	<	0.18	<	0.18
185	0.17	0.84		1.5	<	0.17	E	0.21	<	0.17	<	0.17
187	0.18	0.88		24		3.2		4.4		48		15
189	0.26	1.3	<	0.26	<	0.26	<	0.26	<	0.26	<	0.26
190	0.22	1.1		2.4	E	0.28	E	0.41	<	0.22	<	0.22
191	0.23	1.1	<	0.23	<	0.23	<	0.23	<	0.23	<	0.23

193	0.22	1.1		1.2	E	0.24	E	0.44	<	0.22	<	0.22
194	0.28	1.4		4.7	E	0.54	E	0.83	<	0.28	<	0.28
195	0.23	1.2		1.3	<	0.23	<	0.23	<	0.23	<	0.23
196/203	0.49	2.5		7.9	E	0.92	E	1.4	<	0.49	<	0.49
197	0.19	0.96	<	0.19	<	0.19	<	0.19	<	0.19	<	0.19
199	0.18	0.89		6.2	E	0.82		1.3	<	0.18	<	0.18
200	0.19	0.94	E	0.57	<	0.19	<	0.19	<	0.19	<	0.19
201	0.24	1.2	E	0.46	<	0.24	<	0.24	<	0.24	<	0.24
202	0.18	0.92		1.8	E	0.19	<	0.18	<	0.18	<	0.18
205	0.32	1.6	<	0.32	<	0.32	<	0.32	<	0.32	<	0.32
206	0.35	1.7		4.4	E	0.82	E	1.4	<	0.35	<	0.35
208	0.26	1.3		1.8	E	0.31	E	0.55	<	0.26	<	0.26
209	8.9	12		14	<	8.9	<	8.9		260		67
Total PCBs [b]	33	89		11100		1930		2860		4970		960

[a] combined congener numbers (XX/YY) represent 2 or more PCB congeners that could not be resolved during analysis.

[b] Total PCBs values are the summation of individual congener measurements.

Concentrations of performance reference compounds (PRCs) recovered from in SPMDs from the Eighteenmile Creek 2021 sampling

[SPMD, semipermeable membrane device; ng/SPMD, nanograms of chemical measured in the SPMD]

PRC - PCB Congener number [b]	SPMD Fabrication Blank ng/SPMD	SPMD Field Blank #1 ng/SPMD	SPMD Field Blank #2 ng/SPMD	Mean Blank Conc. ng/SPMD

14	9.85	10.27	10.79	10.30
29	10.18	11.25	11.24	10.89
50	15.92	16.38	16.79	16.36

PRC - PCB Congener number [b]	Site 1 ng/SPMD	Site 2 ng/SPMD	Site 2 Rep ng/SPMD	Site 3 ng/SPMD	Site 3 Rep ng/SPMD	Mean Deployed Conc. ng/SPMD
14	8.29	3.38	4.58	10.18	9.61	7.21
29	9.88	5.24	6.97	13.07	12.29	9.49
50	9.67	4.20	4.80	17.45	16.02	10.43

[a] PRC are chemicals not found in the environment that are added to the SPMD during fabrication. Starting concentrations of the PRCs, obtained from the mean measurements in the blanks, and final concentrations from the field deployed SPMDs are applied to uptake models to increase the accuracy of estimated water concentrations by correcting the uptake kinetics for site-specific environmental conditions. See Alvarez (2010) U.S. Geological Survey, Techniques and Methods 1-D4 (http://pubs.usgs.gov/tm/tm1d4/) for more information on PRCs and related calculations.

[b] congener PCB added to the SPMD during fabrication for use as a performance reference compound (PRC).