Sediment Quality in Canadian Lake Erie Tributaries:

A Screening-Level Survey

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Executive Summary

A survey of sediment quality was undertaken in the summer of 2001 in the mouths of tributaries draining to the St. Clair River, Lake St. Clair and Lake Erie. A total of 115 samples were obtained, representing 100 tributaries. Fourteen (14) samples were blind duplicates and given fictitious names and one sample was taken from a site further upstream to coincide with Ontario Ministry of the Environment sampling sites.

The sampling program was based on the Guidelines for Collecting and Processing Samples of Stream Bed Sediment for Analysis of Trace Elements and Organic Contaminants, developed by the United States Geological Survey (USGS) for the U.S. National Water-Quality Assessment Program (NAWQA; Shelton and Capel, 1994). A number of sub-samples are combined at each site so that one sample is obtained that is representative of the overall conditions in that tributary.

The samples were analyzed for 26 organochlorine compounds plus seven (7) PCB Aroclors and Total PCBs. Sixteen (16) PAH compounds and 30 metals were analyzed, and the inorganic and organic carbon content as well as grain size distribution of each sample was determined. For many of the tributaries, this study represents the first information related to organic compounds in sediments.

Nine (9) organochlorine compounds were not detected in any sample. The DDT metabolite DDE was the most commonly detected organochlorine, with widespread occurrence. A large proportion of sites (35%) had total DDE concentrations exceeding the federal PEL (69% of sites exceeded the TEL). Many sites also had detectable parent DDT or metabolite DDD concentrations. Endosulphan, an in-use organochlorine pesticide, was also commonly found (endosulphan and/or its metabolite was detected at 16% of sites), but there is no sediment quality guidelines for this compound. Other organochlorine pesticides were detected at only one or two sites (e.g., methoxychlor, heptachlor, γ-chlordane, α-chlordane, lindane, β-HCH). The industrial organochlorine HCB and OCS were detected at one and two sites respectively, both of which were located in the St. Clair River corridor.

Polycyclic aromatic hydrocarbons (PAHs) were found more often, with one or more of the 16 PAH compounds detected at 14 sites (i.e., detection frequency of 19%). Exceedences of one or more federal TEL guideline for PAHs occurred at 10% of the sites and PEL exceedences occurred at a further two (2) sites. In general, PAH concentrations were lower than found on the lower great lakes. This is probably do to the lower urbanization found along Lake Erie.

At most sites, the detections of metals are likely related to the natural occurrence of trace elements in stream sediments. For some metals, however, concentrations appear to be elevated to a degree that is considered to be toxic to aquatic biota. These metals include: chromium, mercury, zinc. Nickel has a natural occurrence, in Sudbury which reflects levels of greater than two times the serious effect level. Other metals, including manganese and iron, appeared to be elevated at certain sites but these higher levels might be related to natural sources.

1.0 Introduction and Purpose

The Ecosystem Health Division (EHD) of Environment Canada (EC), Ontario Region, conducted a screening-level survey of sediment quality in Canadian tributaries to Lake Erie during the summer of 2001. The sampling represents the first stages of a track-down program to identify potential sources of contamination to the lower Great Lakes that are not being addressed by other Great Lakes programs. The program constitutes a portion of Environment Canada's commitment towards the Great Lakes Water Quality Agreement (GLWQA), in particular the Lake Erie Lakewide Management Plan (LaMP), in which Canada has committed to the virtual elimination of discharges of persistent toxic substances.

The purpose of the sampling was to assess sediment quality in deposition zones in each tributary prior to discharge to Lake Erie. One sediment sample, consisting of many subsamples, was taken from each tributary in a manner that is representative of the overall sediment quality in that tributary.

The study was designed to maximize the probability of detecting persistent toxic substances entering the lake, if they exist. The intent of the program is to identify remaining sources of contamination for subsequent follow-up work. It is not the intent at this stage to quantify the loadings of contaminants entering Lake Erie. Instead, the results from this program will be combined with existing water quality, fisheries, benthic and sediment contaminant information, using a weight-of-evidence approach, to prioritize subsequent track-down efforts.

The Environmental Monitoring and Reporting Branch (EMRB) of the Ontario Ministry of the Environment (MOE), as part of their ongoing monitoring programs, also conducted sampling in selected Lake Erie tributaries during the year 2001. The EHD program was designed to complement the MOE sampling program, as both parties sampled several tributaries concurrently.

Targeted parameters for the sediment screening were those identified in the Lake Erie Lakewide Management Plan (Lake Erie LaMP) as impairing lake-wide beneficial uses. In addition, a suite of contaminants targeted for virtual elimination in the Canada-U.S. Binational Toxics Strategy (BTS) were considered in order to assess Canada's commitments towards that Strategy. Additional parameters were included for contextual information (such as particle size and total organic carbon) and to improve our understanding of the contaminant status of Lake Erie tributaries (e.g., metals, pesticides, contaminants of emerging concern).

2.0 Methodology

To achieve the study objectives, the sampling program consisted of a survey-level, screening assessment of recently deposited sediment quality near the mouths of tributaries entering Lake Erie. The targeted substances are relatively insoluble in water (i.e., hydrophobic) and are therefore typically found at higher concentrations in sediments than in water. In addition, bed sediments in depositional environments provide a time-integrated sample of particulate matter transported by a stream. Analysis of bed sediments alleviated problems associated with detecting trace levels of substances in water samples. Bed sediment sampling can overcome problems detecting periodic or intermittent sources of contaminants in water from non-point pollution sources.

2.1 Field Program

Tributary Selection

A reconnaissance survey was conducted in May and June 2001 to identify tributaries and select the sampling sites. Sediment deposition zones were sought near the mouths of the tributaries such that they were likely downstream from potential contaminant sources yet sufficiently far upstream not to be influenced by the water body into which it drains. In other words, sites were selected to be outside of the zone of lake influence. Important exceptions to this rule are noted in Section 2.4.

During the reconnaissance survey, the method of access was also identified. Most sites were accessed by wading or were sampled from a bridge crossing. In certain, larger tributaries, sampling sites were accessed by boat. In the majority of cases, the sample site coincided with the most downstream road crossing of the tributary.

Number of Sites

Virtually every tributary draining the Canadian Lake Erie watersheds was sampled in this program. For many sites, this program has provided its first information about organic contaminants in sediments. The geographic extent of the program was from Sarnia in the northwest to the Niagara River outlet of Lake Erie in the southeast. Tributaries to the St. Clair River, Lake St. Clair, the Detroit River and the north shore of Lake Erie were therefore included in this program. The tributaries sampled during the project are shown in Figure 1 and with their labels (i.e. tributary names) in Appendix B.

A total of 115 samples were obtained, representing 100 tributaries in 93 watersheds. As mentioned above, a single site sediment sample was generally taken from depositional zones upstream of the tributary mouth. In the Grand River and Thames River watersheds, additional samples were taken from selected major tributaries draining into the primary tributary. Therefore, five (5) tributaries, Baptiste Creek, Dolsen Creek, Thames Bradley, Big Tilbury and Jeanettes Crk, in addition to a downstream site were sampled in the Thames River watershed, and two tributaries, Feeder Canal and Broad Creek, in additional to a downstream site were sampled in the Grand River watershed.

Of the 115 samples, 14 were blind duplicate samples; that is, they were split samples that were assigned a fictitious name in the field (usually a name of a common bird, unless a more appropriate name was conceived). The blind duplicates were obtained to assess variability due to sample handling and laboratory precision. A list of blind duplicates and the corresponding tributary is provided in Table 1, below.

While the original field work had two sites added as part of the cooperative effort with the EMRB, only one site is reported here. In Talfourd Creek, both parties sampled an upstream site ("Talfourd 40"). The Talfourd Creek sampled proved to be contaminated with St. Clair River sediment and is no longer reported as tributary data. In Little River, both parties sampled at one site ("Little River at Lauzon") but an additional sample was obtained closer to the river mouth ("Little River") to be consistent with the methodology of the current program.

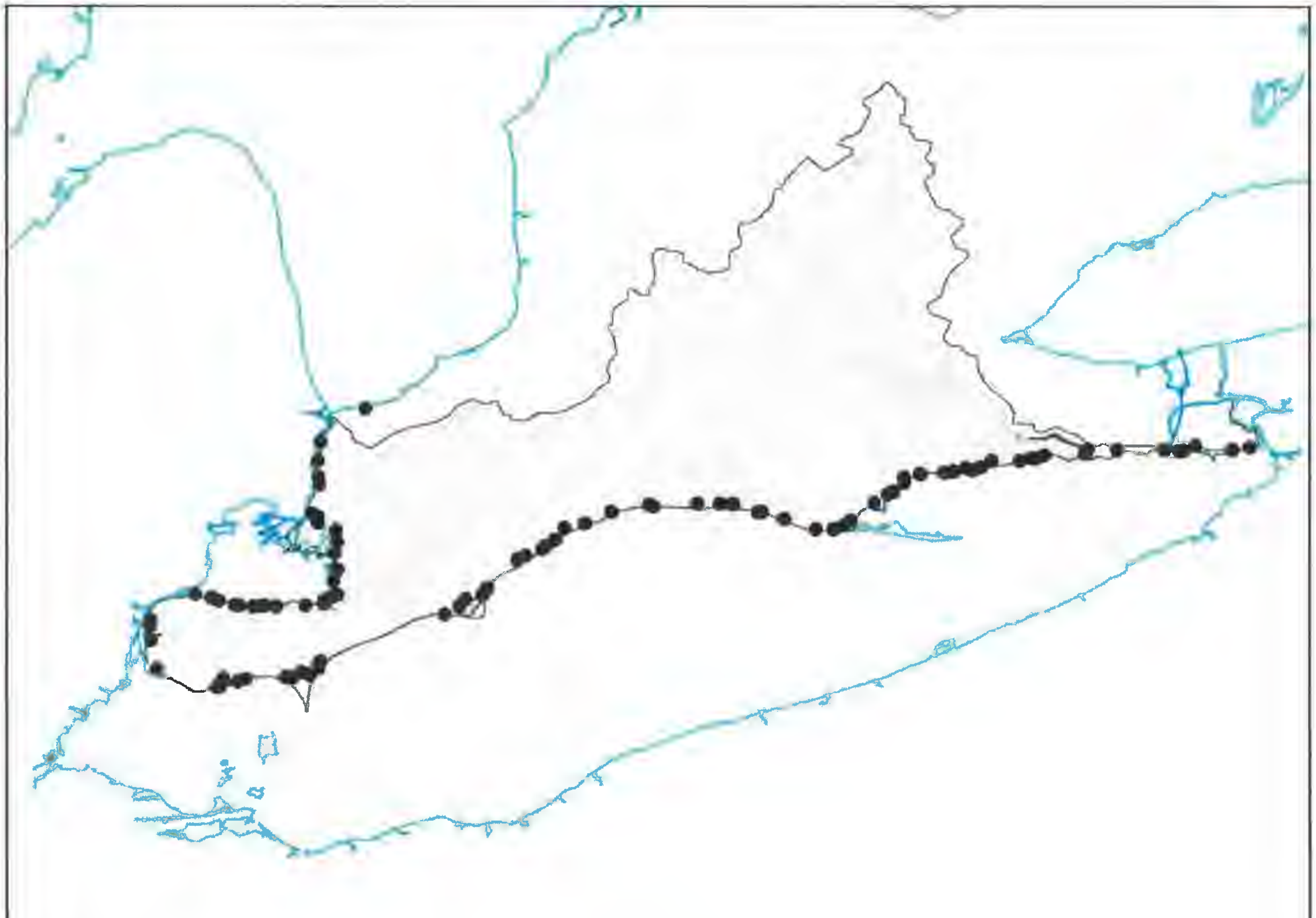

Figure 1. Lake Erie Tributary Sediment Sampling Locations

Table 1. Blind Duplicate Sample Listing

Tributary	Blind Duplicate Sample
Marentette Drain	Buzzard Creek
Fishers Glen Creek	Cardinal Creek
Sturgeon Creek	Dicks Creek
Duck Creek	Drake Creek
Surfside Creek	Eagle Creek
Peacock Creek	Haldimand Creek
Catfish Creek	Jays Creek
Sydenham River	Martin River
Flat Creek	Oriole Creek
Sixteen Mile Creek	Robin Creek
Dedricks Creek	Sparrow Creek
Little River	Swallow River
Grand River	Tern Creek
Big Creek	Wren Creek

Sampling Methodology

The sampling program was based on the Guidelines for Collecting and Processing Samples of Stream Bed Sediment for Analysis of Trace Elements and Organic Contaminants, developed by the United States Geological Survey (USGS) for the U.S. National Water-Quality Assessment Program (NAWQA; Shelton and Capel, 1994). In the NAWQA program, downstream locations in watersheds are selected to provide a coarse-scale network of sites. At these "integrator" sites, large-scale problems that may not be detected in smaller basins have a reasonable chance of being detected. A number of sub-samples are combined so that one sample is obtained that is representative of the overall conditions in that tributary.

Field Campaign

Sampling was conducted between July 9 and September 25, 2001. One or more depositional reach was sampled upstream of the mouth in each tributary. Only the very fine-grained surface deposits, to a maximum depth of approximately 1 or 2 cm, depending on the site, were collected. These surface sediments better represent relatively recent rather than historic deposition. Sites were selected to be representative of the variety of locations (i.e., mid-channel, left bank, right bank) and habitat types (pools, different depths of water, and depositional zones behind obstacles such as boulders or sand bars) present at each site. Only wetted depositional zones were sampled.

Where water depths permitted wading and water velocities were slow enough to permit sample retrieval, samples were obtained using a stainless steel spoon and collected in a glass bowl. At sites where the water depth was too great for wading, or water velocities were swift enough to wash the fine particles from the spoons during sample retrieval, an all-stainless steel Wildco Petite Ponar sampler was used.

Upon arrival at each site, the sampling equipment was thoroughly rinsed in the ambient river water. The surface sediments were collected (either by spoon or Ponar, as described above) and combined in a glass bowl. The sediments were sieved through a 2-mm stainless steel sieve to remove the larger size fractions and to assist with homogenization of the sample. The sample was further homogenized by mixing with a spoon for approximately two minutes.

Several sample jars were filled at each site. In general, four jars were used:

- one 125-mL polyethylene container filled with approximately 2 cm of sediment for metals analysis;
- one 125-mL polyethylene container filled approximately ½ full for total organic carbon and grain size analysis;
- one 250-mL glass container with Teflon-lined screw cap filled approximately ¾ full for organochlorine (OC) and polyaromatic hydrocarbon (PAH) analysis, and;
- one 250-mL Teflon or glass container filled approximately ¾ full for archiving purposes.

Blind duplicate samples were obtained at fourteen sites, including blind duplicate archive samples at 6 of these.

Sample jars were labeled with permanent marker on both the lids and on laboratory tape affixed to the side of the jars. The recorded information included the site name, date, organization (EHD/OR), and parameters for analysis (e.g. OCs and PAHs, metals, TOC and grain size, Archive). After the appropriate sample jars were filled, the sampling equipment was thoroughly rinsed in the ambient river water.

A field drawing was made and digital photos were taken at each site. A sketch of each tributary reach was made to include its major features, habitat types, approximate dimensions, surrounding land uses, major road crossings, etc. The locations and number of sampling sites were identified on each sketch, and the method of sediment retrieval was noted. A Lowrance Global Map 100 geographic positioning system (GPS) device was used to obtain each location using the position averaging function. The GPS location within the site was included on the sketch.

Samples were kept on ice in portable coolers while in the field. Upon return to the Canada Centre for Inland Waters in Burlington, the samples were decanted then frozen at –10°C. Samples in glass bottles were frozen on their sides to prevent bottle breakage.

2.2 Laboratory Methods

The samples in polyethylene containers (i.e., those for metals, TOC and grain size analysis) were freeze-dried prior to analysis. Initially, selected samples were freeze-dried and analyzed for TOC and grain size at CCIW. However, a breakdown of one of the freeze-dryers prevented the use of these facilities for the remainder of the samples. Subsequently, samples were sent to Natural Resources Canada in Ottawa, Ontario. All metals samples and the majority of TOC and grain size samples were freeze-dried at these facilities. Once freeze-dried, TOC was analyzed by Leco Cr-412 and grain size fractions were determined using a Lecotrac Particle Size Analyzer LT100.

Caduceon Enterprises Inc. performed the metals analysis (including mercury) on freeze-dried sediment samples using aqua regia digestion methods.

Analysis of organochlorines (OCs) (including PCBs) and polycyclic aromatic hydrocarbons (PAHs) was awarded to Maxxam Analytics Inc. in Mississauga as the result of a competitive bidding process. Frozen, wet sediment samples were sent to Maxxam in the autumn of 2001. Samples were thawed and OCs were analyzed by gas chromatography/dual column electron capture detector (GC/ECD) after accelerated solvent extraction following the EPA protocol SW846 EPA 3545. Samples for PAH analysis were extracted using a sonication method. The extracts were then concentrated and analyzed by mass spectrometry (GC/MS). Sample results were reported on a dry weight basis.

The archived sediments have proven useful for a variety of purposes to date. The National Laboratory for Environmental Testing (NLET) is analyzing selected samples for selected compounds of emerging concern (e.g., polybrominated diphenyl ethers, selected musk compounds). Other sub-samples have been contributed to Dr. B. Scott for analysis of haloacetic acids and perfluoroalkanoic acids (including PFOA) and comparison with water samples from selected tributaries. Dioxins, furans, dioxin-like PCBs and polychlorinated napthalene analysis are being conducted on 30 samples by the Ontario Ministry of the Environment, and plans are underway to arrange for the analysis of selected additional pesticides. The results of these analyses will be reported under separate cover as they become available.

2.3 Data Analysis

The laboratory results were analyzed in a spreadsheet program. Results were compared with the Federal and Provincial sediment quality objectives and with other sites in the program. The frequency of detection and frequency of exceedence of the sediment quality objectives were computed. Mapping of selected compounds was prepared on 1:250,000 basemaps of the Lake Erie basin using ArcView 8.1.

2.4 Important Field Notes

At several tributaries, site conditions presented challenges that may have resulted in anomalous samples and/or sample results. It should be noted that any anomalous results should be confirmed as a first step of any follow-up to this study. However, at two sites in particular, important notes were made that may have affected the results of this study with respect to its ability to detect persistent toxic substances entering the Great Lakes.

In Talfourd Creek (near Sarnia), a private company owns land located near the river mouth. Samples were taken downstream of the property line, close to the river mouth, and sediments originating from the St. Clair River may therefore have influenced the results at this location. **2005 note: Follow-up work confirmed that original samples were not indicative of Creek sediment. Updated results are now listed for Talfourd Creek, Baby Creek and Bowens Creek. It should be noted that the original screening included both Talfourd Creek and Talfourd 40.** The original Talfourd 40 results have been confirmed as creek sediment data and are the data referred to in the discussion. All following reports and discussions are with updated data and not with original data. Field names for the updated sites were Baby Farm (2003) for Baby Creek and Seager Creek (2003) for Bowen Creek and Talfourd40 for Talfourd Creek.

In Muddy Creek (Wheatley), the low flow in the creek (relative to the water level in Lake Erie downstream) was resulting in a periodic backwards flow at the time of sampling. The creek water and suspended matter could be seen to be traveling alternately in both directions. It was noted in the field that any anomalous results could be due to sources located either upstream or downstream from the sampling location.

3.0 Results

Throughout this report, references and comparisons are made to the federal and provincial sediment quality guidelines. For clarity and consistency, each guideline is assigned a unique colour. The graphics presented in this report use these colours to indicate exceedences of the guidelines. The following colour coding is also referenced in Appendix B:

Guideline	Colour Code
Federal Sediment Quality Guidelines	
Below Threshold Effect Level (TEL)	Green
Above Federal TEL but below PEL	Yellow
Above Probable Effect Level (PEL)	Orange
Provincial Sediment Quality Guidelines	
Below Lowest Effect Level (LEL)	Green
Above LEL but below SEL	Blue
Above Severe Effect Level (SEL)	Red

3.1 Quality Assurance/Quality Control

All laboratories used for the project were CAEAL accredited for their respective analytical parameters. As mentioned above in the methodology, Maxxam Analytical Inc. performed the organochlorine and polycyclic aromatic hydrocarbon analyzes. The Maxxam laboratory QA/QC program consisted of blanks, spiked blanks and duplicate samples (i.e., laboratory replicate runs).

All method blanks were within acceptable limits (below method detection limit) and spikes were within acceptable limits (40-130%) for all parameters.

Varying numbers of laboratory duplicates (replicate runs) were analyzed: six (6) duplicate organochlorine pesticides analyzes, five (5) PCB aroclor analyses, and two (2) PAH analyses. Paired student t-tests were performed to assess differences between the duplicate samples. Only six parameters could be tested, as a minimum of three detections were required for the t-tests. No significant differences were observed between the duplicate samples, for any parameter, at a 95% confidence level.

Paired student t-tests were also performed to assess differences between blind duplicate samples submitted to the laboratory. The majority of parameters could be assessed this way, with the exception of parameters that were detected in fewer than three samples. There were no significant differences observed between the blind duplicate samples, for any parameter, at the 95% confidence level.

3.2 Method Detection Limits

All of the analytical parameters used in the study are hydrophobic, i.e., they have a propensity for solid surfaces such as sediments as opposed to the dissolved phase. The sampling of very fine, flocculent surface deposits, as was done here, serves to maximize the probability of encountering these parameters, if they are present in the environment. Typical laboratory detection limits are therefore sufficient to detect these parameters at ambient concentrations. The laboratory method detection limits are provided in Table 2, below, for both laboratories used in this study. This Table also provides a useful reference of all parameters measured in the study

Table 2. Analytical Parameters and Laboratory Method Detection Limits
a. Maxxam Analytics Inc. (Organics)

Polychlorinated Biphenyls (PCBs)		Polycyclic Aromatic Hydrocarbons (PAHs)		Organochlorine Pesticides (OCs)	
Parameter	**MDL**	**Parameter**	**MDL**	**Parameter**	**MDL**
Aroclor 1016	0.015 µg/g	Naphthalene	5 µg/kg	Hexachlorobenzene	0.002 µg/g
Aroclor 1221	0.03 µg/g	Acenaphthylene	5 µg/kg	o,p'-DDD	0.002 µg/g
Aroclor 1232	0.015 µg/g	Acenaphthene	10 µg/kg	Endrin aldehyde	0.002 µg/g
Aroclor 1242	0.02 µg/g	Fluorene	5 µg/kg	o,p'-DDT	0.002 µg/g
Aroclor 1248	0.015 µg/g	Phenanthrene	5 µg/kg	Toxaphene	0.08 µg/g
Aroclor 1254	0.015 µg/g	Anthracene	5 µg/kg	o,p'-DDE	0.002 µg/g
Aroclor 1260	0.015 µg/g	Fluoranthene	5 µg/kg	Aldrin	0.002 µg/g
Total PCB	0.015 µg/g	Pyrene	5 µg/kg	α-HCH	0.002 µg/g
		Benz(a)anthracene	10 µg/kg	β-HCH	0.002 µg/g
		Chrysene	10 µg/kg	δ-HCH	0.002 µg/g
		Benzo(b)fluoranthene	10 µg/kg	Lindane	0.002 µg/g
		Benzo(k)fluoranthene	10 µg/kg	α-Chlordane	0.002 µg/g
		Benzo(a)pyrene	5 µg/kg	γ-Chlordane	0.002 µg/g
		Indeno(1,2,3-cd)pyrene	20 µg/kg	p,p'-DDD	0.002 µg/g
		Dibenzo(a,h)anthracene	20 µg/kg	p,p'-DDE	0.002 µg/g
		Benzo(ghi)perylene	20 µg/kg	p,p'-DDT	0.002 µg/g
				Dieldrin	0.002 µg/g
				α -Endosulfan	0.002 µg/g
				β-Endosulfan	0.002 µg/g
				Endosulfan sulfate	0.002 µg/g
				Endrin	0.002 µg/g
				Heptachlor	0.002 µg/g
				Heptachlor epoxide	0.002 µg/g
				Methoxychlor	0.008 µg/g
				Mirex	0.002 µg/g
				Octachlorostyrene	0.002 µg/g

All laboratory method detection limits, for the organic analytes are below the federal PEL except for Lindane (PEL sediment quality guideline 0.00138 µg/g). Most of the laboratory detection limits for the organic analytes are below the TEL with the exception of total DDT, total DDE, toxaphene, heptachlor epoxide and acenaphthene.

Table 2 cont. Analytical Parameters and Laboratory Method Detection Limits
b. Caduceon Enterprises (Metals)

Parameters	Units	MDL
Aluminum	%	0.01
Antimony	µg/g	5
Arsenic	µg/g	5
Barium	µg/g	1
Beryllium	µg/g	0.2
Bismuth	µg/g	5
Cadmium	µg/g	1
Calcium	%	0.01
Chromium	µg/g	1
Colbalt	µg/g	1
Copper	µg/g	1
Iron	%	0.01
Lead	µg/g	1
Lithium	µg/g	1
Magnesium	%	0.01
Manganese	µg/g	1
Molybdenum	µg/g	1
Nickel	µg/g	1
Niobium	µg/g	5
Potassium	%	0.05
Silver	µg/g	0.5
Sodium	%	0.01
Strontium	µg/g	1
Tin	µg/g	20
Titanium	µg/g	1
Tungstem	µg/g	20
Vanadium	µg/g	1
Yttrium	µg/g	1
Zinc	µg/g	1
Mercury	ng/g	0.01

All laboratory method detection limits, for metals, were below sediment quality guidelines, with the exception of cadmium (Sediment Quality Guideline = 0.6 µg/g).

3.3 Laboratory Results

A review of the detection frequency of analytical parameters and exceedences of sediment quality guidelines is provided here. A discussion of the highest observed levels is provided for selected parameters in Section 4. A full listing of the laboratory data for the 102 unique sites is provided in Appendix A. The laboratory data for the blind duplicate samples is not provided but can be obtained from Environment Canada.

3.3.1 Frequency of Detection

In general, organochlorine parameters were not detected, with some notable exceptions. A total of nine (9) organochlorine parameters were not detected in any sample. In addition, six (6) of the nine (9) PCB Aroclors analyzed were not detected. Each of the PAHs was detected in at least one sample. Four (4) metals parameters were not detected in any sample. The parameters that were not detected are listed below in Table 3.

3.3.2 Comparison of Results with Sediment Quality Guidelines

The sediment quality results were compared to the Canadian Environmental Quality Guidelines (Canadian Council of Ministers of the Environment, 2001). The CCME sediment quality guidelines provide scientific benchmarks, or reference points, for evaluating the potential for observing adverse biological effects in aquatic systems. The guidelines are derived from available toxicological information. A lower value, referred to as the threshold effect level (TEL), represents the concentration below which adverse biological effects are expected to occur rarely. The upper value, referred to as the probable effect level (PEL), represents the level above which adverse effects are expected to occur frequently. Fewer than 25% of adverse effects (in the Biological Effects Database for Sediments) occur below the TEL, and more than 50% of adverse effects occur above the PEL.

Where no federal guidelines were available, the provincial guidelines were used for comparison (Persaud et al., 1992). Provincial Severe Effect Levels for organic compounds and polycyclic aromatic hydrocarbons were calculated individually for each site using the organic carbon concentration in the sediment. However, no SEL exceedences were determined for these compounds in this study.

A special mention should be made of toxaphene. At present the only guideline that is available is an interim sediment quality guideline which the federal government has adopted from the New York State Department of Environmental Conservation (NYSDEC 1994), 0.01 µg/g TOC, which has been converted to dry weight. This value is the lowest available guideline from other jurisdictions; in fact it is lower than many laboratory detection limits. This guideline is considerably lower than the 80 µg/kg method detection limit reported for this program. While it is acknowledged that lower detection limits would be more beneficial for screening sediments it is pointed out that toxaphene is not a critical pollutant; and that sediment inventories for toxaphene in the Great Lakes support atmospheric transport as opposed to local sources (Muir et. al. 2005).

Table 5 provides a summary of the numbers of exceedences of the federal guidelines, and exceedences of the provincial guidelines for those parameters for which federal guidelines are not available. A complete list of the sediment quality guidelines relevant to this study is provided in Appendix B.

Table 5. Number of Sites Exceeding Sediment Quality Guidelines

A. Metals	Federal Guidelines		Provincial Guidelines	
	Exceeds TEL[1] Below PEL	Exceeds PEL[2]	Exceeds LEL[3] Below SEL	Exceeds SEL[4]
Chromium	3	1		
Zinc	21	5		
Lead	17	2		
Nickel			57	4
Manganese			33	8
Iron			37	1
Copper	13	1		
Cadmium	10	1		
Arsenic	71	5		
Mercury	3	3		
B. Organochlorines				
Lindane	0	1		
Chlordane	0	1		
Total – DDD (o,p' + p,p')	10	19		
Total – DDE (o,p' + p,p')	34	36		
Total – DDT (o,p' + p,p')	12	19		
Dieldrin	11	2		
PCB Aroclor 1254	1	2		
Total PCB	6	3		

Table 5 cont. Number of Sites Exceeding Sediment Quality Guidelines

C. Polycyclic Aromatic Hydrocarbons	Exceeds TEL[1] Below PEL	Exceeds PEL[2]
Acenaphthylene	27	1
Acenaphthene	9	2
Phenanthrene	39	1
Anthracene	13	1
Anthracene	13	1
Pyrene	40	2
Benz(a)anthracene	30	2
Chrysene	25	1
Dibenzo(a,h)anthracene	3	1

Notes:
1 Federal Threshold Effect Level
2 Federal Probable Effect Level
3 Provincial Lowest Effect Level
4 Provincial Severe Effect Level

4.0 Discussion

4.1 DDT and Metabolites

DDT (dichlorodiphenyltrichloroethane) is a chlorinated hydrocarbon that has broad-spectrum pesticide properties. It was used in large quantities in the 1950s and 1960s on crops. The U.S. banned the use of DDT in 1973. The use of DDT in Canada was severely restricted in the early 1970s and discontinued in 1985, with the sale and use of existing stocks permitted until the end of 1990 (CCME, 2001). DDT is still used as an insecticide in other countries.

DDT has two metabolites: DDE (dichlorodiphenyldichloroethylene) and DDD (dichlorodiphenyldichloroethane). Each DDT molecule has several isomeric forms, depending on the configurations of the chlorine atoms on the molecule. For comparison with sediment quality guidelines, the laboratory results were analyzed according to the following:

Total DDT = o-p'- plus p-p'DDT
Total DDE = o-p'- plus p-p'DDE
Total DDD = o-p'- plus p-p'DDD
Total DDT and metabolites = Total DDT + Total DDE + Total DDD

DDT, including its metabolites, was the most commonly detected organochlorine compound in the current study. A full 72% of samples had detectable quantities of one or more isomer of DDT or its metabolites. The most commonly detected isomer was p-p'-DDE, with a detection frequency of 70%.

DDE was also the parameter that most frequently exceeded sediment quality guidelines. Thirty-five (35) tributaries were found to contain DDE concentrations in excess of the federal threshold effect level (1.42 ng/g) and a further 36 tributaries has DDE concentrations exceeding the probable effect level (6.75 ng/g). A listing of the 10 sites with the highest DDE concentrations is provided below.

Tributary	Total DDE Concentration (ng/g)
Dolsons Creek	130
Hillman Creek	110
Muddy Creek	96
Huffman Creek	89
Fox Creek	72
North Road Creek	67
Marentette Drain	67
Youngs Creek	65
Stalter Gully	48
Clear Creek	39

A map of the distribution of the DDE exceedences is shown in Figure 2. The map shows that the exceedences are widespread, but the highest concentrations (in excess of 70 ng/g) are observed in tributaries near Point Pelee.

Analysis of the ratio of parent DDT to the metabolites DDE and DDD indicates that recent sources of the pesticide may be contributing to the observed concentrations in north shore tributaries. In six (6) tributaries, more than ½ of the observed DDT was parent compound, not metabolite. The ten tributaries with the highest ratios of Total DDT to metabolites (Total DDE plus Total DDD) are provided below.

Tributary	Ratio of Parent DDT: Metabolites	Total DDT & Metabolite Concentration (ng/g)
Dedricks Creek	0.45	29
Sturgeon Creek	0.46	79
North Road Creek	0.47	132
West Two Creek	0.50	9
Hillman Creek	0.58	215
Sixteen Mile Creek	0.62	21
Brock Creek	0.67	5
Flat Creek	0.83	11
Boyle Drain	1.00	6
Menno Weins Creek	1.00	8

4.2 Other Pesticides

4.2.1 Dieldrin

Dieldrin is the major breakdown product of aldrin, a pesticide that was used primarily for termite control and on selected crops. Aldrin and dieldrin are banned in the U.S. and have been discontinued in Canada since 1990.

Aldrin was not detected at any site, but dieldrin was detected in 16% of the tributaries in the current study. Dieldrin was found at concentrations exceeding the PEL of 6.67 ng/g at two (2) sites and exceeding the TEL of 2.85 ng/g at a further eleven (11) sites. Data and graphical analyses (Figure 3) show that the highest levels were observed in selected tributaries near Point Pelee and near Rondeau Bay.

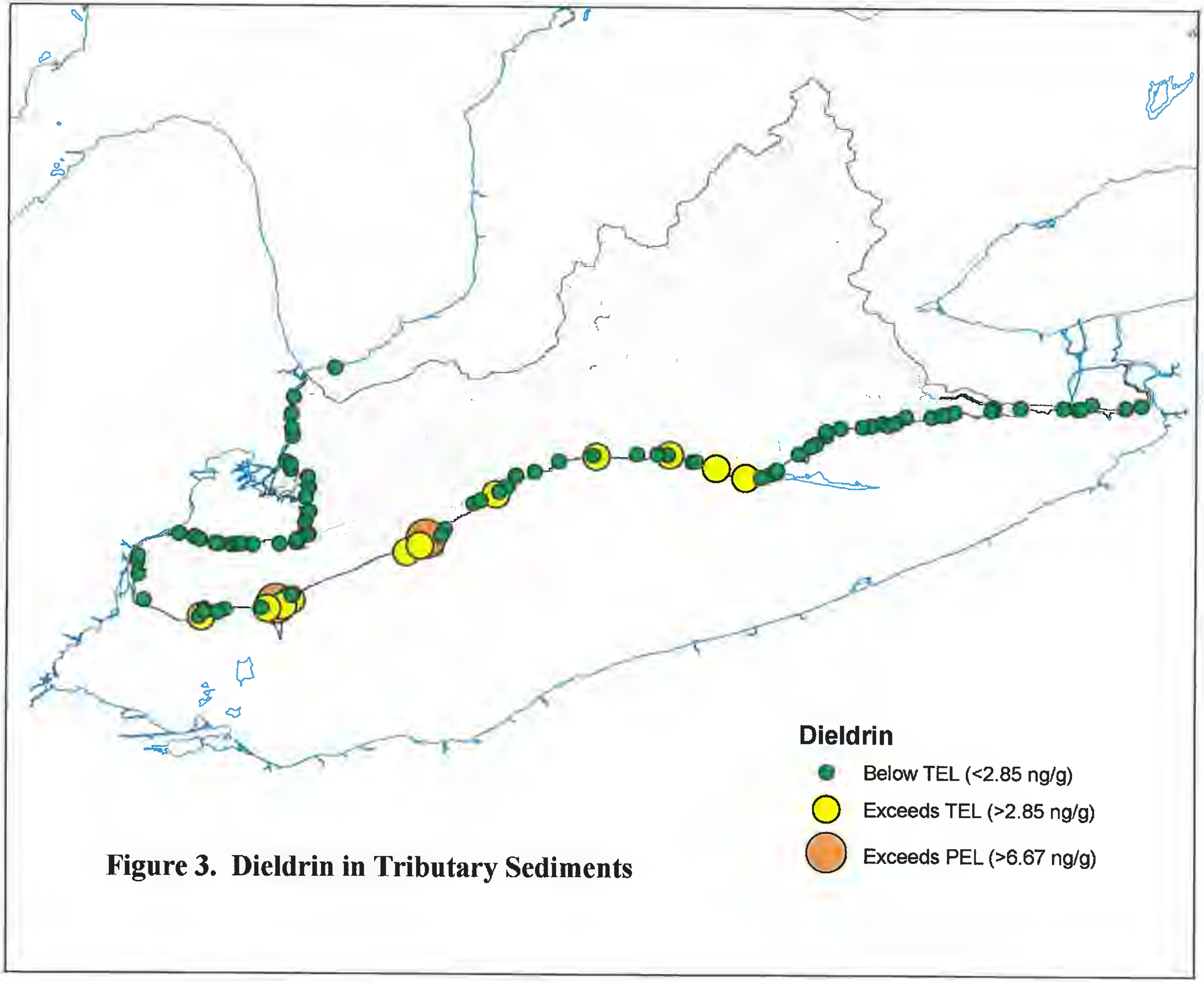

Figure 3. Dieldrin in Tributary Sediments

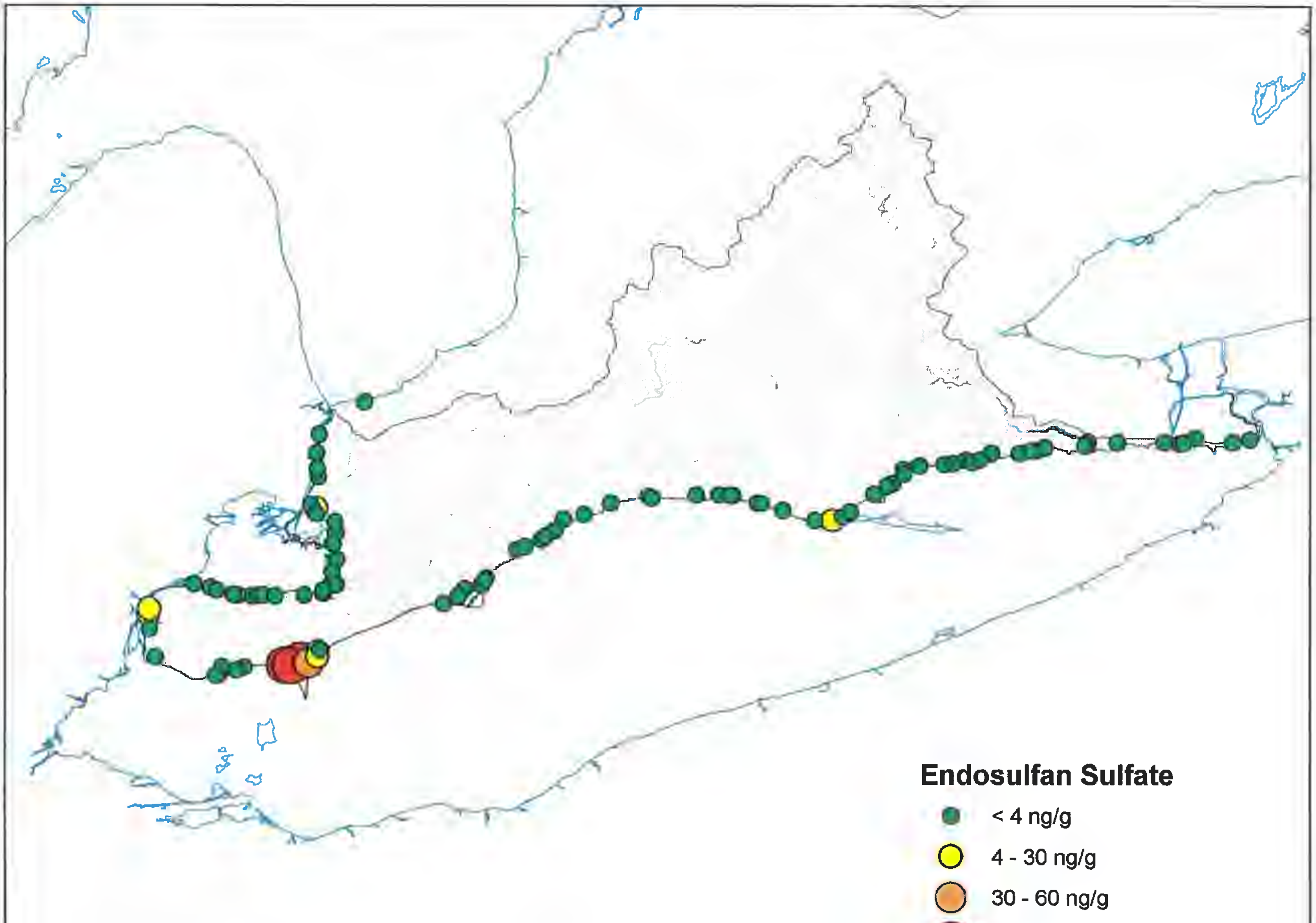

Figure 4. Endosulfan Sulfate in Tributary Sediments

Tributary	Total PCB concentration (ng/g)
Little River	1400
Turkey Creek	780
Muddy Creek	760
Little River at Lauzon Road	110
Evans Creek	60
McKinlay Creek	60
Kleins Drain	50
Snider Creek	40
Broad Creek	40

4.4 Organochlorines of Industrial Origin

4.4.1 Octachlorostyrene

Octochlorostyrene (OCS) is produced inadvertently as a by-product of industrial processes in chlor alkali plants, some metal processing, incineration and chemical manufacturing. OCS is highly bioaccumulative.

OCS was detected in two tributaries; one of these is located in the St. Clair River drainage basin. These tributaries are listed with their respective OCS concentration below. There are no sediment quality guidelines for OCS.

Tributary	OCS Concentration (ng/g)
Running Creek	11
East Two Creek	3

4.4.2 Hexachlorobenzene

Hexachlorobenzene (HCB) is an organic solid that is produced as a by-product from the manufacture of a variety of organic chemicals including rubber, dyes and wood preservatives. It was previously used as a fungicide on grains and in paper products and its use in Canada was discontinued in 1976. Small amounts of HCB are produced during incineration and other industrial processes as it is a byproduct from the manufacture and use of chlorinated solvents and pesticides.

HCB was detected in only one (1) of the tributaries sampled located in the St. Clair River basin (Figure 6). A summary of these results is provided below. Note that there are no federal sediment quality guidelines for HCB. The provincial LEL is 20 ng/g.

Tributary	HCB Concentration (ng/g)
Running Creek	13

4.5 PAHs

Polycyclic aromatic hydrocarbons are produced during the incomplete combustion of organic substances, most commonly the combustion of fossil fuels. As an indicator of human industrial activities, PAH contamination is relatively widespread.

PAHs were commonly detected in the current survey. One or more PAH compound was found in all but five of the tributaries. The eight most commonly detected PAHs were found at more than half of the sites examined (see Table 4). A listing is provided below of tributaries with concentrations of total PAH (i.e., the sum of the 16 PAH compounds investigated here) greater than 1,000 ug/kg. Sites with relatively high PAH concentrations were widely distributed across the basin, and generally corresponded with areas of higher population and/or boat traffic (Figure 7).

Tributary	Total PAH concentration (µg/kg)
Little River at Lauzon	18,791
Muddy Creek	9,023
Lynn River	4,785
Turkey Creek	4,632
Manning Drain	3,832
Bisnett Drain	1,989
Nanticoke Creek	1,745
Marshy Creek	1,724
Little River	1,718
Kettle Creek	1,677
Thames River at Bradley	1,500
Jeanette's Creek	1,481
Mill Creek	1,480
Selkirk Drain	1,303
Kraft Drain	1,282

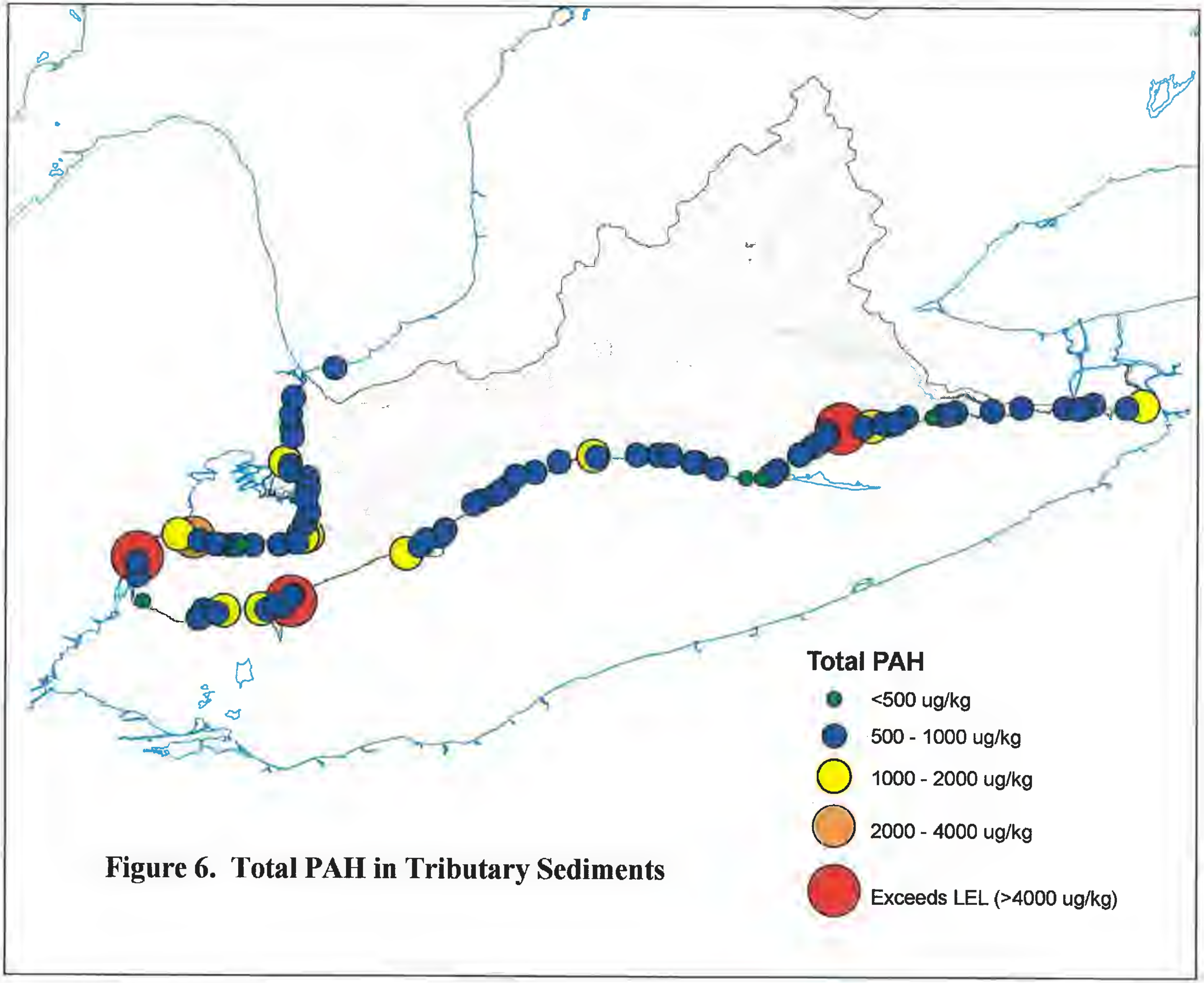

Figure 6. Total PAH in Tributary Sediments

4.6 Metals

4.6.1 Arsenic

Arsenic (As) is a metalloid and a nonessential trace element. Its release from anthropogenic sources is mainly from gold and base metal production facilities, with smaller releases from the use of arsenical pesticides, wood preservatives, coal-fired power generation and disposal of domestic and industrial wastes (Environment Canada, 1993).

In the current study, arsenic was found to exceed sediment quality criteria relatively frequently. Of the 102 unique sites, concentrations were above the federal TEL at 72 sites, and above the PEL at another five (5) sites (see Table 5). At some of these sites, the exceedences may be due to naturally elevated As levels. In the National Geochemical Reconnaissance (NGR) program of the Geological Survey of Canada, the mean concentration of As in stream sediments was determined to be 10.7 µg/g (P.W.B. Friske, 1996 in CCME 2001), which is greater than the federal TEL of 5.9 µg/g. The distribution of TEL exceedences is widespread across the basin. The PEL exceedences are more localized, however, and may be more closely related to anthropogenic activities. A listing of sites showing As concentrations in exceedence of the PEL is provided below.

Tributary	As (µg/g)
Boyle Drain	20
Morden Drain	18
Kleins Drain	18
Stalter Gully	18
Clearville Creek	18

4.6.2 Cadmium

Cadmium (Cd) is a non-essential trace element that is produced commercially from base-metal smelters and refineries especially zinc refining. It is used in batteries, coatings, pigments, stabilizers and alloys (Hoskin, 1991 in Environment Canada, 1994a). In the current study, the laboratory detection limit of 1 µg/g is higher than the federal TEL of 0.6 µg/g. Natural, background levels of Cd may also be greater than the TEL, as the NGR program determined the mean concentration of Cd in stream sediments to be 0.63 µg/g (P.W.B. Friske, 1996 in CCME 2001). In an assessment of the NGR data, Painter et al. (1994) found that 95% of the data were below 1.3 µg/g.

Cadmium concentrations in the current study were generally below the laboratory detection limit or detected at that limit (1 µg/g). Two sites showed Cd concentrations at 2 µg/g (Hillman Creek and Lebo Creek). In Turkey Creek, which drains portions of the Cities of Windsor and LaSalle, the Cd concentration was 13 µg/g. Cd concentrations in this tributary may therefore reflect upstream industrial processes or other sources.

4.6.3 Chromium

Chromium (Cr) is an essential trace element that can be toxic to organisms at elevated levels (CCME 2001). It is not mined in Canada, but its import contributes to the production of pigments, metal finishing, leather tanning and wood preservatives (Nriagu 1988 in Environment Canada 1994b).

Chromium was generally found at concentrations below sediment quality guidelines with the exception of three sites that are listed below. In Turkey Creek, the Cr concentration (112 μg/g) was above the PEL of 90 μg/g; at the other two sites the Cr concentrations were above the TEL of 37.3 μg/g.

Tributary	Cr (μg/g)
Turkey Creek	112
Little River	79
Sydenham River	44

4.6.4 Copper

Copper (Cu) is an essential trace element whose anthropogenic sources are mainly from mining and smelting operations. Naturally elevated Cu concentrations may contribute to the Cu content in streambed sediments. In an analysis of the NGR sediment database, Painter et al. (1994) found that 95% of Cu concentrations were below 76 μg/g. In the current study, 13 sites showed concentrations above the TEL of 35.7 μg/g.

Tributary	Cu (μg/g)
Little River	86
Turkey Creek	77
Moison Creek	67
Muddy Creek	61
Selkirk Drain	60
Sydenham River	46
Lebo Creek	44
Snider Creek	40
Flat Creek	40
Wood Street Creek	39
Canard River	37
Normandale Creek	37
Hillman Creek	37

4.6.5 Mercury

Mercury (Hg) is a nonessential trace element that is toxic, persistent and bioaccumulative. Fish consumption advisories are in effect for mercury in much of the Great Lakes ecosystem. Current uses of mercury include some batteries, dental fillings, thermometers and switches, cathode tubes and household cleaners. Sources of mercury to the environment include mining and smelting, wastewater, fossil fuel combustion and waste incineration.

Sediment from most tributaries contained relatively low concentrations of mercury. Two sites exceeded the federal TEL of 170 ng/g, and another one site exceeded the PEL of 486 ng/g, as listed below. Local, natural mercury deposits can impact environmental concentrations. The 95th percentile for mercury in the NGR database was determined to be 190 ng/g (Painter et al., 1994). Levels above this are therefore unlikely to be of natural origin.

Tributary	Hg (ng/g)
Selkirk Drain	2490
Running Creek	315
Turkey Creek	175

As shown in Figure 8, two of the sites with elevated mercury concentrations are located in the St. Clair corridor. Selkirk Drain, where the highest concentration was observed, is located in the town of Leamington, on the north shore of Lake Erie. Laboratory retests confirmed the mercury concentration is elevated in this sample.

4.6.6 Nickel

Nickel (Ni) is a trace element whose primary anthropogenic sources include primary base metal production and fossil fuel combustion (Environment Canada, 1994c). There is no federal sediment quality guideline for Ni, therefore sediment concentrations were compared with the provincial guidelines. The Lowest Effect Level (LEL) of 16 μg/g was exceeded at 57 sites. However, exceedences of the LEL can occur naturally. Analysis of the NGR database of stream and lake sediment metals concentrations showed that the 95th percentile for Ni concentration was 60 μg/g (Painter et al., 1994). Levels greater than this are more likely to indicate anthropogenic impacts. In the current study, the Severe Effect Guideline (SEL) of 75 μg/g was exceeded at three sites, as shown in the listing below.

Tributary	Ni (μg/g)
Snider Creek	137
Little River	112
Turkey Creek	81

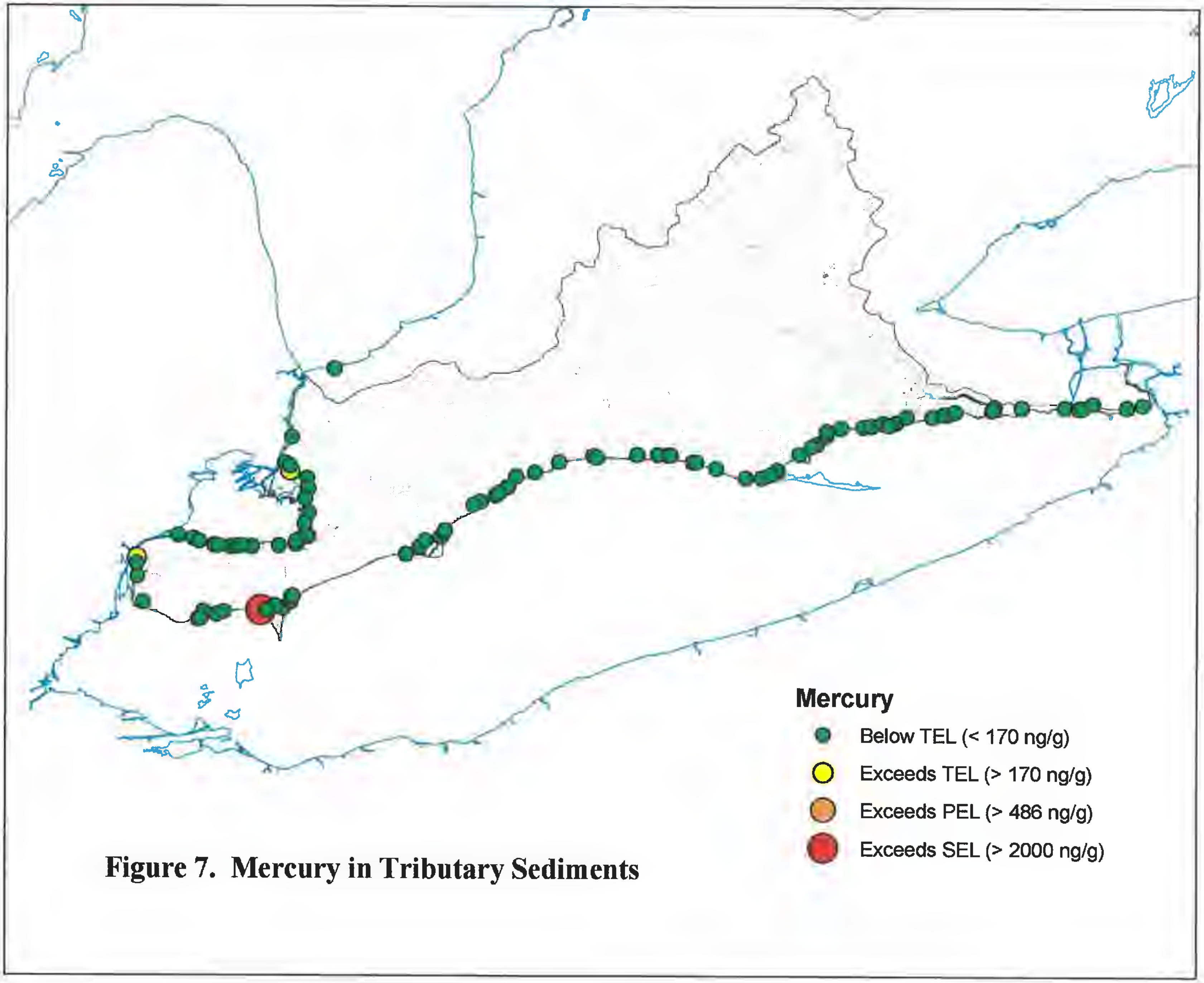

Figure 7. Mercury in Tributary Sediments

4.6.7 Lead

Lead (Pb) is a nonessential trace element. Its past use as an additive in gasoline has resulted in its widespread distribution in the environment above background levels. Currently, sources of lead to the environment include lead processing activities, batteries, and industrial and municipal effluents. Lead concentrations exceeded the federal TEL of 35 µg/g at 18 sites and the PEL of 91.3 µg/g at one site. The 95th percentile of stream and lake sediment Pb concentration in the NGR database was 25 µg/g (Painter et al., 1994), therefore even TEL exceedences are likely to be due to anthropogenic influences. The only PEL exceedence is listed below. TEL exceedences are numerous and are shown in Appendix A.

Tributary	Pb (µg/g)
Turkey Creek	108

4.6.8 Zinc

Zinc (Zn) is an essential trace element that is considered toxic to aquatic biota at elevated concentrations (CCME, 2001). Anthropogenic zinc sources are primarily related to metals processing, with smaller releases from fossil fuel burning and ancillary sources such as fertilizers, rubber goods and pharmaceuticals.

In the current study, the federal TEL of 124 µg/g was exceeded at 22 sites, and the PEL of 315 µg/g was exceeded at five sites. The PEL exceedences are listed below. The 95th percentile zinc sediment concentration in the NGR database was 191 µg/g, therefore PEL exceedences are likely due to anthropogenic sources.

Tributary	Zn (µg/g)
Steel Creek	691
Ruscom River	616
Selkirk Drain	531
Turkey Creek	519
Wood Street Creek	359

4.6.9 Manganese and Iron

Concentrations of the essential metals manganese and iron were compared with provincial sediment quality guidelines as no federal guidelines are available. Manganese concentrations exceeded the LEL of 460 µg/g at 34 sites and the SEL of 1100 µg/g at a further eight sites. The eight SEL exceedences are listed below. These exceedences generally did not appear to be related to industrial impacts in the majority of cases. Indeed, Mn exceedences also occurred in relatively "clean" tributaries that were expected to represent background or unimpacted conditions (e.g. Forestville Creek). The median Mn concentration in the Ontario Geological Survey stream sediment database (Fortescue, 1984) is calculated to be 850 µg/g, and the 95th percentile of concentrations was 2150 µg/g. It might therefore be interpreted that stream sediment concentrations in this range may be attributed to natural sources. Indeed, the application of the Ontario Sediment Quality Guidelines should take the background levels of metals into account prior to any management action (Persaud et al., 1992).

Tributary	Mn (µg/g)
Clear Creek	1910
Dedricks Creek	1602
Peacock Creek	1422
Little Creek	1270
Steel Creek	1227
Youngs Creek	1218
Forestville Creek	1136
Menno Weins Creek	1103

For iron (Fe), background levels may also be high due to natural sources. Ontario Geological Survey stream sediment data (Fortescue, 1984) shows that the median Fe concentration is 3.1% and the 95th percentile of Fe concentrations is 5.5%. These values are comparable to the LEL of 2% and the SEL of 4%. In the current study, 37 sites exceeded the LEL. Many of these included sites at which contamination from anthropogenic sources would not be expected. Only one site, Peacock Creek, showed Fe concentrations in exceedence of the SEL (4.95%), but its blind duplicate (Haldimand Creek) was below the SEL (3.48%). Similar to Mn, the natural or background concentration of Fe would need to be determined in order to interpret sediment quality guideline exceedences.

5.0 Next Steps

This sampling represents the first stage of a track-down program to identify potential sources of contamination to the lower Great Lakes that are not being addressed by other Great Lakes programs. The program constitutes a portion of Environment Canada's commitment towards the Great Lakes Water Quality Agreement (GLWQA), and, in this case, the Lake Erie Lakewide Management Plan (LaMP), in which Canada has committed to the virtual elimination of discharges of persistent toxic substances.

By committing to the track-down program, the federal and provincial partners have agreed to conduct follow-up work at locations where ambient data indicate potentially significant sources of persistent, bioaccumulative and toxic substances (PBTs) may exist. The program has, to date, focused on potential PCB sources. Three pilot projects have been conducted in Lake Ontario tributaries where PCB contamination is suspected based on available ambient information. Based on the experiences in these three projects, the project partners are currently developing a decision framework to guide future track-down projects; in particular, to recommend guidelines for the initiation and termination of such projects and to provide recommendations with respect to appropriate project design and sampling methodologies.

The parties have determined that potential projects must be prioritized based on the available information. The degree of contamination is determined for various media, and a prioritization is then made. These recommendations will require full disclosure and the sharing of ambient information between the project partners. To that end, steps have already been taken to ensure that information is freely shared in a manner that permits a broad prioritization based on the most current and reliable information.

By virtue of this document and a series of booklets (in preparation), the information from the current study is being shared with other environmental authorities and partners in Ontario.

Follow-up studies to investigate observed exceedences of the federal PEL for PCBs have already been carried out in two tributaries by Environment Canada. Confirmatory sampling will be initiated in the remaining two tributaries exceeding the PEL for PCBs in 2002. Based on these sampling results, determinations will be made by the appropriate agencies about how to proceed.

Similar to PCBs, information about other PBTs will be shared with partners at a basin-wide scale. Environment Canada is committed to efforts to virtually eliminate the discharges of PBTs to the Great Lakes. To this end, efforts will be made to identify and abate pollution sources with the cooperation of other environmental agencies and local partners in the Province of Ontario.

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Appendix A Notes

Note: The following Organochlorine compounds were not detected in any sample and are not included in the preceding table of laboratory results:

Endrin aldehyde
Toxaphene
Aldrin
a-BHC
d-BHC
o,p'-DDE
Endrin
Heptachlor epoxide
Mirex
PCB Aroclor 1262
PCB Aroclor 1016
PCB Aroclor 1221
PCB Aroclor 1232
PCB Aroclor 1248
PCB Aroclor 1268

Note: An explanation of Short-Forms:

Federal TEL: Threshold Effect Level
Federal PEL: Probable Effect Level
Provincial LEL: Lowest Effect Level
Provincial SEL: Severe Effect Level

Exceedences of (any) sediment quality guideline is shown in bold (Appendix A

ND Not detected
TR Trace detected and quantified
TRACE Trace detected but not quantified

Note: An explanation of Short-Forms and Chemical Compound Names

HCB	Hexachlorobenzene
OCS	Octachlorostyrene
a-BHC	Alpha-benzene hexachloride
b-BHC	Beta-benzene hexachloride
d-BHC	Delta-benzene hexachloride
Lindane	Gamma-benzene hexachloride
Total Chlordane	Sum of alpha- and gamma-Chlordane
o,p'-DDD	Isomer of Dichlorodiphenyldichloroethane
p,p'-DDD	Isomer of Dichlorodiphenyldichloroethane
o,p'-DDE	Isomer of Dichlorodiphenyldichloroethylene
p,p'-DDE	Isomer of Dichlorodiphenyldichloroethylene
o,p'-DDT	Isomer of Dichlorodiphenyltrichloroethane
p,p'-DDT	Isomer of Dichlorodiphenyltrichloroethane
Total DDD	Sum of o,p'- and p,p'-DDD
Total DDE	Sum of o,p'- and p,p'-DDE
Total DDT	Sum of o,p'- and p,p'-DDT
DDT & Metabolites	Sum of Total DDD, Total DDE and Total DDT
Total PCB	Sum of 9 PCB Aroclors
Total PAH	Sum of 16 PAH Compounds

Ag	Silver
Al	Aluminum
As	Arsenic
Ba	Barium
Be	Beryllium
Bi	Bismuth
Ca	Calcium
Cd	Cadmium
Co	Cobalt
Cr	Chromium
Cu	Copper
Fe	Iron
K	Potassium
Li	Lithium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
Na	Sodium
Nb	Niobium
Ni	Nickel
Pb	Lead
Sb	Antimony
Sn	Tin
Sr	Strontium
Ti	Titanium
V	Vanadium
W	µg/g
Y	Yttrium
Zn	Zinc
Hg	Mercury
TOC	Total organic carbon
TIC	Total inorganic carbon

Tributary	Sampling Date	Latitude	Longitude	Moisture	HCB	OCS	?-HCH	Lindane	?-Chlordane	?-Chlordane	Total Chlordane	o,p'-DDD	p,p'-DDD
	dd-mmm-yy	dec.deg	dec.deg	%	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g
ANTRIM CREEK	17-Jul-01	42.364	81.829	38	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BABY CREEK (Baby Farm)	18-Jun-03	42.833	82.464	40	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BAPTISTE CREEK	28-Aug-01	42.305	82.441	55	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MCLEAN DRAIN	17-Jul-01	42.336	81.846	65	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0.049**
BELLE RIVER	30-Jul-01	42.294	82.713	51	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	**0.014**
BIG CREEK	10-Jul-01	42.064	83.077	67	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BIG CREEK LONG POINT	25-Jul-01	42.595	80.486	34	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	<0.002
BIG OTTER CREEK	25-Jul-01	42.645	80.808	32	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.005
BIG TILBURY	28-Aug-01	42.305	82.445	53	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
BISNETT DRAIN	9-Jul-01	42.266	81.990	42	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.006
BOULTON DITCH	12-Sep-01	42.875	79.453	79	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BOWEN CREEK (Seager Creek)	18-Jun-03	42.775	82.464	47	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BOYLE DRAIN	28-Aug-01	42.431	82.394	58	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BROAD CREEK	23-Aug-01	42.877	79.564	67	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
BROCK CREEK	18-Jul-01	42.542	81.571	34	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CANARD RIVER	31-Jul-01	42.169	83.098	59	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003
CARPYS CREEK	25-Sep-01	42.892	79.158	41	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CATFISH CREEK	19-Jul-01	42.675	81.038	34	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CEDAR CREEK	11-Jul-01	42.027	82.825	55	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003
CLAY CREEK	1-Aug-01	42.742	82.462	45	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CLEAR CREEK	25-Jul-01	42.582	80.590	60	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	**0.013**
CLEARVILLE CREEK	17-Jul-01	42.468	81.713	35	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
DEDRICKS CREEK	25-Jul-01	42.614	80.460	51	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005
DOLSEN CREEK	28-Aug-01	42.337	82.394	52	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
DOLSONS CREEK	11-Jul-01	41.998	82.839	49	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.013	**0.052**
DUCK CREEK	30-Jul-01	42.297	82.689	51	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
EAST TWO CREEK	10-Jul-01	42.092	82.457	41	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MAJOR CREEK	30-Jul-01	42.298	82.765	37	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
EVANS CREEK	24-Aug-01	42.844	79.760	67	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	<0.002
FEEDER CANAL	23-Aug-01	42.863	79.571	51	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
FISHERS GLEN CREEK	26-Jul-01	42.722	80.299	71	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
FLAT CREEK	9-Jul-01	42.321	81.909	44	<0.002	<0.002	<0.002	<0.002	0.004	<0.002	0.004	<0.002	<0.002
FORESTVILLE CREEK	26-Jul-01	42.680	80.368	46	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.005
FOX CREEK	11-Jul-01	41.997	82.850	50	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	**0.016**
GATES CREEK	24-Aug-01	42.835	79.820	66	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
GRAND RIVER	23-Aug-01	42.863	79.575	57	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
HAY CREEK	26-Jul-01	42.774	80.257	46	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
STONEY CREEK	27-Jul-01	42.834	79.927	47	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
HILLMAN CREEK	10-Jul-01	42.052	82.528	62	<0.002	<0.002	<0.002	**0.004**	<0.002	<0.002	<0.002	0.005	**0.021**
HUFFMAN CREEK	11-Jul-01	42.017	82.825	55	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	**0.019**
HICKORY CREEK	27-Jul-01	42.808	80.024	46	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
JEANETTES CK	28-Aug-01	42.330	82.418	49	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004
KETTLE CREEK	18-Jul-01	42.671	81.219	35	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
KLEINS DRAIN	28-Aug-01	42.386	82.409	54	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
KRAFT DRAIN	25-Sep-01	42.886	78.955	54	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
LEBO CREEK	10-Jul-01	42.043	82.499	78	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	**0.012**
LITTLE BEAR CREEK	29-Aug-01	42.532	82.394	51	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
LITTLE R AT LAUZON	1-Aug-01	42.310	82.929	47	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
LITTLE RIVER	27-Aug-01	42.339	82.930	62	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
LYNN RIVER	26-Jul-01	42.786	80.198	50	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003
MORDEN DRAIN	18-Jul-01	42.483	81.683	45	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MANNING DRAIN	27-Aug-01	42.327	82.868	58	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MARENTETTE DRAIN	31-Jul-01	42.224	83.101	58	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	0.007
MARSHY CREEK	29-Aug-01	42.638	82.491	62	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005

Tributary	Sampling Date	Latitude	Longitude	Moisture	HCB	OCS	?-HCH	Lindane	?-Chlordane	?-Chlordane	Total Chlordane	o,p'-DDD	p,p'-DDD
	dd-mmm-yy	dec.deg	dec.deg	%	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g
MAXWELL CREEK	29-Aug-01	42.534	82.396	49	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MCKAY CREEK	18-Jul-01	42.585	81.537	28	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MCKINLAY CREEK	17-Jul-01	42.357	81.833	48	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MENNO WEINS CREEK	25-Jul-01	42.582	80.523	54	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
LITTLE CREEK	18-Jul-01	42.666	81.204	52	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	0.006
MILL CREEK	10-Jul-01	42.027	82.742	49	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.006
MOISON CREEK	30-Jul-01	42.297	82.668	41	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
MUDDY CREEK	10-Jul-01	42.067	82.466	76	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.008	**0.033**
NANTICOKE CREEK	26-Jul-01	42.798	80.070	50	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
NORMANDALE CREEK	26-Jul-01	42.711	80.318	60	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
NORTH ROAD CREEK	25-Jul-01	42.619	80.712	45	<0.002	<0.002	<0.002	<0.002	0.05	0.068	**0.118**	0.006	**0.017**
OX CREEK	18-Jul-01	42.519	81.606	28	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
PEACOCK CREEK	27-Jul-01	42.801	79.999	56	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
PERCH CREEK	2-Aug-01	43.024	82.289	51	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
PIKE CREEK	27-Aug-01	42.314	82.843	47	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004
PUCE RIVER	27-Aug-01	42.300	82.781	43	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003
RANKING CREEK	29-Aug-01	42.490	82.406	42	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
RUNNING CREEK	29-Aug-01	42.604	82.470	36	0.013	0.011	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
RUSCOM RIVER	30-Jul-01	42.294	82.624	50	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004
SANDUSK CREEK	27-Jul-01	42.809	79.969	53	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SELKIRK DRAIN	10-Jul-01	42.033	82.589	47	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.006
SILVER CREEK	19-Jul-01	42.675	80.953	34	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SIXTEEN MILE CREEK	18-Jul-01	42.508	81.621	42	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
SMITH CREEK	24-Aug-01	42.856	79.727	43	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SNIDER CREEK	12-Sep-01	42.872	79.218	63	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	**0.013**
SOUTH OTTER CREEK	25-Jul-01	42.644	80.794	40	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003
STALTER GULLY	19-Jul-01	42.674	80.901	58	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	0.003	0.005	**0.013**
STEEL CREEK	26-Jul-01	42.791	80.105	55	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
STURGEON CREEK	10-Jul-01	42.033	82.565	43	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	**0.012**
SURFSIDE CREEK	12-Sep-01	42.876	79.277	58	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SYDENHAM RIVER	29-Aug-01	42.575	82.398	45	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TALBOT CREEK	18-Jul-01	42.645	81.360	31	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TALFOURD 40 (Creek Site)	1-Aug-01	42.912	82.410	42	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TATE DRAIN	19-Jul-01	42.674	80.910	54	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003
THAMES BRADLEY	28-Aug-01	42.336	82.397	43	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
THAMES RIVER	28-Aug-01	42.317	82.444	43	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
THUNDER BAY CREEK	25-Sep-01	42.876	79.020	57	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.008	**0.025**
TREMBLAY CREEK	30-Jul-01	42.297	82.514	33	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TURKEY CREEK	31-Jul-01	42.245	83.101	50	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TYRCONNEL CREEK	18-Jul-01	42.602	81.460	31	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
WARDELL CREEK	24-Aug-01	42.845	79.775	61	<0.002	<0.002	**0.019**	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
WEAVER DITCH	25-Sep-01	42.873	79.205	40	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	**0.014**
WEST TWO CREEK	10-Jul-01	42.087	82.464	49	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003
GRAPE RUN	29-Aug-01	42.625	82.469	49	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	**0.014**
WIGLE CREEK	10-Jul-01	42.016	82.771	32	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
WOOD STREET CREEK	9-Jul-01	42.295	81.934	53	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
YOUNGS CREEK	26-Jul-01	42.755	80.257	51	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	**0.012**

Tributary	p,p'-DDE	o,p'-DDT	p,p'-DDT	Total DDD	Total DDE	Total DDT	DDT & Metabolites	Dieldrin	?-Endosulfan	?-Endosulfan	Endosulfan sulfate
	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g
ANTRIM CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BABY CREEK (Baby Farm)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BAPTISTE CREEK	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
MCLEAN DRAIN	0.035	<0.002	0.008	0.049	0.035	0.008	0.092	<0.002	<0.002	<0.002	<0.002
BELLE RIVER	0.006	<0.002	<0.002	0.018	0.006	<0.002	0.024	<0.002	<0.002	<0.002	<0.002
BIG CREEK	0.006	<0.002	<0.002	<0.002	0.006	<0.002	0.006	<0.002	<0.002	<0.002	<0.002
BIG CREEK LONG POINT	0.023	<0.002	0.003	0.002	0.023	0.003	0.028	<0.002	<0.002	<0.002	<0.002
BIG OTTER CREEK	0.014	0.004	0.004	0.007	0.014	0.008	0.029	<0.002	<0.002	<0.002	<0.002
BIG TILBURY	0.004	<0.002	<0.002	0.002	0.004	<0.002	0.006	<0.002	<0.002	<0.002	<0.002
BISNETT DRAIN	0.037	<0.002	0.008	0.006	0.037	0.008	0.051	0.006	<0.002	<0.002	<0.002
BOULTON DITCH	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
BOWEN CREEK (Seager Creek)	<0.002	<0.002	<0.002	<0.002	ND	ND	<0.002	<0.002	<0.002	<0.002	<0.002
BOYLE DRAIN	0.003	<0.002	0.003	<0.002	0.003	0.003	0.006	<0.002	<0.002	<0.002	<0.002
BROAD CREEK	0.004	<0.002	<0.002	0.002	0.004	<0.002	0.006	<0.002	<0.002	<0.002	<0.002
BROCK CREEK	0.003	<0.002	0.002	<0.002	0.003	0.002	0.005	<0.002	<0.002	<0.002	<0.002
CANARD RIVER	0.012	<0.002	<0.002	0.003	0.012	<0.002	0.015	<0.002	<0.002	<0.002	<0.002
CARPYS CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CATFISH CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CEDAR CREEK	0.012	<0.002	<0.002	0.003	0.012	<0.002	0.015	<0.002	<0.002	<0.002	<0.002
CLAY CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CLEAR CREEK	0.039	0.003	0.01	0.017	0.039	0.013	0.069	0.003	<0.002	<0.002	<0.002
CLEARVILLE CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
DEDRICKS CREEK	0.015	<0.002	0.009	0.005	0.015	0.009	0.029	<0.002	<0.002	<0.002	<0.002
DOLSEN CREEK	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
DOLSONS CREEK	0.13	0.004	0.025	0.065	0.13	0.029	0.224	0.004	<0.002	<0.002	0.004
DUCK CREEK	0.006	<0.002	<0.002	<0.002	0.006	<0.002	0.006	<0.002	<0.002	<0.002	<0.002
EAST TWO CREEK	0.002	<0.002	<0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002
MAJOR CREEK	0.007	<0.002	<0.002	0.002	0.007	<0.002	0.009	<0.002	<0.002	<0.002	<0.002
EVANS CREEK	0.006	<0.002	<0.002	0.003	0.006	<0.002	0.009	<0.002	<0.002	<0.002	<0.002
FEEDER CANAL	0.002	<0.002	<0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002
FISHERS GLEN CREEK	0.014	<0.002	0.005	<0.002	0.014	0.005	0.019	<0.002	<0.002	<0.002	<0.002
FLAT CREEK	0.006	<0.002	0.005	<0.002	0.006	0.005	0.011	0.024	<0.002	<0.002	<0.002
FORESTVILLE CREEK	0.03	0.003	0.011	0.007	0.03	0.014	0.051	<0.002	<0.002	<0.002	<0.002
FOX CREEK	0.072	<0.002	0.005	0.02	0.072	0.005	0.097	<0.002	<0.002	<0.002	<0.002
GATES CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
GRAND RIVER	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
HAY CREEK	0.005	<0.002	<0.002	<0.002	0.005	<0.002	0.005	<0.002	<0.002	<0.002	<0.002
STONEY CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
HILLMAN CREEK	0.11	0.011	0.068	0.026	0.11	0.079	0.215	0.023	0.3	0.42	0.6
HUFFMAN CREEK	0.089	<0.002	0.004	0.024	0.089	0.004	0.117	<0.002	<0.002	<0.002	0.002
HICKORY CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
JEANETTES CK	0.002	<0.002	<0.002	0.004	0.002	<0.002	0.006	<0.002	<0.002	<0.002	<0.002
KETTLE CREEK	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
KLEINS DRAIN	0.002	<0.002	<0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002
KRAFT DRAIN	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
LEBO CREEK	0.033	<0.002	<0.002	0.016	0.033	<0.002	0.049	0.004	<0.002	0.006	0.056
LITTLE BEAR CREEK	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
LITTLE R AT LAUZON	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	0.034
LITTLE RIVER	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
LYNN RIVER	0.015	<0.002	<0.002	0.003	0.015	<0.002	0.018	<0.002	<0.002	<0.002	<0.002
MORDEN DRAIN	ND	<0.002	<0.002	<0.002	ND	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MANNING DRAIN	0.01	<0.002	<0.002	<0.002	0.01	<0.002	0.01	<0.002	<0.002	<0.002	<0.002
MARENTETTE DRAIN	0.067	<0.002	0.004	0.01	0.067	0.004	0.081	<0.002	<0.002	0.006	0.013
MARSHY CREEK	0.002	<0.002	<0.002	0.005	0.002	<0.002	0.007	<0.002	<0.002	<0.002	<0.002

Tributary	p,p'-DDE	o,p'-DDT	p,p'-DDT	Total DDD	Total DDE	Total DDT	DDT & Metabolites	Dieldrin	?-Endosulfan	?-Endosulfan	Endosulfan sulfate
	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g
MAXWELL CREEK	0.004	<0.002	<0.002	<0.002	0.004	<0.002	0.004	<0.002	<0.002	<0.002	<0.002
MCKAY CREEK	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
MCKINLAY CREEK	0.007	<0.002	<0.002	<0.002	0.007	<0.002	0.007	0.002	<0.002	<0.002	<0.002
MENNO WEINS CREEK	0.004	<0.002	0.004	<0.002	0.004	0.004	0.008	<0.002	0.009	0.019	0.013
LITTLE CREEK	0.022	<0.002	0.005	0.009	0.022	0.005	0.036	0.005	<0.002	<0.002	<0.002
MILL CREEK	0.016	<0.002	0.006	0.006	0.016	0.006	0.028	<0.002	0.026	0.01	0.004
MOISON CREEK	0.006	<0.002	<0.002	0.002	0.006	<0.002	0.008	<0.002	<0.002	<0.002	<0.002
MUDDY CREEK	0.096	<0.002	<0.002	0.041	0.096	<0.002	0.137	0.005	<0.002	<0.002	0.011
NANTICOKE CREEK	0.005	<0.002	<0.002	<0.002	0.005	<0.002	0.005	<0.002	<0.002	<0.002	<0.002
NORMANDALE CREEK	0.005	<0.002	<0.002	<0.002	0.005	<0.002	0.005	<0.002	<0.002	<0.002	<0.002
NORTH ROAD CREEK	0.067	<0.002	0.042	0.023	0.067	0.042	0.132	0.006	0.007	<0.002	<0.002
OX CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
PEACOCK CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
PERCH CREEK	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
PIKE CREEK	0.014	<0.002	<0.002	0.004	0.014	<0.002	0.018	<0.002	<0.002	<0.002	<0.002
PUCE RIVER	0.01	<0.002	<0.002	0.003	0.01	<0.002	0.013	<0.002	<0.002	<0.002	<0.002
RANKING CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
RUNNING CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
RUSCOM RIVER	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	<0.002
SANDUSK CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SELKIRK DRAIN	0.02	<0.002	0.004	0.008	0.02	0.004	0.032	<0.002	0.3	0.18	0.11
SILVER CREEK	0.005	<0.002	0.002	<0.002	0.005	0.002	0.007	<0.002	<0.002	<0.002	<0.002
SIXTEEN MILE CREEK	0.011	<0.002	0.008	0.002	0.011	0.008	0.021	0.003	0.005	0.005	0.003
SMITH CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SNIDER CREEK	0.015	<0.002	0.002	0.018	0.015	0.002	0.035	<0.002	<0.002	<0.002	<0.002
SOUTH OTTER CREEK	0.01	<0.002	0.003	0.003	0.01	0.003	0.016	<0.002	<0.002	<0.002	<0.002
STALTER GULLY	0.048	0.006	0.018	0.018	0.048	0.024	0.09	0.003	<0.002	<0.002	<0.002
STEEL CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
STURGEON CREEK	0.038	0.003	0.022	0.016	0.038	0.025	0.079	0.004	0.075	0.071	0.1
SURFSIDE CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
SYDENHAM RIVER	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TALBOT CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TALFOURD 40 (Creek Site)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TATE DRAIN	0.008	<0.002	0.003	0.003	0.008	0.003	0.014	0.002	<0.002	<0.002	<0.002
THAMES BRADLEY	0.002	<0.002	<0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002
THAMES RIVER	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
THUNDER BAY CREEK	<0.002	<0.002	<0.002	0.033	<0.002	<0.002	0.033	<0.002	<0.002	<0.002	<0.002
TREMBLAY CREEK	0.004	<0.002	<0.002	<0.002	0.004	<0.002	0.004	<0.002	<0.002	<0.002	<0.002
TURKEY CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.013
TYRCONNEL CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
WARDELL CREEK	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
WEAVER DITCH	0.008	<0.002	TRACE	0.019	0.008	TRACE	0.027	<0.002	<0.002	<0.002	<0.002
WEST TWO CREEK	0.003	<0.002	0.003	0.003	0.003	0.003	0.009	<0.002	0.006	0.014	0.023
GRAPE RUN	0.032	<0.002	0.005	0.014	0.032	0.005	0.051	<0.002	0.008	0.011	0.014
WIGLE CREEK	0.003	<0.002	<0.002	<0.002	0.003	<0.002	0.003	<0.002	<0.002	<0.002	<0.002
WOOD STREET CREEK	0.004	<0.002	<0.002	<0.002	0.004	<0.002	0.004	<0.002	<0.002	<0.002	<0.002
YOUNGS CREEK	0.065	0.004	0.014	0.015	0.065	0.018	0.098	0.002	<0.002	<0.002	<0.002

Appendix A. Laboratory Results

Tributary	Heptachlor	Methoxychlor	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total PCB	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene
	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/kg	?g/kg	?g/kg	?g/kg
ANTRIM CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	5	<5	<10	<5
BABY CREEK (Baby Farm)	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
BAPTISTE CREEK	<0.002	<0.008	<0.02	TRACE	TRACE	TRACE	<5	<5	<10	5
MCLEAN DRAIN	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	7	<5	<10	<5
BELLE RIVER	<0.002	<0.008	<0.02	TR(0.016)	TR(0.006)	0.02	8	**7**	<10	9
BIG CREEK	<0.002	<0.008	<0.02	TR(0.009)	<0.015	TR(0.009)	<5	<5	<10	<5
BIG CREEK LONG POINT	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
BIG OTTER CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
BIG TILBURY	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	NA	NA	NA	NA
BISNETT DRAIN	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	11.5	<5	30	**40.9**
BOULTON DITCH	<0.002	<0.008	<0.02	<0.015	TRACE	TRACE	<5	<5	<10	<5
BOWEN CREEK (Seager Creek)	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	16.9	**11.5**	<10	19.1
BOYLE DRAIN	<0.002	<0.008	<0.02	TRACE	<0.015	TRACE	<5	<5	<10	<5
BROAD CREEK	<0.002	<0.008	<0.02	0.03	0.01	**0.04**	NA	NA	NA	NA
BROCK CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	5
CANARD RIVER	<0.002	<0.008	<0.02	TR(0.017)	TR(0.009)	0.03	9	<5	<10	16.5
CARPYS CREEK	<0.002	<0.008	<0.02	TR(0.004)	TR(0.005)	TR(0.009)	5	**10**	<10	5
CATFISH CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
CEDAR CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	10.5	<5	<10	<5
CLAY CREEK	<0.002	<0.008	<0.02	0.02	<0.015	0.02	<5	<5	<10	<5
CLEAR CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
CLEARVILLE CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
DEDRICKS CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	**9**	<10	<5
DOLSEN CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	NA	NA	NA	NA
DOLSONS CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
DUCK CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	**6**	<10	8
EAST TWO CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	8	6	<10	7
MAJOR CREEK	<0.002	<0.008	<0.02	TR(0.007)	<0.015	TR(0.007)	6	<5	<10	<5
EVANS CREEK	<0.002	<0.008	<0.02	0.03	**0.03**	**0.06**	7	<5	<10	<5
FEEDER CANAL	<0.002	<0.008	<0.02	TR(0.009)	TR(0.009)	0.02	NA	NA	NA	NA
FISHERS GLEN CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	11.7
FLAT CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
FORESTVILLE CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
FOX CREEK	<0.002	<0.008	<0.02	0.02	**0.01**	0.03	9	<5	<10	8
GATES CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
GRAND RIVER	<0.002	<0.008	<0.02	0.01	**0.01**	0.03	<5	<5	<10	<5
HAY CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
STONEY CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
HILLMAN CREEK	<0.002	0.022	<0.02	<0.015	<0.015	<0.015	5	**6**	<10	<5
HUFFMAN CREEK	<0.002	<0.008	<0.02	<0.015	**0.01**	0.01	5	7	<10	<5
HICKORY CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	11.8	6	<10	13.5
JEANETTES CK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	**94**	**89**	**93**	**97**
KETTLE CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	18.5	**49.6**	**23**	**22.8**
KLEINS DRAIN	<0.002	<0.008	0.05	TRACE	<0.015	**0.05**	5	<5	<10	<5
KRAFT DRAIN	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	5	<5	<10	10.1
LEBO CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	9	<5	<10	<5
LITTLE BEAR CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	31	<5	<10	<5
LITTLE R AT LAUZON	<0.002	0.018	<0.02	**0.082**	**0.029**	**0.11**	**51**	<5	**141**	**169**
LITTLE RIVER	<0.002	<0.008	<0.02	0.1	**1.3**	1.4	<5	<5	<10	<5
LYNN RIVER	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	17.3	**75.8**	**22**	**40**
MORDEN DRAIN	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
MANNING DRAIN	<0.002	<0.008	<0.02	0.02	**0.01**	0.03	14.6	**9**	**20**	**49.9**
MARENTETTE DRAIN	<0.002	<0.008	<0.02	0.02	TRACE	0.02	7	**10.5**	<10	<5
MARSHY CREEK	<0.002	<0.008	<0.02	<0.015	TR(0.006)	TR(0.019)	**61.1**	<5	<10	<5

Tributary	Heptachlor	Methoxychlor	Aroclor 1242	Aroclor 1254	Aroclor 1260	Total PCB	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene
	?g/g	?g/g	?g/g	?g/g	?g/g	?g/g	?g/kg	?g/kg	?g/kg	?g/kg
MAXWELL CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
MCKAY CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
MCKINLAY CREEK	<0.002	<0.008	<0.02	0.04	**0.02**	**0.06**	<5	<5	<10	<5
MENNO WEINS CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
LITTLE CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	11.9	<5	<10	<5
MILL CREEK	<0.002	<0.008	<0.02	0.02	TR(0.004)	0.02	10	10.3	<10	9
MOISON CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
MUDDY CREEK	<0.002	<0.008	<0.02	**0.59**	**0.17**	**0.76**	9	**255**	**21**	**40.4**
NANTICOKE CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	7	**29.2**	**24**	**22.3**
NORMANDALE CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	**9**	<10	6
NORTH ROAD CREEK	0.014	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
OX CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
PEACOCK CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	5	<5	<10	14.5
PERCH CREEK	<0.002	<0.008	<0.02	TR(0.012)	TRACE	TR(0.016)	<5	<5	<10	<5
PIKE CREEK	<0.002	<0.008	<0.02	TR(0.012)	TRACE	TR(0.012)	<5	9	<10	9
PUCE RIVER	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
RANKING CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
RUNNING CREEK	<0.002	<0.008	<0.02	TR(0.015)	<0.015	TR(0.015)	8	**17.2**	<10	13.4
RUSCOM RIVER	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	6	<5	<10	14
SANDUSK CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
SELKIRK DRAIN	<0.002	<0.008	<0.02	0.02	TR(0.005)	0.03	13.5	5	**11**	16.9
SILVER CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	11
SIXTEEN MILE CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
SMITH CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
SNIDER CREEK	<0.002	<0.008	<0.02	0.02	TR(0.016)	**0.04**	6	<5	<10	<5
SOUTH OTTER CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
STALTER GULLY	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
STEEL CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	12.5	**34.6**	<10	10
STURGEON CREEK	<0.002	<0.008	<0.02	TR(0.007)	<0.015	TR(0.007)	6	**6**	<10	8
SURFSIDE CREEK	<0.002	<0.008	<0.02	<0.015	TRACE	TRACE	<5	<5	<10	<5
SYDENHAM RIVER	<0.002	<0.008	<0.02	TRACE	<0.015	TRACE	15.5	<5	<10	7
TALBOT CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
TALFOURD 40 (Creek Site)	<0.002	<0.008	<0.02	TR(0.009)	TR(0.008)	0.02	<5	<5	<10	<5
TATE DRAIN	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	9	**11**	14.9
THAMES BRADLEY	<0.002	<0.008	<0.02	0.01	<0.015	0.01	**50**	**50**	**100**	**50**
THAMES RIVER	<0.002	<0.008	<0.02	0.01	<0.015	0.01	<5	<5	<10	<5
THUNDER BAY CREEK	<0.002	<0.008	<0.02	TR(0.014)	TRACE	TR(0.014)	<5	**9**	<10	10
TREMBLAY CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	**12.7**	<10	11.1
TURKEY CREEK	<0.002	<0.008	<0.02	**0.55**	**0.24**	**0.78**	<5	**80**	<10	**63**
TYRCONNEL CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
WARDELL CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	**6**	<10	<5
WEAVER DITCH	<0.002	<0.008	<0.02	TRACE	TRACE	TRACE	<5	<5	<10	6
WEST TWO CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5
GRAPE RUN	<0.002	<0.008	<0.02	TRACE	<0.015	TRACE	<5	<5	**11**	17.6
WIGLE CREEK	<0.002	<0.008	<0.02	0.02	<0.015	0.02	6	<5	<10	<5
WOOD STREET CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	6	<5	<10	7
YOUNGS CREEK	<0.002	<0.008	<0.02	<0.015	<0.015	<0.015	<5	<5	<10	<5

Tributary	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene
	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg
ANTRIM CREEK	30.9	<5	27.2	28.8	11	27	14	<10	9
BABY CREEK (Baby Farm)	123	<5	153	137	<10	<10	<10	<10	<5
BAPTISTE CREEK	11.5	6	23.5	16.7	<10	11	<10	<10	<5
MCLEAN DRAIN	19.4	16.4	33.2	25.8	<10	<10	<10	<10	<5
BELLE RIVER	55	19.9	174	164	105	66	48	24	40
BIG CREEK	<5	<5	<5	<5	<10	<10	<10	<10	<5
BIG CREEK LONG POINT	<5	<5	10	8	<10	<10	<10	<10	<5
BIG OTTER CREEK	8	<5	16.6	18.3	<10	<10	<10	<10	<5
BIG TILBURY	NA	NA	NA	NA	NA	NA	NA	NA	NA
BISNETT DRAIN	386	130	468	390	114	198	56	36	66.4
BOULTON DITCH	35.6	<5	<5	<5	<10	<10	<10	<10	<5
BOWEN CREEK (Seager Creek)	94.7	27.6	85	130	40	32	<10	<10	11.5
BOYLE DRAIN	6	10	9	7	<10	<10	<10	<10	21.1
BROAD CREEK	NA	NA	NA	NA	NA	NA	NA	NA	NA
BROCK CREEK	36.2	12.2	63.8	47.6	22	32	25	12	19.1
CANARD RIVER	101	35.4	214	172	104	74	39	21	36.4
CARPYS CREEK	67	15.5	131	108	34	79	37	21	24.6
CATFISH CREEK	6	<5	9	8	<10	<10	<10	<10	<5
CEDAR CREEK	18.9	12.8	34.4	24.7	<10	21	<10	<10	<5
CLAY CREEK	61	<5	107	83	<10	<10	<10	<10	<5
CLEAR CREEK	<5	<5	<5	<5	<10	<10	<10	<10	<5
CLEARVILLE CREEK	6	<5	<5	<5	<10	<10	<10	<10	<5
DEDRICKS CREEK	43.2	18.8	91	68.1	37	41	27	21	33.5
DOLSEN CREEK	NA	NA	NA	NA	NA	NA	NA	NA	NA
DOLSONS CREEK	11	<5	17.8	12.4	<10	13	<10	<10	<5
DUCK CREEK	57.9	20.8	146	103	20	76	37	16	20.6
EAST TWO CREEK	45.7	21	64.5	56.4	18	39	16	11	11.8
MAJOR CREEK	25	6	48.4	42.2	37	19	14	<10	10.6
EVANS CREEK	7	<5	25.8	27	15	<10	10	<10	9
FEEDER CANAL	NA	NA	NA	NA	NA	NA	NA	NA	NA
FISHERS GLEN CREEK	14.9	<5	12.7	<5	14	<10	<10	<10	<5
FLAT CREEK	7	<5	7	<5	<10	<10	<10	<10	<5
FORESTVILLE CREEK	5	<5	8	<5	<10	<10	<10	<10	<5
FOX CREEK	18.4	11.8	27.3	22.8	<10	18	<10	<10	<5
GATES CREEK	<5	<5	<5	<5	<10	<10	<10	<10	<5
GRAND RIVER	<5	<5	91	76	<10	<10	<10	<10	<5
HAY CREEK	20.2	<5	31.2	22.2	11	18	<10	<10	6
STONEY CREEK	33.1	10.8	30.7	20.7	<10	16	<10	<10	<5
HILLMAN CREEK	22.2	<5	39.9	26.7	13	14	<10	<10	<5
HUFFMAN CREEK	38.6	18.1	44.9	30.8	<10	30	<10	<10	<5
HICKORY CREEK	82.2	28.9	77.1	52.3	14	37	13	<10	9
JEANETTES CK	98	97	98	98	104	101	51	115	91
KETTLE CREEK	167	65.8	229	398	143	153	110	66	145
KLEINS DRAIN	26.5	13.2	52.1	42.7	20	26	18	<10	12.9
KRAFT DRAIN	142	30.8	335	253	69	164	64	35	39.6
LEBO CREEK	41.3	19.8	54.7	38.5	15	23	<10	<10	<5
LITTLE BEAR CREEK	9	<5	10.6	9	<10	<10	<10	<10	<5
LITTLE R AT LAUZON	2110	344	4290	3250	1400	2180	1590	1210	982
LITTLE RIVER	176	<5	368	331	124	172	266	139	142
LYNN RIVER	317	187	1370	1260	343	326	119	98	172
MORDEN DRAIN	6	<5	<5	<5	11	<10	<10	<10	<5
MANNING DRAIN	461	101	930	740	256	428	250	122	177
MARENTETTE DRAIN	35.6	18.4	103	86.4	72	39	28	14	20.5
MARSHY CREEK	220	92.4	492	372	117	287	82	ND	<5

Appendix A. Laboratory Results

Tributary	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene
	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg	?g/kg
MAXWELL CREEK	8	<5	10	8	<10	<10	<10	<10	<5
MCKAY CREEK	<5	<5	6	5	<10	<10	<10	<10	<5
MCKINLAY CREEK	11.9	<5	22.2	16.7	12	14	10	ND	**175**
MENNO WEINS CREEK	<5	<5	<5	<5	<10	<10	<10	<10	<5
LITTLE CREEK	33.2	9	71.9	**56.8**	25	35	23	14	16.3
MILL CREEK	**157**	**59.2**	**376**	**313**	**82**	**148**	42	31	**37.3**
MOISON CREEK	<5	<5	<5	<5	<10	<10	<10	<10	<5
MUDDY CREEK	**844**	**335**	**2260**	**2790**	**464**	**1040**	152	111	**162**
NANTICOKE CREEK	**208**	**72.5**	**428**	**366**	**117**	**184**	61	42	**69.9**
NORMANDALE CREEK	23.5	15	58.8	44.3	26	29	16	11	17.2
NORTH ROAD CREEK	38.2	22	57.6	49.6	19	24	11	<10	<5
OX CREEK	<5	<5	<5	<5	<10	<10	<10	<10	17
PEACOCK CREEK	**68.3**	29.3	95.2	**66.3**	18	49	20	12	14.9
PERCH CREEK	21.1	6	38.9	33.7	20	22	<10	<10	<5
PIKE CREEK	**43.4**	20.3	**115**	**101**	46	**63**	45	27	**32.1**
PUCE RIVER	17.7	6	42.4	39.1	15	27	16	<10	10.6
RANKING CREEK	6	<5	10.6	8	<10	<10	<10	<10	<5
RUNNING CREEK	**78.2**	27	**100**	**117**	**45**	**75**	29	13	24.5
RUSCOM RIVER	**48.2**	18.5	97.4	**73.5**	18	**93**	33	19	16.1
SANDUSK CREEK	13.9	6	26.1	18.5	<10	14	<10	<10	6
SELKIRK DRAIN	**199**	33	**289**	**210**	**99**	**121**	101	60	**74.1**
SILVER CREEK	**70.2**	27.8	**127**	**95.3**	**42**	45	34	20	28.7
SIXTEEN MILE CREEK	34.2	10.5	70.4	**57.7**	22	37	34	15	22.9
SMITH CREEK	**66**	26.5	102	**93**	**42**	42	30	20	**33.9**
SNIDER CREEK	13.7	10.8	26.6	21.2	12	16	<10	<10	7
SOUTH OTTER CREEK	**45.4**	**74.7**	**156**	**264**	**32**	39	17	<10	<5
STALTER GULLY	12.6	<5	29.9	22.9	<10	<10	<10	<10	<5
STEEL CREEK	39.5	26.7	**114**	**71.7**	**59**	**71**	52	34	**49.3**
STURGEON CREEK	**64.4**	20.8	87.3	**72.8**	19	56	15	11	14.3
SURFSIDE CREEK	15.8	9	50.7	37.3	17	19	14	<10	8
SYDENHAM RIVER	32.1	8	46.9	40.8	16	27	11	<10	7
TALBOT CREEK	18.3	<5	27.3	20.8	<10	14	10	<10	9
TALFOURD 40 (Creek Site)	**86**	<5	105	**88**	<10	<10	<10	<10	<5
TATE DRAIN	**84.1**	33.7	**192**	**145**	**64**	**73**	53	32	**43.3**
THAMES BRADLEY	**50**	**50**	50	50	**100**	**100**	100	100	**50**
THAMES RIVER	**74**	<5	108	**94**	<10	<10	<10	<10	<5
THUNDER BAY CREEK	**44.8**	**47.8**	**117**	**90.5**	**40**	**81**	33	19	24.9
TREMBLAY CREEK	**76.4**	16.9	60.3	39.2	11	26	10	<10	8
TURKEY CREEK	**455**	**120**	**959**	**834**	**378**	**644**	474	344	**281**
TYRCONNEL CREEK	18.6	6	42.8	31.2	13	24	13	<10	10
WARDELL CREEK	11.5	<5	31.3	31.7	18	12	11	<10	11.7
WEAVER DITCH	22.6	9	44.2	33.9	15	34	10	<10	7
WEST TWO CREEK	12.3	<5	27	21.8	<10	ND	<10	<10	<5
GRAPE RUN	134	38.3	**171**	**129**	**40**	57	27	16	22.6
WIGLE CREEK	13.5	6	14.2	9	<10	ND	<10	<10	<5
WOOD STREET CREEK	16.3	<5	35.9	<5	11	14	<10	<10	11.9
YOUNGS CREEK	8	<5	20.2	14.1	<10	<10	<10	<10	<5

Tributary	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(ghi)perylene	Total PAH	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr
	?g/kg	?g/kg	?g/kg	?g/kg	?g/g	pct	?g/g	?g/g	?g/g	?g/g	pct	µg/g	µg/g	µg/g
ANTRIM CREEK	<20	<20	<20	153	2.1	0.84	**16**	59	0.4	<5	7.35	<1	19	13
BABY CREEK (Baby Farm)	<20	<20	<20	413	NA	0.99	<5	86	<0.2	<5	2.70	<0.5	11	14
BAPTISTE CREEK	<20	<20	<20	73.7	0.5	1.71	**11**	100	0.9	<5	3.07	**1**	20	25
MCLEAN DRAIN	<20	<20	<20	102	<0.5	1.20	**6**	129	0.6	<5	3.26	<1	17	17
BELLE RIVER	37	<20	29	786	0.6	1.51	**16**	98	0.7	<5	3.54	<1	19	22
BIG CREEK	<20	<20	<20	ND	0.5	1.58	**12**	99	0.8	<5	4.39	<1	19	21
BIG CREEK LONG POINT	<20	<20	<20	18	0.8	0.36	<5	25	0.2	<5	4.19	<1	9	7
BIG OTTER CREEK	<20	<20	<20	42.9	1.1	0.51	**12**	32	0.2	<5	6.44	<1	12	8
BIG TILBURY	NA	NA	NA	NA	0.6	1.66	**13**	93	0.9	<5	3.50	<1	20	25
BISNETT DRAIN	<20	<20	62	1989	0.7	0.89	<5	56	0.5	<5	3.51	<1	15	13
BOULTON DITCH	<20	<20	<20	35.6	1.2	0.83	**15**	87	0.4	<5	7.86	<1	17	13
BOWEN CREEK (Seager Creek)	<20	<20	<20	468	< 0.5	1.0	**7**	95	< 0.2	<5	1.86	< 0.5	15	25
BOYLE DRAIN	<20	<20	<20	53.1	1.3	0.97	**20**	81	0.5	<5	8.37	<1	18	14
BROAD CREEK	NA	NA	NA	NA	0.6	1.72	**9**	121	0.8	<5	3.50	**1**	17	**28**
BROCK CREEK	<20	<20	<20	275	0.8	0.56	**13**	45	0.3	<5	6.10	<1	14	10
CANARD RIVER	31	<20	30	883	0.6	1.43	**11**	93	0.8	<5	2.71	<1	16	22
CARPYS CREEK	31	<20	33	601	0.7	0.98	**11**	89	0.5	<5	4.88	<1	15	14
CATFISH CREEK	<20	<20	<20	23	<0.5	0.46	**9**	32	0.2	<5	8.35	<1	14	8
CEDAR CREEK	<20	<20	<20	122	0.5	0.86	**8**	76	0.5	<5	3.41	<1	16	15
CLAY CREEK	<20	<20	<20	251	0.5	1.34	**13**	78	0.7	<5	4.12	<1	21	22
CLEAR CREEK	<20	<20	<20	ND	<0.5	1.06	**8**	104	0.6	<5	3.33	<1	17	16
CLEARVILLE CREEK	<20	<20	<20	6	0.9	0.85	**18**	85	0.4	<5	8.39	<1	21	12
DEDRICKS CREEK	<20	<20	<20	390	0.8	1.20	**15**	103	0.6	<5	4.16	<1	19	18
DOLSEN CREEK	NA	NA	NA	NA	1.1	0.92	**10**	65	0.5	<5	9.66	<1	21	14
DOLSONS CREEK	<20	<20	<20	54.2	1.2	0.89	**13**	75	0.5	<5	5.33	<1	15	13
DUCK CREEK	<20	<20	<20	511	<0.5	1.29	**7**	73	0.7	<5	2.94	<1	16	20
EAST TWO CREEK	<20	<20	<20	304	<0.5	0.59	<5	39	0.3	<5	2.93	<1	10	10
MAJOR CREEK	<20	<20	<20	208	<0.5	0.85	<5	59	0.4	<5	3.85	<1	14	14
EVANS CREEK	<20	<20	<20	101	<0.5	2.30	<5	137	1.0	<5	1.73	**1**	18	**28**
FEEDER CANAL	NA	NA	NA	NA	<0.5	0.72	**13**	86	0.4	<5	6.55	**1**	15	13
FISHERS GLEN CREEK	<20	<20	<20	53.3	<0.5	0.34	**10**	59	<0.2	<5	3.77	<1	9	9
FLAT CREEK	<20	<20	<20	14	<0.5	2.38	**11**	114	1.1	<5	1.48	<1	25	**29**
FORESTVILLE CREEK	<20	<20	<20	13	0.5	0.56	**6**	54	0.2	<5	4.54	<1	12	9
FOX CREEK	<20	<20	<20	115	<0.5	1.19	**13**	61	0.5	<5	4.68	<1	16	17
GATES CREEK	<20	<20	<20	ND	0.7	1.07	**7**	95	0.4	<5	4.60	<1	13	14
GRAND RIVER	<20	<20	<20	167	1.1	1.19	**16**	85	0.5	<5	8.91	<1	21	21
HAY CREEK	<20	<20	<20	109	0.7	0.60	**13**	49	0.3	<5	7.32	<1	14	8
STONEY CREEK	<20	<20	<20	111	0.6	1.25	<5	73	0.6	<5	3.53	<1	16	16
HILLMAN CREEK	<20	<20	<20	127	0.5	1.89	**9**	158	0.9	<5	3.06	**2**	17	25
HUFFMAN CREEK	<20	<20	<20	174	<0.5	1.95	**10**	110	0.9	<5	1.96	<1	16	26
HICKORY CREEK	<20	<20	<20	345	<0.5	1.40	**8**	73	1.0	<5	2.26	<1	20	19
JEANETTES CK	86	**88**	81	1481	0.5	2.23	<5	117	1.0	<5	7.11	<1	23	**30**
KETTLE CREEK	42	<20	44	1677	0.8	0.80	**15**	50	0.3	<5	9.79	<1	17	13
KLEINS DRAIN	<20	<20	<20	216	0.9	0.81	**18**	57	0.4	<5	10.39	<1	19	13
KRAFT DRAIN	71	<20	63	1282	0.7	1.73	<5	109	0.8	<5	6.62	**1**	24	24
LEBO CREEK	<20	<20	<20	201	<0.5	1.93	**9**	133	0.9	<5	3.26	**2**	19	**27**
LITTLE BEAR CREEK	<20	<20	<20	59.6	<0.5	1.54	<5	79	0.7	<5	9.95	<1	23	21
LITTLE R AT LAUZON	**537**	<20	**537**	**18791**	1.0	0.59	**12**	69	0.3	<5	7.79	<1	15	22
LITTLE RIVER	<20	<20	<20	1718	1.9	1.56	**10**	106	0.6	<5	4.08	<1	18	**79**
LYNN RIVER	**259**	**43**	136	**4785**	<0.5	0.88	**14**	83	0.4	<5	9.15	<1	17	14
MORDEN DRAIN	<20	<20	<20	17	0.9	0.79	**18**	61	0.4	<5	10.32	<1	22	11
MANNING DRAIN	125	**34**	114	3832	<0.5	0.83	**15**	76	0.4	<5	5.32	<1	14	21
MARENTETTE DRAIN	<20	<20	<20	434	0.6	1.19	**13**	93	0.6	<5	5.36	<1	17	22
MARSHY CREEK	<20	<20	<20	1724	<0.5	0.55	<5	45	0.4	<5	3.06	<1	10	10

Tributary	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(ghi)perylene	Total PAH	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr
	?g/kg	?g/kg	?g/kg	?g/kg	?g/g	pct	?g/g	?g/g	?g/g	?g/g	pct	ug/g	ug/g	ug/g
MAXWELL CREEK	<20	<20	<20	26	0.9	1.31	9	69	0.6	<5	9.84	<1	22	20
MCKAY CREEK	<20	<20	<20	11	<0.5	0.27	<5	18	0.2	<5	1.88	<1	5	5
MCKINLAY CREEK	<20	<20	<20	262	<0.5	1.44	6	72	0.7	<5	4.28	<1	16	19
MENNO WEINS CREEK	<20	<20	<20	ND	<0.5	2.17	<5	114	0.9	<5	3.31	<1	17	29
LITTLE CREEK	<20	<20	<20	296	<0.5	0.58	7	71	0.3	<5	5.97	<1	13	10
MILL CREEK	109	<20	96	1480	0.8	0.32	9	46	0.2	<5	7.68	1	12	7
MOISON CREEK	<20	<20	<20	ND	<0.5	0.78	<5	52	0.4	<5	1.67	<1	10	13
MUDDY CREEK	303	<20	237	9023	<0.5	1.31	17	135	0.8	<5	2.18	<1	14	23
NANTICOKE CREEK	66	<20	48	1745	0.6	1.15	10	90	0.5	<5	4.52	<1	15	21
NORMANDALE CREEK	<20	<20	<20	256	<0.5	0.45	13	88	0.2	<5	3.78	<1	23	16
NORTH ROAD CREEK	<20	<20	<20	221	0.6	0.23	12	58	<0.2	<5	5.32	<1	9	4
OX CREEK	<20	<20	<20	17	0.7	0.59	6	54	0.3	<5	4.45	<1	12	10
PEACOCK CREEK	<20	<20	<20	393	0.9	1.79	8	154	1.2	<5	6.32	<1	31	26
PERCH CREEK	<20	<20	<20	142	4.5	1.26	7	72	0.5	<5	12.97	<1	26	23
PIKE CREEK	22	<20	24	557	1.1	1.40	6	82	0.7	<5	3.88	<1	16	21
PUCE RIVER	<20	<20	<20	174	0.5	1.17	9	71	0.6	<5	2.86	<1	16	18
RANKING CREEK	<20	<20	<20	24.6	1.8	0.55	5	45	0.3	<5	7.43	<1	13	9
RUNNING CREEK	<20	<20	21	568	1.2	0.48	15	24	0.2	<5	7.13	<1	13	10
RUSCOM RIVER	<20	<20	<20	437	1.1	1.60	11	190	0.8	<5	6.02	<1	20	26
SANDUSK CREEK	<20	<20	<20	84.5	<0.5	2.43	<5	148	1.1	<5	2.39	<1	21	32
SELKIRK DRAIN	38	<20	32	1303	1.7	0.90	13	94	0.4	<5	7.89	<1	18	26
SILVER CREEK	<20	<20	<20	501	<0.5	0.30	<5	34	<0.2	<5	5.06	<1	9	5
SIXTEEN MILE CREEK	<20	<20	<20	304	<0.5	1.03	9	80	0.5	<5	5.04	<1	17	15
SMITH CREEK	<20	<20	<20	455	<0.5	1.07	<5	65	0.6	<5	3.03	<1	14	16
SNIDER CREEK	<20	<20	<20	113	0.7	0.94	13	57	0.4	<5	6.72	<1	19	12
SOUTH OTTER CREEK	<20	<20	<20	638	0.6	0.47	<5	41	0.2	<5	5.04	<1	12	8
STALTER GULLY	<20	<20	<20	65	2.6	0.99	18	206	0.4	<5	11.06	<1	21	13
STEEL CREEK	60	<20	42	676	<0.5	1.46	8	100	1.2	<5	3.82	1	22	28
STURGEON CREEK	<20	<20	<20	381	<0.5	0.58	6	101	0.3	<5	5.62	<1	14	11
SURFSIDE CREEK	<20	<20	<20	171	0.7	1.27	8	55	0.6	<5	5.95	<1	17	16
SYDENHAM RIVER	<20	<20	<20	211	<0.5	1.85	9	106	0.8	<5	5.55	<1	20	44
TALBOT CREEK	<20	<20	<20	99.4	0.6	0.62	7	36	0.3	<5	7.03	<1	14	10
TALFOURD 40 (Creek Site)	<20	<20	<20	279	1.1	0.71	15	49	0.4	<5	8.58	<1	17	11
TATE DRAIN	<20	<20	<20	755	0.5	0.99	13	127	0.4	<5	6.54	<1	15	13
THAMES BRADLEY	200	200	200	1500	2.4	1.19	15	77	0.5	<5	12.00	<1	25	19
THAMES RIVER	<20	<20	<20	276	0.9	1.42	6	90	0.6	<5	8.58	<1	21	22
THUNDER BAY CREEK	<20	<20	<20	517	<0.5	1.80	<5	123	0.8	<5	1.71	<1	14	22
TREMBLAY CREEK	<20	<20	<20	272	<0.5	0.57	<5	31	0.3	<5	1.31	<1	8	10
TURKEY CREEK	<20	<20	<20	4632	0.8	1.06	16	241	0.5	<5	5.85	13	17	112
TYRCONNEL CREEK	<20	<20	<20	159	0.7	0.57	6	42	0.2	<5	5.80	<1	13	9
WARDELL CREEK	<20	<20	<20	133	<0.5	1.47	<5	116	0.6	<5	4.53	<1	16	20
WEAVER DITCH	<20	<20	<20	182	<0.5	0.63	<5	41	0.3	<5	2.38	<1	12	10
WEST TWO CREEK	<20	<20	<20	61.1	<0.5	0.82	5	56	0.5	<5	3.34	1	14	12
GRAPE RUN	<20	<20	21	685	0.5	1.14	10	58	0.5	<5	6.16	<1	17	17
WIGLE CREEK	<20	<20	<20	48.7	<0.5	0.52	7	38	0.3	<5	3.19	<1	11	10
WOOD STREET CREEK	<20	<20	<20	102	<0.5	1.73	9	104	0.8	<5	5.09	<1	20	25
YOUNGS CREEK	ND	<20	<20	42.3	0.5	0.56	5	72	0.2	<5	6.26	<1	12	9

Tributary	Cu	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Nb	Ni	Pb	Sb	Sn	Sr	Ti	V	W	Y	Zn	TOC	TIC
	ug/g	pct	ng/g	pct	ug/g	pct	ug/g	ug/g	pct	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	%	%
ANTRIM CREEK	19	1.81	25	0.14	16	0.97	479	<1	0.03	<5	16	27	<5	<20	82	161	20	<20	9	69	1.62	2.48
BABY CREEK (Baby Farm)	20	2.30	21	0.14	19	1.40	543	10	<0.02	NA	32	13	<5	<10	64	128	30	NA	<0.5	88	2.00	2.10
BAPTISTE CREEK	35	2.77	62	0.23	25	0.97	324	2	0.04	<5	40	22	<5	<20	75	95	38	<20	11	140	2.48	1.02
MCLEAN DRAIN	27	1.89	70	0.10	14	0.55	352	<1	0.03	<5	21	19	<5	<20	55	159	24	<20	11	70	6.79	0.91
BELLE RIVER	33	2.45	54	0.24	22	0.88	252	<1	0.03	<5	29	44	<5	<20	54	94	31	<20	8	147	0.83	1.53
BIG CREEK	26	2.42	62	0.22	22	0.80	406	<1	0.08	<5	27	28	<5	<20	451	139	33	<20	9	102	5.71	1.39
BIG CREEK LONG POINT	6	0.83	20	0.05	5	0.84	337	<1	0.03	<5	7	16	<5	<20	57	182	10	<20	7	30	0.39	1.65
BIG OTTER CREEK	10	1.05	22	0.11	8	1.47	394	<1	0.03	<5	8	24	<5	<20	78	215	14	<20	8	38	0.36	3.10
BIG TILBURY	31	2.58	54	0.28	25	1.21	326	2	0.04	<5	38	24	<5	<20	73	111	38	<20	10	130	2.31	1.30
BISNETT DRAIN	19	1.71	44	0.11	10	0.40	307	1	0.03	<5	18	23	<5	<20	39	156	21	<20	10	76	1.66	1.14
BOULTON DITCH	22	1.54	33	0.21	15	1.87	364	<1	0.04	<5	18	37	<5	<20	107	188	19	<20	8	88	5.42	2.78
BOWEN CREEK (Seager Creek)	25	3.14	74	0.18	26	0.84	795	4	<0.02	NA	36	20	< 5	< 10	44	134	37	NA	< 0.5	108	2.90	0.80
BOYLE DRAIN	14	1.59	36	0.17	10	0.68	447	<1	0.03	<5	11	31	<5	<20	83	137	17	<20	8	75	2.49	2.51
BROAD CREEK	32	2.04	167	0.17	23	0.85	287	<1	0.05	<5	26	28	<5	<20	183	254	25	<20	15	308	8.25	1.05
BROCK CREEK	10	1.18	20	0.11	11	0.80	472	<1	0.03	<5	11	24	<5	<20	82	191	15	<20	6	34	0.95	1.85
CANARD RIVER	37	2.23	60	0.18	20	0.86	327	<1	0.03	<5	30	33	<5	<20	76	116	30	<20	11	115	2.07	1.90
CARPYS CREEK	23	1.71	41	0.15	18	1.87	995	<1	0.06	<5	32	50	<5	<20	186	142	21	<20	9	151	1.03	2.87
CATFISH CREEK	7	1.01	11	0.10	9	1.83	363	<1	0.03	<5	6	29	<5	<20	87	225	15	<20	6	27	0.48	3.32
CEDAR CREEK	21	1.66	48	0.11	14	0.75	182	<1	0.03	<5	22	23	<5	<20	193	116	22	<20	8	66	3.90	1.10
CLAY CREEK	24	2.33	46	0.22	24	0.94	448	2	0.03	<5	31	25	<5	<20	60	151	29	<20	9	83	0.78	1.63
CLEAR CREEK	18	2.69	43	0.13	15	0.62	1910	1	0.03	<5	17	24	<5	<20	54	227	28	<20	11	84	3.38	1.00
CLEARVILLE CREEK	13	1.76	16	0.19	17	1.53	543	1	0.03	<5	14	31	<5	<20	98	268	20	<20	11	40	0.88	2.42
DEDRICKS CREEK	17	2.36	36	0.16	18	0.80	1602	1	0.04	<5	18	26	<5	<20	75	271	26	<20	12	72	1.25	1.48
DOLSEN CREEK	19	1.60	33	0.18	15	1.88	404	<1	0.04	<5	15	38	<5	<20	138	201	20	<20	9	65	3.05	3.35
DOLSONS CREEK	19	1.78	36	0.12	12	0.68	356	<1	0.03	<5	16	27	<5	<20	135	142	21	<20	9	79	2.29	1.41
DUCK CREEK	25	2.17	26	0.18	20	0.98	324	<1	0.03	<5	29	26	<5	<20	52	123	29	<20	8	106	0.79	1.58
EAST TWO CREEK	12	1.19	16	0.09	8	0.53	298	<1	0.03	<5	16	17	<5	<20	46	126	16	<20	5	60	1.54	0.86
MAJOR CREEK	15	1.52	16	0.14	13	1.28	299	<1	0.03	<5	22	23	<5	<20	49	130	21	<20	6	83	0.44	1.98
EVANS CREEK	21	2.48	63	0.27	30	0.86	311	<1	0.04	<5	27	30	<5	<20	128	288	30	<20	17	111	4.41	0.79
FEEDER CANAL	20	1.27	65	0.13	12	1.27	358	<1	0.03	<5	14	32	<5	<20	144	206	13	<20	10	269	2.99	2.31
FISHERS GLEN CREEK	8	1.01	38	0.06	5	0.46	702	<1	0.02	<5	6	20	<5	<20	52	149	12	<20	6	42	4.52	0.98
FLAT CREEK	40	3.33	36	0.27	24	0.70	981	2	0.03	<5	35	25	<5	<20	33	277	46	<20	20	120	1.94	0.46
FORESTVILLE CREEK	9	1.24	19	0.09	8	0.75	1136	<1	0.03	<5	8	15	<5	<20	62	250	17	<20	8	50	0.89	1.54
FOX CREEK	21	1.90	63	0.14	14	0.70	303	<1	0.03	<5	18	28	<5	<20	91	209	27	<20	9	97	2.91	1.49
GATES CREEK	17	1.50	74	0.19	15	0.72	346	<1	0.03	<5	16	18	<5	<20	87	251	20	<20	7	56	2.38	1.22
GRAND RIVER	24	1.86	68	0.21	18	1.62	569	<1	0.04	<5	14	38	<5	<20	206	266	21	<20	11	143	2.95	3.05
HAY CREEK	8	1.20	16	0.13	9	0.80	978	<1	0.03	<5	6	23	<5	<20	119	292	16	<20	7	29	0.43	2.06
STONEY CREEK	14	1.69	48	0.21	22	0.99	463	<1	0.03	<5	17	22	<5	<20	98	284	22	<20	10	67	0.72	1.35
HILLMAN CREEK	37	2.73	68	0.32	21	0.91	798	1	0.03	<5	30	29	<5	<20	60	185	42	<20	13	185	3.71	0.99
HUFFMAN CREEK	32	2.66	80	0.22	24	0.59	286	1	0.04	<5	28	30	<5	<20	136	151	41	<20	12	120	4.01	0.89
HICKORY CREEK	16	2.55	26	0.21	23	0.77	391	<1	0.04	<5	20	24	<5	<20	144	326	39	<20	15	58	0.66	1.13
JEANETTES CK	32	2.92	48	0.41	31	1.64	515	<1	0.05	<5	33	27	<5	<20	127	215	45	<20	13	126	2.16	2.24
KETTLE CREEK	14	1.95	26	0.19	12	1.72	435	<1	0.04	<5	7	34	<5	<20	115	320	21	<20	9	54	1.10	3.20
KLEINS DRAIN	18	1.38	26	0.16	13	1.79	370	<1	0.03	<5	7	35	<5	<20	136	196	21	<20	9	76	5.06	0.94
KRAFT DRAIN	29	2.55	65	0.34	33	2.02	689	<1	0.04	<5	30	45	<5	<20	166	299	34	<20	12	200	2.69	2.51
LEBO CREEK	44	2.53	100	0.32	27	0.69	288	2	0.03	<5	31	33	<5	<20	90	89	38	<20	12	152	9.86	0.84
LITTLE BEAR CREEK	22	2.28	41	0.29	24	1.86	533	<1	0.03	<5	20	35	<5	<20	102	229	30	<20	11	81	2.10	3.20
LITTLE R AT LAUZON	35	1.26	41	0.15	10	1.83	285	<1	0.03	<5	13	45	<5	<20	122	233	19	<20	6	158	0.57	4.43
LITTLE RIVER	86	2.68	136	0.27	21	1.36	538	<1	0.05	<5	112	55	<5	<20	97	127	33	<20	8	299	4.18	1.62
LYNN RIVER	34	1.62	39	0.18	13	0.97	727	<1	0.04	<5	6	67	<5	<20	126	292	19	<20	9	110	0.94	2.69
MORDEN DRAIN	20	1.80	19	0.18	18	0.93	752	<1	0.03	<5	11	31	<5	<20	138	207	18	<20	9	38	0.81	3.29
MANNING DRAIN	32	1.48	41	0.15	13	1.40	178	<1	0.03	<5	18	48	<5	<20	114	132	20	<20	6	237	3.35	2.45
MARENTETTE DRAIN	26	2.17	91	0.19	15	0.90	705	<1	0.04	<5	23	30	<5	<20	254	208	28	<20	9	242	1.16	2.19
MARSHY CREEK	23	1.05	77	0.09	9	0.90	180	<1	0.02	<5	19	22	<5	<20	39	126	13	<20	6	60	5.59	1.41

Tributary	Cu	Fe	Hg	K	Li	Mg	Mn	Mo	Na	Nb	Ni	Pb	Sb	Sn	Sr	Ti	V	W	Y	Zn	TOC	TIC
	ug/g	pct	ng/g	pct	ug/g	pct	ug/g	ug/g	pct	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	%	%
MAXWELL CREEK	21	2.03	52	0.23	22	1.87	471	<1	0.03	<5	19	35	<5	<20	104	210	26	<20	11	73	2.86	3.24
MCKAY CREEK	3	0.56	10	0.07	5	0.32	268	<1	0.03	<5	7	8	<5	<20	26	243	9	<20	6	15	0.11	0.89
MCKINLAY CREEK	19	2.25	32	0.26	20	0.72	478	<1	0.04	<5	22	17	<5	<20	69	212	29	<20	12	81	2.07	1.23
MENNO WEINS CREEK	23	2.66	50	0.26	23	0.66	1103	<1	0.04	<5	21	32	<5	<20	50	434	43	<20	15	106	1.31	0.56
LITTLE CREEK	14	1.50	21	0.10	11	1.02	1270	<1	0.03	<5	8	24	<5	<20	73	212	18	<20	9	60	3.51	1.99
MILL CREEK	14	0.91	25	0.13	5	0.89	232	<1	0.03	<5	5	30	<5	<20	96	144	11	<20	7	103	3.25	0.95
MOISON CREEK	67	1.40	16	0.11	13	0.69	175	<1	0.02	<5	20	23	<5	<20	26	116	19	<20	6	71	0.54	0.79
MUDDY CREEK	61	1.92	88	0.17	18	0.60	195	2	0.03	<5	32	29	<5	<20	92	137	24	<20	12	201	10.42	0.68
NANTICOKE CREEK	16	1.75	41	0.18	16	0.77	474	<1	0.03	<5	16	27	<5	<20	101	273	21	<20	9	87	0.97	1.59
NORMANDALE CREEK	37	2.03	30	<0.05	5	0.53	864	<1	0.03	<5	34	19	<5	<20	51	186	16	<20	8	53	2.95	0.79
NORTH ROAD CREEK	8	0.96	16	<0.05	4	0.64	1022	<1	0.03	<5	5	18	<5	<20	81	125	11	<20	5	45	2.21	1.78
OX CREEK	11	1.19	10	0.13	10	0.78	456	<1	0.02	<5	13	16	<5	<20	58	232	16	<20	8	31	0.83	1.37
PEACOCK CREEK	21	4.95	23	0.30	28	0.93	1422	<1	0.04	<5	27	33	<5	<20	114	399	52	<20	14	88	0.63	1.86
PERCH CREEK	25	2.06	37	0.31	28	2.15	529	<1	0.05	<5	20	55	<5	<20	108	253	27	<20	8	123	0.78	4.94
PIKE CREEK	30	2.22	39	0.21	22	1.67	285	<1	0.03	<5	28	32	<5	<20	68	119	29	<20	8	125	1.88	1.22
PUCE RIVER	20	1.89	32	0.19	18	0.89	243	<1	0.04	<5	26	21	<5	<20	60	125	26	<20	7	94	1.25	1.05
RANKING CREEK	8	1.11	19	0.11	8	0.93	286	<1	0.03	<5	8	25	<5	<20	77	159	13	<20	6	36	1.30	2.40
RUNNING CREEK	17	1.05	315	0.09	10	2.07	215	<1	0.02	<5	14	48	<5	<20	44	173	14	<20	5	68	1.49	2.81
RUSCOM RIVER	32	3.22	39	0.30	24	0.93	326	2	0.03	<5	33	36	<5	<20	135	101	36	<20	9	616	0.86	1.35
SANDUSK CREEK	27	3.11	61	0.29	34	0.95	582	<1	0.03	<5	32	21	<5	<20	122	398	41	<20	14	113	0.98	0.89
SELKIRK DRAIN	60	2.10	2490	0.20	16	1.86	464	<1	0.03	<5	26	70	<5	20	96	163	26	<20	9	531	2.45	2.75
SILVER CREEK	5	0.75	28	0.06	6	0.92	405	<1	0.03	<5	4	15	<5	<20	61	168	10	<20	5	32	0.53	1.87
SIXTEEN MILE CREEK	17	1.86	32	0.16	17	0.79	1028	<1	0.03	<5	21	20	<5	<20	70	243	23	<20	10	69	2.00	1.60
SMITH CREEK	12	1.94	23	0.17	16	0.91	326	<1	0.03	<5	17	22	<5	<20	75	291	28	<20	9	69	1.15	1.05
SNIDER CREEK	40	1.51	75	0.15	20	1.96	256	<1	0.07	<5	137	35	<5	<20	168	190	17	<20	12	79	2.65	3.35
SOUTH OTTER CREEK	7	1.06	14	0.12	7	0.71	595	<1	0.02	<5	9	19	<5	<20	61	196	14	<20	7	36	0.57	1.74
STALTER GULLY	17	1.92	23	0.17	16	1.39	533	<1	0.03	<5	5	37	<5	<20	203	250	20	<20	10	59	2.68	3.52
STEEL CREEK	33	2.93	73	0.20	24	0.74	1227	1	0.07	<5	30	54	<5	<20	95	329	34	<20	13	691	1.12	2.00
STURGEON CREEK	23	1.33	25	0.16	10	1.23	449	1	0.03	<5	14	26	<5	<20	102	116	18	<20	7	135	1.49	2.01
SURFSIDE CREEK	18	1.80	28	0.19	24	1.73	232	<1	0.04	<5	33	24	<5	<20	362	177	21	<20	9	74	3.04	1.66
SYDENHAM RIVER	46	2.83	52	0.26	31	1.53	558	<1	0.03	<5	43	29	<5	<20	66	164	34	<20	11	128	1.81	1.69
TALBOT CREEK	8	1.15	12	0.10	11	0.93	342	<1	0.03	<5	8	21	<5	<20	80	232	17	<20	8	28	0.66	2.14
TALFOURD 40 (Creek Site)	10	1.34	23	0.16	14	1.99	518	<1	0.03	<5	13	32	<5	<20	65	152	19	<20	6	55	0.48	2.66
TATE DRAIN	16	1.80	32	0.15	15	0.91	1045	<1	0.03	<5	13	23	<5	<20	90	212	22	<20	9	71	2.64	1.96
THAMES BRADLEY	21	2.09	30	0.27	21	1.77	576	<1	0.04	<5	14	38	<5	<20	180	243	24	<20	10	76	1.64	3.26
THAMES RIVER	26	2.39	32	0.26	25	1.74	591	<1	0.04	<5	24	32	<5	<20	131	232	29	<20	11	100	1.86	2.74
THUNDER BAY CREEK	23	2.21	69	0.17	26	0.81	358	<1	0.03	<5	29	21	<5	<20	96	168	27	<20	15	141	3.26	0.64
TREMBLAY CREEK	14	0.99	30	0.07	8	0.37	115	<1	0.02	<5	16	12	<5	<20	26	89	15	<20	4	55	0.41	0.56
TURKEY CREEK	77	1.99	175	0.16	18	1.72	377	<1	0.04	<5	81	106	<5	<20	176	184	25	<20	8	519	1.65	2.60
TYRCONNEL CREEK	7	1.10	19	0.13	10	0.76	365	<1	0.03	<5	10	18	<5	<20	73	214	13	<20	6	37	0.95	2.15
WARDELL CREEK	19	1.84	48	0.18	18	0.74	284	<1	0.03	<5	22	16	<5	<20	83	222	25	<20	12	71	2.50	1.20
WEAVER DITCH	18	1.30	43	0.12	10	0.86	172	<1	0.03	<5	64	19	<5	<20	79	195	19	<20	8	61	2.76	0.94
WEST TWO CREEK	16	1.56	37	0.19	13	0.53	784	1	0.03	<5	20	18	<5	<20	51	99	20	<20	8	73	2.45	0.85
GRAPE RUN	20	1.74	41	0.19	17	1.26	261	<1	0.02	<5	21	25	<5	<20	51	154	25	<20	8	81	1.72	2.28
WIGLE CREEK	9	1.14	30	0.07	9	0.65	173	<	0.03	<5	16	17	<5	<20	76	133	15	<20	5	41	1.74	1.26
WOOD STREET CREEK	39	2.74	61	0.22	21	0.69	444	3	0.05	<5	27	26	<5	<20	77	223	33	<20	15	359	3.73	1.27
YOUNGS CREEK	10	1.42	25	0.11	8	0.82	1218	<1	0.03	<5	7	24	<5	<20	90	201	16	<20	8	44	1.11	2.19

Appendix A Notes

Note: The following Organochlorine compounds were not detected in any sample and are not included in the preceding table of laboratory results:

Endrin aldehyde
Toxaphene
Aldrin
a-BHC
d-BHC
o,p'-DDE
Endrin
Heptachlor epoxide
Mirex
PCB Aroclor 1262
PCB Aroclor 1016
PCB Aroclor 1221
PCB Aroclor 1232
PCB Aroclor 1248
PCB Aroclor 1268

Note: An explanation of Short-Forms:

Federal TEL: Threshold Effect Level
Federal PEL: Probable Effect Level
Provincial LEL: Lowest Effect Level
Provincial SEL: Severe Effect Level

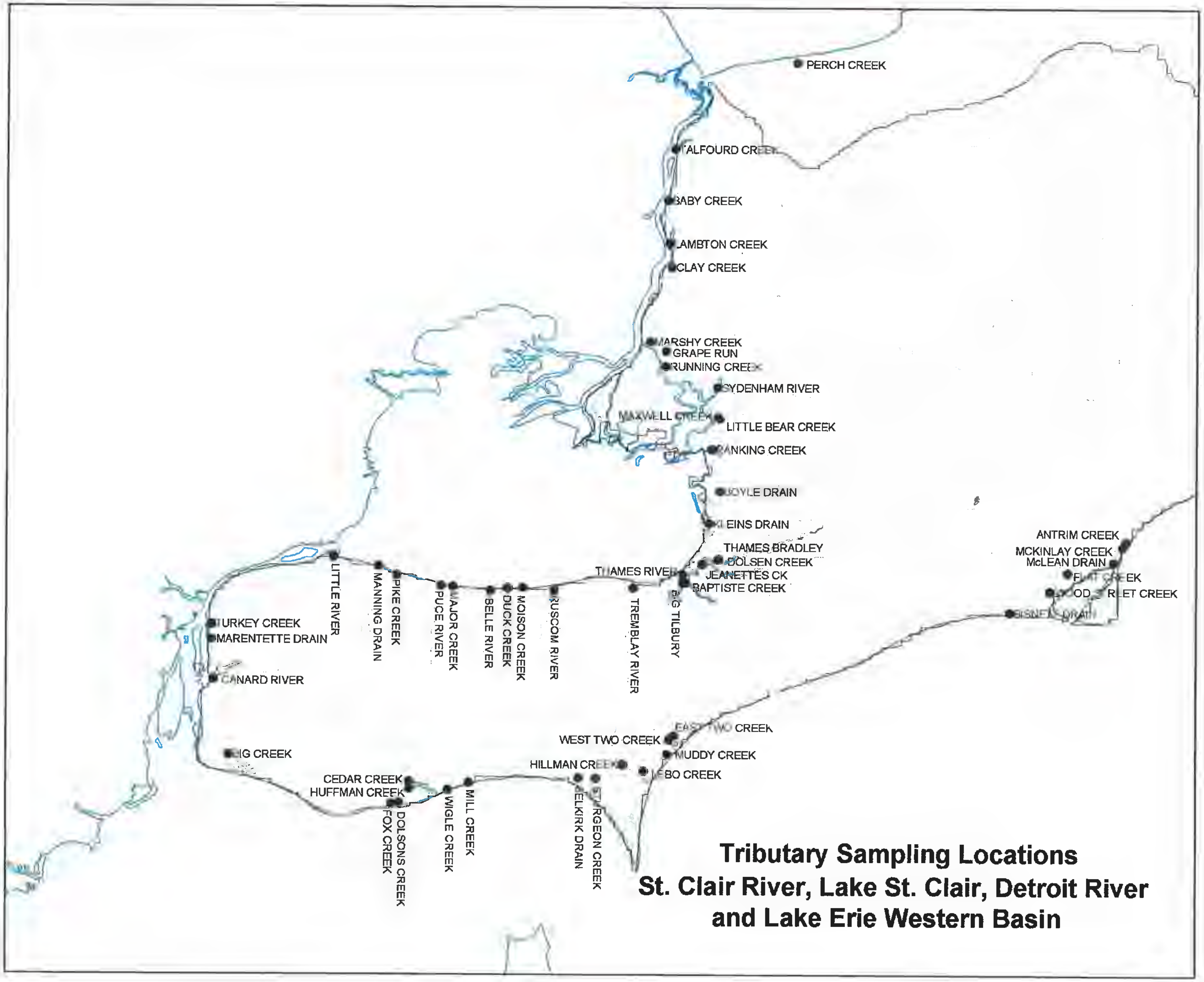
Exceedences of (any) sediment quality guideline is shown in bold (Appendix A

ND Not detected
TR Trace detected and quantified
TRACE Trace detected but not quantified

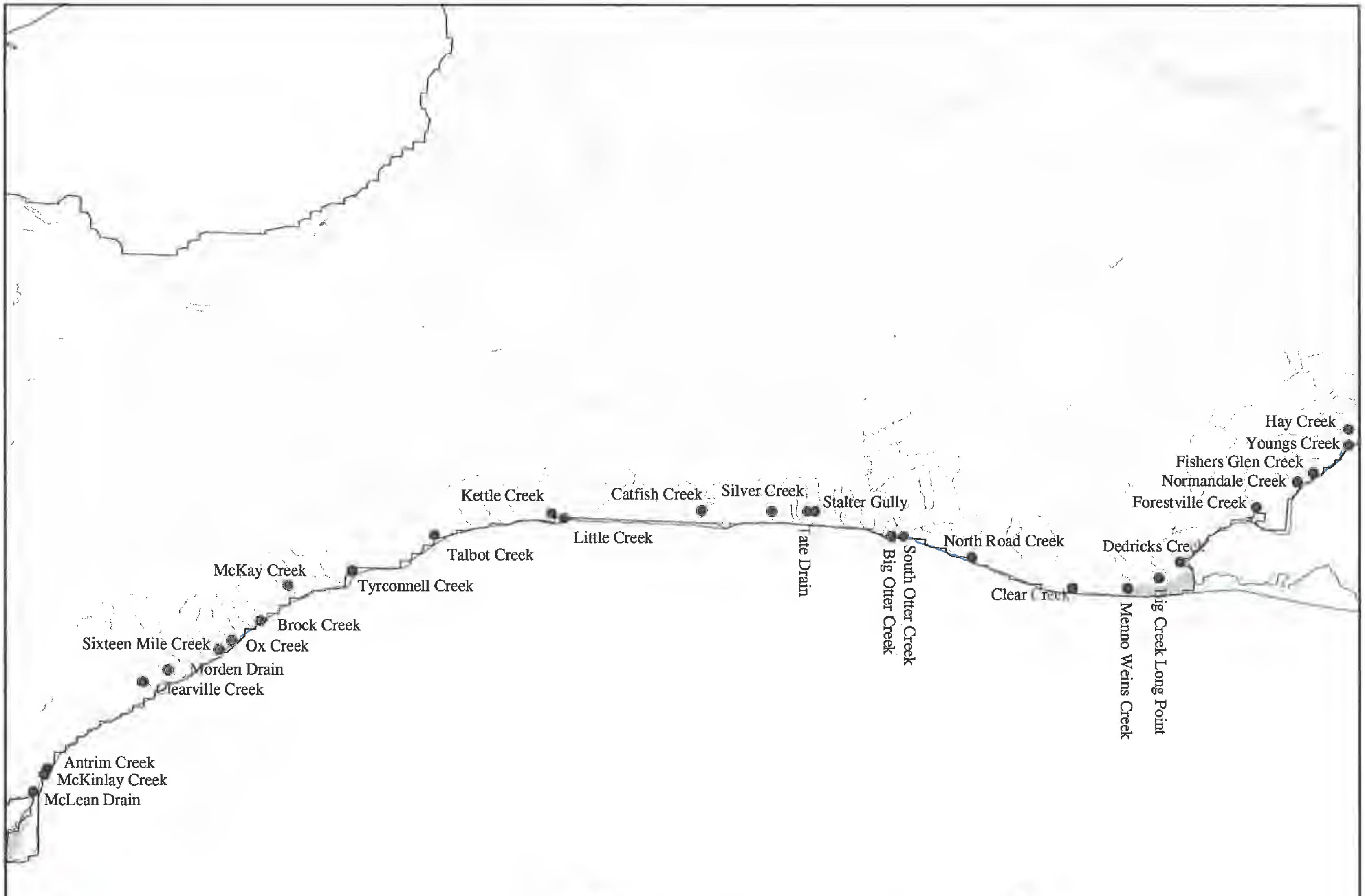
Note: An explanation of Short-Forms and Chemical Compound Names

HCB	Hexachlorobenzene
OCS	Octachlorostyrene
a-BHC	Alpha-benzene hexachloride
b-BHC	Beta-benzene hexachloride
d-BHC	Delta-benzene hexachloride
Lindane	Gamma-benzene hexachloride
Total Chlordane	Sum of alpha- and gamma-Chlordane
o,p'-DDD	Isomer of Dichlorodiphenyldichloroethane
p,p'-DDD	Isomer of Dichlorodiphenyldichloroethane
o,p'-DDE	Isomer of Dichlorodiphenyldichloroethylene
p,p'-DDE	Isomer of Dichlorodiphenyldichloroethylene
o,p'-DDT	Isomer of Dichlorodiphenyltrichloroethane
p,p'-DDT	Isomer of Dichlorodiphenyltrichloroethane
Total DDD	Sum of o,p'- and p,p'-DDD
Total DDE	Sum of o,p'- and p,p'-DDE
Total DDT	Sum of o,p'- and p,p'-DDT
DDT & Metabolites	Sum of Total DDD, Total DDE and Total DDT
Total PCB	Sum of 9 PCB Aroclors
Total PAH	Sum of 16 PAH Compounds

Ag	Silver
Al	Aluminum
As	Arsenic
Ba	Barium
Be	Beryllium
Bi	Bismuth
Ca	Calcium
Cd	Cadmium
Co	Cobalt
Cr	Chromium
Cu	Copper
Fe	Iron
K	Potassium
Li	Lithium
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
Na	Sodium
Nb	Niobium
Ni	Nickel
Pb	Lead
Sb	Antimony
Sn	Tin
Sr	Strontium
Ti	Titanium
V	Vanadium
W	µg/g
Y	Yttrium
Zn	Zinc
Hg	Mercury
TOC	Total organic carbon
TIC	Total inorganic carbon



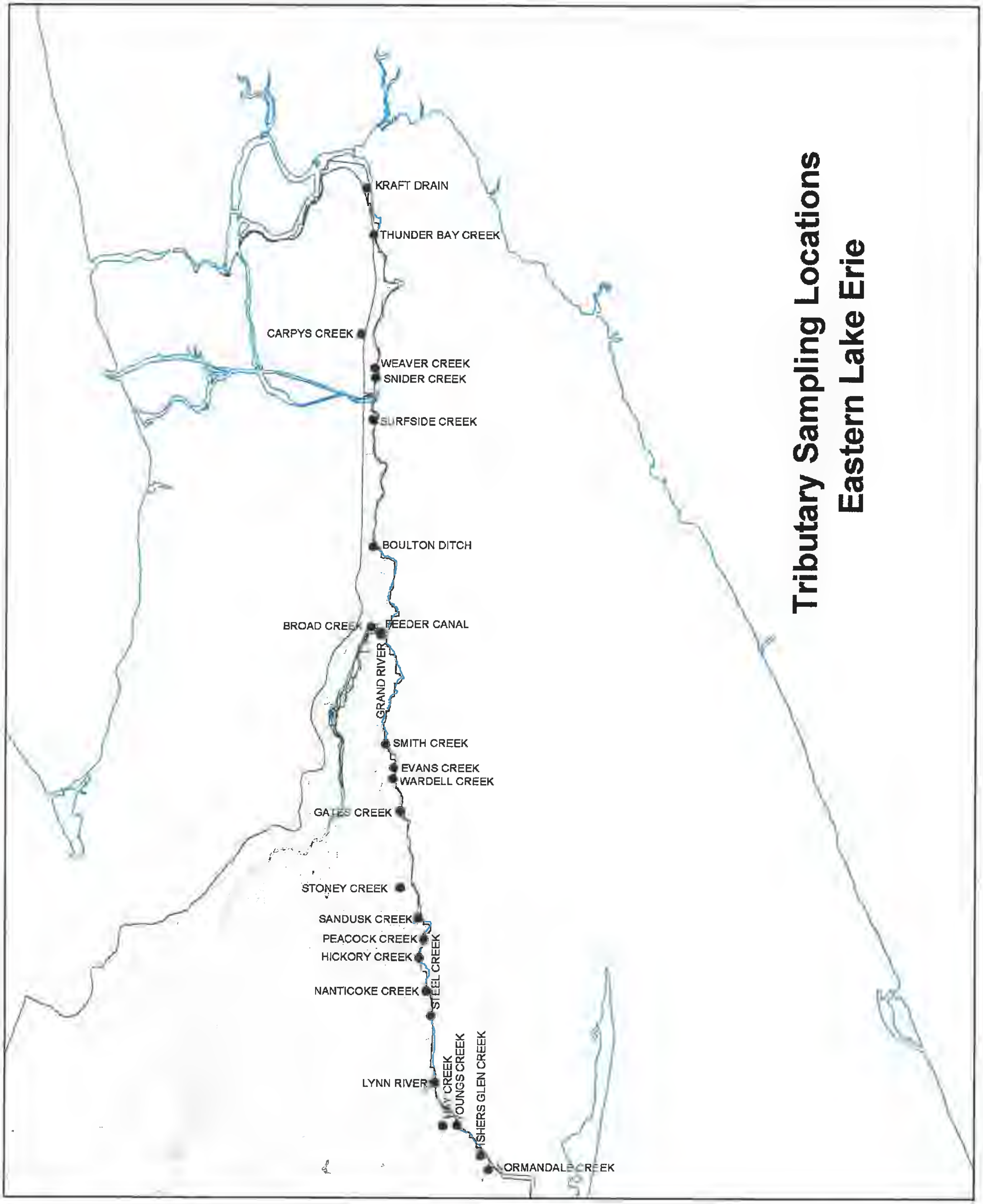
Tributary Sampling Locations
St. Clair River, Lake St. Clair, Detroit River and Lake Erie Western Basin



Tributary Sampling Locations
Central Lake Erie

Ecosystem Health Division

Environment Canada Environnement Canada


Tributary Sampling Locations
Eastern Lake Erie
KRAFT DRAIN
THUNDER BAY CREEK
CARPYS CREEK
WEAVER CREEK
SNIDER CREEK
SURFSIDE CREEK
BOULTON DITCH
BROAD CREEK
FEEDER CANAL
GRAND RIVER
SMITH CREEK
EVANS CREEK
WARDELL CREEK
GATES CREEK
STONEY CREEK
SANDUSK CREEK
PEACOCK CREEK
HICKORY CREEK
STEEL CREEK
NANTICOKE CREEK
LYNN RIVER
AY CREEK
OUNGS CREEK
ISHERS GLEN CREEK
ORMANDALE CREEK

Appendix B: Summary of Federal and Ontario Sediment Quality Guidelines

Compound	Unit	Federal TEL	Federal PEL	Provincial LEL	Provincial SEL
Hexachlorobenzene	ug/g			0.02	24
Endrin aldehyde	ug/g	0.00267	0.0624		
Toxaphene	ug/g	0.0001			
Aldrin	ug/g			0.002	8
a-BHC	ug/g			0.006	10
b-BHC	ug/g			0.005	21
Lindane	ug/g	0.00094	0.00138	0.003	1
Total Chlordane	ug/g	0.0045	0.00887	0.007	6
p,p'-DDD	ug/g			0.008	6
p,p'-DDE	ug/g			0.005	19
Total DDD	ug/g	0.00354	0.00851		
Total DDE	ug/g	0.00142	0.00675		
Total DDT	ug/g	0.00119	0.00477	0.008	71
DDT & Metabolites	ug/g			0.007	12
Dieldrin	ug/g	0.00285	0.00667	0.002	91
Endrin	ug/g	0.00267	0.0624	0.003	130
Heptachlor epoxide	ug/g	0.0006	0.00274	0.005	5
Mirex	ug/g			0.007	130
Aroclor 1016	ug/g			0.007	53
Aroclor 1248	ug/g			0.03	150
Aroclor 1254	ug/g	0.06	0.34	0.06	34
Aroclor 1260	ug/g			0.005	24
Total PCB	ug/g	0.0341	0.277	0.07	530
Naphthalene	ug/kg	34.6	391		
Acenaphthylene	ug/kg	5.87	128		
Acenaphthene	ug/kg	6.71	88.9		
Fluorene	ug/kg	21.2	144	190	
Phenanthrene	ug/kg	41.9	515	560	
Anthracene	ug/kg	46.9	245	220	
Fluoranthene	ug/kg	111	2355	750	
Pyrene	ug/kg	53	875	490	
Benz(a)anthracene	ug/kg	31.7	385	320	
Chrysene	ug/kg	57.1	862	340	
Benzo(k)fluoranthene	ug/kg			240	
Benzo(a)pyrene	ug/kg	31.9	782	370	
Indeno(1,2,3-cd)pyrene	ug/kg			200	
Dibenzo(a,h)anthracene	ug/kg	6.22	135	60	
Benzo(ghi)perylene	ug/kg			170	
Total PAH	ug/kg			4,000	
As (Arsenic)	µg/g	5.9	17	6	33
Cd	µg/g	0.6	3.5	0.6	10
Cr	µg/g	37.3	90	26	110
Cu	µg/g	35.7	197	16	110
Fe	pct			2	4
Mn	µg/g			460	1100
Ni	µg/g			16	75
Pb	µg/g	35	91.3	31	250
Zn	µg/g	123	315	120	820
Mercury	ng/g	170	486	200	2000