ANALYSIS OF SPMD SAMPLES FROM THE APRIL 2004 DEPLOYMENT IN BLUESTONE RIVER, VA FOR PCBs AS BIOAVAILABLE ORGANIC CONTAMINANTS

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EXECUTIVE SUMMARY

This report summarizes findings from a study using lipid-containing semipermeable membrane devices (SPMDs) to monitor Polychlorinated Biphenyls (PCBs) as bioavailable organic contaminants in the waters of the Bluestone River watershed near Bluefield, Virginia. The work was conducted as part of a continuing collaborative effort between the U.S. Geological Survey's (USGS) Columbia Environmental Research Center (CERC) and the Virginia Department of Environmental Quality (DEQ) to assess waterborne hydrophobic contaminants in the rivers and streams within in the Commonwealth of Virginia. CERC scientists fabricated the SPMDs, and DEQ personnel deployed them for 30 days (March 31, 2004 to April 30, 2004) at six sites in the aquatic environments of the Bluestone River watershed, Virginia.

"Summary of Deployment Locations"

DEQ CEDS ID	DEQ Site Description
9-BST021.26	YARDS: Norfolk Southern rail yard @ state line; in mainstem Bluestone River, just downstream of the railroad bridge, on RHS looking upstream.
9-BFK000.02	BRUSH FORK: In Brush Creak tributary, 40 yards above confluence with Bluestone River, just upstream of Rt 717 bridge, on RHS looking upstream.
VA0025054-001	BLUEFIELD WESTSIDE STP: In last chlorine contact tank (in sewage treatment plant chlorine contact channel, just before exiting into main flow) discharges into mainstem of Bluestone River, on LHS looking upstream.
9-BPB000.02	BEAVERPOND CREEK: In Beaverpond Creek tributary, 3 yards above confluence with Bluestone River.
9-WVC000.05	WRIGHT'S VALLEY CREEK: In Wright's Valley Creek tributary, 10 yards above confluence with Bluestone River, on LHS looking upstream.
9-BST028.90	BELOW WTP: In mainstem of Bluestone River, behind First Church of God parsonage, at Fincastle Country Club water withdrawal location, on RHS looking upstream.

The SPMDs were subsequently shipped to the CERC where they were processed and analyzed for polychlorinated biphenyls (PCBs). Concentrations of total PCB contamination were found to be present above the gas chromatographic (GC) method quantitation limits (MQL) at all sites as given in "Summary Table I," Previously developed models were employed to estimate the water concentrations of PCBs within the aquatic environments of the Bluestone River watershed as given in " Summary Table I."

"Summary Table I"

Results from the PCB Analysis of SPMDs Deployed During April of 2004 in the Bluefield River (Virginia) Watershed

DEQ CEDS ID	**Total PCBs Sequestered by SPMDs (ng/SPMD)**	**SPMD derived water concentration of Total PCBs (pg / Liter)**
9-BST021.26	180	1300
9-BFK000.02	167	1200
VA0025054-001	89	640
9-BPB000.02	505	3700
9-WVC000.05	170	1200
9-BST028.90	32	230

Determinations for total PCBs sequestered in deployed SPMDs were measured as the sums of the individual analytical responses from 140 individual PCB congeners as

detected during GC-ECD analysis. Not all targeted congeners were detected in individual study samples. And, not all detected congeners gave response signals which were quantifiable. Whereas all detected signals were summed to derive the total PCB levels reported, summations of quantifiable congeners do add up to the total PCB values reported. The analyses results from these six study sites, along with the analytical method detection limits (MDLs) and method quantitation limits (MQLs) for total PCBs and individual PCB congeners are reported herein.

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INTRODUCTION

Increasingly, human activities adversely affect the quality of our water resources. Anthropogenic contaminants are often released as a result of these activities, which may have deleterious effects on aquatic life and humans at ultra-trace levels. Thus, it is critical to determine the presence of these chemicals and trends in the concentrations to aid in designing effective mitigation strategies.

Unfortunately, there is a paucity of water concentration data for toxicologically significant waterborne contaminants such as PCBs. The levels of these very hydrophobic compounds in waters are usually below the detection limits of commonly employed low volume (i.e., ≤ 5 L) sampling and analytical methods. Even when high volume solid phase extraction systems are used for the analysis of environmental waters, concerns exist for sample contamination, analyte losses, and procedurally mediated changes in the aqueous distribution of target compounds due to the collection, filtration, and extraction of large volumes of water. Also, episodic changes in environmental contaminant concentrations may not be detected, because sampling with conventional methods provide data only for a single point or small window in time.

To address most of these analytical methods issues and others related to organism exposure, scientists at the U.S. Geological Survey's Columbia Environmental Research Center (CERC) have developed a semipermeable membrane device (SPMD) for *in situ* passive integrative monitoring of aquatic contaminants (3-5). The SPMD consists of layflat, low-density polyethylene (LDPE) tubing containing a thin film of high-molecular

weight (~800 Da), high-purity triolein. The nonporous polymeric membrane used in the SPMD sampler functions by allowing the readily bioavailable contaminant molecules to pass through transient membrane cavities approaching 10 Å in cross sectional diameter. The molecular size limitation of the LDPE used for SPMD membrane suggests that only dissolved chemicals will be sampled by SPMDs, which has been confirmed by Ellis et al. (6). Note that for compounds with log octanol-water partition coefficients (K_{ow}s) ≤ 6.0, the dissolved phase is the major source of residues accumulated in aquatic organism tissues (7). Also, residue transfer through the polymeric cavities in the LDPE membrane of SPMDs appears to mimic the transport of contaminants through biomembranes (8), which leads to bioconcentration of recalcitrant hydrophobic contaminants.

Lipid containing SPMDs are applicable to all neutral organic compounds with K_{ow}s ≥ 3.0, which includes PCBs, and in general all persistent organic pollutants (POPs). In the case of very hydrophobic analytes with log K_{ow}s > 6.0, where a large portion of the total waterborne chemical is associated with particulate or dissolved organic carbon phases, SPMDs readily concentrate ultra-trace residues of these compounds present in the dissolved phase to quantifiable levels (3, 9). Depending on environmental conditions such as velocity-turbulence at the membrane surface, temperature, and biofouling level, a "standard" 1-mL triolein SPMD (5) will passively extract hydrophobic contaminant residues from about 1 to 10 L of water per day. Sampling of hydrophobic compounds will generally remain integrative (i.e., no significant losses of residues accumulated in the device, even when ambient concentrations fall) throughout a 30 day (d) sampling period. Thus, more than 100 L of water is typically extracted of hydrophobic organic

contaminant residues by one-standard SPMD during a 30 d exposure period. Also, we have developed an approach (10) that permits determination of site-specific SPMD sampling rates. Details of this method are given in the experimental section. The purpose of this project was to assess the levels of total PCBs in the watershed of the Bluestone River, VA for the Virginia Department of Environmental Quality (DEQ), and to provide previously unattainable water column concentrations of PCBs to evaluate any impairment of water quality. A secondary objective of the work was to provide DEQ with an assessment of the distribution of individual sequestered PCB congeners within the SPMDs from each study deployment site. The congener specific information was intended as an aid to DEQ personnel in the identification of potential sources of environmental contamination and as a comparison to historic PCB congener specific analyses data from sediments of the Bluestone River.

EXPERIMENTAL

Materials: LDPE layflat tubing was purchased from Environmental Sampling Technologies, St. Joseph, MO. The tubing was a 2.54 cm wide, No. 940, untreated (pure PE; no slip additives, antioxidants, etc.) clear tubing. The wall thickness of this lot ranged from 84 to 89 µm. Triolein (1,2,3-tri-[cis-9-octadecenoyl]glycerol) was obtained from Nu-Check Prep Inc. Elysian, MN, this 99% triolein, Lot T-235-05-L and was further purified at CERC (11) prior to use in SPMD preparation. Florisil® (60-100 mesh) was obtained from Fisher Scientific Company, Pittsburgh, PA. The Florisil® was first heated at 475^{o}C for 8 hours, then equilibrated at 130^{o}C for 48 hours, and subsequently

stored at room temperature over P_2O_5 as desiccant. Silica gel (SG-60, 70-230 mesh) was obtained from Thomas Scientific, Swedesboro, NJ. The silica gel was washed with 40:60 methyl tert-butyl ether:hexane (V:V) followed by 100% hexane. The silica gel was activated at 130^oC for a minimum of 72 hours before use and stored at room temperature over P_2O_5 as a desiccant. All organic solvents were Optima grade from Fisher Scientific.

SPMD Preparation: The "standard" (6) SPMDs used in this project consisted of a 90 cm length of 2.5 cm wide layflat LDPE tubing containing 1 mL (≥ 99% purity) triolein. The resulting SA-V (membrane surface area to total SPMD volume) ratio is ≈ 90 cm^2/mL or ≈ 460 cm^2/mL of triolein, where the SPMD consisted of ≈ 20% triolein. The SPMDs weighed 4.4 to 4.6 g with the active exchanging or sampling surface of ≈ 440 cm^2.

Four of the five SPMDs for each deployment site and one of the two SPMD Field Blanks for each deployment site were spiked with 14 µg of each of five perdeuterated compounds 1) Acenaphthylene-d_{10}, 2) Acenaphthene-d_{10}, 3) Fluorene-d_{10}, 4) Phenanthrene-d_{10}, and 5) Pyrene-d_{10}, which are permeability/performance reference compounds (PRCs) A discussion of PRCs follows. The SPMDs were then placed into labeled, solvent rinsed, gas-tight cans. Afterwards, the cans were flushed with argon and sealed. These cans were placed in coolers and then shipped overnight to the Virginia DEQ for deployment.

Permeability/Performance Reference Compounds: PRCs are analytically non-interfering organic compounds with moderate to high fugacity from SPMDs that are added to the

lipid prior to membrane enclosure and field deployment (5). The functional basis of the PRC approach has been previously described in detail by Huckins et al. (10). In this study Phenanthrene-d_{10} was used as the PRC. Of the five PRCs added to the study SPMDs, only Phenanthrene-d_{10} was found to dissipate during deployment at greater than 20 % and less than 80 %. The rate constants for Phenanthrene-d_{10} dissipation from SPMDs at each sample site were determined and compared to PRC dissipation rate constants measured during laboratory calibration studies. The values so determined were similar for the six sites and a mean value was used in the calculation of an exposure adjustment factor (EAF). Using the EAF ratios, calibration data (i.e., SPMD uptake rate constants for analytes of interest) were adjusted to more accurately reflect actual *in situ* sampling rates. As suggested earlier, the effects of exposure conditions on SPMD uptake and dissipation rates are largely a function of 1) exposure medium temperature, 2) facial velocity-turbulence at the membrane surface, which is affected by the design of the deployment apparatus (i.e., baffling of media flow-turbulence), and 3) membrane biofouling. Based on our PRC research (10), the use of EAFs should permit the estimation of analyte water concentrations within ± 75 % of the actual time weighted average values.

SPMD Deployment and Retrieval: Study samples, as previously identified, were deployed by personnel of the Virginia DEQ on 3/31/2004. The SPMD deployment containers used were provided by the Virginia DEQ. All sites were visited weekly to ensure that the deployment canisters were fully submersed. All SPMDs were collected on 4/30/2004 and shipped to CERC.

SPMD Storage and Custody: Following receipt of the samples at CERC and prior to processing, the SPMDs were stored in a laboratory freezer at -15°C as described in CERC SOP: P.453 entitled, "Documentation of Sample Receipt and Storage by Chemical Fate and Dynamics Branch."

Sample Processing and Residue Enrichment : Sample processing was similar to published procedures (5) as described in CERC SOP: P002 entitled, "Procedure for Cleanup and Fractionation of SPMD Dialysates and Extracts of Other Environmental Samples for Chlorinated Pesticides, PAHs, PCBs and Other Targeted Contaminants," with abbreviated details noted in the following sections.

SPMD Membrane Cleaning: The exterior membrane surfaces of all SPMDs were cleaned prior to dialysis. Sealed cans with SPMDs were opened and the SPMDs were removed and momentarily immersed (< 30 sec.) in 100 mL of hexane. Then the SPMDs were washed thoroughly to remove all remaining surface adhering material. Any SPMD tether loops outside the lipid containment seals were cut away and discarded. The SPMDs were then immersed in a glass tank containing 1-N HCl for approximately 30 seconds. Subsequently, they were rinsed with tap water to remove the acid. All surface water was removed from individual SPMDs by successive rinses of acetone followed by isopropanol.

SPMD Dialysis (i.e., Recovery of Analytes): Each SPMD was submersed in 175 mL of hexane in glass jars and was dialyzed individually at 18 ^{o}C for 18 hours. The hexane was removed and transferred into an evaporation flask. A second volume of 175 mL of hexane was added to each sample jar and the SPMDs were dialyzed for an additional 6 hours at 18 ^{o}C. The second dialysate was transferred into the flask containing the first dialysate. The dialysates from three SPMDs from each deployment site were combined into a composite. These were reduced to 3 to 5 mL by rotary evaporation, filtered, and quantitatively transferred into test tubes. The solvent volume was then reduced to about 1.0 mL, using high purity nitrogen.

SEC Cleanup: The size exclusion chromatography (SEC) cleanup of study samples followed CERC SOP p.588 entitled, "The Use of Size Exclusion Chromatography (SEC) in the Cleanup of Dialysates From SPMDs and Other Extracts." A Perkin-Elmer Series 410 HPLC (Perkin-Elmer, Inc., Norwalk, CT) was employed as the solvent delivery system. This HPLC unit was equipped with a Thermo Finnigan AS3000 variable-volume injection auto sampler (Thermo Finnigan, Inc. San Jose, CA). The SEC column was a 300-mm x 21.2-mm I.D. (10-µm particle size, 100 Å pore size) Phenogel column (Phenomenex, Inc., Torrance, CA), equipped with a 50-mm x 7.5-mm I.D. Phenogel guard column. A DFW-20 series fixed wavelength UV absorption detector (D-Star Instruments, Inc. Manasses, VA) operating at 254 nm, a Hewlett-Packard Co, HP 3396 Series II Integrator (Hewlett Packard, Inc., Palo Alto, CA), and an ISCO Foxy® 200 (ISCO, Inc., Lincoln, NE) fraction collector completed the SEC system. The isocratic

mobile phase was 98:2 (V:V) dichloromethane:methanol (DCM:MeOH) with a flow rate of 4.0 mL per minute.

In keeping with CERC SOP p.588, the SEC system was calibrated on a daily basis using compounds of environmental interest and potentially interfering materials. These compounds, in sequence of elution, were diethylhexylphthalate (DEHP; a common plasticizer with lipid-like chromatographic behavior), biphenyl and naphthalene (small aromatic analytes), coronene (a large PAH later eluting than any anticipated analyte), and elemental sulfur (a problematic interference frequently encountered in environmental samples). SEC cleanup was accomplished using a collect fraction (i.e., window in which target analytes elute) determined by the calibration of the system on the day of operation. The fractions collected were amended with approximately 2 mL of isooctane, reduced to a volume of about 1 mL on a rotary evaporation system, and quantitatively transferred with hexane into appropriately labeled test tubes.

Post-SEC Column Chromatography: After SEC cleanup, samples were further processed using open column chromatography. The fractions (1 mL volume) were applied to Florisil® columns (5 g) and subsequently eluted with 60 mL of 75:25 (V:V) methyl tert-butyl ether:hexane. Following volume reduction to 0.5 mL, each sample was applied to a silica gel (SG) column (5 g). Two fractions were collected; fraction SG-1 (46 mL of hexane) and fraction SG-2 (55 mL of 40:60 [V:V] methyl tert-butyl ether:hexane). This enrichment procedure provided fractions for the analysis of PCBs (in SG-1) and PRCs (in SG-2).

Gas Chromatographic Analysis of PRCs: Analyses of SG-2 Fractions for PRCs was conducted on a Hewlett Packard 5890 series gas chromatograph (GC) equipped with a Hewlett Packard 7673A autosampler (Hewlett Packard, Inc., Palo Alto, CA). In all analyses, 1.0 μL of sample extract was injected using the "cool-on-column" technique with hydrogen as the carrier gas. Analysis of the SG-2 fractions was performed using a DB-5 (30 m x 0.25 mm i.d x 0.25 μm film thickness.) capillary column (J&W Scientific, Folsom, CA) with the following temperature program: injection at 60^{o}C with a 2 minute hold at 60^{o}C, then 10^{o}C/min to 110^{o}C and held for 5 minutes at 110^{o}C, followed by 3^{o}C/min to 200^{o}C and held for 10 minutes at 200^{o}C, then 4^{o}C/min to 310^{o}C and held at 310^{o}C for 3 minutes. Detection was performed using a Hewlett Packard flame ionization detector (FID) operating at 330^{o}C. Quantitation was accomplished using an eight point calibration curve spanning a 50-fold range of concentration from 0.2 to10 μg/mL for each of the five perdeuterated PRCs. 4-Terphenyl- d_{14} was used as the instrumental internal standard (IIS). Figures 1,2, and 3 show representative chromatograms of standards, field blank SPMDs, and deployed SPMDs analyzed for PRCs.

Gas Chromatographic Analysis of PCB Congeners: Gas chromatographic analyses of SG-1 fractions for PCB congeners were conducted using a Hewlett Packard 5890 series gas chromatograph (GC) equipped with two Hewlett Packard 7673A autosamplers (Hewlett Packard, Inc., Palo Alto, CA) to allow for dual column injection. In all analyses, 1.0 μL of sample extract was injected using the "cool-on-column" technique with hydrogen as

the carrier gas (25 psig). Analyses were performed using both a DB-5 (60 m x 0.25 mm i.d. x 0.25 µm film thickness) capillary column (J&W Scientific, Folsom, CA) and a DB-17 (60 m x 0.25 mm i.d. x 0.25 µm film thickness) capillary column (J&W Scientific, Folsom, CA) with the following temperature program: injection at 60 ^{o}C; then ramped at 15 ^{o}C/min to 150 ^{o}C; followed by 1 ^{o}C/min ramp to 260 ^{o}C; and finally ramped at 10 ^{o}C/min to 300 ^{o}C with a final hold of 15 minutes at 300 ^{o}C. The electron capture detectors (ECDs, Hewlett Packard, Inc., Palo Alto, CA) were maintained at 330 ^{0}C with nitrogen at 55-60 mL/minute as make-up gas. Individual PCB congeners were identified on one or both GC capillary columns based upon known retention times for each congener in the calibration standards. The best resolved peak was picked from the column giving the best resolution, with some congeners being analyzed on both columns for confirmatory analysis. A 1:1:1:1 mixture of Aroclor® 1242, 1248, 1254, and 1260 was used to produce the PCB congener calibration standards. These standards were quantified based on pure primary PCB standards (Accustandard, New Haven, CT) and were used as secondary standards (12) at five calibration levels to quantify up to 140 congeners and combined congener peaks in the study samples by an internal standard method. The levels of the PCB standards spanned a 160-fold concentration range from 50 to 8,000 total ng/mL. PCB congener I-30 was employed as the instrumental internal standard, and congeners I-30 and I-207 were used as retention time references. Determinations for total PCBs sequestered in deployed SPMDs were measured as the sums of the individual analytical responses from 140 individual PCB congeners as detected during GC-ECD analysis. Figures 4,5, and 6 show representative

chromatograms of SG-1 fractions for standards, field blank SPMDs, and deployed SPMDs analyzed for PCBs.

Quality Control: Field blank SPMDs accompanied the deployment SPMDs during transportation to the field, deployment, retrieval, and transportation to CERC. These field blanks were processed and analyzed exactly as the deployed SPMDs. The field blank samples exhibited no coincident GC peaks at levels significantly higher than those associated with the laboratory control SPMDs and were indicative of successful deployments and retrievals.

The method detection limit (MDL) and method quantitation limit (MQL) for analysis of SPMD samples were determined for each analyte by measuring the values of coincident GC-ECD or GC-FID peaks for each compound in all blank samples processed with this study. The MDL was defined as the mean plus three standard deviations of values so determined (13). The MQL was defined as the mean plus 10 standard deviations of values so determined (13). For individual analytes having no coincident GC peak, an assumed value equal to the low sample reject for the GC method was used to calculate the mean. In the cases where the MQLs were below the level of the calibration curve employed in the GC-analysis, the MQLs were set at the value of the lowest level of the calibration curve employed in quantifying the analyte levels. The background, MDLs and MQLs for analysis of the study samples for PCBs and PRCs are presented in Table I.

QC checks were employed to demonstrate an acceptable outcome of sample analyses. These checks included (but were not limited to) monitoring the recovery of PCBs through

the entire dialysis, fractionation and enrichment procedures by spiking a blank SPMD with a known quantity of PCBs (nominal amount of total PCBs was 4000 ng) and measuring recovery following dialysis, SEC , Florisil®, and Silica Gel chromatographic cleanup. Recoveries of individual PCB congeners and total PCBs are given in Table II. These values are consistent with those typically obtained at CERC.

RESULTS AND DISCUSSIONS

Observations and Findings: The deployed SPMDs from this study were processed concurrently with the above referenced quality control samples. Therefore, the results obtained from processing and analyses conducted on riverine exposed SPMDs were taken to be similar to the observed results for the quality control samples described.

The reported values of PCB levels are from SG-1 fraction analyses only. The low recoveries observed (Table II) for 12 of the 140 individual congeners is an artifact of the silica gel fractionation. These congeners elute from silica gel, in part or in whole, in the SG-2 fraction. A more rigorous analysis, including determination of PCBs in the SG-2 fraction, was beyond the scope of this project and was considered to be an excessive expenditure of time and effort for a minimal increase of useful information. The SG-2 fraction was not included in the analyses for total PCBs because historic CERC data shows that carry-over of these congeners into SG-2 (using the materials and methods described in this report) represents less than 5 % of total PBCs. This level of potential processing loss was not considered to be significant in the determinations of total PCB levels wherein reported results were not corrected for recovery and were reported to only two significant figures.

During the gas chromatographic analysis of study samples for PCB congeners, two GC columns were used to obtain sufficient resolution for quantitation of the targeted PCB congeners. Quantitation for each congener was done using the column giving the better resolution where the second column then became the conformational analysis (Table III).

The results of the gas chromatographic analyses of the deployed SPMDs are given for all PCB congeners in Tables IV through IX. The results of the gas chromatographic analyses of the deployment SPMDs are given for all PRCs in Table X. PCB congener analyses results are corrected for background, but are not corrected for recovery and therefore represent minimum levels of PCBs within the aquatic environments of the Bluestone River watershed. Although the backgrounds, MDLs, and MQLs (Table I) are given in units of ng/3-SPMD composite (because this is representative of the sample size and matrix as injected), SPMD analysis results (Tables IV through IX) are given in units of ng/SPMD. Raw results (after subtracting out background) were divided by three to give these values. These units were used because they are applicable to deriving water concentrations from modeling equations.

Derivation of Water Concentrations from SPMD Levels (Modeling): SPMD uptake kinetic data are required to accurately estimate aquatic concentrations of environmental contaminants. Using models previously developed (2, 5, 10, 14), data from the analysis of the PRC levels, and from calibration studies, the bioavailable (i.e., dissolved phase) concentrations of PCBs in SPMDs exposed to water in the Bluefield River Watershed can

be estimated. For compounds with log K_{ow} values ≥ 5.0, sampling is integrative and reported water concentration values represent a time weighted average of residue concentration (i.e., residues were accumulated in an additive manner throughout the exposure with no significant losses of sequestered PCBs) during the 30 day exposure period. For compounds with log K_{ow}s < 5.0, equilibrium is reached in less than 30 days. Therefore, sampling of these compounds is not integrative throughout the whole exposure period and reported water concentrations represent a smaller window of time than the 30 day exposure. Regardless of these considerations, water concentrations can be determined by using different assumptions and models (5).

An example of the overall modeling procedure for compounds with log K_{ow}s ≥ 5.0 is as follows. Note that Huckins et al. (5) have also described modeling procedures for water concentration estimates of compounds with log K_{ow}s < 5.0. The analyte sampling rate (R_{sw}) is determined from laboratory exposures conducted under some of the same conditions (i.e., water temperature and exposure duration) as the current study. The linear or integrative uptake of OCs by SPMDs as applicable to PCBs has been described by Huckins, et al. (5) as follows:

$$C_{SPMD} = C_w k_o K_{mw} A t / V_{SPMD} \quad (1)$$

substituting R_{sw} for $k_o K_{mw} A$ in equation 1 gives

$$C_{SPMD} = C_w R_{sw} t / V_{SPMD} \quad (2)$$

where C_{SPMD} is the concentration of the PCB in the whole SPMD (i.e., the membrane + lipid), C_w is the concentration of the PCB in the water, t is the exposure time in days, and V_{SPMD} is the volume of the SPMD. Rearranging equation 2 results in

$$C_w = C_{SPMD}V_{SPMD}/R_{sw}t \quad (3)$$

In the present case we use the uptake rate constant (k_{uw}) defined as L/d g (liter/day·gram) of SPMD (membrane + lipid).

$$C_w = C_{SPMD}/(R_{sw}/M_{SPMD})t = C_w = C_{SPMD}/k_{uw}t \quad (4)$$

where M_{SPMD} is the mass of the SPMD and is substituted for V_{SPMD}.

SPMD sampling rates can change due to changes in temperature, turbulence/facial velocity of water at the membrane surface, and buildup of periphyton on the membrane surface. To account for changes in these variables from the laboratory calibration studies, PRCs are used to allow estimation of actual *in situ* sampling rates. The PRC concept was described earlier. However, models to enable the use of a PRC were not. Measuring the loss of a PRC over a study exposure period provides in situ k_e values which when compared to the calibration k_e values can serve as an indicator of differences in the environmental conditions. If large differences exist between the k_e calibration and exposure values, adjustments must be made to the laboratory calibration data (Table X). The k_{eprc} values are derived as follows

$$C_{SPMD} = C_{SPMDo} \exp(-k_{eprc}t) \quad (5)$$

$$k_{eprc} = \ln(C_{SPMDo}/C_{SPMD})/t \quad (6)$$

where C_{SPMDo} is the day 0 level of the PRC and C_{SPMD} is the concentration of PRC remaining in the SPMD following exposure. Comparison of the k_{eprc} values derived from the field-exposed SPMDs (Equations 7 or 8), to the k_e values of the PRCs measured in SPMD calibration exposures (i.e., k_{eprc} / k_{ec}), provides an estimate of the relative effect of

environmental variables on SPMD sampling. Laboratory k_{ec} values of PRCs are determined by direct measurement or by

$$k_{ec} = R_s/K_{SPMD}\, V_{SPMD} d_{SPMD} \qquad (7)$$

where K_{SPMD} is the equilibrium SPMD-water partition coefficient and d_{SPMD} is the SPMD density (g/mL), which is 0.91. Estimates of in situ R_s values from the k_{ec}s of PRCs can be made with the following relationship

$$R_{sf} = (k_{eprc}/k_{ec})\, R_{sc} \qquad (8)$$

These models and assumptions as well as others have been incorporated into an Excel spreadsheet (5) for rapid estimation of water concentrations and the Excel calculator was used for water concentration estimates in this work (Tables XI through XVI). Note that an average temperature of 11.8 ^{o}C was assumed for SPMD exposure at all sample sites because this temperature is the most representative water temperature for which calibration data exists (14). The k_{eprc} values (Equation # 6 above) incorporated into the Excel calculator for water concentration estimations was the average obtained from the PRC analyses of the SG-2 fractions from four of the six study sites. The SG-2 fractions from the other two sites contained chromatographic interferences which prohibited the determinations of PRC compound levels in these samples. Therefore, the values obtained for the other four sites (being within a range of 20 %) were averaged and mean was applied uniformly to all six sites (Table X).

The analytical sampling rate (R_{sw}) value for total PCBs which was incorporated into the Excel calculator for water concentration estimations (Table XI through XVI) from total

PCB levels, (5,14) is a weighted average of R_{sw} values from the eighty individual PCB congeners for which calibration data exists (14). This weighted average does not reflect the distribution of PCB congeners seen at each study site, does not reflect the relative amounts of each congener seen at each study site, and is not representative of any specific Aroclor® mixture.

When congener distributions are known, as in this study where analytical data was obtained for 140 congeners, an alternate method of estimation of water concentrations would involve the inclusion of the remaining 60 congeners (for which calibration data does not exists) into the Excel calculator for water concentration estimations. In this case, average R_{sw} values for these 60 additional congeners can be employed to estimate the water concentration of these congeners. The summation of the individual water concentrations of the 140 total congeners would then be taken as an estimation of the total PCB water concentration. The overall accuracy of this technique has not been fully evaluated using these 60 estimated R_{sw} values. The results so obtained are within the two-fold margin of error associated in determinations of water concentrations from SPMDs (5, 14). For example, the estimated water concentration of total PCB from site 9-BPB000.02 using this method would be 2900 ng/L as compared to 3700 ng/L (Table XVI) as reported using the more traditional modeling methods as described above.

In addition to the inherent limitations of estimation of water concentrations by application of SPMD technology (i.e. the two-fold margin of error), the utility of this technology is further limited by three other factors, 1) Sample size, i.e. number of SPMDs used, 2)

Length of deployment, and 3) sensitivity of the analytical method used to determine the levels of contaminants sequestered. Insertion of the MQL values (Table I) for individual congeners and total PCBs specific to this project with adjustment of units to ng/SPMD into the Excel calculator for water concentration estimations gives minimum values at which water concentrations can be estimated (Table XVII) under the specific conditions as they existed during the deployment phase of this study.

Conclusions: Levels of PCBs within the Bluestone River watershed differ significantly from site to site both in quantity and profile. The observed levels of total PCBs sequestered are given below in order of highest to lowest.

DEQ CEDS ID	**Total PCBs Sequestered by SPMDs (ng/SPMD)**
9-BPB000.02	505
9-BST021.26	180
9-WVC000.05	170
9-BFK000.02	167
VA0025054-001	89
9-BST028.90	32

The GC-ECD profiles of Aroclors® 1242, 1248, 1254, and 1260 along with those observed from the six study sites are presented in Figures 7 through 16. These graphic representations are intended to assist, by pattern recognition, in the identification of

potential sources of introduction of PCBs into the Bluestone River watershed. Figures are given at the same scale to give a visual representation of relative quantity of sequestered PCBs.

The high recovery (Table X) of pyridine-d_{10} (a PRC) indicates that photolysis of PRC did not occur during deployment and that the EAFs used in calculating water concentrations are accurate. The elucidation of the potential biological effects from exposure to these levels of PCBs will require further research. While the chronic effects on aquatic organisms present in the Bluestone River watershed from exposure to the PCBs found in the SPMD samples is unknown, the water concentrations of the PCBs found in these samples may be of concern.

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Table I

Background, MDL, & MQL Values for PCB Congeners

Congener Identification	Background ng / 3-SPMD Composite	MDL ng / 3-SPMD Composite	MQL ng / 3-SPMD Composite
001	0.15	0.52	5.33
003	0.01	0.07	0.73
004	0.03	0.16	1.69
005	0.00	0.01	0.10
006	0.05	0.20	2.09
007	0.06	0.10	1.01
008	0.22	0.54	5.49
009	0.02	0.09	0.88
010	0.00	0.01	0.12
011	0.00	0.01	0.10
015	0.04	0.13	1.30
016	0.04	0.08	0.77
017	0.12	0.23	2.30
018	0.31	0.54	5.49
019	0.07	0.34	3.45
020	0.00	0.02	0.17
022	0.04	0.08	0.87
024	0.00	0.01	0.10
025	0.01	0.02	0.20
026	0.04	0.08	0.82
027	0.01	0.03	0.35
028	0.14	0.30	3.01
031	0.22	0.44	4.44
032	0.05	0.12	1.24
033	0.11	0.23	2.31
034	0.00	0.01	0.06
035	0.02	0.07	0.67
037,059	0.03	0.04	0.42
040	0.03	0.07	0.74
041	0.01	0.03	0.33
042	0.10	0.19	1.92
043	0.01	0.04	0.39
044	1.57	3.24	32.9
045	0.06	0.11	1.14
046	0.02	0.05	0.55
047	0.09	0.21	2.10

Table I (continued)

Background, MDL, & MQL Values for PCB Congeners

Congener Identification	Background ng / 3-SPMD Composite	MDL ng / 3-SPMD Composite	MQL ng / 3-SPMD Composite
048	0.05	0.14	1.41
049	1.07	2.19	22.3
051	0.02	0.04	0.38
052	5.45	10.7	109
053	0.31	0.53	5.42
054	0.01	0.04	0.39
055	0.00	0.01	0.12
056,060	0.10	0.19	1.97
057	0.01	0.04	0.44
058	0.00	0.01	0.10
063	0.01	0.02	0.21
064	0.30	0.62	6.29
066	0.15	0.29	2.99
067	0.00	0.02	0.17
069	0.01	0.02	0.22
070	0.55	1.15	11.8
071	0.12	0.21	2.18
072	0.01	0.06	0.60
074	0.11	0.21	2.17
075	0.02	0.05	0.52
082	0.11	0.23	2.37
083	0.02	0.05	0.49
084	0.78	1.65	16.8
085	0.00	0.01	0.10
086	0.01	0.03	0.28
087	0.53	1.13	11.5
090	0.02	0.05	0.47
091	0.35	0.75	7.65
092	0.33	0.70	7.10
095	3.07	6.24	63.4
096	0.43	2.52	25.9
097	0.40	0.88	8.96
099	0.46	0.98	9.98
101	1.42	3.02	30.7
102	0.06	0.12	1.23
105	0.18	0.42	4.24

Table I (continued)

Background, MDL, & MQL Values for PCB Congeners

Congener Identification	Background ng / 3-SPMD Composite	MDL ng / 3-SPMD Composite	MQL ng / 3-SPMD Composite
109	0.05	0.12	1.18
110	1.06	2.31	23.6
112	0.00	0.01	0.10
113	0.00	0.02	0.20
114	0.00	0.02	0.17
115	0.02	0.07	0.67
117	0.04	0.06	0.64
118	0.64	1.43	14.6
119	0.01	0.04	0.37
122	0.00	0.01	0.06
123	0.01	0.02	0.23
128	0.08	0.18	1.79
129	0.03	0.06	0.64
130	0.02	0.07	0.69
131	0.01	0.05	0.47
132	0.25	0.61	6.25
133	0.01	0.02	0.22
134	0.06	0.12	1.22
136	0.24	0.53	5.36
137	0.02	0.06	0.57
138	0.42	0.88	8.97
139	0.01	0.02	0.22
141	0.10	0.22	2.28
144	0.05	0.10	0.97
146	0.07	0.15	1.57
147	0.01	0.02	0.21
149	0.61	1.31	13.3
151	0.16	0.31	3.17
153	0.56	1.12	11.4
156	0.05	0.12	1.18
157	0.01	0.03	0.34
158	0.07	0.15	1.53
163	0.10	0.18	1.79
164	0.04	0.09	0.88
166	0.00	0.01	0.10
167	0.01	0.01	0.10

Table I (continued)

Background, MDL, & MQL Values for PCB Congeners

Congener Identification	Background ng / 3-SPMD Composite	MDL ng / 3-SPMD Composite	MQL ng / 3-SPMD Composite
170	0.12	0.29	2.94
171	0.01	0.04	0.39
172	0.00	0.01	0.13
173	0.00	0.01	0.10
174	0.05	0.12	1.20
175	0.00	0.01	0.10
176	0.00	0.01	0.13
177	0.02	0.04	0.45
178	0.01	0.02	0.22
179	0.03	0.07	0.76
180	0.10	0.18	1.86
183	0.03	0.07	0.72
185	0.00	0.01	0.10
187	0.06	0.11	1.14
189	0.00	0.01	0.10
190	0.01	0.05	0.48
191	0.00	0.01	0.10
193	0.00	0.01	0.10
194	0.01	0.02	0.22
195	0.00	0.03	0.32
196	0.02	0.03	0.34
197	0.02	0.03	0.32
198	0.00	0.01	0.10
199	0.02	0.05	0.53
200	0.03	0.11	1.14
201	0.00	0.02	0.17
202	0.00	0.02	0.18
203	0.01	0.03	0.35
205	0.00	0.01	0.10
206	0.01	0.04	0.41
208	0.11	0.17	1.67
209	0.46	0.73	7.35
Total PCBs*	26.1	10.0*	50.0*

* The values reported for MDLs and MQLs (of Total PCBs) are representative of residues following substraction of summed values for individual congener signals (i.e.values above total background). Units of ng/3-SPMD composite are representative of sample sizes and matrix as injected

Table II

Recovery of PCBs From Spiked SPMDs

Congener Identification	Spiking Level ng	SPMD Spike ng	Recovery %
001	11.6	0.09	0.8*
003	3.85	0.13	3.4*
004	40.7	0.78	1.9*
006	20.5	12.9	62.9
007	3.38	1.07	31.7*
008	86.8	54.2	62.4
009	6.18	2.80	45.3*
010	2.26	0.18	8.0*
015	26.9	21.0	78.1
016	67.2	15.0	22.3*
017	60.5	43.7	72.2
018	156	104	66.9
019	13.9	0.22	1.6*
020	6.53	5.04	77.2
022	51.2	39.9	77.9
024	1.71	0.01	0.8*
025	8.69	6.98	80.3
026	22.3	17.9	80.5
027	6.94	4.87	70.2
028	121	98.7	81.8
031	125	101	80.4
032	36.3	27.5	75.8
033	87.3	71.0	81.3
034	0.42	0.37	88.1
035	0.91	0.93	102
037,059	11.9	10.8	90.2
040	25.6	12.6	49.2
041	18.3	11.8	64.2
042	37.8	30.4	80.5
043	5.55	4.33	78.0
044	134	106	79.0
045	30.5	13.8	45.4
046	13.0	4.98	38.2
047	25.5	20.6	80.9

Table II (continued)

Recovery of PCBs From Spiked SPMDs

Congener Identification	Spiking Level ng	SPMD Spike ng	Recovery %
048	37.0	27.4	74.2
049	103	82.5	80.4
051	6.20	4.85	78.2
052	177	143	81.0
053	27.7	20.8	75.1
054	0.16	0.03	18.8*
055	1.88	1.56	83.0
056,060	84.4	70.8	83.9
057	0.75	0.64	85.3
058	0.31	0.19	61.3
063	4.41	3.67	83.2
064	64.4	52.7	81.8
066	96.9	82.6	85.3
067	3.28	2.71	82.6
069	0.20	0.20	100
070	161	134	83.2
071	34.6	28.1	81.2
072	1.07	0.45	42.1*
074	56.1	47.8	85.2
075	2.32	1.45	62.5
082	20.8	16.4	78.9
083	2.35	1.86	79.1
084	49.0	37.4	76.3
086	3.74	1.10	29.4
087	68.4	57.1	83.4
090	3.66	2.92	79.8
091	22.6	18.3	80.9
092	30.2	24.4	81.0
095	140	111	79.6
096	1.95	1.28	65.6
097	55.9	42.5	76.0
099	52.9	44.0	83.3
101	139	114	82.1
102	3.78	3.03	80.2
105	48.3	41.5	86.0

Table II (continued)

Recovery of PCBs From Spiked SPMDs

Congener Identification	Spiking Level ng	SPMD Spike ng	Recovery %
109	10.7	9.03	84.5
110	145	118	81.3
112	0.64	0.63	98.4
113	0.52	0.48	92.3
114	4.88	3.92	80.3
115	4.54	3.89	85.7
117	8.02	4.77	59.5
118	110	92.8	84.5
119	2.43	2.02	83.1
122	1.50	1.26	84.0
123	2.19	1.28	58.6
128	26.4	21.2	80.2
129	8.29	6.67	80.5
130	8.50	6.84	80.5
131	2.95	2.40	81.4
132	54.5	41.8	76.7
133	2.34	1.86	79.5
134	11.5	9.22	80.5
136	37.7	26.0	68.9
137	7.07	5.64	79.8
138	124	101	81.5
139	3.59	2.25	62.7
141	49.6	36.7	74.0
144	15.1	11.0	73.2
146	24.4	19.4	79.4
147	0.65	0.53	81.5
149	156	122	77.9
151	53.9	42.1	78.2
153	160	130	81.3
156	17.5	15.5	88.7
157	3.36	2.72	81.0
158	21.7	17.4	80.3
163	38.5	31.5	81.8
164	12.2	9.58	78.5
166	0.59	0.49	83.1
167	4.68	3.83	81.8

Table II (continued)

Recovery of PCBs From Spiked SPMDs

Congener Identification	Spiking Level ng	SPMD Spike ng	Recovery %
170	87.6	68.8	78.5
171	18.8	14.8	79.1
172	10.1	7.72	76.4
173	1.30	1.01	77.7
174	73.1	56.5	77.2
175	3.39	2.58	76.1
176	6.02	4.45	73.9
177	32.2	24.9	77.2
178	12.6	9.63	76.4
179	25.7	23.5	91.4
180	113	87.0	76.9
183	39.4	30.6	77.7
185	7.73	6.00	77.6
187	65.5	50.1	76.6
189	2.25	1.77	78.7
190	12.9	10.9	84.4
191	2.44	1.90	77.9
193	6.35	4.88	76.9
194	22.7	16.8	73.6
195	12.7	9.84	77.3
196	8.31	7.37	88.7
197	1.31	0.97	74.0
198	1.60	1.20	75.0
199	23.3	17.3	74.3
200	3.92	2.96	75.5
201	3.43	2.53	73.8
202	4.59	3.51	76.5
203	18.6	14.4	77.6
205	1.41	1.03	73.0
206	6.22	4.66	74.9
208	1.12	0.88	78.6
209	0.58	0.58	99.1
Total PCBs	4540	3475	76.5

* The reported values are from SG-1 analysis only. Low recoveries for these congeners result from carry-over into SG-2 during silica gel fractionation. Historic CERC data shows that carry-over of these congeners into SG-2 (using the materials and methods described in this report) represents less than 5 % of total PBCs.

Table III

GC-ECD Congener Specific Analysis for PCBs

Column Selection by Congener

Congener Identification	Analytical Column	Congener Identification	Analytical Column	Congener Identification	Analytical Column	Congener Identification	Analytical Column
001	DB-17	048	DB-17	109	DB-5	170	DB-5&17
003	DB-17	049	DB-5	110	DB-5	171	DB-17
004	DB-17	051	DB-17	112	DB-5	172	DB-5
005	DB-17	052	DB-5	113	DB-5	173	DB-5
006	DB-17	053	DB-5	114	DB-17	174	DB-17
007	DB-17	054	DB-17	115	DB-17	175	DB-5
008	DB-17	055	DB-17	117	DB-5	176	DB-17
009	DB-17	056,060	DB-5	118	DB-5	177	DB-5
010	DB-17	057	DB-5	119	DB-17	178	DB-5
011	DB-17	058	DB-5	122	DB-17	179	DB-5
015	DB-17	063	DB-17	123	DB-5	180	DB-5
016	DB-5&17	064	DB-17	128	DB-5	183	DB-17
017	DB-5&17	066	DB-17	129	DB-5	185	DB-17
018	DB-5	067	DB-17	130	DB-17	187	DB-5
019	DB-5	069	DB-17	131	DB-17	189	DB-5
020	DB-17	070	DB-5	132	DB-17	190	DB-5&17
022	DB-5	071	DB-5	133	DB-5	191	DB-5
024	DB-5&17	072	DB-5	134	DB-5	193	DB-5
025	DB-5	074	DB-5	136	DB-5	194	DB-5
026	DB-17	075	DB-5	137	DB-5	195	DB-17
027	DB-17	082	DB-5	138	DB-17	196	DB-5
028	DB-5&17	083	DB-17	139	DB-17	197	DB-5
031	DB-17	084	DB-5	141	DB-5	198	DB-5
032	DB-17	085	DB-5	144	DB-17	199	DB-5
033	DB-17	086	DB-5	146	DB-5	200	DB-5
034	DB-5	087	DB-17	147	DB-5	201	DB-5
035	DB-5	090	DB-17	149	DB-5	202	DB-17
037,059	DB-5	091	DB-5	151	DB-5	203	DB-17
040	DB-17	092	DB-5	153	DB-5&17	205	DB-5
041	DB-17	095	DB-5&17	156	DB-5&17	206	DB-17
042	DB-17	096	DB-5	157	DB-5	208	DB-17
043	DB-5	097	DB-5	158	DB-5	209	DB-5&17
044	DB-5	099	DB-17	163	DB-17		
045	DB-5	101	DB-17	164	DB-17		
046	DB-5	102	DB-5	166	DB-5		
047	DB-5&17	105	DB-17	167	DB-5		

Table IV

Congener Specific Analyses Results for Site 9-BST021.26 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
001	<MDL	048	1.28
003	0.37	049	<MQL
004	0.61	051	0.77
005	<MDL	052	<MQL
006	<MQL	053	3.76
007	<MQL	054	<MQL
008	<MQL	055	0.12
009	<MQL	056,060	2.82
010	0.11	057	0.29
011	<MDL	058	<MDL
015	2.20	063	0.21
016	3.30	064	3.78
017	3.45	066	3.73
018	5.02	067	0.33
019	<MQL	069	0.96
020	0.25	070	<MQL
022	1.93	071	2.48
024	0.09	072	0.38
025	0.35	074	1.66
026	1.73	075	<MQL
027	1.46	082	<MQL
028	5.87	083	<MQL
031	2.95	084	<MQL
032	6.16	085	<MDL
033	1.48	086	0.21
034	0.31	087	<MQL
035	3.69	090	<MQL
037,059	1.06	091	<MQL
040	1.19	092	<MQL
041	0.54	095	<MQL
042	2.51	096	<MDL
043	5.95	097	<MQL
044	<MQL	099	<MQL
045	2.47	101	<MQL
046	1.30	102	<MQL
047	2.77	105	<MQL

Table IV (continued)

Congener Specific Analyses Results for Site 9-BST021.26 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
109	<MQL	170	1.05
110	<MQL	171	0.26
112	<MQL	172	0.14
113	0.10	173	<MQL
114	0.16	174	1.27
115	<MQL	175	0.05
117	0.23	176	0.06
118	<MQL	177	0.62
119	0.13	178	0.26
122	0.04	179	0.69
123	0.15	180	1.52
128	0.88	183	0.76
129	<MQL	185	0.12
130	0.31	187	1.53
131	<MQL	189	<MQL
132	<MQL	190	<MQL
133	0.08	191	0.05
134	0.41	193	0.10
136	<MQL	194	0.20
137	0.28	195	0.13
138	3.36	196	0.16
139	1.08	197	<MDL
141	0.99	198	<MQL
144	<MQL	199	0.36
146	0.85	200	<MQL
147	<MQL	201	<MQL
149	5.05	202	0.11
151	1.83	203	0.27
153	4.90	205	<MQL
156	0.18	206	<MQL
157	<MQL	208	<MDL
158	<MQL	209	<MDL
163	1.04	Total PCBs**	180
164	0.52		
166	0.08		
167	0.13		

* (raw analysis results – background)/3 = ng/SPMD

** Total PCBs not calculated as sum of quantifiable congeners

Table V

Congener Specific Analyses Results for Site 9-BFK000.02 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
001	<MDL	048	2.32
003	<MQL	049	<MQL
004	1.10	051	0.70
005	<MDL	052	<MQL
006	<MQL	053	3.68
007	<MQL	054	<MQL
008	3.80	055	0.15
009	<MQL	056,060	4.66
010	0.78	057	<MQL
011	<MDL	058	<MDL
015	2.64	063	0.23
016	4.65	064	4.89
017	8.23	066	6.03
018	9.52	067	0.25
019	<MQL	069	1.11
020	0.38	070	4.79
022	3.99	071	3.14
024	<MDL	072	<MDL
025	0.82	074	3.12
026	2.02	075	0.48
027	1.83	082	<MQL
028	18.2	083	<MQL
031	7.51	084	<MDL
032	9.42	085	<MDL
033	1.88	086	<MQL
034	0.07	087	<MQL
035	1.15	090	<MQL
037,059	0.93	091	<MDL
040	1.33	092	<MQL
041	0.96	095	<MDL
042	3.06	096	<MQL
043	1.73	097	<MQL
044	<MQL	099	<MQL
045	2.06	101	<MQL
046	0.81	102	<MDL
047	3.03	105	<MQL

Table V (continued)

Congener Specific Analyses Results for Site 9-BFK000.02 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
109	<MQL	170	<MQL
110	<MQL	171	<MQL
112	<MQL	172	<MQL
113	<MQL	173	<MDL
114	<MQL	174	<MQL
115	<MQL	175	<MQL
117	<MQL	176	<MDL
118	<MQL	177	<MQL
119	<MQL	178	<MQL
122	<MQL	179	<MQL
123	<MQL	180	<MQL
128	<MQL	183	<MQL
129	<MQL	185	<MQL
130	<MQL	187	<MQL
131	<MQL	189	<MDL
132	<MQL	190	<MQL
133	<MQL	191	<MQL
134	<MQL	193	<MQL
136	<MDL	194	<MQL
137	<MDL	195	<MQL
138	<MQL	196	<MQL
139	0.17	197	<MDL
141	<MQL	198	<MDL
144	<MQL	199	<MQL
146	<MQL	200	<MDL
147	<MDL	201	<MDL
149	<MQL	202	<MQL
151	<MQL	203	<MQL
153	<MQL	205	<MDL
156	<MQL	206	<MQL
157	<MQL	208	<MDL
158	<MQL	209	<MDL
163	<MQL	Total PCBs**	167
164	<MQL		
166	<MQL		
167	<MQL		

* (raw analysis results – background)/3 = ng/SPMD

** Total PCBs not calculated as sum of quantifiable congeners

Table VI

Congener Specific Analyses Results for Site VA0025054-001 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
001	3.04	048	<MQL
003	6.09	049	<MQL
004	7.72	051	<MDL
005	<MDL	052	<MDL
006	3.53	053	<MQL
007	0.50	054	<MQL
008	<MQL	055	<MQL
009	0.43	056,060	0.94
010	0.09	057	<MDL
011	<MDL	058	<MDL
015	3.23	063	<MQL
016	0.99	064	<MQL
017	4.24	066	1.04
018	6.57	067	0.17
019	<MQL	069	0.38
020	0.17	070	<MQL
022	1.12	071	<MQL
024	<MDL	072	<MDL
025	<MDL	074	1.06
026	6.43	075	0.34
027	0.68	082	0.88
028	2.45	083	<MDL
031	2.43	084	<MQL
032	1.55	085	<MDL
033	1.80	086	<MDL
034	1.04	087	<MDL
035	5.41	090	<MQL
037,059	0.76	091	<MDL
040	<MQL	092	<MQL
041	<MDL	095	<MDL
042	1.07	096	<MDL
043	0.38	097	<MQL
044	<MQL	099	<MDL
045	0.39	101	<MDL
046	0.59	102	<MQL
047	3.29	105	<MQL

Table VI (continued)

Congener Specific Analyses Results for Site VA0025054-001 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
109	<MQL	170	<MDL
110	<MQL	171	<MQL
112	<MQL	172	<MDL
113	0.10	173	<MQL
114	<MQL	174	<MQL
115	<MDL	175	<MQL
117	<MDL	176	<MDL
118	<MQL	177	<MQL
119	0.17	178	<MQL
122	<MQL	179	<MQL
123	0.39	180	<MDL
128	<MQL	183	0.68
129	<MQL	185	<MQL
130	<MQL	187	<MQL
131	<MQL	189	<MQL
132	<MDL	190	<MDL
133	<MDL	191	0.11
134	<MDL	193	<MQL
136	<MQL	194	<MQL
137	<MQL	195	<MDL
138	<MDL	196	<MDL
139	0.21	197	<MDL
141	<MQL	198	0.04
144	<MQL	199	<MDL
146	<MQL	200	<MQL
147	<MDL	201	<MQL
149	<MQL	202	<MQL
151	<MQL	203	<MDL
153	<MQL	205	<MDL
156	<MDL	206	<MDL
157	<MQL	208	<MDL
158	<MQL	209	<MDL
163	<MDL	Total PCBs**	89
164	<MDL		
166	0.04		
167	<MQL		

* (raw analysis results – background)/3 = ng/SPMD

** Total PCBs not calculated as sum of quantifiable congeners

Table VII

Congener Specific Analyses Results for Site 9-BPB000.02 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
001	<MDL	048	3.44
003	<MDL	049	32.7
004	8.16	051	3.09
005	<MDL	052	36.5
006	2.08	053	18.0
007	0.85	054	<MDL
008	1.97	055	0.39
009	0.69	056,060	12.1
010	1.39	057	0.49
011	<MDL	058	0.11
015	5.94	063	0.92
016	22.3	064	19.3
017	5.19	066	15.7
018	8.43	067	1.26
019	1.20	069	2.69
020	0.70	070	7.51
022	4.94	071	11.7
024	0.37	072	0.45
025	0.66	074	5.69
026	2.70	075	1.77
027	8.14	082	1.58
028	10.7	083	0.16
031	5.50	084	<MQL
032	34.6	085	<MDL
033	2.26	086	0.36
034	0.40	087	<MQL
035	10.4	090	0.22
037,059	5.13	091	<MQL
040	5.46	092	<MQL
041	1.98	095	<MQL
042	11.8	096	20.70
043	5.77	097	3.74
044	40.3	099	<MQL
045	12.8	101	<MQL
046	5.43	102	0.59
047	7.03	105	1.57

Table VII (continued)

Congener Specific Analyses Results for Site 9-BPB000.02 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
109	0.46	170	<MQL
110	9.13	171	0.14
112	0.23	172	0.07
113	0.18	173	<MQL
114	0.16	174	0.72
115	0.35	175	0.05
117	0.45	176	<MQL
118	<MQL	177	0.34
119	0.29	178	0.15
122	0.05	179	0.48
123	<MQL	180	0.93
128	<MQL	183	0.53
129	<MQL	185	0.08
130	<MQL	187	0.97
131	<MQL	189	<MQL
132	<MQL	190	<MQL
133	<MQL	191	0.07
134	<MQL	193	0.05
136	<MQL	194	0.11
137	<MQL	195	<MQL
138	<MQL	196	<MQL
139	0.65	197	<MDL
141	<MQL	198	<MQL
144	<MQL	199	0.22
146	0.56	200	<MQL
147	<MQL	201	<MQL
149	<MQL	202	0.08
151	1.26	203	0.19
153	<MQL	205	0.04
156	<MQL	206	<MQL
157	0.13	208	<MDL
158	<MQL	209	<MDL
163	0.71	Total PCBs**	505
164	0.41		
166	0.11		
167	0.12		

* (raw analysis results – background)/3 = ng/SPMD

** Total PCBs not calculated as sum of quantifiable congeners

Table VIII

Congener Specific Analyses Results for Site 9-WVC000.05 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
001	<MDL	048	1.03
003	<MDL	049	<MQL
004	1.19	051	0.86
005	<MDL	052	<MDL
006	<MQL	053	2.07
007	<MQL	054	<MQL
008	<MQL	055	0.08
009	<MDL	056,060	1.35
010	0.14	057	0.22
011	<MDL	058	<MDL
015	1.03	063	0.17
016	1.29	064	2.23
017	3.04	066	2.45
018	3.53	067	0.26
019	<MQL	069	1.46
020	0.19	070	<MQL
022	1.82	071	1.73
024	<MQL	072	<MQL
025	0.20	074	0.97
026	1.17	075	0.63
027	0.47	082	<MQL
028	4.72	083	<MQL
031	2.34	084	<MQL
032	2.05	085	<MDL
033	1.27	086	<MQL
034	0.09	087	<MQL
035	3.02	090	0.23
037,059	0.50	091	<MQL
040	0.75	092	<MQL
041	0.50	095	<MQL
042	1.53	096	<MDL
043	2.69	097	<MQL
044	<MQL	099	<MQL
045	1.09	101	<MQL
046	0.57	102	<MQL
047	3.17	105	<MQL

Table VIII (continued)

Congener Specific Analyses Results for Site 9-WVC000.05 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
109	<MQL	170	2.27
110	<MQL	171	0.63
112	<MQL	172	0.41
113	<MQL	173	0.05
114	0.17	174	3.83
115	<MQL	175	0.13
117	0.22	176	0.29
118	<MQL	177	1.73
119	0.14	178	0.95
122	<MQL	179	2.33
123	0.09	180	4.22
128	0.73	183	1.70
129	<MQL	185	0.38
130	0.29	187	4.62
131	<MQL	189	0.04
132	2.50	190	0.36
133	0.09	191	0.07
134	0.53	193	0.32
136	2.18	194	0.49
137	<MQL	195	0.27
138	4.73	196	0.34
139	0.62	197	<MQL
141	2.12	198	0.05
144	0.61	199	0.84
146	1.59	200	<MQL
147	0.08	201	0.10
149	10.75	202	0.19
151	5.36	203	0.55
153	9.97	205	0.05
156	<MQL	206	<MQL
157	<MQL	208	<MDL
158	0.60	209	<MDL
163	2.33	Total PCBs**	170
164	0.55		
166	<MQL		
167	0.12		

* (raw analysis results – background)/3 = ng/SPMD

** Total PCBs not calculated as sum of quantifiable congeners

Table IX

Congener Specific Analyses Results for Site 9-BST028.90 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
001	<MDL	048	<MQL
003	0.31	049	<MDL
004	1.17	051	<MQL
005	<MDL	052	<MDL
006	<MQL	053	<MDL
007	<MDL	054	<MDL
008	<MQL	055	<MDL
009	<MDL	056,060	<MQL
010	0.26	057	<MDL
011	<MDL	058	<MDL
015	<MQL	063	<MQL
016	<MQL	064	<MDL
017	1.93	066	<MQL
018	<MQL	067	0.13
019	<MDL	069	2.09
020	<MQL	070	<MDL
022	<MQL	071	<MQL
024	<MDL	072	2.57
025	<MDL	074	<MQL
026	1.42	075	0.26
027	<MQL	082	<MQL
028	<MQL	083	<MDL
031	<MQL	084	<MDL
032	<MQL	085	<MDL
033	<MQL	086	<MDL
034	0.08	087	<MQL
035	3.02	090	<MQL
037,059	0.15	091	<MDL
040	<MQL	092	<MQL
041	<MQL	095	<MDL
042	<MQL	096	<MDL
043	4.29	097	<MDL
044	<MDL	099	<MQL
045	<MQL	101	<MQL
046	0.19	102	<MDL
047	0.94	105	<MQL

Table IX (continued)

Congener Specific Analyses Results for Site 9-BST028.90 SPMDs

(Corrected for Background)*

Congener Identification	ng/SPMD	Congener Identification	ng/SPMD
109	<MQL	170	<MQL
110	<MQL	171	<MQL
112	<MDL	172	<MQL
113	<MDL	173	<MDL
114	<MQL	174	<MQL
115	<MQL	175	<MQL
117	<MDL	176	<MQL
118	<MQL	177	<MQL
119	<MQL	178	<MQL
122	<MQL	179	<MQL
123	<MQL	180	<MQL
128	<MQL	183	<MQL
129	<MQL	185	<MQL
130	<MQL	187	<MQL
131	<MDL	189	<MDL
132	<MQL	190	<MDL
133	<MQL	191	<MQL
134	<MQL	193	<MQL
136	<MQL	194	<MQL
137	<MQL	195	<MQL
138	<MQL	196	<MQL
139	0.12	197	<MDL
141	<MQL	198	<MDL
144	<MDL	199	<MQL
146	<MQL	200	<MDL
147	<MDL	201	<MDL
149	<MQL	202	<MQL
151	<MQL	203	<MQL
153	<MQL	205	<MQL
156	<MDL	206	<MQL
157	<MQL	208	<MDL
158	<MQL	209	<MDL
163	<MQL	Total PCBs**	32
164	<MQL		
166	<MQL		
167	<MQL		

* (raw analysis results – background)/3 = ng/SPMD

** Total PCBs not calculated as sum of quantifiable congeners

Table X

Recovery of Performance Reference Compounds and Water Concentration

Mean Recovery From Fabrication Blanks, Field Blanks,

and Procedural Blanks (n=8)

PRC Compounds	**μg / SPMD by GC-FID**
Acenaphthylene-d_{10}	6.18 ± 1.07
Acenaphthene-d_{10}	6.55 ± 1.01
Fluorene-d_{10}	7.18 * ± 0.98
Phenanthrene-d_{10}	11.1 ± 1.18
Pyrene-d_{10}	11.2 ± 1.17

Mean Recovery From Deployment Sites (n=4)

PRC Compounds	**μg / SPMD by GC-FID**
Acenaphthylene-d_{10}	0.74 ± 0.25
Acenaphthene-d_{10}	1.66 ± 0.72
Fluorene-d_{10}	2.65 ** ± 1.03
Phenanthrene-d_{10}	10.3*** ± 3.95
Pyrene-d_{10}	11.0*** ± 0.85

Estimation of Water Concentration Using PRC Measurements

PRC Compound	**k_{eprc} (d^{-1})**
Acenaphthylene-d_{10}	0.0708
Acenaphthene-d_{10}	0.0458
Fluorene-d_{10}	0.0332 ****
Phenanthrene-d_{10}	0.0025
Pyrene-d_{10}	0.0006

$$k_{eprc} = \frac{\ln(C_{SPMDo} / C_{SPMD})}{t}$$

* C_{SPMDDo}

** C_{SPMD}

*** High recovery indicates no photodegradation

**** Value used in calculation of water concentrations

Table XI

SPMD Derived Water Concentrations at Site 9-BST021.26

Congener Identification	pg / L	Congener Identification	pg / L	Congener Identification	pg / L
6	UtD	77	UtD	134	3.0
18	8.8	78	UtD	136	UtD
19	UtD	79	UtD	137	2.8
22	12	81	UtD	138	24
25	2.1	82	UtD	141	7.1
26	11	83	UtD	146	6.2
28	24	84	UtD	149	31
31	15	85	UtD	151	12
40	6.2	87	UtD	153	53
41	3.1	90	UtD	156	2.5
42	14	91	UtD	157	UtD
43	33	92	UtD	158	UtD
44	UtD	95	UtD	169	UtD
45	11	97	UtD	172	3.9
46	10	99	UtD	174	14
47	13	101	UtD	176	1.0
48	13	105	UtD	178	3.0
49	UtD	107	1.9	179	11
51	5.6	110	UtD	180	20
52	UtD	114	1.3	183	8.6
53	27	118	UtD	187	1.2
63	1.4	119	1.0	194	5.4
64	18	126	0.62	199	6.9
66	24	127	3.2	201	UtD
67	2.2	128	6.9	207	UtD
70	UtD	129	UtD	Total PCB*	1300
74	9.3	130	2.7		

UtD = Unable to Derive (i.e. individual congeners not present at > MQL)

* Total PCB value calculated directly from Total PCB (ng/SPMD) and not as sum of those individual congeners present at > MQL.

Table XII

SPMD Derived Water Concentrations at Site 9-BFK000.02

Congener Identification	pg / L	Congener Identification	pg / L	Congener Identification	pg / L
6	UtD	77	UtD	134	UtD
18	17	78	UtD	136	UtD
19	UtD	79	UtD	137	UtD
22	24	81	UtD	138	UtD
25	5.0	82	UtD	141	UtD
26	12	83	UtD	146	UtD
28	75	84	UtD	149	UtD
31	37	85	UtD	151	UtD
40	7.0	87	UtD	153	UtD
41	5.4	90	UtD	156	UtD
42	17	91	UtD	157	UtD
43	9.7	92	UtD	158	UtD
44	UtD	95	UtD	169	UtD
45	9.0	97	UtD	172	0.84
46	6.4	99	UtD	174	2.3
47	14	101	UtD	176	0.00
48	23	105	UtD	178	0.57
49	UtD	107	UtD	179	1.7
51	5.1	110	UtD	180	4.2
52	UtD	114	UtD	183	1.7
53	27	118	UtD	187	0.26
63	1.5	119	UtD	194	1.3
64	23	126	UtD	199	1.8
66	40	127	UtD	201	0.13
67	1.6	128	UtD	207	0.00
70	24	129	UtD	Total PCB*	1200
74	18	130	UtD		

UtD = Unable to Derive (i.e. individual congeners not present at > MQL)

* Total PCB value calculated directly from Total PCB (ng/SPMD) and not as sum of those individual congeners present at > MQL.

Table XIII

SPMD Derived Water Concentrations at Site VA0025054-001

Congener Identification	pg / L	Congener Identification	pg / L	Congener Identification	pg / L
6	9.6	77	UtD	134	UtD
18	12	78	UtD	136	UtD
19	UtD	79	UtD	137	UtD
22	6.8	81	UtD	138	UtD
25	UtD	82	6.9	141	UtD
26	39	83	UtD	146	UtD
28	10	84	UtD	149	UtD
31	12	85	UtD	151	UtD
40	UtD	87	UtD	153	UtD
41	UtD	90	UtD	156	UtD
42	6.0	91	UtD	157	UtD
43	2.1	92	UtD	158	UtD
44	UtD	95	UtD	169	UtD
45	1.7	97	UtD	172	UtD
46	4.7	99	UtD	174	UtD
47	15	101	UtD	176	UtD
48	UtD	105	UtD	178	UtD
49	UtD	107	UtD	179	UtD
51	UtD	110	UtD	180	UtD
52	UtD	114	UtD	183	7.6
53	UtD	118	UtD	187	UtD
63	UtD	119	1.3	194	UtD
64	UtD	126	0.17	199	UtD
66	6.9	127	8.5	201	UtD
67	1.1	128	UtD	207	UtD
70	UtD	129	UtD	Total PCB*	640
74	6.0	130	UtD		

UtD = Unable to Derive (i.e. individual congeners not present at > MQL)

* Total PCB value calculated directly from Total PCB (ng/SPMD) and not as sum of those individual congeners present at > MQL.

Table XIV

SPMD Derived Water Concentrations at Site 9-BPB000.02

Congener Identification	pg / L	Congener Identification	pg / L	Congener Identification	pg / L
6	5.7	77	UtD	134	UtD
18	15	78	UtD	136	UtD
19	7.9	79	UtD	137	UtD
22	30	81	UtD	138	UtD
25	4.0	82	12	141	UtD
26	16	83	1.2	146	4.1
28	44	84	UtD	149	UtD
31	27	85	UtD	151	8.2
40	29	87	UtD	153	UtD
41	11	90	1.2	156	UtD
42	66	91	UtD	157	1.7
43	32	92	UtD	158	UtD
44	190	95	UtD	169	UtD
45	56	97	30	172	2.0
46	43	99	UtD	174	8.1
47	33	101	UtD	176	UtD
48	34	105	14	178	1.6
49	210	107	3.0	179	7.6
51	22	110	56	180	12
52	200	114	1.3	183	5.9
53	130	118	UtD	187	0.76
63	6.0	119	2.3	194	3.0
64	89	126	0.83	199	4.3
66	100	127	0.92	201	UtD
67	8.3	128	UtD	207	UtD
70	37	129	UtD	Total PCB*	3700
74	32	130	UtD		

UtD = Unable to Derive (i.e. individual congeners not present at > MQL)

* Total PCB value calculated directly from Total PCB (ng/SPMD) and not as sum of those individual congeners present at > MQL.

Table XV

SPMD Derived Water Concentrations at Site 9-WVC000.05

Congener Identification	pg / L	Congener Identification	pg / L	Congener Identification	pg / L
6	UtD	77	UtD	134	3.8
18	6.2	78	UtD	136	14
19	UtD	79	UtD	137	UtD
22	11	81	UtD	138	34
25	1.2	82	UtD	141	15
26	7.1	83	UtD	146	12
28	20	84	UtD	149	66
31	12	85	UtD	151	35
40	4.0	87	UtD	153	110
41	2.8	90	1.3	156	UtD
42	8.6	91	UtD	157	UtD
43	15	92	UtD	158	6.00
44	UtD	95	UtD	169	UtD
45	4.8	97	UtD	172	11
46	4.5	99	UtD	174	43
47	15	101	UtD	176	4.6
48	10	105	UtD	178	11
49	UtD	107	UtD	179	37
51	6.3	110	UtD	180	56
52	UtD	114	1.3	183	19
53	15	118	UtD	187	3.8
63	1.1	119	1.1	194	13
64	10	126	UtD	199	16
66	16	127	2.0	201	1.9
67	1.7	128	5.7	207	UtD
70	UtD	129	UtD	Total PCB*	1200
74	5.5	130	2.5		

UtD = Unable to Derive (i.e. individual congeners not present at > MQL)

* Total PCB value calculated directly from Total PCB (ng/SPMD) and not as sum of those individual congeners present at > MQL.

Table XVI

SPMD Derived Water Concentrations at Site 9-BST028.90

Congener Identification	pg / L	Congener Identification	pg / L	Congener Identification	pg / L
6	UtD	77	UtD	134	UtD
18	UtD	78	UtD	136	UtD
19	UtD	79	UtD	137	UtD
22	UtD	81	UtD	138	UtD
25	0.00	82	UtD	141	UtD
26	8.6	83	UtD	146	UtD
28	UtD	84	UtD	149	UtD
31	UtD	85	UtD	151	UtD
40	UtD	87	UtD	153	UtD
41	UtD	90	UtD	156	UtD
42	UtD	91	UtD	157	UtD
43	24	92	UtD	158	UtD
44	UtD	95	UtD	169	UtD
45	UtD	97	UtD	172	UtD
46	1.5	99	UtD	174	UtD
47	4.4	101	UtD	176	UtD
48	UtD	105	UtD	178	UtD
49	UtD	107	UtD	179	UtD
51	UtD	110	UtD	180	UtD
52	UtD	114	UtD	183	UtD
53	UtD	118	UtD	187	UtD
63	UtD	119	UtD	194	UtD
64	UtD	126	UtD	199	UtD
66	UtD	127	UtD	201	UtD
67	0.83	128	UtD	207	UtD
70	UtD	129	UtD	Total PCB*	230
74	UtD	130	UtD		

UtD = Unable to Derive (i.e. individual congeners not present at > MQL)

* Total PCB value calculated directly from Total PCB (ng/SPMD) and not as sum of those individual congeners present at > MQL.

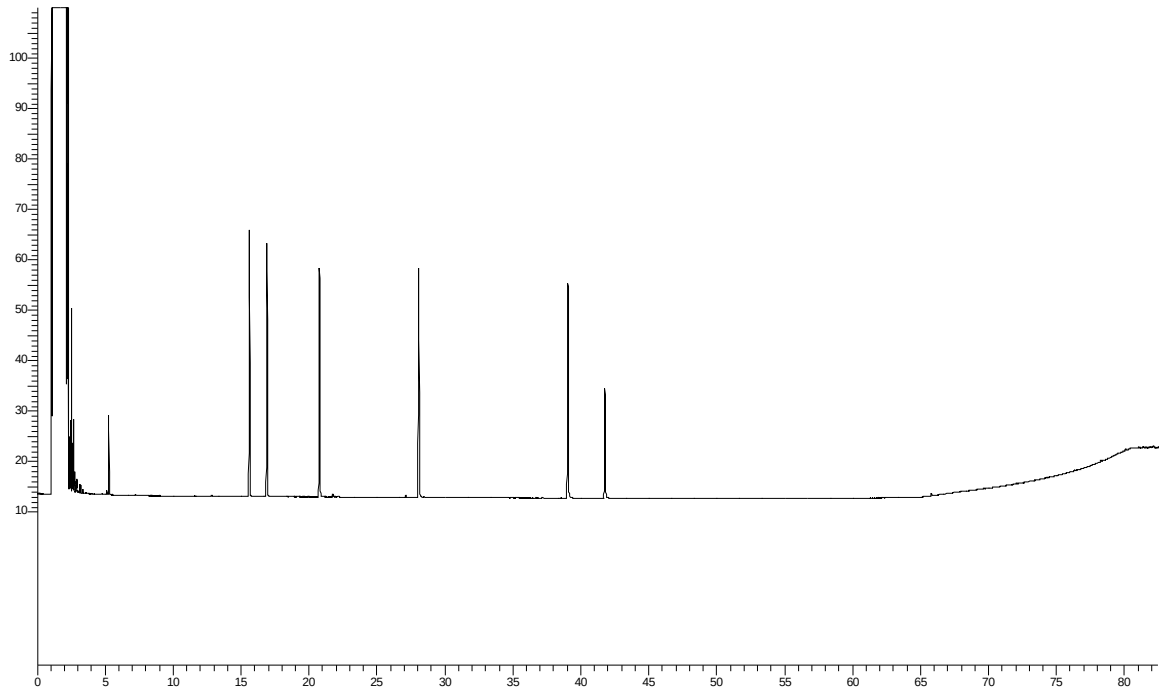
Table XVII

Lower Limits of PCB Water Concentration Estimation* For Sampling Conditions
In the Bluestone River Virginia During the April 2004 SPMD Deployment

Congener Identification	Estimated pg/L	Congener Identification	Estimated pg/L	Congener Identification	Estimated pg/L	Congener Identification	Estimated pg/L
4	0.67	51	53	112	57	172	3.3
5	1.5	52	0.70	113	0.23	173	0.60
6	0.10	53	2.6	114	0.50	174	0.37
7	1.9	54	11	115	0.43	175	5.3
8	0.93	55	0.77	117	1.6	176	0.53
9	5.0	56	0.23	118	1.5	177	0.60
10	0.80	57	4.0	119	37	178	1.6
11	0.10	58	0.87	122	0.90	179	1.2
15	0.10	63	0.20	123	0.13	180	3.3
16	2.2	64	0.33	128	0.60	183	7.0
17	1.3	66	14	129	6.0	185	3.2
18	1.4	67	6.3	130	1.8	187	0.33
19	12	69	0.33	131	1.9	189	5.0
20	6.0	70	0.37	132	1.3	190	0.43
22	0.33	71	23	133	17	191	2.13
24	1.5	72	4.3	134	0.53	193	0.43
25	0.20	74	1.1	136	2.6	194	0.87
26	0.40	75	4.3	137	17	195	1.6
27	1.4	82	1.3	138	1.4	196	2.3
28	0.47	83	5.7	139	25	197	2.4
31	5.0	84	1.3	141	0.53	198	2.3
32	7.7	85	40	144	6.3	199	0.70
33	2.1	86	0.23	146	2.30	201	8.0
34	4.0	87	0.60	147	4.33	202	1.2
35	0.10	90	21	149	0.43	203	1.3
37	1.1	91	1.2	151	29	205	2.5
40	0.73	92	16	153	11	206	0.70
41	1.4	95	13	156	50	208	2.9
42	0.60	96	15	157	5.3	Total PCBs	40
43	3.7	97	67	158	1.1		
44	0.60	99	23	163	4.3		
45	47	101	18	164	5.0		
46	2.9	102	73	166	2.4		
47	0.83	105	3.7	167	0.27		
48	7.0	109	10	170	0.43		
49	3.0	110	2.4	171	13		

* NOTE: MQL values applied to Excel calculator for water concentration estimation.

Figure 1
GC-FID Analysis of PRC Standard



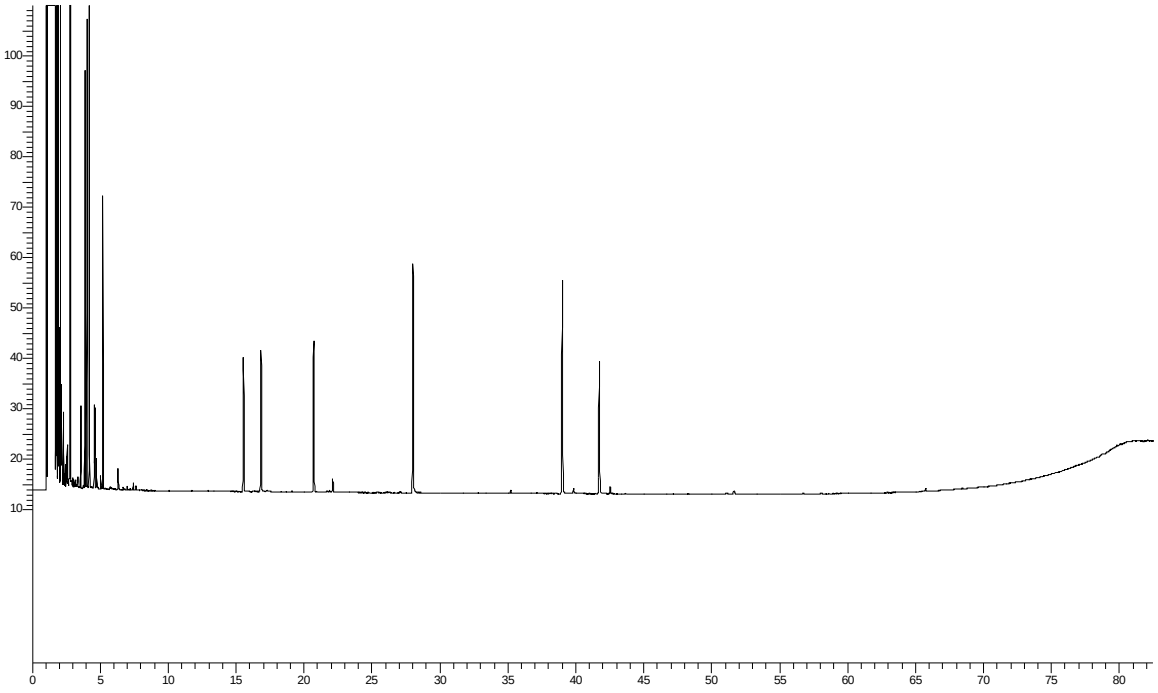
10 µg/mL PRC standard

NOTE: This chromatogram is representative of the analytical method for determinations of PRCs (Table X) with peak identifications as follows:

PRC Compounds	Retention times (minutes)
Acenaphthylene-d_{10}	15.71
Acenaphthene-d_{10}	17.00
Fluorene-d_{10}	20.87
Phenanthrene-d_{10}	28.17
Pyrene-d_{10}	39.16
4-Terphenyl- d_{14} as IIS	41.87

Figure 2

Representative GC-FID Analysis of SG-2 Fraction of SPMD Field Blank

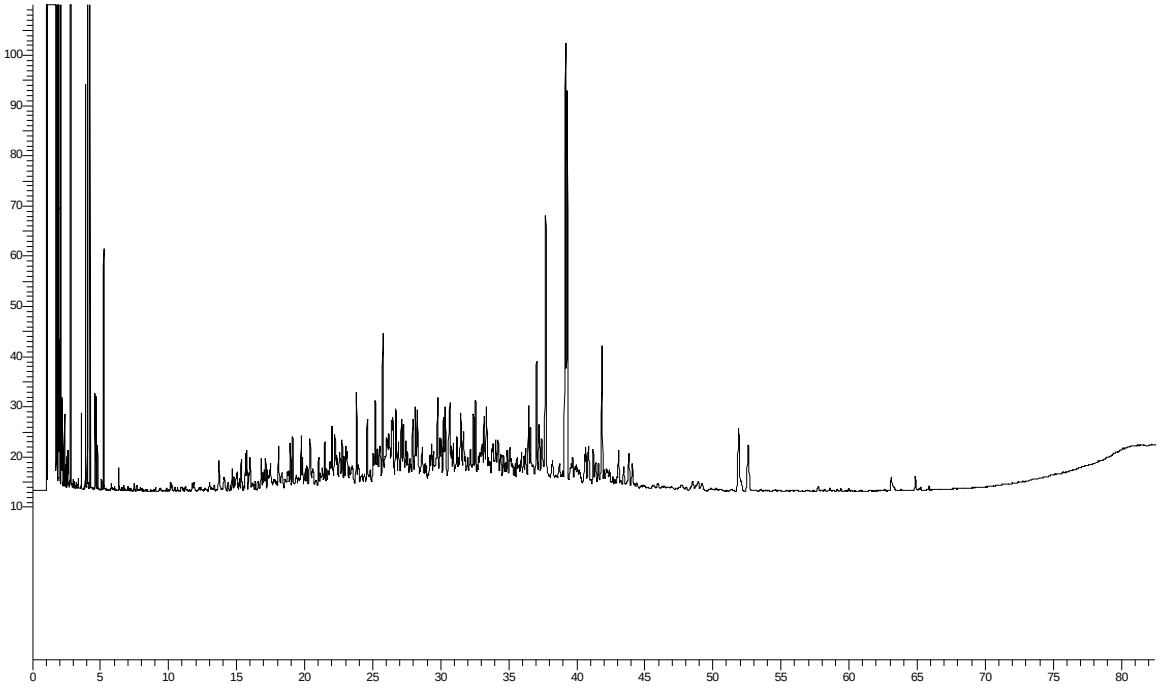


SPMD Field Blank of Site 9-BPB000.02

NOTE: This chromatogram is representative of the determinations of "C_{SPMDDo}" values from analyses of SPMD blanks (Table X)

Figure 3

Representative GC-FID Analysis of SG-2 Fraction of SPMD Deployment

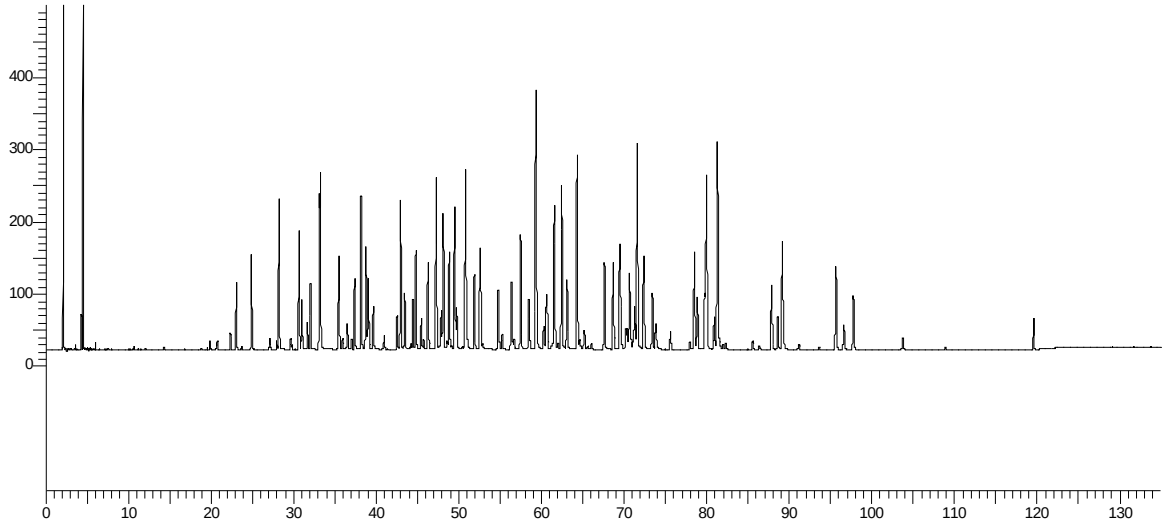


Deployed SPMD from Site 9-BPB000.02

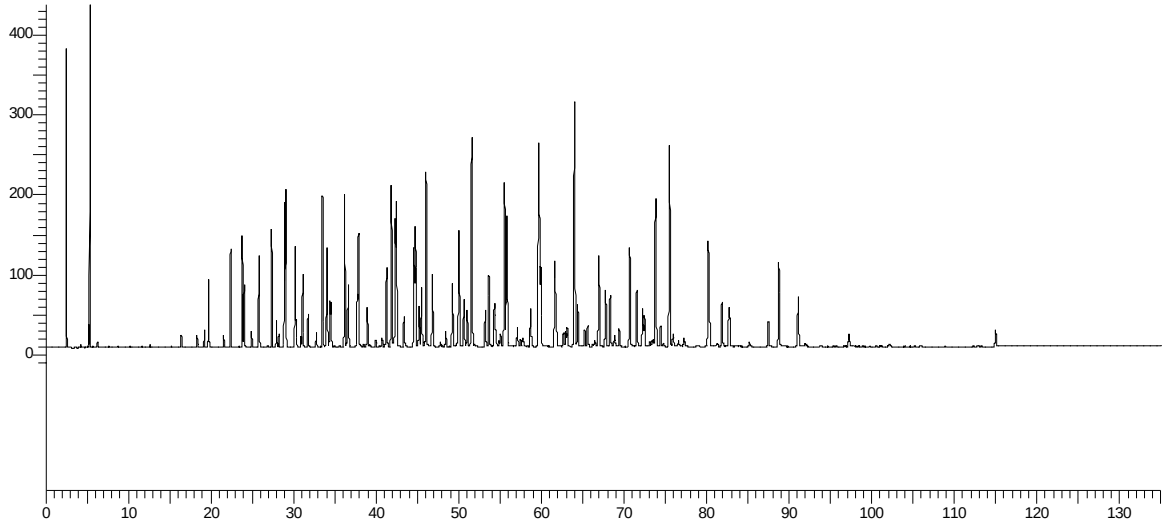
NOTE: This chromatogram is representative of the determinations of "C_{SPMD}" values from analyses of SPMD blanks (Table X)

Figure 4

GC-ECD Analyses of PCB Standard



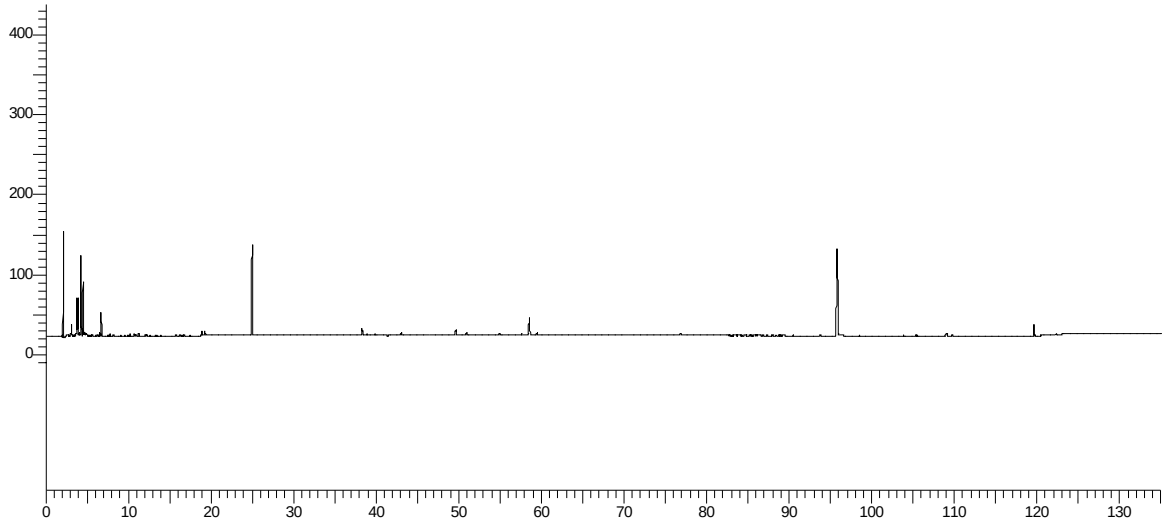
4000 ng/mL Total PCB Standard on DB-17



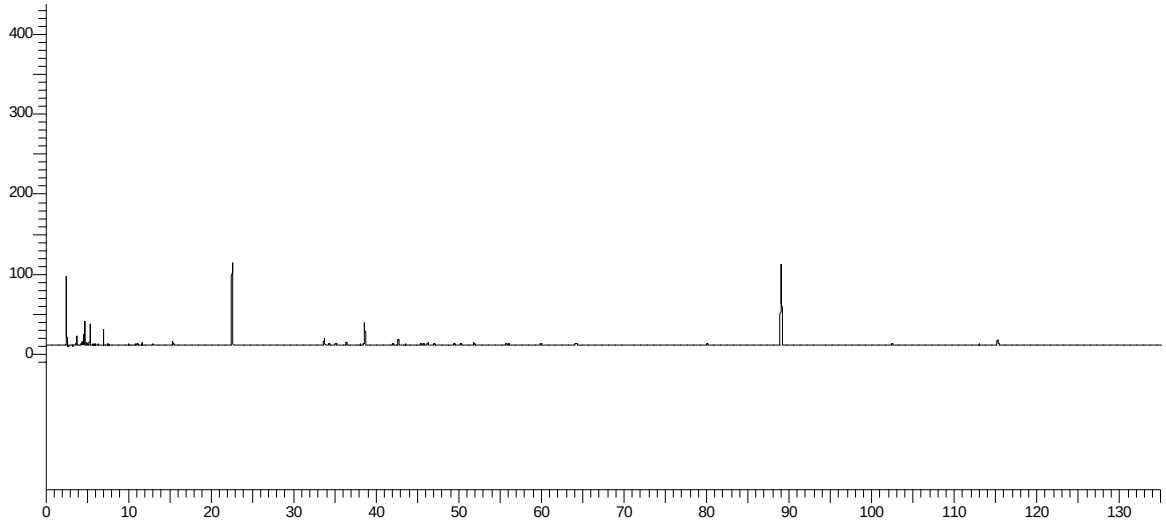
4000 ng/mL Total PCB Standard on DB-5

Figure 5

Representative GC-ECD Analysis of SG-1 Fraction of SPMD Field Blank



SPMD Field Blank of Site 9-BPB000.02 on DB-17

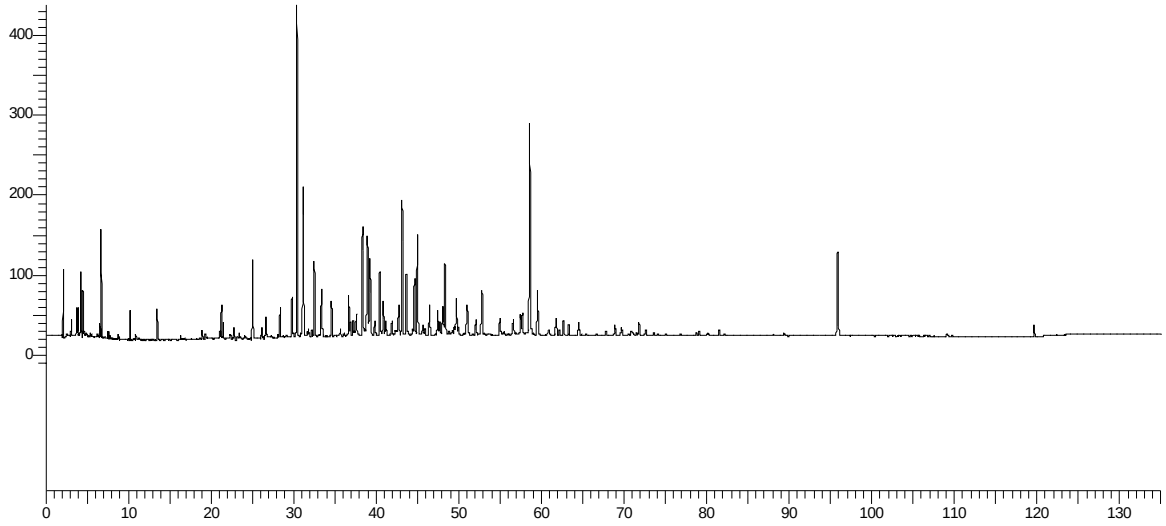


SPMD Field Blank of Site 9-BPB000.02 on DB-5

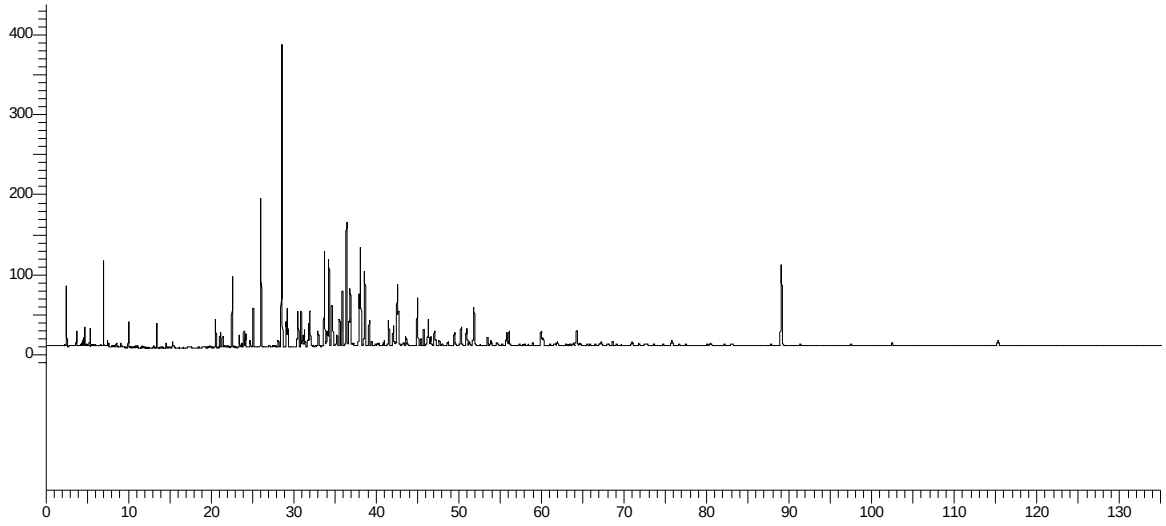
NOTE: Duel column analysis required (Table III) for complete resolution and quantification of individual congeners.

Figure 6

Representative GC-ECD Analysis of SG-1 Fraction of SPMD Deployment



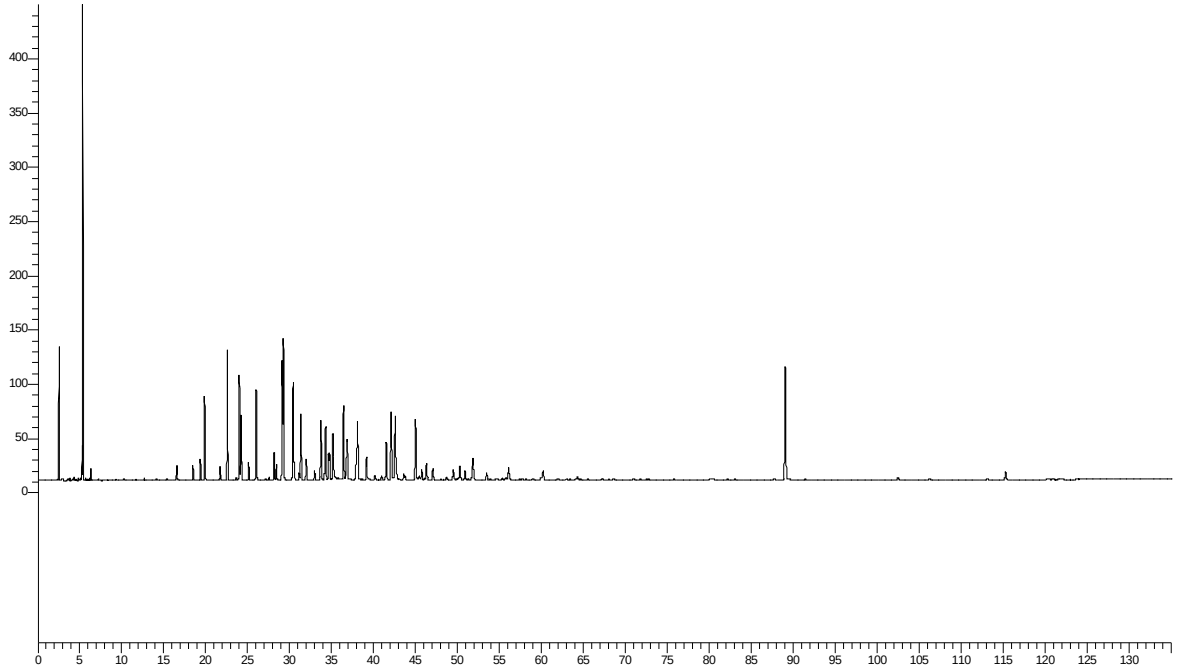
Deployed SPMD from Site 9-BPB000.02 on DB-17



Deployed SPMD from Site 9-BPB000.02 on DB-5

Figure 7

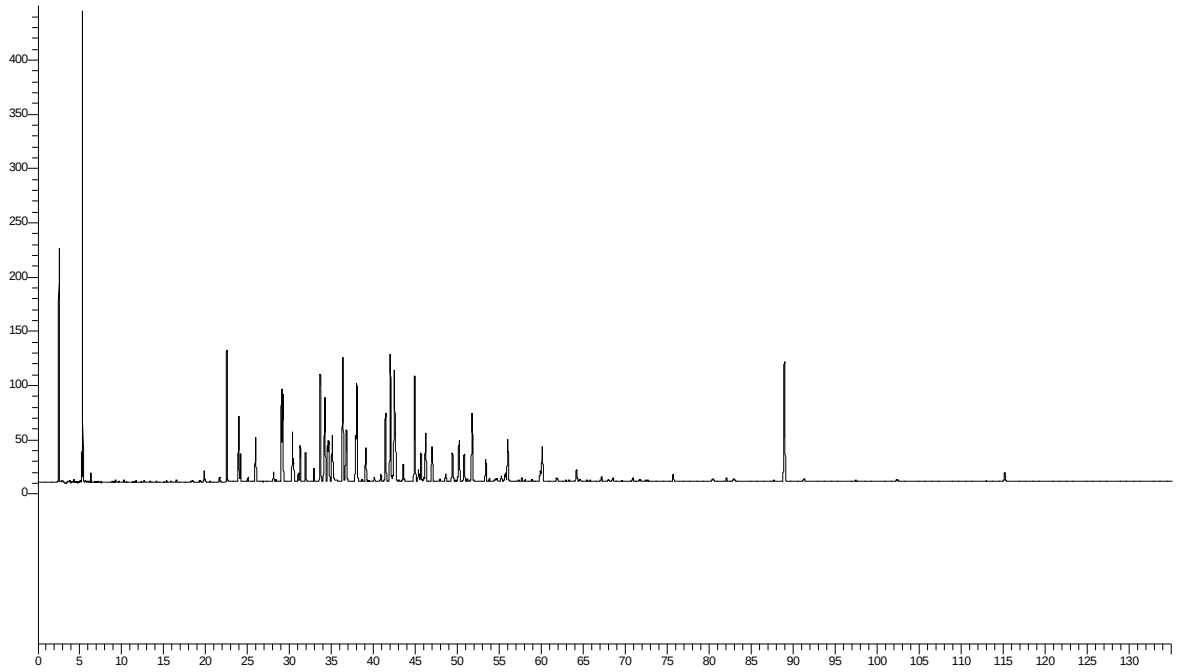
GC-ECD Profile of Aroclor® 1242 on DB-5



NOTE: 1000 ng/mL Standard

Figure 8

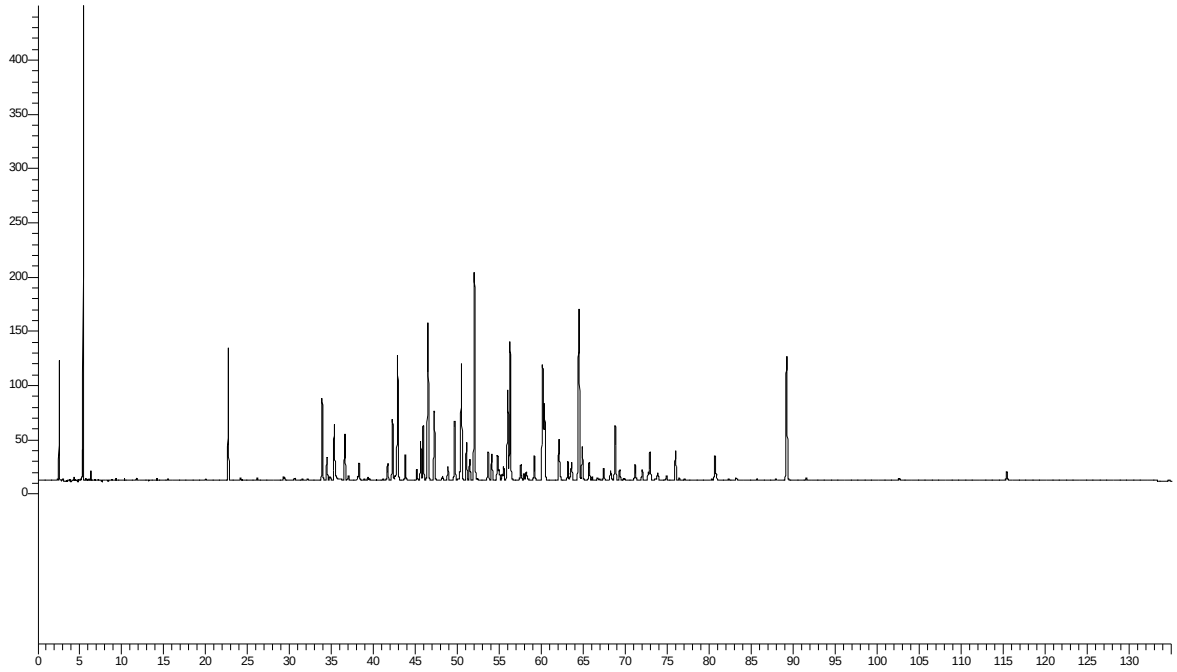
GC-ECD Profile of Aroclor® 1248 on DB-5



NOTE: 1000 ng/mL Standard

Figure 9

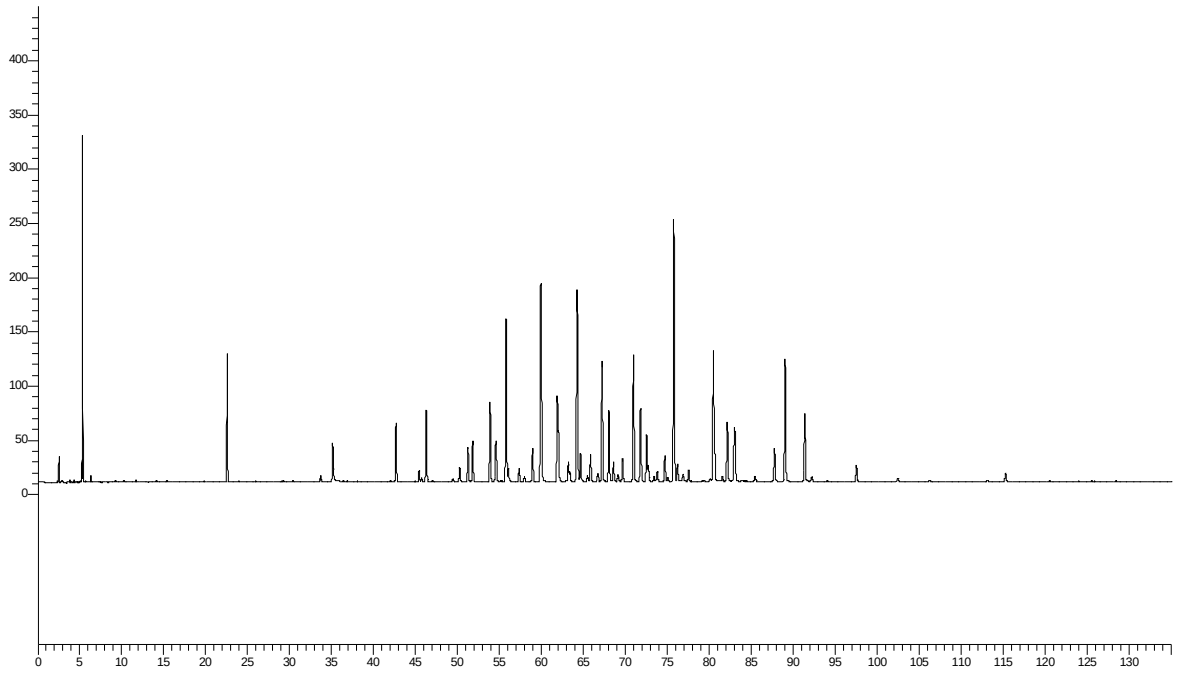
GC-ECD Profile of Aroclor® 1254 on DB-5



NOTE: 1000 ng/mL Standard

Figure 10

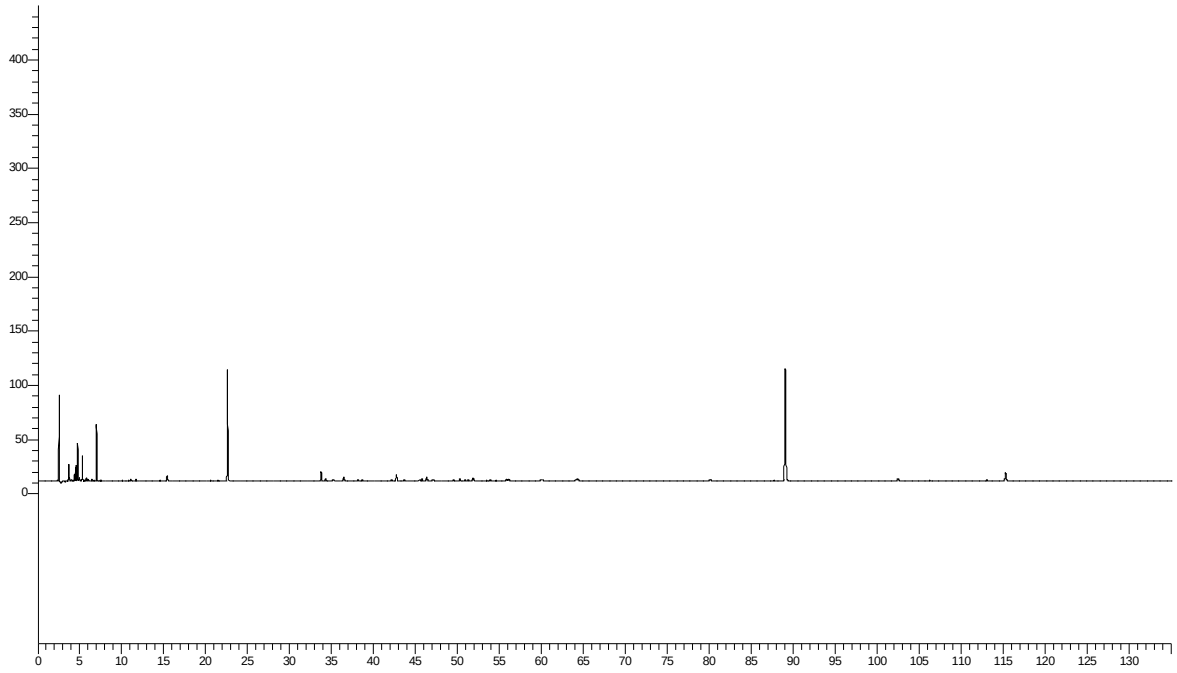
GC-ECD Profile of Aroclor® 1260 on DB-5



NOTE: 1000 ng/mL Standard

Figure 11

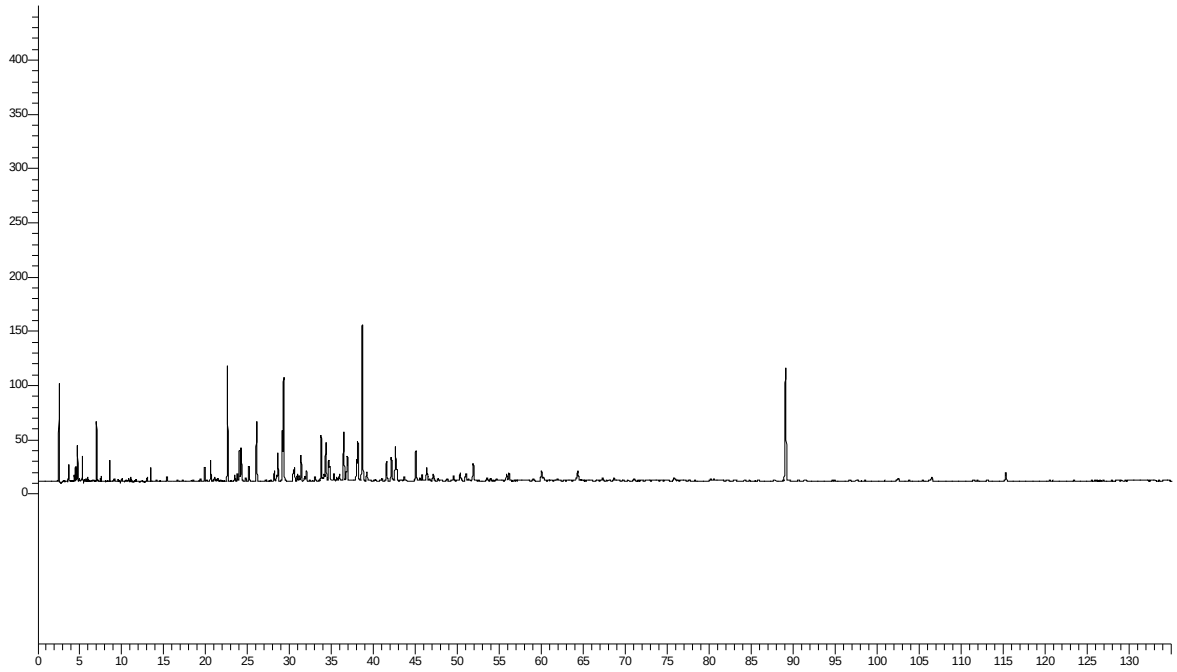
GC-ECD Profile of Site 9-BST021.26 on DB-5



NOTE: 3-SPMD composite injected at 1.0 mL in hexane

Figure 12

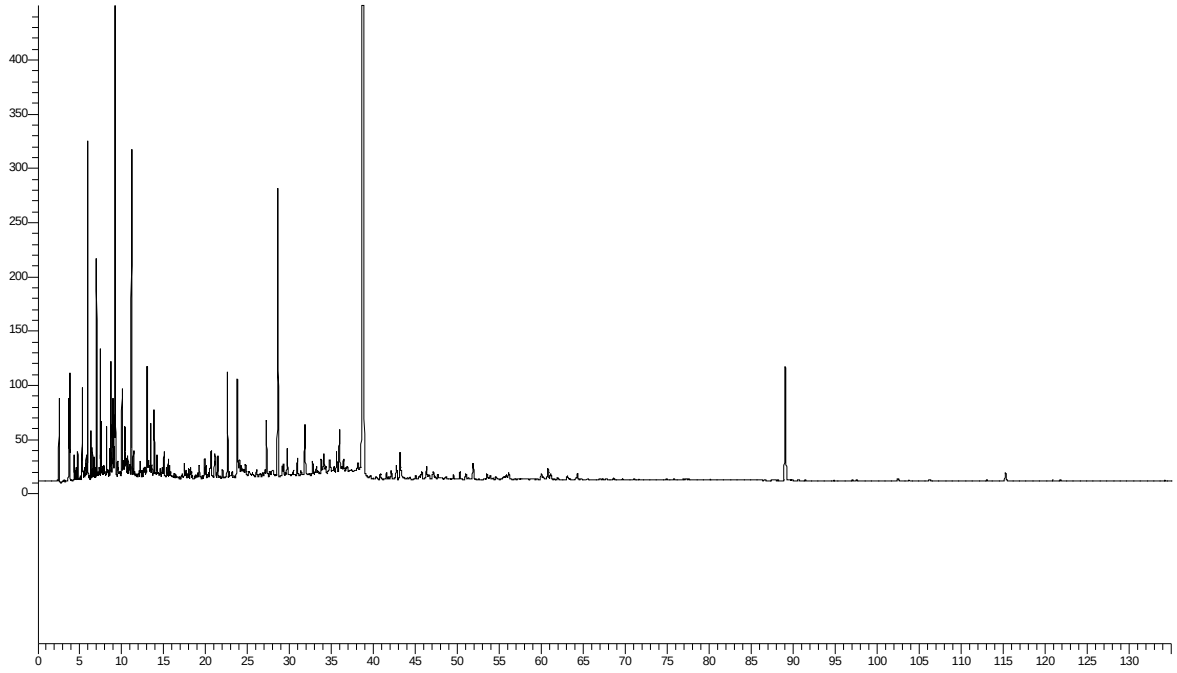
GC-ECD Profile of Site 9-BFK000.02 on DB-5



NOTE: 3-SPMD composite injected at 1.0 mL in hexane

Figure 13

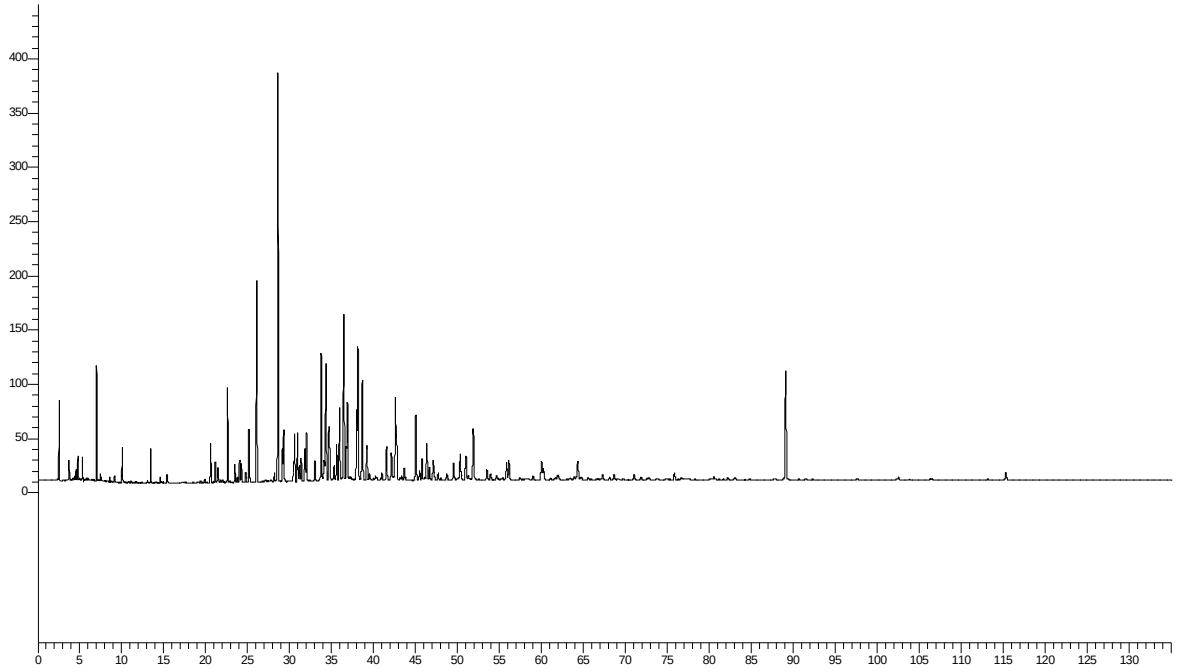
GC-ECD Profile of Site VA0025054-001 on DB-5



NOTE: 3-SPMD composite injected at 1.0 mL in hexane

Figure 14

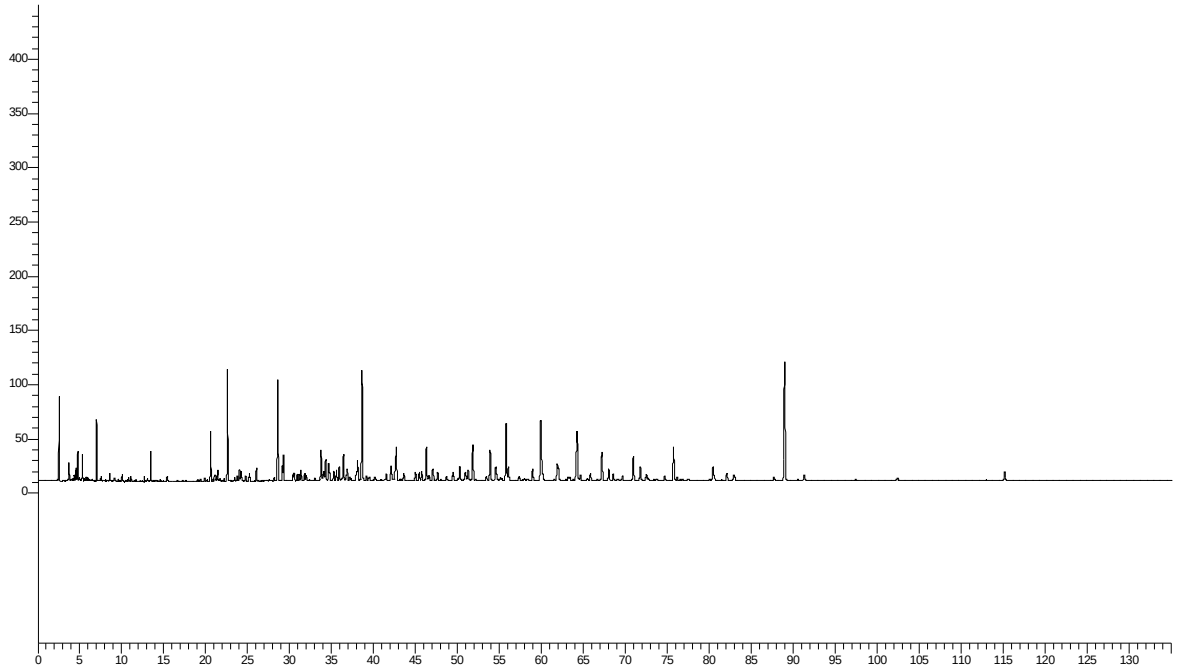
GC-ECD Profile of Site 9-BPB000.02 on DB-5



NOTE: 3-SPMD composite injected at 1.0 mL in hexane

Figure 15

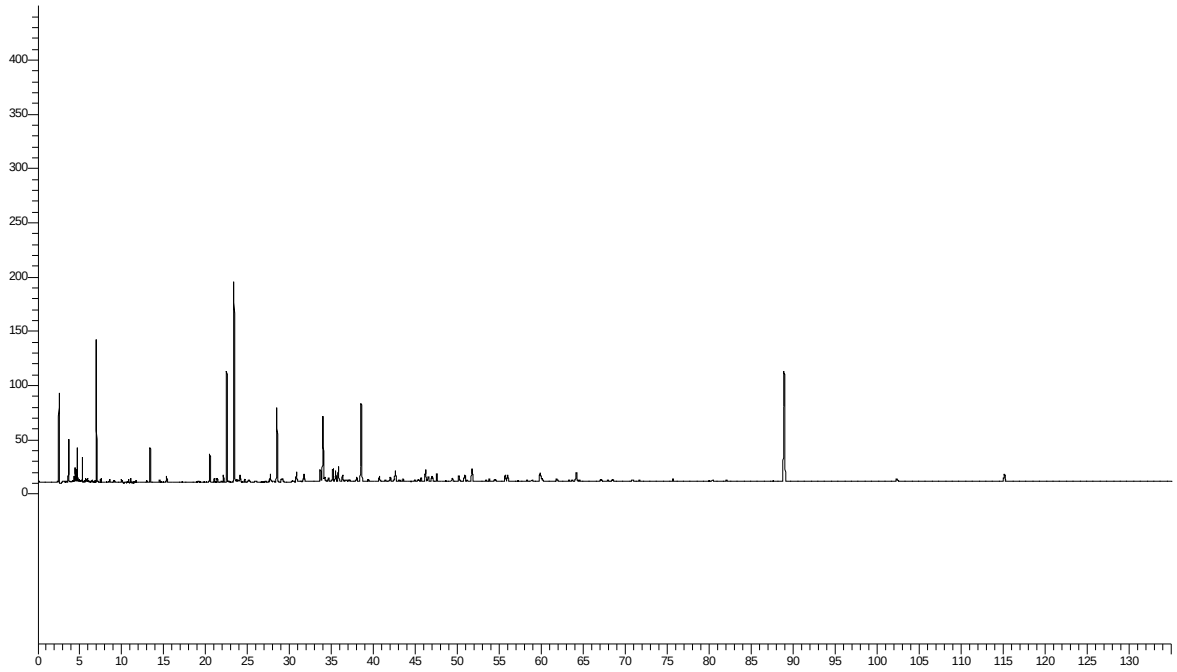
GC-ECD Profile of Site 9-WVC000.05 on DB-5



NOTE: 3-SPMD composite injected at 1.0 mL in hexane

Figure 16

GC-ECD Profile of Site 9-BST028.90 on DB-5



NOTE: 3-SPMD composite injected at 1.0 mL in hexane