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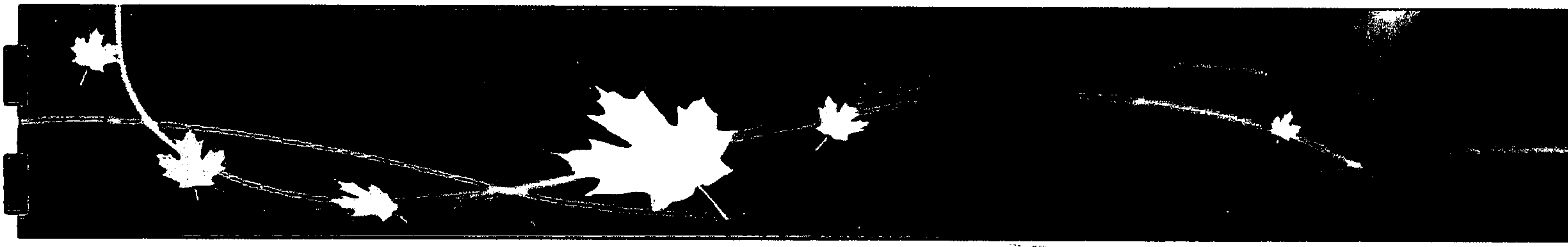

Water Science and Technology Directorate

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Benthic Conditions in the Spanish Harbour Area of Concern in 2009 and Comparison to 2003

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Canada

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SUMMARY

To evaluate benthic conditions in the Spanish Harbour Area of Concern (AOC) and whether they are improving over time, benthic invertebrate community structure, sediment toxicity and sediment contaminant concentrations were assessed. Spatial differences between conditions at contaminated and Great Lakes reference sediments as well as temporal differences between 2009 (current conditions) and 2003 (when a similar assessment was conducted) were examined for 7 sites. Benthic macroinvertebrate community composition and toxicological response of four benthic invertebrates in laboratory toxicity test sites were compared to biological criteria developed for the Laurentian Great Lakes using multivariate analysis. Based on the sediment decision-making framework, data from the multiple lines of evidence were integrated to arrive at an assessment outcome on a site per site basis.

Sediment nickel and manganese concentrations were above Sediment Quality Guidelines (Severe Effect Level), ranging from 133 to 803 μg/g and 1400 to 6700 μg/g, respectively. These concentrations were similar to those found in 2003 indicating little or no change. Although differences in station to station locations and sampling coverage within locations of the AOC make it difficult to determine specific trends, there appears to be relatively little change in concentrations of nickel, manganese, as well as copper and iron over the last few decades. Dioxin and furan and dioxin-like PCB concentrations, expressed as toxic equivalents (TEQs), ranged from 23 to 236 ng·TEQ/kg, exceeding the Canadian Probable Effect Level by 7.5 to 11 times; dioxin-like PCBs contributed very little to the overall total TEQ. While TEQs were decreased at some sites in 2009, they were generally similar to that found at the same sites sampled in 2003. The highest contaminant concentrations were found in the sheltered depositional area north of the middle to western part of Aird Island.

The sediment macroinvertebrate community in Spanish Harbour was dominated by the midge Chironomidae (17 species), the worm Tubificidae (mostly unidentified immature worms), the clam Sphaeriidae and the phantom midge Chaoboridae. Generally, there was a trend of lower taxon diversity and decreased macroinvertebrate abundances when compared to Great Lakes reference sites, which what was found in 2003. However, there were some improvements observed in 2009. Taxon diversity ranged from 4 to 11 taxa in 2009, compared to 4 to 6 in 2003 at the same sites; 5 of the 7 sites had higher diversity in 2009. Three of the seven 2009 sites showed increased abundance of several taxa and decreased abundance of chaoborids to densities more similar to those found at reference sites while the remaining four sites showed no change from 2003. Overall, there was no strong evidence of benthos

alteration in the current study; 6 of the 7 sites had benthic communities that were *equivalent* to reference and the remaining site had a *possibly different* communities.

Severe toxicity to the amphipod *Hyalella azteca* was evident at 4 of the 7 sites in 2009 with survival ranging from 0 to 37%; survival at remaining sites ranged from 60 to 98%. Acute toxicity to *H. azteca* was also observed in 2003 at 11 of the 15 sites sampled. However, positive changes were noted in 2009 for both survival and growth endpoints at concomitant sites: survival of *H. azteca* increased dramatically at three sites and impaired growth to the mayfly *Hexagenia*, evident at 5 of the 7 sites in 2003, showed no growth effects in 2009. Based on the assessment of integrated endpoints, four of the seven sites were categorized as *severely toxic*, one site was *potentially toxic*, and two sites were *non-toxic*. The severely toxic sites were located in ordination space along an increasing gradient of nickel. In 2003, high ammonia concentrations and low pH observed in the test overlying water at some sites may have confounded toxicity results although toxicity could not be fully explained by the poor water quality. In the current study, water quality in the beakers was improved over 2003; however, high ammonia/conductivity and low pH were observed in some test beakers, which was not representative of in-situ conditions, indicating an effect of the sediment on the overlying water under laboratory conditions.

The application of the decision-making framework for the management of contaminated sediment indicated *management actions required* at one site due to elevated sediment contaminants and concurrence of benthos alteration and toxicity. Four sites indicated *determine reason(s) for sediment toxicity* and remaining two sites indicated *no further action*. The assessment outcome was improved at some sites over 2003 due reduced toxicity and slight improvement in benthic communities in 2009.

The possible reason(s) for sediment toxicity were investigated, which included the measurement of trace metal bioaccumulation in laboratory-exposed amphipod *Hyalella azteca* as well as the evaluation of water quality in relation to toxicity (different overlying water to sediment ratios) and will be reported separately. Due to the high levels of dioxins and furans found in sediments in certain locations in the AOC, recommended next steps include the measurement of dioxins/furans in the tissue of resident benthic invertebrates providing information on bioavailability and the potential risks to higher trophic level receptors of concern (scheduled for summer 2011). It is also recommended that the Spanish Harbour AOC continue to be monitored to assess whether there are consistent positive changes in benthic conditions and/or conditions improve with time.

RÉSUMÉ

Pour évaluer l'état du milieu benthique dans le secteur préoccupant (SP) du port de Spanish et juger s'il s'améliore, nous avons évalué la structure des communautés d'invertébrés benthiques, la toxicité des sédiments et les concentrations de contaminants dans les sédiments. Nous avons examiné à 7 sites les différences spatiales entre les sédiments contaminés et les sédiments de référence des Grands Lacs, ainsi que les différences temporelles entre l'état actuel (en 2009) et l'état en 2003, quand une évaluation analogue a été menée. Nous avons comparé la composition des communautés de macroinvertébrés benthiques et la réaction de quatre de ces invertébrés à des essais de toxicité en laboratoire en fonction des critères biologiques établis par analyse multivariée pour les Grands Lacs laurentiens. En nous fondant sur le cadre décisionnel relatif aux sédiments, nous avons intégré les données de plusieurs sources pour arriver à un résultat d'évaluation pour chaque site.

Les concentrations de nickel et de manganèse dépassaient le seuil d'effet grave indiqué dans les directives provinciales de qualité des sédiments, allant respectivement de 133 à 803 µg/g et de 1400 à 6700 µg/g. Ces concentrations étant semblables à celles trouvées en 2003, il y a eu peu d'évolution, voire aucune. Même si les différences d'emplacement d'une station à une autre et les différences de couverture de l'échantillonnage au sein des sites du SP permettent difficilement de déterminer des tendances précises, les concentrations de nickel, de manganèse, ainsi que de cuivre et de fer semblent avoir assez peu changé depuis quelques dizaines d'années. Les concentrations de dioxines et de furanes et de BPC de type dioxine, exprimées en équivalent toxique (EQT), vont de 23 à 236 ng·EQT/kg, dépassant de 7,5 à 11 fois la concentration d'effet probable définie au Canada; les BPC de type dioxine contribuent très peu à la quantité totale des EQT. Si les EQT ont diminué à certains sites en 2009, ils étaient généralement semblables à ceux trouvés aux mêmes sites en 2003. Les plus fortes concentrations de contaminant ont été trouvées dans la zone d'accumulation protégée au nord de la partie centre-ouest de l'île Aird.

La communauté de macroinvertébrés dans les sédiments du port de Spanish était dominée par les moucherons de la famille des chironomidés (17 espèces), les vers de la famille des tubificidés (surtout des vers immatures non identifiés), les mollusques sphaeriidés et les diptères nématocères de la famille des chaoboridés. En général, une tendance à la baisse de la diversité taxinomique et de l'abondance des macroinvertébrés, par comparaison aux sites de référence des Grands Lacs, a été décelée depuis 2003. Toutefois, certaines améliorations ont été observées en 2009 : la diversité taxinomique allait de 4 à 11 taxons, contre 4 à 6 en 2003 aux mêmes sites, et 5 des 7 sites avait une plus grande diversité. En 2009, 3 des 7 sites montraient une plus grande abondance de plusieurs taxons, mais un moindre nombre de chaoboridés, dont les densités approchaient celles trouvées dans les sites de référence, tandis que les

4 autres sites n'ont pas montré de modification par rapport à 2003. Dans l'ensemble, la présente étude ne relève aucune dégradation évidente du benthos; 6 des 7 sites avaient des communautés benthiques qui étaient *équivalentes* à celles des sites de référence. Le dernier site avait des communautés *éventuellement différentes*.

Des cas de toxicité grave ont été observés chez l'amphipode *Hyalella azteca* à 4 des 7 sites en 2009, avec taux de survie allant de 0 à 37 %; aux autres sites, ce taux allait de 60 à 98 %. En 2003, un effet toxique aigu chez *H. azteca* avait aussi été observé à 11 des 15 sites échantillonnés. Toutefois, des changements positifs ont été notés en 2009 pour les paramètres de survie et de croissance à des sites concomitants : la survie de *H. azteca* s'est considérablement accrue à trois sites, et aucun effet sur la croissance n'a été observé en 2009 chez les éphémères du genre *Hexagenia*, dont la croissance était évidemment perturbée à 5 des 7 sites en 2003. D'après l'évaluation des paramètres intégrés, 4 des 7 sites ont été catégorisés *gravement toxiques*, 1 site était *potentiellement toxique* et 2 sites étaient *non toxiques*. Les sites gravement toxiques se trouvaient dans un espace d'ordination suivant un gradient croissant de concentration de nickel. En 2003, les fortes concentrations d'ammoniac et le faible pH observés dans l'eau sus-jacente à certains sites ont pu avoir un effet confondant sur les résultats de toxicité, quoique ces résultats ne pouvaient s'expliquer entièrement par la piètre qualité de l'eau. Dans la présente étude, la qualité de l'eau dans les béchers était meilleure qu'en 2003; toutefois, dans certains béchers, nous avons observé une forte concentration d'ammoniac, une conductivité élevée et un pH faible qui n'étaient pas représentatifs des conditions *in situ*, ce qui révélait un effet des sédiments sur l'eau sus-jacente dans les conditions de laboratoire.

L'application du cadre décisionnel pour la gestion des sédiments contaminés a donné l'indication *mesures de gestion nécessaires* à 1 site, à cause des concentrations élevées de contaminants dans les sédiments et de l'altération du benthos et de la toxicité concurrentes. Pour 4 sites, l'indication était *déterminer les causes de la toxicité des sédiments*, et pour les 2 autres, *aucune mesure complémentaire n'est nécessaire*. En 2009, le résultat de l'évaluation était meilleur à certains sites par rapport à 2003, en raison de la toxicité réduite et de la légère amélioration des communautés benthiques.

Nous avons étudié les causes possibles de la toxicité des sédiments, notamment en mesurant la bioaccumulation des métaux traces chez l'amphipode *Hyalella azteca* exposé en laboratoire et en évaluant la qualité de l'eau en fonction de la toxicité (selon divers rapports de l'eau sus-jacente aux sédiments). Environnement Canada fera connaître les résultats dans une communication distincte. Vu les fortes concentrations de dioxines et de furanes trouvées dans les sédiments à certains endroits du SP, les prochaines étapes recommandées sont de mesurer les dioxines et les furanes dans les tissus des invertébrés benthiques afin d'obtenir des informations sur la biodisponibilité et les risques potentiels pour les récepteurs d'intérêt à de niveaux trophiques supérieurs (étapes programmées pour l'été 2011). Il est aussi recommandé de continuer à surveiller le secteur préoccupant du port de Spanish, pour évaluer s'il y a des changements positifs constants de l'état du benthos et/ou si les conditions s'améliorent avec le temps.

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ABBREVIATIONS, ACRONYMS AND SYMBOLS

AOC	Area of Concern
BTEX	benzene, toluene, ethylbenzene and xylene
CCME	Canadian Council of Ministers of the Environment
CV	coefficient of variation
DL PCBs	dioxin-like polychlorinated biphenyls
dw	dry weight
EC	Environment Canada
GL	Great Lakes
HMDS	hybrid multidimensional scaling
LEL	lowest effect level
MOE	Ministry of the Environment (Ontario)
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	probable effect level
PHC	petroleum hydrocarbon
QA/QC	quality assurance/quality control
RPD	relative percent difference
SEL	severe effect level
PSQG	provincial sediment quality guideline
TEF	toxic equivalency factor
TEQ	toxic equivalency unit
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TP	total phosphorus
wt	weight
PCDD/F	polychlorinated dibenzodioxin/dibenzofuran
TCDD/TCDF	tetrachlorodioxin/tetrachlorofuran
PeCDD/CDF	pentachlorodioxin/pentachlorofuran
HxCDD/CDF	hexachlorodioxin/hexachlorofuran
HpCDD/CDF	heptachlorodioxin/heptachlorofuran
OCD	octachlorodioxins
OCF	octachlorofuran

1 INTRODUCTION

In September 2003, Environment Canada (EC) undertook a sampling program to define the general status of contamination in the Spanish Harbour Area of Concern (AOC) from the Spanish River mouth (at the town of Spanish) to Greenway Island (Whalesback Channel). The benthic assessment of sediment (BEAST) methodology was applied to 15 sites and information within and among the lines of evidence was integrated using the sediment decision-making framework (Milani and Grapentine 2006). Main conclusions from the 2003 study were:

- Nickel (Ni) was elevated in the sediment (up to 13 times the Severe Effect Level) at the majority of sites (concentration range: 24 to 977μg/g); highest concentrations were observed in the Whalesback Channel and in the sheltered depositional area north of Aird Island.
- Concentrations of manganese (Mn), copper (Cu), and iron (Fe) followed a similar trend.
- Dioxin and furan toxic equivalents (TEQs), measured at a subset of sites, were 6 to 9 times the Probable Effect Level north of Aird Island; TEQs were 1.2 to 2.5 times the PEL in the Whalesback Channel.
- The majority of Spanish Harbour sites (73%) had benthic communities that were equivalent or at most "possibly different" than reference; however, there was a trend of lower taxon diversity and decreased macroinvertebrate abundances at test sites compared to Great Lakes reference sites. There was strong evidence of impaired benthic community at two sites (north of Aird Island and in Aird Bay).
- Severe toxicity was evident at 73% of sites; toxicity to *Hyalella* and *Hexagenia* supported a causal link to Ni contamination; however, the lack of response in the midge *Chironomus* suggested that other stressor(s) may be involved.
- Poor water quality (high ammonia and low pH in some cases in the overlying water in toxicity tests) may have been a contributing factor in some cases but did not explain all the toxicity.

Recommendations from 2003 study

Based on these conclusions, several recommendations were made:

1. Investigate whether poor water quality (e.g., high ammonia and low pH) may have contributed to toxicity. For example, repeat the toxicity tests employing a greater overlying water to sediment ratio (e.g., beaker vs. Imhoff settling cone setup), which may eliminate the water quality issues.

2. Measure Ni bioaccumulation in the tissues of *Hyalella*. Borgmann et al. (2001) used this tool to clearly demonstrate that Ni present in sediments collected from Sudbury, Ontario was bioavailable to *Hyalella* and that it accumulated in sufficient amounts to cause toxicity.
3. Continue to monitor benthic populations for change in status.

Purpose of 2009 Study

The purpose of the current study was to provide an update on status of benthic conditions in the Spanish Harbour AOC at a subset of sites 7 sites that were sampled in 2003 and to compare current conditions to those in the previous study. Recommendations made from the 2003 study that pertain to determining reasons for sediment toxicity will be addressed by Environment Canada in a separate report.

2 METHODS

2.1 Sample Collection

Overlying water, sediment (for physico-chemical analysis and toxicity testing) and benthic invertebrate samples were collected October 8, 2009 from 7 locations in the Spanish Harbour AOC (Fig. 1). Stations were positioned using a CDGPS-enabled GPS receiver resulting in 1 to 5 m level accuracy. Site positions are provided in Table 1 and environmental variables measured at each site provided in Table 2. A 40 cm × 40 cm mini-box corer was used to obtain the benthic community and sediment chemistry samples. Invertebrates were subsampled from the mini-box corer using 10 cm length × 6.5 cm diameter acrylic tubes. Sediment in the tubes was sieved through a 250-µm mesh screen and the residue in the screen preserved with 10% formalin for later identification. The remaining top 10 cm of sediment from the mini-box core was removed, homogenized in a Pyrex dish, and allocated to containers for chemical and physical analyses of the sediment. Five mini-Ponar grab samples were collected per site for the laboratory toxicity tests (approximately 2 L sediment per replicate). Each of the five sediment grabs was placed in separate plastic bag, sealed, and stored in a 10-L bucket. All samples were stored at 4°C with the exception of the organic contaminant samples, which were frozen (-20°C).

2.2 Sample Analyses

Overlying water analyses (alkalinity, total phosphorus, nitrate+nitrite-N, ammonia-N and total Kjeldahl N) were performed by EC's National Laboratory for Environmental Testing (NLET) (Burlington, ON) by procedures equivalent to those described in Cancilla (1994) and EC (2008).

Surficial sediments (top 10 cm) were analyzed for total mercury, 29 trace elements, major oxides, loss on ignition (LOI), total organic carbon (TOC), total phosphorus (TP), and total Kjeldahl nitrogen (TKN) by Caduceon Environmental Laboratories (Ottawa, ON), using standard techniques outlined by the USEPA/CE (1981) or by in-house laboratory procedures.

Sediment particle size was analyzed by EC's Sedimentology Laboratory (Burlington, ON) following procedures of Duncan and LaHaie (1979). Petroleum hydrocarbons (PHCs), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dioxins and furans (PCDD/Fs), and dioxin-like PCBs (DL PCBs) were analyzed by ALS Laboratory Group (Waterloo, ON). PHCs were analyzed by GC/FIC based on CCME Canada-Wide Standards (CCME 2008). PAHs and PCBs (Aroclors 1242, 1248, 1254, 1260) were analyzed by GC/MS based on EPA SW846 8270 (USEPA 1992). PCDD/Fs and DL PCBs were determined by high resolution mass spectrometry (HRMS) based on EPA methods 1613B and 1668A, respectively (USEPA 1994, 2003).

2.3 Taxonomic Identification

Sorting, enumeration, identification and verification of benthic invertebrate samples were performed by EcoAnalysts, Inc. (Moscow, Idaho, USA). Certain taxa and microinvertebrates (e.g., poriferans, nematodes, copepods, and cladocerans) were excluded. Material was sorted under a dissecting microscope (minimum magnification = 10×), and organisms were enumerated and placed in vials for identification to lowest practical level by qualified NABS (North American Benthological Society) certified taxonomists.

2.4 Sediment Toxicity Tests

Four toxicity tests (bioassays) were conducted under standardized laboratory conductions at Environment Canada's Ecotoxicology Laboratory (Burlington, ON):

1) *Chironomus riparius* 10-day survival and growth test;
2) *Hyalella azteca* 28-day survival and growth test;
3) *Hexagenia* spp. 21-day survival and growth test; and
4) *Tubifex tubifex* 28-day adult survival and reproduction test.

Prior to testing, sediments were sieved through a 250 µm mesh screen to remove indigenous organisms. Water chemistry variables (pH, dissolved oxygen (mg/L), conductivity (µS/cm), temperature (°C), and total ammonia (mg/L)) were measured for each test in each replicate test beaker on day 0 (start of test –

prior to introduction of organisms) and at completion of the test. Tests consisted of a 4 to 1 ratio of overlying water to sediment for *Chironomus*, *Hyalella* and *Hexagenia*, and a 1.5 to 1 ratio for *Tubifex*. Tests were run under static conditions in environmental chambers at 23 ± 1 °C, under a photoperiod of 16L: 8D and an illumination of 500 - 1000 Lux, except the *Tubifex* test, which was run in the dark. All tests passed acceptability criteria for their data to be used in the site assessments. The criteria are based on percent control survival in a reference sediment (Long Point Marsh, Lake Erie): i.e., ≥ 80% for *H. azteca* and ≥70% for *C. riparius;* ≥80% for *Hexagenia* spp., and ≥75% for *T. tubifex* (Reynoldson et al. 1998). Individual test methods are described in Milani and Grapentine (2007).

2.5 Data Analysis

<u>BEAST Analysis</u>

Test sites were assessed using BEAST methodology (Reynoldson et al. 2000). The BEAST model predicts the invertebrate community group that should occur at a test site based on natural environmental conditions. Multiple discriminant analysis was used to predict the test sites to one of five GL reference community groups using a previously computed relationship between five environmental variables (latitude, longitude, depth, total organic carbon, and alkalinity) and the community groups (Reynoldson et al. 1995; 2000). For each test site, the model assigned a probability of it belonging to each of five reference faunal groups. Benthic community assessments were conducted at the family level, as this taxonomic detail is shown to be sensitive for the determination of stress (Reynoldson et al. 2000). Community data for each 2009 site, as well as the concomitant 2003 site, were merged with the reference site invertebrate data of the best matched reference group (group to which the test site has the highest probability of belonging) and ordinated using hybrid multidimensional scaling (HMDS; Belbin 1993), with Bray-Curtis distance site × site association matrices calculated from raw data. Test sites were assessed by comparison to confidence bands of appropriate reference sites. Probability ellipses were constructed around reference sites, establishing four categories of difference from reference: equivalent/unstressed (within the 90% probability ellipse), possibly different/possibly stressed (between the 90 and 99% ellipses), different/stressed (between the 99 and 99.9% ellipses), and very different/very stressed (outside the 99.9% ellipse).

Toxicity data were analysed using HMDS, with Euclidean distance site × site association matrices calculated from standardized data. Toxicity endpoints for the test sites were compared to those for all reference sites. (There are no distinct groups as with the invertebrate community assessment.) Probability ellipses were constructed around all reference sites, establishing four categories of difference from reference: equivalent /non-toxic (within the 90% probability ellipse), potentially toxic (between the 90 and 99% ellipses), toxic (between the 99 and 99.9% ellipses), and severely toxic (outside the 99.9% ellipse). Test site toxicological responses were also compared to numerical criteria previously established for each category (non-toxic, potentially toxic and toxic) and species from reference site data (Reynoldson and Day 1998).

Principal axis correlation (Belbin 1993) was used to identify relationships between habitat attributes and community or toxicity responses. This did not include organic contaminant data, which were not measured in the reference sediments. Significant endpoints and environmental attributes were identified using Monte-Carlo permutation tests (Manly 1991). Multiple discriminant analysis was performed using the software SYSTAT (Systat Software, Inc. 2007). HMDS, principal axis correlation, and Monte-Carlo tests were performed using the software PATN (Blatant Fabrications Pty Ltd. 2001).

Comparison of Key Taxa Abundances

Paired t-tests (95% confidence level) were used to compare mean differences in tubificid, chironomid and chaoborid abundances between 2009 and 2003. T-tests were performed using the software MINITAB (Minitab Inc. 2007).

Dioxin/Furan (PCDD/F) Distribution in Sediment

PCDD/Fs and the DL PCBs have been reported to cause a number of toxic responses similar to the most toxic dioxin (2,3,7,8-tetrachlorodibenzo-*p*-dioxin) (Van den Berg et al., 1998). Using toxic equivalency factors (TEFs) for each congener determined by the World Health Organization, the toxicity of PCDD/Fs relative to the toxicity of the most toxic dioxin congener (2,3,7,8-TCDD; TEF=1) was determined using the following equation:

$$TEQ = \Sigma_{n1} [PCDD_i \times TEF_i] + \Sigma_{n2} [PCDF_i \times TEF_i]$$

The TEQ for the DL PCBs were also similarly calculated.

$$\text{Total TEQ} = TEQ_{PCDD/Fs} + TEQ_{DL\ PCBs}$$

For values that were below detection limits, the calculation of the TEQs was performed two ways: 1) assigning a value of zero to the value (lower bound TEQ), and 2) using the reporting limit itself (upper bound TEQ). Thus, the actual TEQ would be bounded by the two values. Sediment TEQs were compared to the CCME Probable Effect Level (PEL) of 21.5 ng TEQ/kg (CCME 2001).

2.6 Quality Assurance/Quality Control

One site was randomly selected as a QA/QC station (SRC17). At this site, triplicate sediment, water, and benthic community samples were collected for determination of within-site and among-sample variability. Coefficients of variation (CV = standard deviation ÷ mean × 100) were examined for the analytical data. Each laboratory employed procedures such as: analyses of method blanks, sample duplicates and repeats, matrix and surrogate spike recoveries, labelled extraction standards, laboratory control samples, and certified reference materials.

Caduceon Environmental Laboratories

Quality control (QC) procedures included the control charting of influences, standards, and blanks. Reference materials and standards were used in each analytical run. Calibration standards were run before and after each run. Run blanks and reference standards were run 1 in 20 samples. Precision was assessed by the analyses of laboratory duplicates. The relative percent difference ($RPD = [(x_1 - x_2)/ (x_1 + x_2)/2) \times 100]$ was calculated to determine differences in two or more measurements. Sample duplicates were analyzed once every 16 samples.

ALS Laboratory Group

QC procedures involved control charts established for specific samples and control limits (e.g., the Lowest Quantification Limit or Method Detection Limit). A RPD was calculated to determine differences in two or more sample measurements. Duplicates were analyzed at a minimum frequency of 1 in 20 samples or 1 per batch. Samples were pre-screened by analyzing on a less sensitive instrument prior to the final analysis to eliminate the need for running blanks between high samples; however, if this was not possible, then blanks were run between samples. To determine accuracy, the degree of agreement between an observed value and the accepted reference or true value was assessed by analysis of blank spikes, matrix spikes, QC check samples, surrogate compound spikes, and standard reference material analysis. Method blanks, a control verification standard, a laboratory control sample and duplicates were performed for 1 in every 20 samples. Matrix spikes and surrogates were analyzed with every batch of samples.

Benthic Enumeration and Identification

In sorting the samples, 20-25% of every sample was re-sorted to achieve the 95% level sorting efficiency. At least one specimen of each taxon encountered was kept in a separate vial to comprise a project reference collection. Internal quality assurance of the identifications involved examination of the reference collection by a second taxonomist to verify accuracy of all taxa identified. Additionally, 10% of samples were randomly selected and re-identified by a QA taxonomist. Data entry involved visual confirmations on the taxonomic identification and number of specimens in each taxon and the data was entered directly on a computer database.

Variability in invertebrate family counts between box core samples was examined by comparing positions of sites in the ordination plots. To examine within-site variability in benthic invertebrate composition and abundance, the three replicate samples of site SRC17 (SRC17-1, SRC17-2, SRC17-3) as well as the average of the three box cores (SRC17×) were ordinated using HMDS as described in Section 2.5.

3 RESULTS AND DISCUSSION

3.1 Sediment and Water Physico-Chemical Properties

3.1.1 Overlying water

The variables measured in the overlying water (0.5 m above the sediment) were similar across sites suggesting homogeneity in water mass across the sampling sites (Table 3). The difference in variables across sites were: alkalinity 12 mg/L, conductivity 14 µS/cm, dissolved oxygen 0.6 mg/L, NO_3/NO_2 0.06 mg/L, ammonia 0.02 mg/L, pH 0.2, temperature 0.8 °C, total Kjeldahl nitrogen 0.07 mg/L and total phosphorus 0.007 mg/L.

3.1.2 Sediment field observations

Visual observations of sediment (e.g., colour, texture, odour) were recorded in the field at each 2009 site and are provided in Table 1. (Observations for 2003 sites not sampled in 2009 are also provided.) Sediments were noted for the most part noted as being very soft fine sediment, with an upper 2-3 cm layer of light brown mud over darker brown or brown-grey mud. The fine nature of the sediment enabled sealed intact mini-box cores to be collected at all sites. Wood debris was present at sites SRC10 and SRC11, located in the sheltered area north of Aird Island. The wood debris was present at an approximate depth of 7-10 cm, which hindered the core tube from being inserted in the sediment to a depth of 10 cm.

3.1.3 Sediment particle size

Physical characteristics of Spanish Harbour sediments are shown in Table 4. Spanish Harbour sediments consisted of silty clay: silt ranged from 45 to 65% (median: 50%) and clay from 34 to 54% (median: 49%). All sites had a low percentage of sand ranging from 0.5 to 1.3% (median: 1.0%) and no gravel present. With the exception of site MWC, 2009 sites were less silty (more clay) than 2003 (concomitant) sites where silt ranged from 47.8 to 94.8% (median 54.4%) and clay from 5.0 to 51.4% (median 45.2%) (Table 4). The greatest difference in substrate type was for SRC09 (57% silt/42% clay in 2009 vs. 95%

silt/5% clay in 2003) and SRC13 (50% silt/49% clay in 2009 vs. 71% silt/28% clay in 2003). Sampling depths were relatively consistent between years (Table 1); however, sites were located from 7 to 17 m apart between years, which could account for some noted differences in grain size.

3.1.4 Sediment nutrients and trace metals

Sediment nutrients such as TOC, TKN and TP exceeded the Provincial Sediment Quality Guidelines (PSQG) Lowest Effect Level (LEL; Fletcher et al. 2008) at all sites (Table 5). Ranges for the selected nutrients were: TOC 1.5 to 3.5% (median: 2.1%); TKN 1480 to 3500 μg/g (median: 2280 μg/g); and TP 862 to 2080 μg/g (median: 1380 μg/g). The highest levels of TKN and TOC were north of Aird Island (SRC10 and SRC11), the same that was found in 2003 (Milani and Grapentine 2006).

Nickel and Mn concentrations exceeded PSQG Severe Effect Levels (SELs; Fletcher et al. 2008), ranging from 133 to 803 μg/g and 1400 to 6700 μg/g, respectively (Table 5). Concentrations of Ni and Mn were similar to those found in 2003 at the same sites with the highest Ni accumulation at SRC10 and SRC11 (Figs. 2a, 2b). Other metals that were above high guidelines (SELs) included iron and copper, which marginally exceeded SELs at 4 sites (by up to 1.3×) and 2 sites (by up to 1.1×), respectively (Table 5). Metals exceeding LELs included arsenic (5 sites), cadmium (5 sites), chromium (all sites), copper (remaining 5 sites), iron (remaining 3 sites), lead (5 sites), mercury (1 site) and zinc (6 sites); the highest concentrations of most metal were north of Aird Island at sites SRC10 and SRC11 (Table 5). The spatial pattern of metals is consistent with the flow of the river and the location of depositional zones in the harbour above Aird Island, a sheltered area created by the surrounding islands to the north (from west to east: Jackson Island, Otter Islands, Villiers Island, Passage Island and Shanly Island). The range in surficial concentrations of Ni, Cu, Fe and Mn from 1988 to 2009/2010 (EC studies) are provided in Table 6. The distributions of metals follow similar patterns observed in past studies, where the highest concentrations are found in the soft depositional sediments in the deeper Whalesback Channel and in the sheltered area North of Aird Island (Spanish Harbour RAP Team 1992). Aird Bay sediments also have elevated concentrations but generally lower than the above two previously mentioned areas and lower metal concentrations are found in coarser sediments near the mouth of the Spanish River and below Frenchman Island (Table 6). (Note the area south and to the southwest of Frenchman Island was sampled in 2003 and sediment particle size distributions are provided in Milani and Grapentine (2006)). Difference in station locations between years (other than some sites sampled in 2003 and 2009) and the inconsistent number of sites sampled in some locations of the AOC (e.g., Whalesback Channel, Aird Bay, and South of Frenchman Island) makes it difficult to determine if metal concentrations are trending downward or remaining fairly consistent over the last two decades. Nickel concentrations in the current study (2009) were similar to what was found in 2003 north of Aird Island and in Aird Bay (Table 6, Fig. 2a). Although Ni was overall lower in the Whalesback Channel in 2009, one site was sampled in 2009 (in the middle of the Channel compared to 4 sites (extending to the far east of the Channel to Greenway Island) in 2003. Whalesback Channel site MWC had similar concentrations in 2003 and 2009 (393 and 329 µg/g, respectively; Fig. 2a). For the most part Ni concentrations appear relatively unchanged from 1988 to 2009 (current concentrations were mostly within the range reported back in 1988); however, sampling coverage in Aird Bay and in the Whalesback Channel in the current study (as well as 2003) was minimal compared to the coverage in 1988 (Table 6). Copper, Fe and Mn concentrations also appear to be generally consistent over the years as well given the difference in sampling locations within areas and the fact that Fe and Mn data were not available from 1988 (Table 6). The increased Mn observed at the mouth of the Spanish River in 2010 is likely due to the site location in 2010 (280 m further downstream from the site in 2003 in the marsh area).

3.1.5 Organic Contaminants

PCDD/Fs and DL PCBs

Concentrations of PCDD/Fs and the DL PCBs are provided in Table 7. Dioxin concentrations generally increased with increasing chlorine atoms; however, total TCDD concentrations (range 11.6 to 104 pg/g) were higher than the PeCDD (range 2.1 to 42.3 pg/g). This is similar to that found in 2003 (TCDD: 13.9 to 87.9 pg/g; PeCDD: 3.2 to 33.4 pg/g) (Milani and Grapentine 2006). The most toxic dioxin congener, 2,3,7,8-TCDD, was detected at all sites, ranging from 15.7 to 94.6 pg/g, while similarly toxic congener 1,2,3,7,8-PeCDD (TEF=1), was below detection at 2 sites, and ranged from 0.97 to 9.3 pg/g at remaining five sites (Table 7). The percentage of 2,3,7,8-TCDD to total TCDD was high, ranging from 74.5 to 100%; in 2003, this percentage was also high at 68 to 88% (Milani and Grapentine 2006). For furans, total TCDF concentrations were highest, ranging from 319 to 3640 pg/g (2003 range: 332 to 2680 pg/g); overall concentrations decreased with an increase in chlorine atoms (generally opposite to that observed with dioxin congeners) (Table 7). The most toxic furan, 2,3,4,7,8-PeCDF (toxic equivalency factor (TEF) =0.05), ranged from 4.2 to 41.1 pg/g. The highest concentrations of PCDD/F were at sites SRC10 and SRC11, to the northeast of Aird Island.

The DL PCBs ranged from < detection to 1120 pg/g) and consisted mainly of PCB 118 (range 287 to 1120 ng/g), followed by PCB 105 (range 105 to 366 pg/g) (range 0.12 to 0.26 ng/g) (Table 7).

Toxic Equivalents (TEQs)

Upper and lower total TEQs for 2009 sites are shown in Figure 3a and in Table 7. All TEQs were above the PEL with the exception of SRC09, where the exceedence was marginal (Fig. 3a). TEQs ranged from 23 to 236 ng·TEQ/kg; the highest was at site SRC11, followed by SRC13, which were from 7.5 to 11 times the PEL. Figure 3b shows a comparison of the PCDD/F TEQs for the sites sampled in both 2009 and 2003. TEQs were fairly similar for both years; SRC13 and SRC10 had TEQs of 136 and 196 ng·TEQ/kg, respectively (6 and 9× the PEL) in 2003, compared to 162 and 145 ng·TEQ/kg (8 and 7× the PEL) in 2009. The other two sites (MWC and SRC09) had slighter lower TEQs in 2009 (Fig. 3b). The high TEQs in Spanish Harbour sediments (specifically north of Aird Island at sites SRC-10, 11, 13 and 17), are due to 2, 3, 7, 8-TCDD and 2, 3, 7, 8-TCDF, which are present in high concentrations (Table 7); these two compounds account for 79 to 84% of the PCDD/F TEQ. In 1999, the TEQ for an index station located in eastern Whalesback Channel (north of Green Island) was reported at 49.2 to 51.0 ng TEQ/kg (Richman 2004), similar the TEQ for the Whalesback Channel site MWC in the current study (39 to 41 ngTEQ/kg; Table 7). (Site MWC is located ~ 6 km west of the index station sampled in 1999.) The TEQs for the DL PCBs were quite low (0.002 to 0.08 ng TEQ/kg; Table 7), and contributed very little to the total TEQs (0.004 to 0.07% of total TEQ). Dioxin-like PCBs also contributed essentially nothing to the total TEQs in 2003 (Milani and Grapentine 2006).

The PCDD/F TEQs for the Spanish Harbour AOC are higher than those reported for other AOCs such as Jackfish Bay (Milani and Grapentine 2007, 2009). Moberly Bay (Eastern Arm of Jackfish Bay), which receives effluent from the pulp and paper mill at Terrace Bay via Blackbird Creek, had the highest TEQs, ranging from to 23 to 57 ngTEQ/kg (Milani and Grapentine 2007, 2009). The TEQs in Moberly Bay were similar to those in the Whalesback Channel but were much lower than those for the sites north of Aird Island.

PCBs (Aroclors)

Spanish Harbour sediments were also analyzed for PCBs based on aroclors (1242, 1248, 1254, and 1260). Aroclor concentrations were below detection limits (<0.10 μg/g) at all sites (Table 8).

BTEX and Petroleum Hydrocarbons (PHCs)

BTEX and F1, F2 and F4 fractions of the PHCs were below detection limits (Table 8). Total PHCs ranged from 120 to 360 μg/g, which consisted solely of the F3 (C16-C34) fraction; concentrations were quite low and well below the soil guidelines (CCME 2008). PHCs were not measured in 2003.

Polycyclic Aromatic Hydrocarbons

PAHs were below detection limits at all sites with the exception of SRC10, which had detectable levels of benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene; levels were low and below the Canadian Probable Effect Levels (PELs; CCME 2003) and LELs, where available (Table 8). PAHs were not measured in 2003.

3.2 Benthic Invertebrate Community Structure

The BEAST discriminant model matched all 2009 Spanish Harbour sites to Great Lakes (GL) Reference Group 1. However, sites MWC (Whalesback Channel) and SRC09 (Northeast of Aird Island) had low probabilities of belonging to Group 1 (49% and 52%, respectively) (Table 9). The low probabilities for these two sites are consistent with those found in 2003 (52% and 51%, respectively; Table 9). Sites MWC and SRC09 are the deepest sites (depth range: 22.1 to 22.6 m, Table 1), which is likely why their probabilities were lower than the rest of the sites; remaining site depths ranged from 8.1 to 15.7 m and the mean site depth for reference Group 1 is 9.8 m. Generally, sites with a <60% probability of belonging to a reference group should be interpreted with caution. Probabilities of remaining 2009 test sites belonging to Group 1 were higher, ranging from to 68 to 88%, again consistent with 2003 results (Table 9).

GL Reference Group 1 has a total of 108 located in: Georgian Bay (39), the North Channel (24), Lake Ontario (21), Lake Erie (16), Lake Huron (4), and Lake Michigan (4). The group is characterized by Chironomidae (midge – 39.9% occurrence in Group 1), followed by Tubificidae (oligochaete worm – 16.7% occurrence) and Sphaeriidae (fingernail clam – 14.5% occurrence) (Table 10). Group 1 also consists of Asellidae (isopod – 5.5% occurrence), Naididae (oligochaete worm – 4.3% occurrence), and Sabellidae (polychaete worm – 3.6% occurrence). Pontoporeiidae (amphipod), Valvatidae (snail), Dreissenidae (zebra mussel) and Gammaridae (amphipod) are also present to a much lesser degree (1.6 – 2.2% occurrence; Table 10). These 10 groups make up 92% of the total families found in this GL reference group. Chaoboridae (phantom midge) is present minimally at reference sites (0.7% occurrence) but is included in the table as this family was present at most test sites. The mean abundance (per 33 cm^2 – the area of the subsampling core tube) for dominant GL families and the densities of these families at Spanish Harbour test sites, sampled in 2009 and 2003, is shown in Table 10. Genus/species level identifications (or lowest practical level) are provided in Appendix A; Table A1. Spanish Harbour sites were characterized primarily by the midge Chironomidae (17 species) with densities ranging from 0.6 to 7.0 per $33cm^2$ (predominantly *Procladius* sp. followed *Tanytarus* sp. and *Harnischia* sp.), and the oligochaete worm Tubificidae with densities ranging from 1.2 to 24.2 per $33cm^2$ (mainly unidentified tubificids with and without cap setae) (Appendix A, Table A1). The phantom midge Chaoboridae

(*Chaoborus* sp.) was also present at 6 of the 7 sites (0 to 6.6/ $33cm^2$), the clam Sphaeriidae (either identified to family level or *Pisidium* sp.) present at all sites (0.2 to 2.4 per $33cm^2$), and the oligochaete worm Naididae (5 species) present at 5 of the 7 sites (0.3 to 2.6/33 cm^2). Families with a ≤5.5% occurrence at reference sites were mostly absent or in low abundance compared to reference. Generally, there were lower abundances of most macroinvertebrates at Spanish Harbour sites than at Great Lakes reference sites, with the exception of the chaoborids (all sites) and tubificids at SRC09 (in both 2003 and 2009) (Table 10). Changes in tubificid and chironomid densities between 2009 and 2003 varied from site to site (Figs. 4a, 4b). Significant differences (paired t-tests), denoted by an asterix in Figs. 4a and 4b, were evident at some sites. The greatest differences observed for tubificids were for site MSI, which, in 2009, showed an increase of $9.4/33cm^2$ ($t=7.2$; $p=0.002$) and site SRC09, which showed a decrease of $14.2/33cm^2$ ($t=-2.8$; $p=0.049$; Fig. 4a). Site SRC17 showed increases in both tubificids ($t=3.1$; $p=0.038$) and chironomids ($t=3.0$; $p=0.042$) (Figs. 4a, 4b). Chaoborid midges, however, were lower at all sites in 2009, ranging from -1.0 to $-18.4/33cm^2$ (Fig, 4c); differences at 5 of the 7 sites were significant ($t=-3.2$ to -3.8; $p \leq 0.034$). It is not clear why chaoborid abundances were consistency lower in 2009; small scale heterogeneity could account for some differences (concomitant sites were between 7 to 17 m apart between years) or there may be other unaccounted factors (e.g., predation, food supply, etc). Environmental conditions were fairly similar between years, and chaoborids are known to occur in a wide range of chemical conditions (such as pH), are able to tolerate high concentrations of trace metals (Munger and Hare 1997; Croteau et al. 1998). Family diversity in 2009 ranged from 4 to 11 taxa per site and was higher than in 2003 at 5 of the 7 sites (from 1 to 6 additional taxa present in 2009) (Table 10). The same sites sampled in 2003 had from 4 to 8 taxa present; the greatest increase in taxon diversity was at SRC17 (Aird Bay) which had 5 taxa in 2003 and 11 in 2009 (not all taxa are shown in Table 10).

The outcome of the BEAST community structure evaluations are summarized in Table 10; ordination plots are shown in Figures 5a-g, with each figure representing a 2009 test site relative to where the site fell in 2003. The 2009 Spanish Harbour sites were either *equivalent* to reference (Band 1 - 6 sites) or *possibly different* than reference (Band 2 - 1 site); no sites fell in Bands 3 or 4 (Fig. 5a-g). Three of the seven sites showed improvement from 2003, with movement of Whalesback Channel site MSI from *different* (Band 3) to *equivalent* to reference (Band 1) (Fig. 5a) and movement of sites north of Aird Island (SRC09, SRC17) from *possibly different* (Band 2) to *equivalent* to reference (Fig. 5c, 5g). Remaining four sites (Fig. 5b, 5d - f) showed no change from 2003. The greatest change (MSI) is due to increased abundances of several taxa (e.g., chironomids, tubificids, naidids and sabellids) and decreased abundance of chaoborids to densities more similar to those found at Great Lakes reference sites. Significant ($p \leq 0.01$) invertebrate families and environmental variables are shown in each ordination. The site in Band 2 (SRC11) is generally associated with decreased abundance of families as was the case in 2003. Examination of the relationship between the community response and habitat variables was examined by correlation of the ordination of the community data and the habitat information. There were no high correlations ($r^2 \leq 0.16$). Overall, some improvement in benthic communities was evident in 2009 at some sites but for the most part they were similar to communities in 2003. A spatial map indicating the level of benthic community alteration of 2009 Spanish Harbour sites compared to Great Lakes reference is provided in Figure 6.

3.3 Sediment Toxicity Tests

Mean species survival, growth and reproduction in Spanish Harbour sediment are shown in Table 11. The established numerical criteria for each category (non-toxic, potentially toxic and toxic) for each species are included. Toxicity is highlighted red and potential toxicity is bolded and italicized. Toxicity to *Hyalella* was evident in the Whalesback Channel (MWC), Aird Bay (SRC17) and north of Aird Island (SRC11, SRC13), with survival ranging from 0 to 36%; reduced survival (60%) was also evident at SRC10 (Table 11). Remaining 2 sites, also located above Aird Island, had 93 to 98% survival. In 2003, 11 of the 15 sites sampled were acutely toxic to *Hyalella* and 9 sites had zero survival. Chronic effects to the mayfly *Hexagenia* were also evident in 2003 at 5 of the 15 sites which exhibited negative growth. There were no effects on *Hexagenia*, *Chironomus* and *Tubifex* in 2009 (Table 11). Figures 7a-7c show the changes in *Hyalella* and *Hexagenia* endpoints from 2003 to 2009 (the bars are the 2009 results minus 2003 results). Where, changes were evident, all changes were positive, with a 36 to 95% increase in *Hyalella* survival at 3 of the 7 sites (Fig. 7a), an increase in growth at most sites for *Hyalella* (Fig. 7b), and an increase in growth at all sites for *Hexagenia* (Fig. 7c). At remaining 2009 sites, there was either no change or a minor positive change from 2003.

Water quality measurements such as total ammonia ($NH_3 + NH_4^+$), dissolved oxygen, pH, temperature and conductivity in the overlying water of test beakers are provided in Appendix B; Tables B1 and B2. There were cases where low pH (<6) was observed, mostly at the end of the tests; pH did not get below 5 except at one site (MWC, *Hexagenia* day 21 – 4.7), but for the most part pH was above 7 (Appendix B, Table B1). Low pH values are not representative of in-situ conditions, where pH ranged from 7.7 to ~8 (Table 3). Conductivity measurements in the test site beakers were quite high compared to in-situ overlying water (134-148 µS/cm, Table 3), Lake Ontario water used in the toxicity tests (typically ~300-340 µS/cm) and for the most part the North Channel reference site (site 2201 – up to 420 µS/cm) (Table B1). Conductivity was as high as 731 µS/cm on day 0 (MWC –*Tubifex* test) and 721 µS/cm at the end of the tests (MWC – *Hexagenia* spp) (Table B1). The high conductivity indicates an effect of sediment on the overlying water and readings are higher in tests with the infaunal organisms (e.g., *Tubifex*, *Hexagenia*) which typically cause more disturbances to the sediment. Total ammonia at the start of the tests was fairly low at all sites, with the exception of Whalesback Channel site MWC, where total ammonia ranged from 0.5 up to 3-4 ppm on day 0 (Table B2). Total ammonia increased by the end of the test in some cases. Sites SRC09, SRC11, and SRC13 all had increased ammonia by day 21 (*Hexagenia*) (Table B2). Overlying water pH and total ammonia in the present study was not as bad as it was in 2003. In 2003, low pH (5.0 to 5.9) and total ammonia concentrations ≥ 6 ppm were observed for samples from Aird Bay (including SRC17), Whalesback Channel (including MWC) and north of Aird Island (including SRC11 and SRC13) (Milani and Grapentine 2006). The poor water quality observed in 2003 (low pH) and the deterioration of water quality over the course of the toxicity tests (increase in total ammonia) lead to a recommendation that a greater overlying water to sediment ratio be used in future toxicity tests with sediments from the Spanish AOC. For the 2009 sites, toxicity tests were conducted using a 4 to 1 ratio of overlying water to sediment (results which are reported here) as well as using the Imhoff settling cone method described in Borgmann and Norwood (1999), which employs a 67 to 1 overlying water to sediment ratio (results to be reported separately). An increase in water to sediment ratio has been shown to dramatically increase water quality in problem sediments (Borgmann and Norwood 1999; Borgmann et al. 2001). In a study of Sudbury area lakes, Borgmann et al. (2001) found that toxicity conducted in beakers with 4 to 1 overlying water to sediment ratios led to a decrease in test overlying water pH to around 4 and subsequent high or complete mortality to *Hyalella* and *Hexagenia* in tests sediments. Examination of the change in pH over time in various test sediments employing a 4 to 1 resulted in a pH drop to below 5 in 3 days, whereas there was no water change over the course of the test when a 67 to 1 overlying water to sediment ratio was used (Borgmann and Norwood 1999). The evaluation of water quality with respect to toxicity as well as trace metal bioaccumulation in *H. azteca* will be presented in a future report.

BEAST toxicity evaluations are summarized in Table 11. A spatial map indicating the level of toxicity compared to Great Lakes reference is shown in Figure 8. Ordinations are shown in Appendix C; Figures C1 and C2 (stress ≤ 0.11). Each figure represents a separate ordination for a subset of 4 sites. Significant ($p \leq 0.01$) toxicity endpoints and the most significant environmental variables are shown in each ordination. The most highly correlated toxicity endpoints and environmental variables are shown as vectors. Four of the seven sites were *severely toxic* (MWC, SRC11, SRC13, SRC17), one site was *potentially toxic* (SRC10), and two sites were *non-toxic* (MSI, SRC09). The severely toxic sites were correlated with decreased *Hyalella* survival (r^2=0.54-0.96) as well as decreased *Hexagenia* growth; although the *Hexagenia* growth correlation was much weaker (r^2=0.12-0.11) (test sites are located along the same vector lines as these two endpoints in the opposite direction – Figs. C1 and C2). In the first ordination plot (Fig. C1), mercury (Hg), cobalt (Co), depth and Ni were significant variables ($p<0.01$), although correlations were not very strong ($r^2 \leq 0.13$). Sites were associated with increased concentrations of these metals. In the second ordination plot (Fig. C2), Ni was the most highly correlated variable ($r^2=0.22$), followed by Hg, Cu and Co. As in the first ordination, sites were located along an increasing gradient of these metals. Similar results were found in 2003, where toxic sites were also located along an increasing gradient of Ni, as well as Cu and Co (Milani and Grapentine 2006). Table 11 also shows the BEAST results for 2003 sites, which were identical for 4 of the 7 sites. The remaining 3 sites (located north of Aird Island) were less toxic in 2009; most notably sites MSI and SRC10, both *severely toxic* in 2003 while *non-toxic* (MSI) or *potentially toxic* (SRC10) in 2009, due to increased *Hyalella* survival and *Hexagenia* growth as discussed above.

3.4 Sediment PCDD/Fs Bioavailability

The elevated PCDD/Fs in the sediments of Spanish Harbour suggest an exposure pathway to the benthos, which are in direct contact with the sediment. However, bulk sediment concentrations are not good predictors of bioavailability, rather it is the combination of individual chemical, physical, and biological interactions that determine the exposure of the organism associated with sediments (National Research Council 2003). Additionally, PCDD/Fs may bioaccumulate in benthic organisms, but not to sufficient concentrations to induce acute or chronic effects in laboratory toxicity tests. The lack of sensitivity of invertebrates to PCDD/Fs and DL PCBs has been documented in several studies (West et al. 1997; Borgmann et al. 1990; Dillon et al. 1990). Dioxin and furan compounds are known to induce aryl hydrocarbon hydroxylase in fish and mammals; however, the aryl hydrocarbon (Ah) receptor does not appear to be present in invertebrates which could explain their insensitivity (West et al. 1997; Borgmann et al. 1990; Dillon et al. 1990). It is well known that PCDD/Fs are persistent chemicals in the environment that are hydrophobic, bioaccumulative and resistant to metabolism (Van den Berg et al. 1998; CCME 2001). Thus, the dietary transfer of PCDD/Fs from exposed benthos to higher trophic levels (e.g., consumers of benthos) could be of concern since these compounds biomagnify. To address this concern, the measurement of PCDD/Fs bioaccumulation in the tissues of resident benthos is recommended to determine if the compounds are bioavailable, and if they bioaccumulate to levels that could pose a risk to higher trophic level organisms.

3.5 Quality Assurance/Quality Control

Field replication

Variability among the field-replicated site (SRC17), expressed as the coefficient of variation (CV), is shown in Appendix D; Table D1. Coefficients of variation were low, ranging from 0 to 44.1 % (median: 2.6%, mean: 4.2%); 95% of the parameters had a CV less than 10%, which is very good for field-replicated samples (samples were taken from three separate box core drops).

Benthic Community Variability

The replicate sites of SRC17 (SRC17-1, SRC17-2, and SRC17-3) were in very close proximity to each other in ordination space, indicating good agreement in benthic community composition for the field replicates (Appendix D, Figure D1). All three replicates of SRC17 as well as the mean of the three replicate box cores (SRC17x) fell in Band 1. These results indicated that the benthic invertebrate community within a site was well represented by the box core sample.

Laboratory Quality Control

Caducean Environmental Laboratories – trace metals and nutrients

Relative percent difference (RPD) for sample duplicates for Caducean laboratories is provided in Appendix D, Table D2. Sample duplicates showed good agreement, with RPDs ranging from 0 to 51.7%; 95% of parameters had RPD < 15%, which is very good. The highest RPD was noted for sodium for both samples. Recoveries of reference materials and standards ranged from 30 to 130% (median: 95%, mean: 93%) (Appendix D, Table D3); recoveries were high (>85%) for most parameters measured and within the specified control limits. (Molybdenum had the lowest recovery at 30%, similar to 2003 results of 35%.)

ALS Laboratory Group- organic contaminants

To test the effects of the matrix and precision of the laboratories sample preparation, surrogate spikes were performed. (Prior to sample preparation, samples were spiked with the surrogate.) Recoveries ranged from: 77 to 114% (median 83%) for the BTEX surrogate (2,5-dibromotoluene); 90 to 99% (median 95%) for the hydrocarbon surrogate (octacosane); 89 to 118% (median 98%) for the PAH surrogates (2-fluorobiphenyl, p-Terphenyl d14) and from 86 to 123% (median 103%) for the PCB surrogate (d14-Terphenyl) (Table 8). These high recoveries indicate a good ability of the laboratory to analyze these organic compounds.

The RPD for laboratory replicates (matrix spike and laboratory control sample duplicates) is provided in Appendix D, Table D4 and showed good results, ranging from 0 to 48% (median 3.8%, mean 5.5%); 92% of samples had a RPD below 15% and all values were below the RPD limit. Some RPDs were not available (N/A) because results were less than detection limit (Appendix D, Table D4).

Percent recoveries for the laboratory control samples (LCS) and method blanks (MB) are provided in Appendix D, Table D5. Recoveries were good for the LCS, ranging from 67 to 142% (median: 93%, mean: 91%) and were within QC limits, with the exception of one sample (indicated in red) which was just slightly above the limit (142%; QC limit: 50-140; Appendix D, Table D5). Due to the number of analytes 10% may exceed QC limits, although only one did marginally. Recoveries could not be reported for all MB samples where result and target values were below reporting limits. The purpose of the MB is to control any source of contamination during the procedure and is a sample free of the analyte of concern of a matrix that is similar to the batch of associated samples; it is processed simultaneously with and under the same conditions as samples (through all analytical procedure) (Emerson Perez, ALS Laboratory Group, pers. comm.).

QC results for PCDD/Fs and DL PCBs are summarized below; full results are available electronically upon request. All samples were spiked with ^{13}C-labelled extraction standards before the extraction to ensure that the analytes of interest could be recovered. Recoveries of for the labelled PCDD/F extraction standards ranged from 48 to 95% (median and mean 73%). Recoveries for the ^{13}C-labelled DL PCB extractions standard were lower, ranging from 23 to 94% (median and mean 63%). While lower, recoveries were DL PCB standards were still within QC limits with the exception of one sample (site SRC13; ^{13}C12-PCB-189), which was just slightly below the limit. However, overall there is likely little compromise to the actual data as the low recoveries were for DL PCBs which contribute very little to the TEQ.

Recoveries of the non-labelled analytes of interest in Laboratory Control Samples (LCS) ranged from 94 to 119% for PCDD/Fs and from 92 to 98% for DL PCBs. Recoveries of the ^{13}C-labelled analytes ranged from 50 to 104% (median 76%) for PCDD/Fs, and from 65 to 85% (median 81%) for DL PCBs. Although lower for the labelled analytes, recovery in LCS was within the QC limits for each specific analyte. Recoveries of ^{13}C-labelled analytes in Method Blanks ranged from 63 to 108% (median 85%) for PCDD/Fs and from 63 to 72% (median 68%) for DL PCBs. Recoveries for blanks were within QC limits. These QC results indicate a good ability of both laboratories to extract and efficiently recovery the analytes of interest.

3.6 Decision–Making Framework for Sediment Contamination

Based on data from three lines of evidence (sediment chemistry, sediment toxicity, benthic invertebrate community structure), a decision matrix table was developed (Table 12). The information obtained allowed for the assessment of three possibilities (EC/MOE 2007):

1. the contaminated sediments pose an environmental risk;
2. the contaminated sediments may pose an environmental risk, but further assessment is required before a definitive decision can be made;
3. the contaminated sediments pose a negligible environmental risk.

The overall assessment for each site was achieved by integrating the information obtained both within and among the lines of evidence. For the sediment chemistry column, sites with exceedences of a sediment quality guideline (SQG) – high (e.g., the Severe Effect Level or Probable Effect Level) are indicated by "■"; sites with exceedences of a SQG – low (e.g., the Lowest Effect Level) by "◘". Variables exceeding SQG – high are included in the table. For the benthos alteration column, sites determined from BEAST analyses as *different* or *very different* from reference are indicated by "■"; sites determined as *possibly different* from reference by "◘". For the toxicity column, sites that had multiple endpoints exhibiting major toxicological effects are indicated by "■"; sites that had multiple endpoints exhibiting minor toxicological effect and/or one endpoint exhibiting a major effect by "◘". Sites with no SQG exceedences, no toxicity, or benthic communities that were equivalent to reference conditions are indicated by "□". Results for the 2003 study are also provided for comparison.

The assessment outcomes are as follows for 2009 sites:

No further actions:	MSI, SRC09
Determine reason(s) for sediment toxicity:	MWC, SRC10, SRC13, and SRC17
Management action required:	SRC11

A spatial map indicating the sediment decision-making framework assessment outcomes is provided in Figure 9. Compared to outcomes for 2003, there is an improvement for 4 of the 7 sites due to absence of toxicity, no benthos alteration, or both. Identical outcomes were obtained for three sites, MWC, SRC10 and SRC11, which indicate either management actions required or determine reason(s) for sediment toxicity in both years (Table 12). Exceedences of the SEL for several metals (mainly Ni and Mn) and the PEL (PCDD/F) were almost identical between years (Table 12).

4 CONCLUSIONS

Sediment contaminants

- Nickel and manganese were elevated (up to ~11 and 6 times the SEL, respectively) at all sites.
- Dioxin and furan concentrations, expressed as toxic equivalents (TEQs) were elevated – up to 10-11 times higher than the Probable Effect Level; DL PCB congeners contributed essentially nothing to the total TEQ.
- The depositional area above the middle to western end of Aird Island had the highest metals and TEQs.
- Results were very similar to 2003.

Benthic community structure

- There was no strong evidence of impaired benthic communities.
- Overall there was a trend of lower taxon diversity and decreased macroinvertebrate abundances at test sites compared to Great Lakes reference, similar to that found in 2003.
- The 2009 benthic communities were similar or mildly improved from 2003 with higher taxon diversity evident at some sites.

Toxicity

- Severe toxicity was evident in the Whalesback Channel, Aird Bay and northwest of Aird Island, similar to that observed in 2003; sites were located along an increasing gradient of nickel. However, there were some positive improvements in 2009 over 2003, with increased survival of *H. azteca* at some sites and the absence of growth effects to the mayfly *Hexagenia*.
- High ammonia and conductivity and low pH was observed in the overlying water of test beakers indicating an effect of the sediment on the overlying water under laboratory conditions (this was not representative of in-situ conditions). This was also observed in 2003.
- Investigations into cause(s) of sediment toxicity, including measurement of trace metal bioaccumulation in *H. azteca* and the evaluation of test methodology (difference in overlying water to sediment ratio) are ongoing and will be presented in a separate report by Environment Canada.

Decision-making framework for sediment contamination

- *Management actions required* was indicated at 1 site, the same that was indicated in 2003 for this site.
- *Determine the reason(s) for sediment toxicity* was indicated at 4 sites. This was an improvement over 2003 for 2 of the 4 sites, which indicated *management actions required* in 2003.
- *No further actions needed* was indicated at 2 sites, an improvement over 2003, where either *management actions required* or *determine reasons for benthos alteration* were indicated at these sites.

5 RECOMMENDATIONS AND NEXT STEPS

- Evaluate PCDD/F bioaccumulation in the resident benthos. The measurement of tissue PCDD/F concentrations will provide evidence of bioavailability and potential risks to higher trophic level organisms from contaminants originating from the sediment.
- An assessment of benthic invertebrate tissue concentrations for dioxins/furans is scheduled for summer 2011.
- Complete investigation into cause(s) of sediment toxicity (bioaccumulation / water quality study). A report will be available fall 2011.
- Continue to monitor the Spanish Harbour AOC periodically to assess whether positive changes are consistent and/or conditions improve with time.

6 REFERENCES

Belbin, L. 1993. PATN, pattern analysis package. Division of Wildlife and Ecology, CSIRO, Canberra, Australia.

Blatant Fabrications Pty Ltd. 2001. PATN Version 3.03. December 2, 2004.

Borgmann U, W.P. Norwood, and K.M. Ralph. 1990. Chronic toxicity and bioaccumulation of 2,5,2′,5′- and 3,4,3′,4′-tetrachlorobiphenyl and Aroclor 1242 in the amphipod *Hyalella azteca*. Arch. Environ. Contam. Toxicol. 19: 558-564.

Borgmann, U., and W.P. Norwood. 1999. Sediment toxicity testing using large water-sediment ratios: an alternative to water renewal. Environ. Poll. 106: 333-339.

Borgmann, U., W.P. Norwood, T.B. Reynoldson, and F. Rosa. 2001. Identifying cause in sediment assessments: bioavailability and the sediment quality triad. Can. J. Fish. Aquat. Sci. 58: 950-960.

Burniston, D. Spanish River 2010 chemical data, unpublished. Water Quality Monitoring and Surveillance, Environment Canada, Burlington, Ontario.

Cancilla, D. (ed.) 1994. Manual of analytical methods. Vol. 1. National Laboratory for Environmental Testing, Canada Centre for Inland Waters, Environment Canada, Burlington, Ontario.

CCME (Canadian Council of Ministers of the Environment). 2001. Canadian sediment quality guidelines for the protection of aquatic life). In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME. 2008. Canada-wide standards for petroleum hydrocarbons (PHCs) in soil. Endorsed by CCME Council of Ministers, April 30-May 1, 2001, Winnipeg, MN. Table 1 Revised January 2008. 8 pp. http://www.ccme.ca/ourwork/soil.html?category_id=43

Dillon, T.M., W.H. Benson, R.A. Stackhouse, and A.M. Crider. 1990. Effects of selected PCB congeners on survival, growth and reproduction in Daphnia magna. Environ. Toxicol. Chem. 9: 1317-1326.

Duncan, G.A., and G.G. LaHaie. 1979. Size analysis procedures in the Sedimentology laboratory. National Water Research Institute Manual. Environment Canada, Burlington, Ontario.

Croteau, M-N., L. Hare, and A. Tessier. 1998. Refining and testing a treace metal biomonotir (Chaoborus) in highly acidic lakes. Enviorn. Sci. Technol. 32: 1348-1353.

EC (Environment Canada) 2008. 2008-09. NLET Schedule of Services. The National Laboratory for Environmental Testing, Burlington, On.

EC/MOE (Environment Canada/Ministry of the Environment). 2007. Canada-Ontario decision making framework for assessment of Great Lakes contaminated sediment. Prepared by P. Chapman with the COA Sediment Task Group on behalf of Environment Canada and the Ontario Ministry of the Environment. June 2007. ISBN 978-0-662-46147-0.

Fletcher, R., P. Welsh, and T. Fletcher. 2008. Guidelines for identifying, assessing and managing contaminated sediment in Ontario: an integrated approach. Ontario Ministry of the Environment. PIBS 6658e. May 2008.

Manly, B.F.J. 1991. Randomization and Monte Carlo methods in biology. Chapman & Hall, London. 281 p. In: Belbin, L. 1993. PATN, pattern analysis package. Division of Wildlife and Ecology, CSIRO, Canberra, Australia.

Milani, D., and L.C. Grapentine. 2006. The application of BEAST sediment quality guidelines to the Spanish Harbour Area of Concern. WSTD Contribution No. 06-438.

Milani, D., and L.C. Grapentine. 2007. The application of BEAST sediment quality guidelines to the Jackfish Bay Area of Concern. WSTD Contribution No. 07-504.

Milani, D., and L.C. Grapentine. 2009. Benthic conditions in the Jackfish Bay Area of Concern 2008. WSTD Contribution No. 09-541.

Munger, C., and L. Hare. 1997. Relative importance of water rand food as cadmium sources to an aquatic insect (*Chaoborus punctipennis*): Implications for predicting Cd bioaccumulation in nature. Environ. Sci. Technol. 31: 891-895.

National Research Council 2003. Bioavailability of Contaminants in Soils and Sediments: Processes, Tools, and Applications.

Reynoldson T. B., R.C. Bailey, K.E. Day and R.H. Norris. 1995. Biological guidelines for freshwater sediment based on benthic assessment of sediment (the BEAST) using a multivariate approach for predicting biological state. Aust. J. Ecol. 20: 198-219.

Reynoldson, T.B. and K.E. Day. 1998. Biological guidelines for the assessment of sediment quality in the Laurentian Great Lakes. National Water Research Institute, Burlington, Ontario, Canada. NWRI Report No. 98-232.

Reynoldson, T.B., K.E. Day, and T. Pascoe. 2000. The development of the BEAST: a predictive approach for assessing sediment quality in the North American Great Lakes. In: Assessing the biological quality of fresh waters. RIVPACS and other techniques. J.F. Wright, D.W. Sutcliffe, and M.T. Furse (Eds). Freshwater Biological Association, UK.pp. 165 – 180.

Richman, L. 2004. Great Lakes Reconnaissance Survey. Water and Sediment Quality Monitoring Survey: Harbours and Embayments, Lake Superior and the Spanish River. Ontario Ministry of the Environment, Environmental Monitoring and Reporting Branch, Toronto. ISBN 0-7794-7103-2.

Spanish Harbour RAP Team. 1992. Spanish Harbour Area of Concern. Stage 1 – Environmental conditions and problem definition. October, 1992.

Systat Software, Inc. 2007. SYSTAT 12 for Windows. Version 12.02.

USEPA/CE (United States Environmental Protection Agency/Corps of Engineers). 1981. Procedures for handling and chemical analysis of sediment and water samples. Environmental laboratory, US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, pp 3-118. EPA/CE-81-1.

USEPA. 1992. Test methods for evaluating solid waste, SW-846, US EPA Office of Solid Waste, 3rd Edition. http://www.epa.gov/epawaste/hazard/testmethods/sw846/index.htm

USEPA. 1994. Method 1613 Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS. U.S. Environmental Protection Agency Office of Water Engineering and Analysis Division (4303) 401 M Street S.W. Washington, D.C. 20460 October 1994 http://water.epa.gov/scitech/swguidance/methods/organics/dioxins/index.cfm

USEPA. 2003. Method 1668, Revision A: Chlorinated Biphenyl Congeners in Water, Soil, Sediment, and Tissue by HRGC/HRMS (EPA 821-R-00-002).

Van den Berg, M., L. Birnbaum, A.T.C. Bosveld., B. Brunström, P. Cook, M. Feeley, J.P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, F.X. Rolaf van Leeuwen, A.K.D. Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillitt, M. Tysklind, M. Younes, F. Waern, and T. Zacharewski. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ. Health Perspect. 106(12): 775–792.

West, C.W., G.T. Ankley, J.W. Nichols, G.E. Elonen, and D.E. Nessa. 1997. Toxicity and bioaccumulation of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin in long-term tests with the freshwater benthic invertebrates *Chironomus tentans* and *Lumbriculus variegatus*. Environ. Toxicol. Chem. 16 (6): 1287-1294.

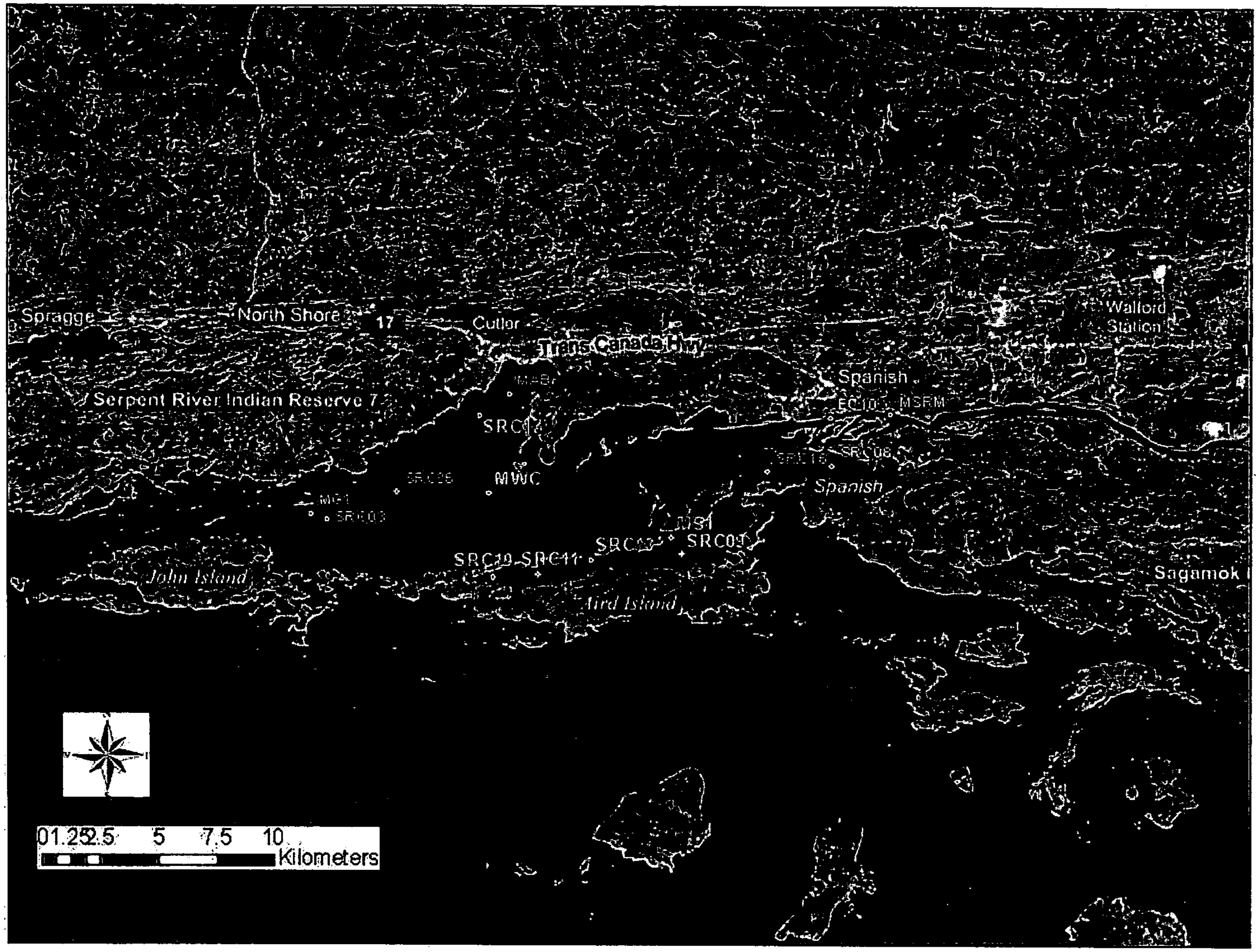

Figure 1. Sampling locations in the Spanish Harbour Area of Concern in 2009 (n=7, green labels) and 2003 (n=15, all sites).

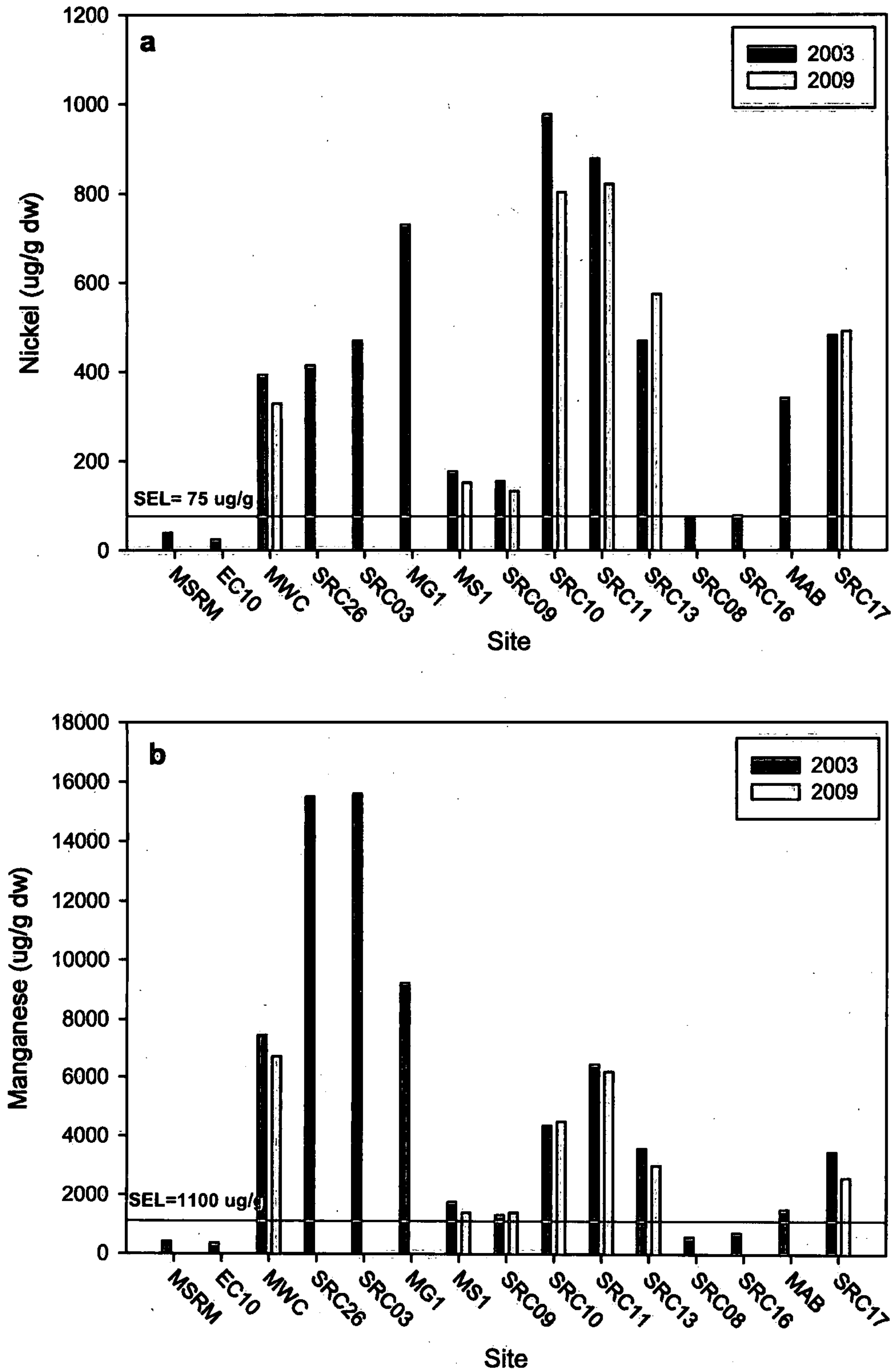

Figure 2. Concentrations of (a) nickel, and (b) manganese (µg/g dw) in Spanish Harbour sediment, 2009 and 2003. The red horizontal line represents the Severe Effect Level (SEL).

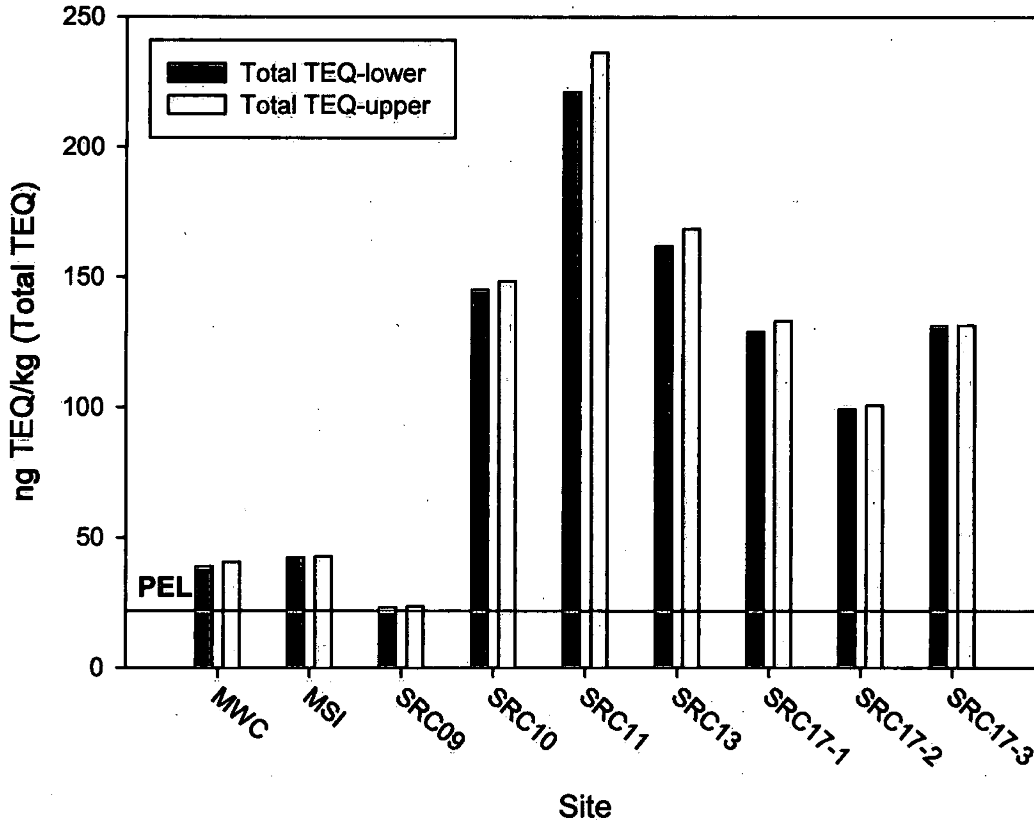

Figure 3a. Total (sum of dioxin and furan and dioxin-like PCBs) toxic equivalency units (TEQ) for 2009 Spanish Harbour sites, showing the lower and upper values. World Health Organization toxic equivalency factors for fish were used in the calculations (Van den Berg et al. 1998). Values below detection limits were assigned a zero for the lower TEQ calculation and assigned the value for the upper limit. The Probable Effect Level (PEL; CCME 2001) (21.5ng·TEQ/kg dw) is shown (blue line).

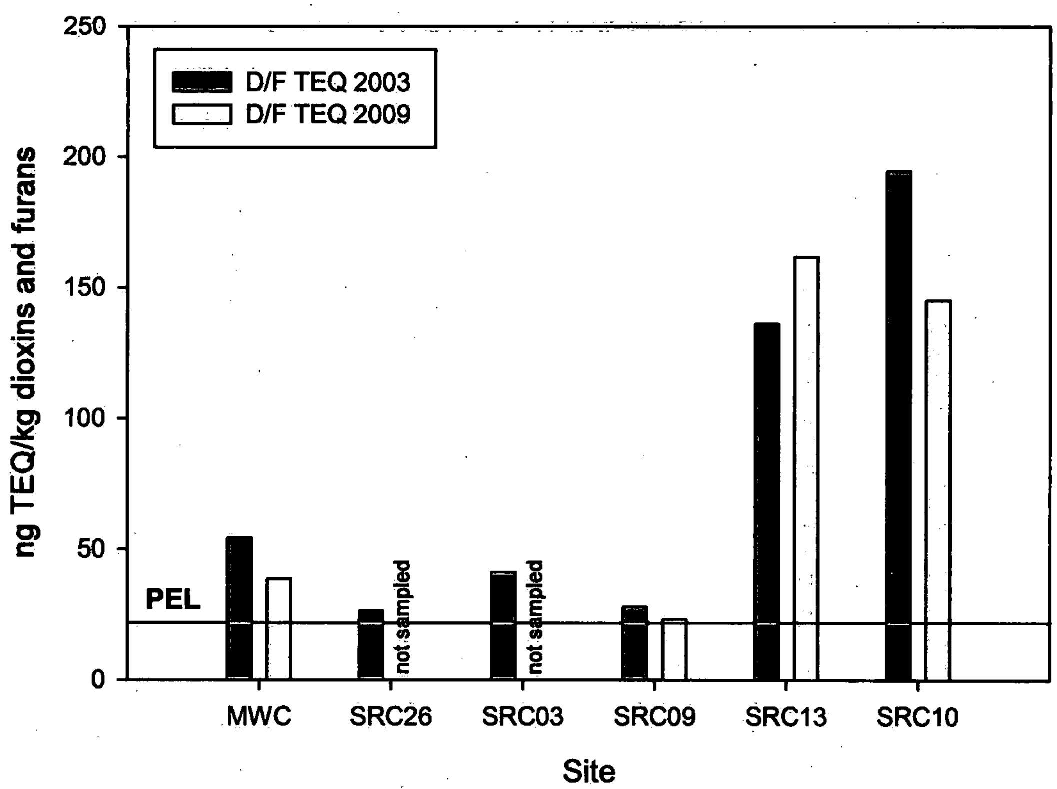

Figure 3b. Comparison of dioxins and furan toxic equivalency (TEQ) units for a subset of Spanish Harbour sites that were sampled in 2009 and 2003. World Health Organization toxic equivalency factors for fish were used in the calculations (Van den Berg et al. 1998). Non-detect values were assigned a zero in the calculations. The Probable Effect Level (PEL; CCME 2001) (21.5ng·TEQ/kg dw) is shown (blue line).

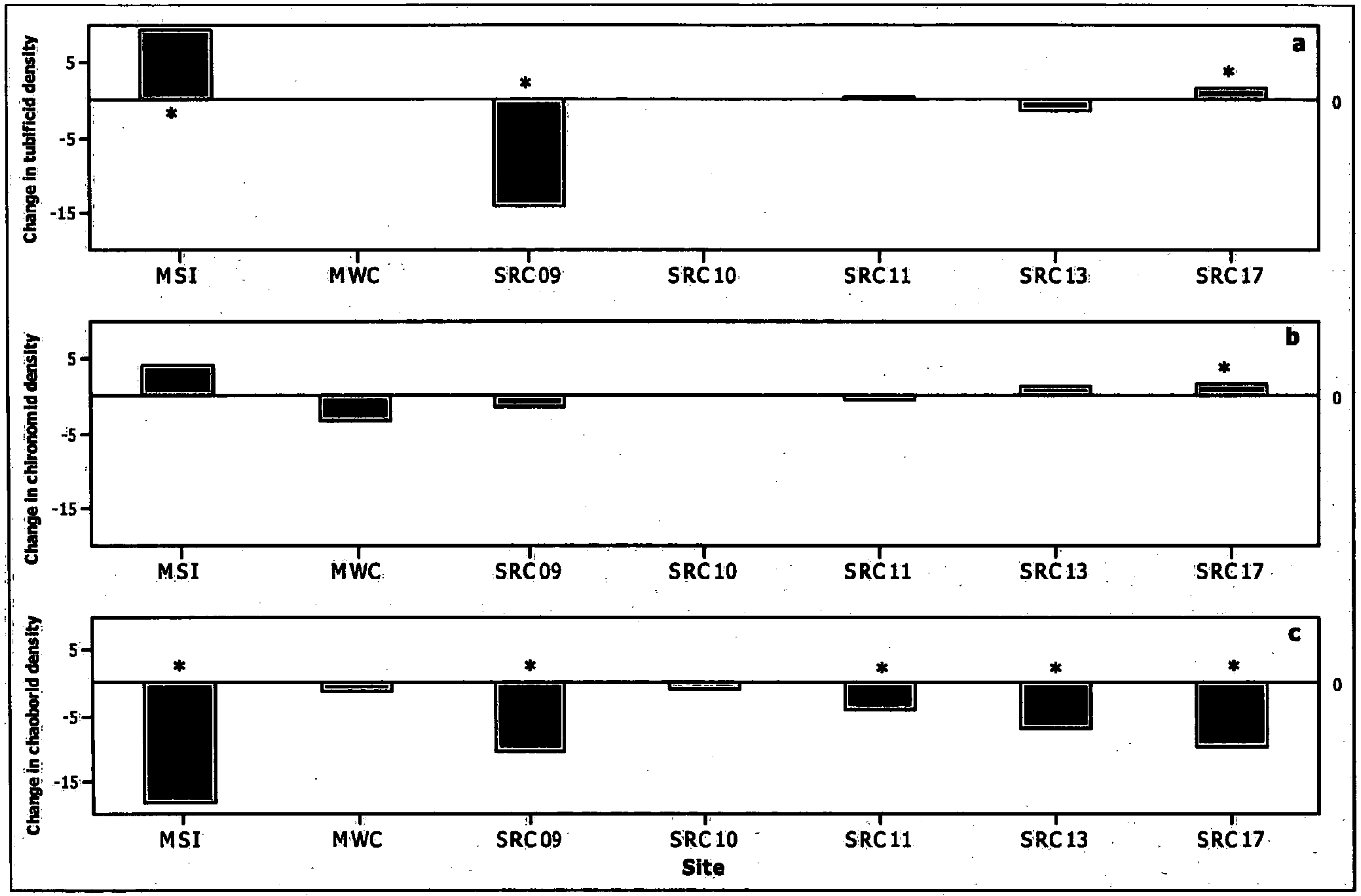

Figure 4. Change in (a) tubificid, (b) chironomid, and (c) chaoborid densities (per 33.14 cm^2 – area of core tube) between 2009 and 2003 sampling years (n=7). Bars represent abundance for 2009 minus abundance for 2003 with decreases are in red and increases in green. An asterix denotes a significant difference in abundances between 2009 and 2003 (paired t-test, confidence level = 95%).

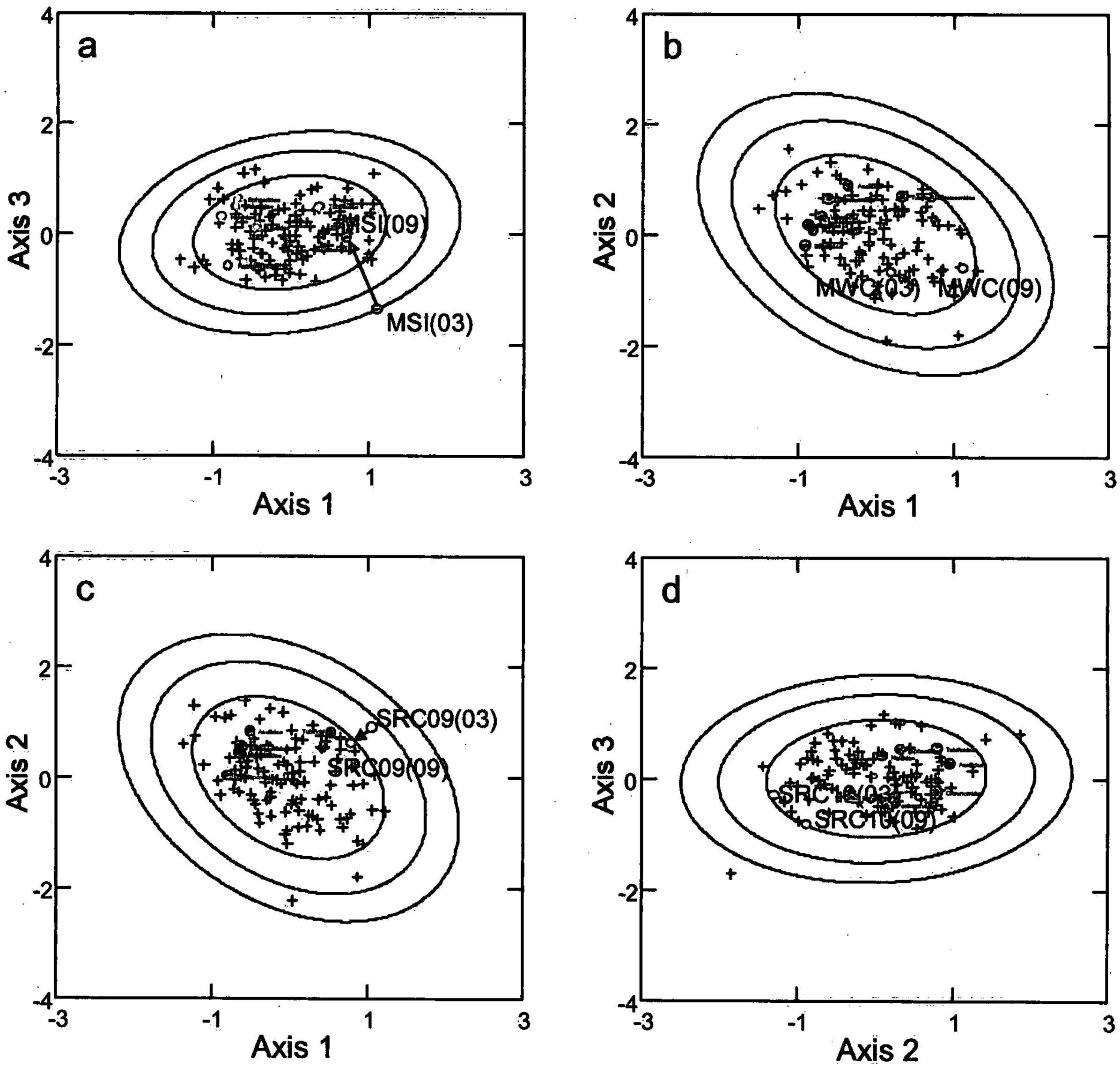

Figure 5. Assessment of Spanish Harbour sites using multidimensional scaling with family-level benthic invertebrate community data. Site scores are summarized on two of three axes for each sub-plot with 90% (smallest ellipse), 99% (middle ellipse), and 99.9% (largest ellipse) probability ellipses around Great Lakes reference sites shown (reference site scores shown as cross hairs). Stress = 0.158-0.163. The 2009 site as well as the 2003 site (concomitant site) are shown in each sub-plot, with the vector indicating the direction of shift.

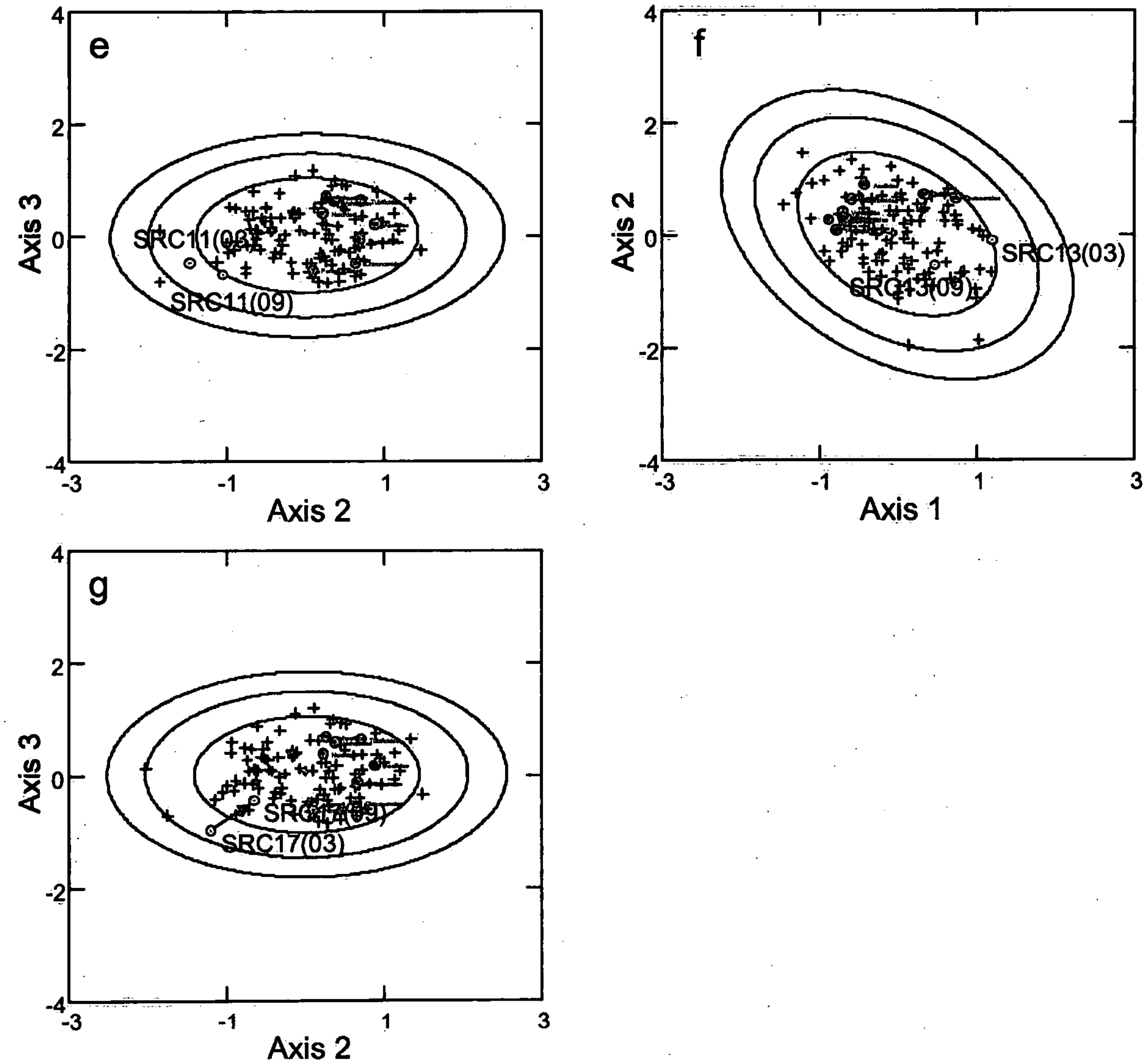

Figure 5. Continued.

Benthic Invertebrate Community - 2009

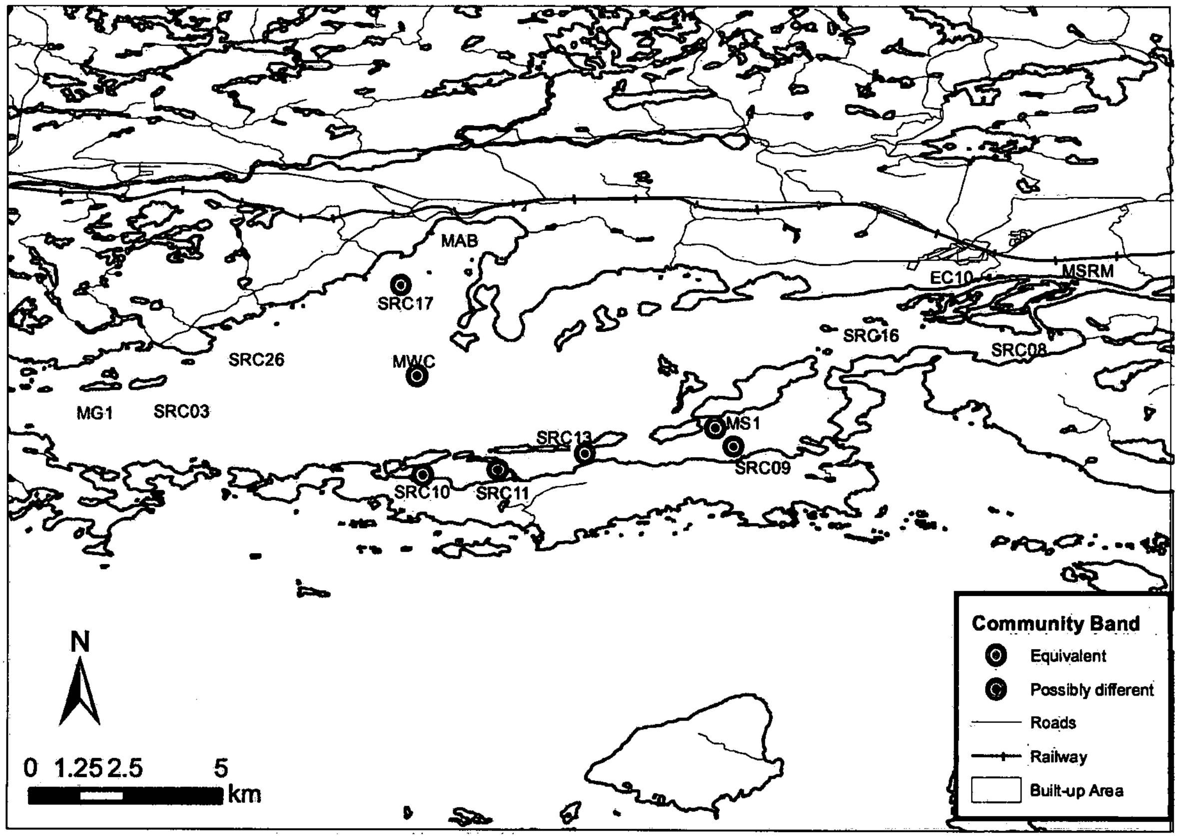

Figure 6. Spatial distribution of 2009 sites (n=7) indicating the level of benthic community alteration compared to Great Lakes reference sites (location of 2003 sites are shown for reference).

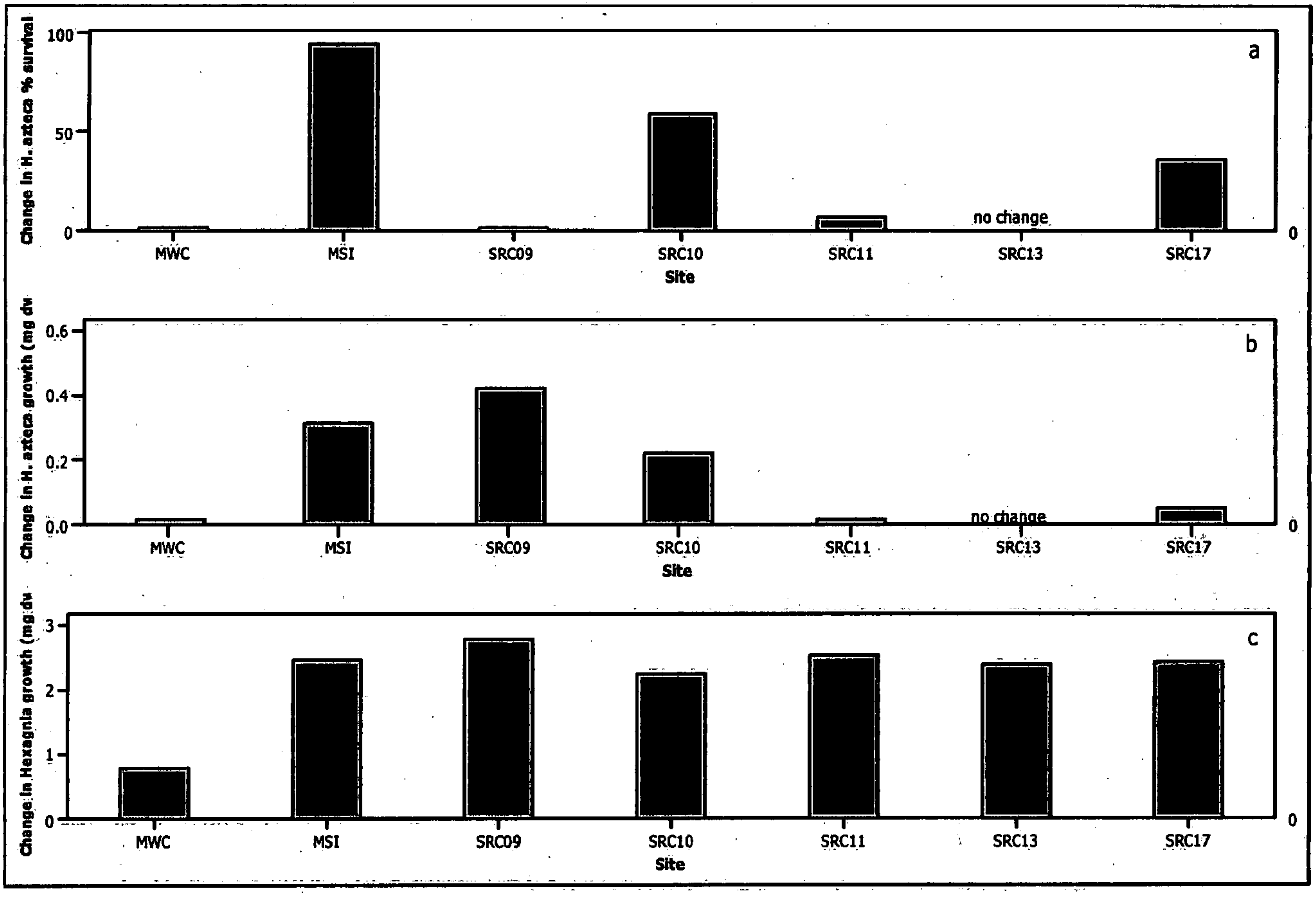

Figure 7. Change in (a) *Hyalella* survival (%), (b) *Hyalella* growth, and (c) *Hexagenia* growth at sites sampled in both 2003 and 2009 (n=7). Bars represent % survival or growth (mg dw) for 2009 minus that for 2003.

Toxicity - 2009

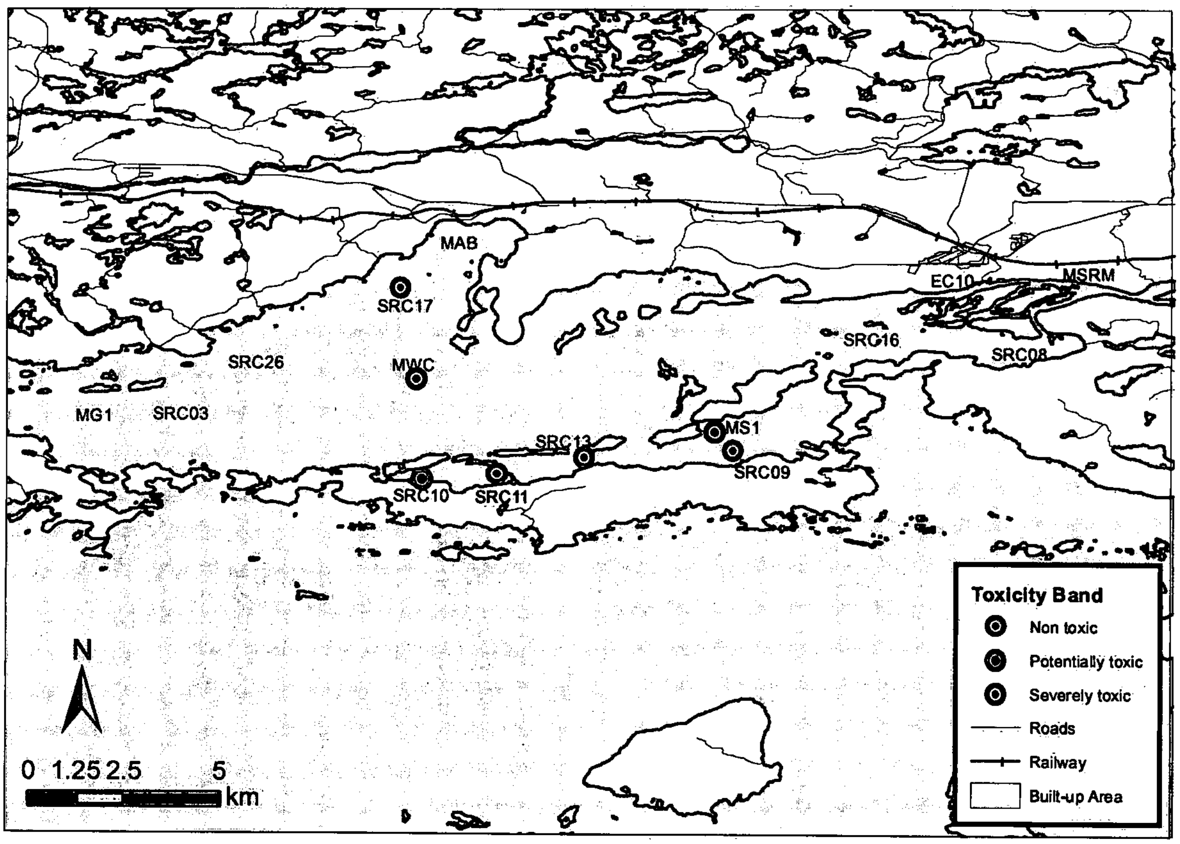

Figure 8. Spatial distribution of 2009 sites (n=7) indicating the level of toxicity compared to Great Lakes reference sites (location of 2003 sites are shown for reference).

Assessment Outcome - 2009

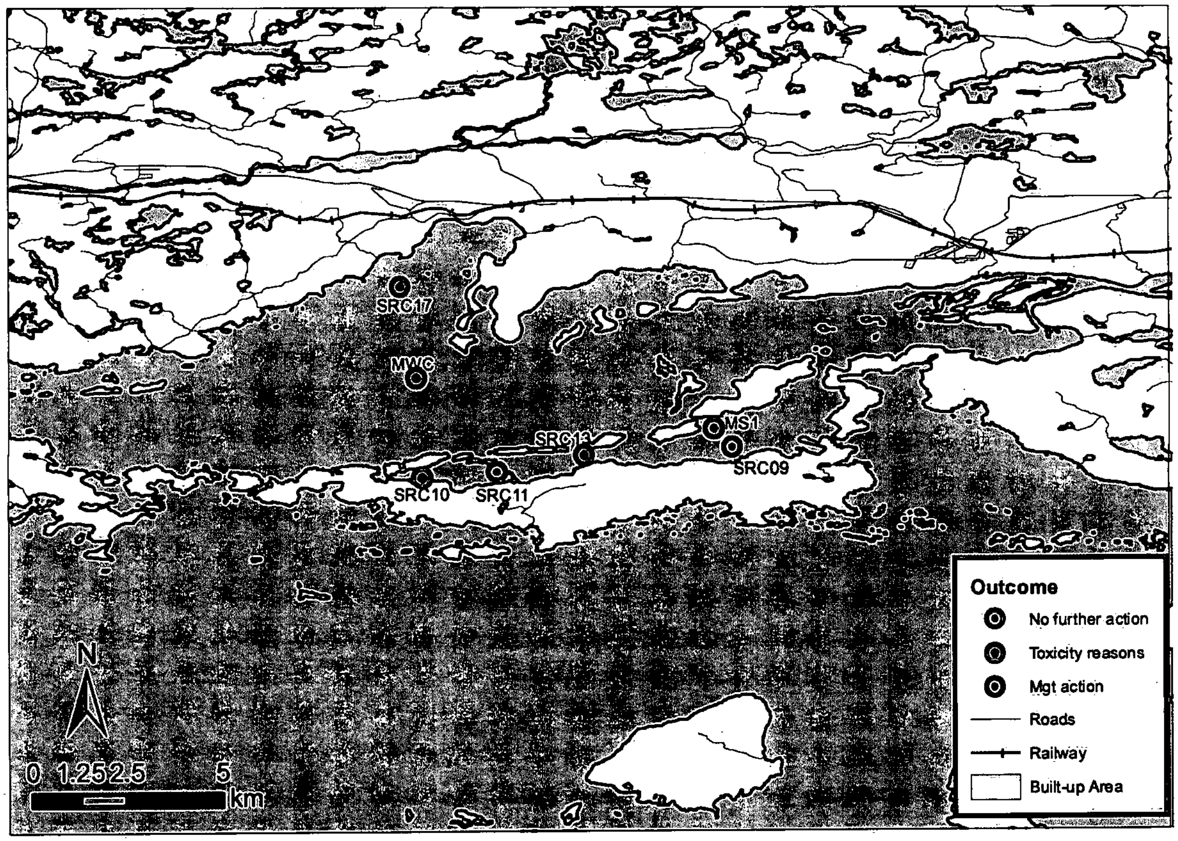

Figure 9. Spatial distribution of 2009 sites (n=7) indicating sediment decision-making framework assessment outcomes.

Table 1. Spanish Harbour 2009 and 2003 site positions (UTM Nad 83), sampling device and depth (m).

Location	2003					2009					
	Site	Sampling device	Site Depth (m)	Northing	Easting	Site	Sampling Device	Site Depth (m)	Northing	Easting	Comments
Spanish River Mouth	MSRM	Ponar	2.1	5115538.2	398324.5						Sand over clay sand. Box core not possible.
	EC10	Ponar	1.6	5115476.3	396522.2						Hard grey mud. Clay prevented box core from closing
Whalesback Channel	MWC	Mini-box corer	21.9	5113321.7	386289.3	MWC	Mini-box corer	22.6	5113311.6	386275.6	Very soft fine sediment, brown top 2-3 cm layer with black bottom layer.
	SRC26	Mini-box corer	20.6	5113407.0	383453.6						2-3 cm brown silt over light grey, darker gray below 6 cm.
	SRC03	Mini-box corer	21.3	5112614.9	381337.8						2-3 cm brown silt over light grey. Darker grey below 6 cm.
	MG1	Mini-box corer	12.5	5112804.6	380859.6						2-3 cm brown silt over grey clay mud
North of Aird Island	MS1	Mini-box corer	11.3	5111890.0	391683.5	MS1	Mini-box corer	11.9	5111881.7	391681.8	2-3 cm light brown silt over brown-grey fine silty mud..
	SRC09	Mini-box corer	21.4	5111396.9	392015.3	SRC09	Mini-box corer	22.1	5111387.7	392009.8	2-3cm light brown over darker brown. Fine silty mud.
	SRC10	Mini-box corer	7.8	5110753.4	386341.0	SRC10	Mini-box corer	8.1	5110745.4	386331.7	Wood debris present near 10 cm depth. Silty brown mud.
	SRC11	Mini-box corer	10.5	5110821.6	387695.1	SRC11	Mini-box corer	10.6	5110829.8	387703.4	Wood debris present near ~7-8 cm depth, difficult to get core tube in to 10 cm due to wood. Silty mud
	SRC13	Mini-box corer	15.0	5111253.9	389305.0	SRC13	Mini-box corer	15.7	5111253.3	389312.1	Soft, very fine, silty brown mud
South of Frenchman Island	SRC08	Mini-box corer	6.8	5114005.1	396560.1						2-3 cm brown silt over grey clay mud.
South of Forbes Island	SRC16	Mini-box corer	6.2	5113853.6	394636.9						Silt and clay with a thick organic layer 3 to 4 cm deep
Aird Bay	MAB	Mini-box corer	7.7	5116333.5	386930.4						2-3 cm brown silt over grey clay mud.
	SRC17	Mini-box corer	9.4	5115673.6	386025.4	SRC17	Mini-box corer	10.3	5115661.0	386032.0	2-3 cm reddish brown silt over brown grey soft mud, very fine sediment

Table 2. Environmental variables measured at each site.

Field	Overlying Water	Sediment (top 10 cm)
Northing	Alkalinity	Trace Metals and Major Oxides
Easting	Conductivity (on site)	Total Phosphorus
Site Depth	Dissolved Oxygen (on site)	Total Kjeldahl Nitrogen
	pH (on site)	Total Organic Carbon, Loss on Ignition
	Temperature (on site)	Percents Clay, Silt, Sand and Gravel
	Total Kjeldahl Nitrogen	BTEX and Petroleum Hydrocarbons
	Nitrates/Nitrites (NO_3/NO_2)	PAHs, PCBs (aroclors)
	Total Ammonia (NH_3)	Dioxins and Furans
	Total Phosphorus	Dioxin-like PCBs

Table 3. Characteristics of 2009 Spanish Harbour overlying water. Values in mg/L dry weight unless otherwise noted.

Site	Alkalinity	Conductivity µS/cm	Dissolved O_2	NH_3	NO_3/NO_2	pH	Temperature bottom (°C)	Total Kjeldahl Nitrogen	Total Phosphorus
MWC	36.1	141	9.2	0.021	0.145	7.77	13.6	0.275	0.0131
MS1	43.7	148	9.5	0.006	0.178	7.96	14.1	0.219	0.0081
SRC09	31.9	134	9.4	0.019	0.134	7.74	13.3	0.291	0.0150
SRC10	37.9	141	9.5	0.011	0.138	7.80	13.6	0.235	0.0093
SRC11	38.5	142	9.6	0.013	0.137	7.80	13.9	0.239	0.0100
SRC13	38.4	145	9.4	0.015	0.144	7.77	13.9	0.250	0.0107
SRC17[a]	40.9	143	9.8	0.010	0.173	7.87	13.8	0.234	0.0113

[a]QA/QC site; value represents average of three casts

Table 4. Physical characteristics of 2009 Spanish Harbour sediment (top 10 cm). The 2003 values are indicated in brackets.

Site	% Sand	% Silt	% Clay	% Gravel
MWC	0.5 (0.1)	65.2 (50.8)	34.3 (49.1)	0.0 (0)
MS1	1.3 (0.3)	45.9 (67.2)	52.8 (32.5)	0.0 (0)
SRC09	1.1 (0.2)	56.8 (94.8)	42.1 (5.0)	0.0 (0)
SRC10	1.0 (0.8)	45.3 (47.8)	53.7 (51.4)	0.0 (0)
SRC11	1.0 (0.4)	46.8 (54.4)	52.2 (45.2)	0.0 (0)
SRC13	1.2 (1.4)	49.7 (70.8)	49.1 (27.8)	0.0 (0)
SRC17[a]	0.8 (0.3)	50.2 (52.7)	49.0 (47.0)	0.0 (0)

[a]QA/QC site -value represents average of three mini-box core drops

Table 5. Nutrient and trace metal concentrations for 2009 Spanish Harbour sediment (top 10 cm). Values exceeding the provincial Severe Effect Level (SEL) and Lowest Effect Level (LEL) are highlighted red and blue, respectively.

						Site	MWC	MS1	SRC09	SRC10	SRC11	SRC13	SRC1700	SRC1701	SRC1702
						Date Collected:	8-Oct-09	8-Oct-09	8-Oct-09	8-Oct-09	8-Oct-09	8-Oct-09	8-Oct-09	8-Oct-09	8-Oct-09
Parameter	Units	M.D.L.	Reference Method	LEL	SEL	Date Analyzed									
Aluminum	µg/g	10	EPA 6010			23-Mar-10	21000	14000	14000	22000	22000	19000	20000	20000	19000
Antimony	µg/g	0.5	EPA 6020			23-Mar-10	< 0.5	< 0.5	< 0.5	0.6	0.6	< 0.5	< 0.5	< 0.5	< 0.5
Arsenic	µg/g	0.5	EPA 6020	6	33	23-Mar-10	19.8	4.0	4.3	20.6	23.2	14.3	20.8	19.9	20.6
Barium	µg/g	1	EPA 6010			23-Mar-10	230	78	88	211	272	151	151	152	153
Beryllium	µg/g	0.2	EPA 6010			23-Mar-10	0.7	0.5	0.5	0.9	0.9	0.7	0.7	0.7	0.7
Bismuth	µg/g	5	EPA 6010			23-Mar-10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Cadmium	µg/g	0.5	EPA 6010	0.6	10	23-Mar-10	1.5	0.6	0.6	2.4	2.6	2.0	1.6	1.6	1.6
Calcium	µg/g	10	EPA 6010			23-Mar-10	6030	5080	6280	6420	6210	5470	5990	5570	5750
Chromium	µg/g	1	EPA 6010	26	110	23-Mar-10	55	41	41	57	56	52	54	52	53
Cobalt	µg/g	1	EPA 6010			23-Mar-10	44	24	23	68	76	58	53	50	53
Copper	µg/g	1	EPA 6010	16	110	23-Mar-10	68	40	38	125	123	92	85	86	88
Iron	µg/g	10	EPA 6010	20000	40000	23-Mar-10	43000	27000	27000	49000	53000	39000	46000	45000	46000
Lead	µg/g	5	EPA 6010	31	250	23-Mar-10	33	18	17	83	76	50	52	52	53
Magnesium	µg/g	10	EPA 6010			23-Mar-10	7980	6230	7120	7780	7640	7410	7830	7640	7690
Manganese	µg/g	1	EPA 6010	460	1100	23-Mar-10	6700	1400	1400	4500	6200	3000	2700	2400	2600
Mercury	µg/g	0.005	EPA 7471A	0.2	2	23-Mar-10	0.125	0.073	0.07	0.2	0.42	0.15	0.147	0.15	0.154
Molybdenum	µg/g	1	EPA 6010			23-Mar-10	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Nickel	µg/g	1	EPA 6010	16	75	23-Mar-10	329	152	133	803	821	574	482	486	506
Phosphorus	µg/g	5	EPA 6010			23-Mar-10	1800	876	939	1400	2000	1100	1300	1200	1300
Potassium	µg/g	30	EPA 6010			23-Mar-10	1840	1170	1210	1780	1800	1610	1740	1640	1680
Silicon	µg/g	1	EPA 6010			23-Mar-10	151	199	161	170	161	184	215	184	203
Silver	µg/g	0.2	EPA 6010			23-Mar-10	0.4	< 0.2	< 0.2	0.5	0.6	0.4	0.4	0.3	0.4
Sodium	µg/g	20	EPA 6010			23-Mar-10	200	270	250	200	180	160	260	250	240
Strontium	µg/g	1	EPA 6010			23-Mar-10	32	22	21	30	31	26	28	26	27
Tin	µg/g	10	EPA 6010			23-Mar-10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Titanium	µg/g	1	EPA 6010			23-Mar-10	849	827	759	779	763	888	900	833	877
Vanadium	µg/g	1	EPA 6010			23-Mar-10	54	37	36	61	60	51	54	52	53
Yttrium	µg/g	0.5	EPA 6010			23-Mar-10	11.7	8.8	8.5	15.1	14.2	11.6	12.5	12.2	12.4
Zinc	µg/g	1	EPA 6010	120	820	23-Mar-10	200	127	117	302	303	229	224	220	226
Zirconium	µg/g	0.1	EPA 6010			23-Mar-10	< 0.1	1.1	0.6	< 0.1	< 0.1	0.3	0.5	0.9	0.4
Aluminum (Al2O3)	%	0.01	IN-HOUSE			1-Apr-10	11.8	–	12.60	12.3	11.70	13.1	12.6	12.3	12.6
Barium (BaO)	%	0.001	IN-HOUSE			1-Apr-10	0.07	–	0.06	0.07	0.07	0.07	0.06	0.06	0.06
Calcium (CaO)	%	0.01	IN-HOUSE			1-Apr-10	2.03	–	2.39	2.04	1.73	2.24	2.06	2.14	2.10
Chromium (Cr2O3)	%	0.01	IN-HOUSE			1-Apr-10	< 0.01	–	< 0.01	< 0.01	< 0.01	0.01	< 0.01	0.01	< 0.01
Iron (Fe2O3)	%	0.05	IN-HOUSE			1-Apr-10	6.46	–	4.89	7.6	8.01	6.39	7.22	6.81	7.39
Magnesium (MgO)	%	0.01	IN-HOUSE			1-Apr-10	1.87	–	1.84	1.84	1.77	1.97	1.92	1.91	1.84
Manganese (MnO)	%	0.01	IN-HOUSE			1-Apr-10	0.77	–	0.18	0.67	0.72	0.39	0.34	0.31	0.34
Phosphorus (P2O5)	%	0.03	IN-HOUSE			1-Apr-10	< 0.03	–	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Potasium (K20)	%	0.01	IN-HOUSE			1-Apr-10	1.88	–	1.86	1.89	1.70	1.95	1.86	1.95	1.99
Silica (SiO2)	%	0.01	IN-HOUSE			1-Apr-10	52.6	–	60.8	54.5	50.3	59.3	55.6	52.8	52.8
Sodium (Na2O)	%	0.01	IN-HOUSE			1-Apr-10	2.10	–	2.48	< 0.01	< 0.01	2.47	2.29	2.10	2.18
Titanium (TiO2)	%	0.01	IN-HOUSE			1-Apr-10	0.45	–	0.47	0.5	0.47	0.52	0.52	0.48	0.5
Loss on Ignition	%	0.05	IN-HOUSE			1-Apr-10	10.7	–	7.14	13.2	13.1	8.98	9.37	9.09	9.46
Whole Rock Total	%		IN-HOUSE			1-Apr-10	90.7	–	94.7	94.7	89.5	97.3	93.9	90.0	91.3
Total Organic Carbon	% by wt	0.1	LECO	1	10	9-Apr-10	2.4	1.5	1.7	3.4	3.5	2.0	2.1	2.0	2.4
Total Kjeldahl Nitrogen	µg/g	0.05	EPA 351.2	550	4800	16-Mar-10	2590	1480	1730	3500	3470	2220	2370	2280	2240
Phosphorus-Total	µg/g	0.01	EPA 365.4	600	2000	16-Mar-10	1760	862	978	1540	2080	1200	1380	1400	1330

Table 6. Range of sediment nickel, copper, iron and manganese concentrations (dry wt) in similar locations of the Spanish Harbour Area of Concern from 1988 to 2009.

Area/Year	No. Sites	Nickel (µg/g)	Copper (µg/g)	Iron (%)	Manganese (µg/g)
Spanish River Mouth					
1988[a]	2	36 - 52	8 - 27	-[e]	-[e]
1999[b]	1	38 - 46	5 - 8	0.79 - 0.88	200 - 280
2003[c]	2	24 - 39	13 - 18	1.73 - 1.74	361 - 400
2009	0	-[f]	-[f]	-[f]	-[f]
2010[d]	1	38	13	1.79	700
South/Southwest of Frenchman Island					
1988[a]	7-8	77-131	18-53	-[d]	-[d]
1999[b]	0	-[f]	-[f]	-[f]	-[f]
2003[c]	2	72-78	27-28	1.66 - 1.68	582-710
2009	0	-[f]	-[f]	-[f]	-[f]
Whalesback Channel					
1988[a]	17-19	270 - 1032	63 - 174	-[e]	-[e]
1999[b]	2	450 - 840	100 - 160	3.8 - 4.7	3200 - 5000
2003[c]	4	382 - 782	80 - 160	3.8 - 5.1	5660 - 15600
2009	1	329	68	4.3	6700
North of Aird Island					
1988[a]	4	444 - 932	77 - 182	-[e]	-[e]
1999[b]	1	200	52 - 54	2.8	1200 - 1400
2003[c]	5	155 - 977	48 - 158	2.5 - 4.7	1320 - 6440
2009	5	133 - 821	38 - 125	2.7 - 5.3	1400 - 6200
Aird Bay					
1988[a]	12-13	21 - 630	7 - 120	-[e]	-[e]
1999[b]	1	370 - 390	86 - 90	4.2 - 4.3	1200 - 1300
2003[c]	2	341 - 482	84 - 94	4.0 - 4.2	1510 - 3460
2009	1	482 - 506	85 - 88	4.5 - 4.6	2400 - 2700

[a] NWRI study (RAP Stage 1, Spanish Harbour RAP Team 1992)
[b] Richman (2004)
[c] Milani and Grapentine (2006)
[d] Burniston (unpublished)
[e] Not analyzed
[f] Not sampled

Table 7. Polychlorinated dibenzo-*p*-dioxins and furans (PCDD/F) and dioxin-like PCBs (pg/g) and toxic equivalent concentrations (ngTEQkg^{-1}) in Spanish Harbour sediments, 2009.

Sample Name	MWC	MSI	SRC09	SRC09 - duplicate	SRC10	SRC11	SRC13	SRC17-1	SRC17-2	SRC17-3
Matrix	sediment	sediment	sediment	QC	sediment	sediment	sediment	sediment	sediment	sediment
PCDD/F	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g
2,3,7,8-TCDD	15.7	16.7	9.69	8.72	60.4	94.6	65.8	53.1	40	50.7
1,2,3,7,8-PeCDD	<1.6	1.56	0.973	<0.59	7.71	<9.5	9.25	<4.2	4.09	5.2
1,2,3,4,7,8-HxCDD	1.95	<0.73	<0.51	0.545	<5.2	<7.4	<6.9	3.62	<3.1	4.76
1,2,3,6,7,8-HxCDD	5.97	5.02	3.68	2.9	26.7	37.6	44.7	19	16.9	19.1
1,2,3,7,8,9-HxCDD	4.99	<2.1	1.92	1.69	16.4	18.5	22.2	9.86	10.4	11
1,2,3,4,6,7,8-HpCDD	102	77.2	64.4	51.7	428	624	774	261	251	291
OCDD	1190	936	717	592	4160	6110	9040	3040	2860	3550
2,3,7,8-TCDF	329	374	208	181	1180	2000	1340	1180	860	1170
1,2,3,7,8-PeCDF	5.6	5.85	3.99	3.51	16.3	26.2	21.7	13.8	10.7	13
2,3,4,7,8-PeCDF	7.52	6.96	4.86	4.17	25.7	41.1	29	22.3	16.9	20.8
1,2,3,4,7,8-HxCDF	6.36	6.79	5.66	5.05	14.5	19.7	<21	9.33	8.97	9.7
1,2,3,6,7,8-HxCDF	2.3	2.12	<1.5	1.41	6.2	<9.0	<8.4	4.12	3.7	4.32
2,3,4,6,7,8-HxCDF	<2.2	1.49	1.14	0.994	<7.1	<8.9	9.26	3.96	4.5	4.78
1,2,3,7,8,9-HxCDF	1.04	0.674	0.76	0.473	1.94	<1.4	<2.4	1.3	1.46	1.42
1,2,3,4,6,7,8-HpCDF	16.1	11.5	10.1	8.63	57.2	80.6	81.9	30.6	32.3	35.6
1,2,3,4,7,8,9-HpCDF	<1.5	1.72	1.37	1.07	5.55	<6.8	<7.5	<3.2	<2.9	<2.6
OCDF	19.6	15.8	14.5	12.7	68.2	111	126	46.2	42.7	42.9
TEQ (WHO 1998 FISH) ND=0	**38.6**	**42.2**	**24.8**	**21.4**	**144.9**	**221.0**	**161.7**	**128.8**	**99.1**	**131.2**
TEQ (WHO 1998 FISH) ND=DL	**40.5**	**42.6**	**25.2**	**21.9**	**148.3**	**236.2**	**168.4**	**133.0**	**100.7**	**131.2**
Homologue Group Totals	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g
Total-TCDD	19.5	22.3	11.6	11.7	72.3	104	65.8	64.9	51.2	58.7
Total-PeCDD	7.03	8.47	7.04	3.96	42.3	2.09	38.7	20.2	25.5	26.4
Total-HxCDD	53.8	33.2	26.6	22.9	198	274	273	134	117	136
Total-HpCDD	202	146	125	104	817	1210	1380	476	467	528
Total-TCDF	572	675	372	319	2070	3640	2430	2130	1560	2110
Total-PeCDF	40	34	22.2	19.7	129	150	93.4	93.1	82.6	98.3
Total-HxCDF	29.1	25.4	17.8	15.9	111	135	116	60.8	66.1	72.5
Total-HpCDF	33.6	28.8	25.2	21.3	142	205	231	76.1	80.2	87
Dioxin-like PCBs	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g
PCB-81	<0.28	<0.032	<0.37	<0.50	<2.1	<2.0	<1.6	<0.10	<1.0	<0.74
PCB-77	<19	<15	<11	12.7	72.1	<61	<41	<39	<40	<35
PCB-123	55.9	35.7	39.7	30.9	84.3	106	83.9	71.6	59.4	79.9
PCB-118	495	389	317	287	663	1120	850	703	582	587
PCB-114	12.4	9.9	8.63	8.17	20.6	24.3	22.8	17.5	14.7	14.6
PCB-105	186	130	109	105	269	366	280	246	216	204
PCB-126	4.04	2.44	<1.7	1.77	9.4	12.5	7.49	7.35	6.02	<5.1
PCB-167	<29	25.1	22.2	20.2	68.2	97.6	76.1	61.8	50.2	50.3
PCB-156	<63	60.1	51.6	44.1	114	182	137	113	93.7	96.7
PCB-157	20.8	15.2	12.5	10.8	42.9	57	41.3	35.9	29.2	29.1
PCB-169	<0.74	<0.35	<0.17	<0.29	2.06	<2.0	<1.1	<1.3	<1.5	<0.58
PCB-189	5.35	2.9	2.65	2.4	<10	<14	8	9.24	7.17	7.74
TEQ (WHO 1998 FISH) ND=0	**0.024**	**0.016**	**0.002**	**0.013**	**0.061**	**0.072**	**0.045**	**0.043**	**0.035**	**0.005**
TEQ (WHO 1998 FISH) ND=DL	**0.027**	**0.017**	**0.013**	**0.013**	**0.062**	**0.08**	**0.05**	**0.047**	**0.04**	**0.035**
SUM TOTAL TEQ (ND=0)	**38.7**	**42.2**	**24.8**	**21.4**	**145.0**	**221.1**	**161.8**	**128.8**	**99.1**	**131.2**
SUM TOTAL TEQ (ND=DL)	**40.5**	**42.6**	**25.2**	**22.0**	**148.4**	**236.3**	**168.5**	**133.1**	**100.7**	**131.2**

Table 8. Organic contaminant concentrations in Spanish Harbour sediments, 2009.

Analyte	Guideline mg/kg	MWC	MS1	SRC09	SRC10	SRC11	SRC13	SRC17-1	SRC17-2	SRC17-3
Physical Tests										
% Moisture		62.0	50.6	52.7	64.5	62.9	60.5	56.6	55.0	58.9
Compounds										
Benzene		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ethyl Benzene		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Toluene		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
o-Xylene		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
m+p-Xylenes		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Xylene, (total)		<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Surrogate: 2,5-Dibromotoluene		88	89	84	77	114	83	81	83	78
CCME Hydrocarbons	**CCME[a]**									
F1 (C6-C10)	210	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
F1-BTEX		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
F2 (C10-C16)	150	<20	<20	<20	<20	<20	<20	<20	<20	<20
F2-Naphth		<20	<20	<20	<20	<20	<20	<20	<20	<20
F3 (C16-C34)	1300	200	250	120	360	290	220	290	260	300
F3-PAH		200	250	120	360	290	220	290	260	300
F4 (C34-C50)	5600	<100	<100	<100	<100	<100	<100	<100	<100	<100
F4G-SG (GHH-Silica)		<500	<500	<500	<500	<500	<500	<500	<500	<500
Total Hydrocarbons (C6-C50)		200	250	120	360	290	220	290	260	300
Chromatogram to baseline at nC50		YES	YES	YES	YES	YES	YES	YES	YES	YES
Surrogate: Octacosane		95	95	99	98	93	90	90	95	98
Polycyclic Aromatic Hydrocarbons	**LEL[b]/PEL[c]**									
Acenaphthene	0.0889	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Acenaphthylene	0.128	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Acridine		<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
Anthracene	0.22/0.245	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Benzo(a)anthracene	0.32/0.385	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Benzo(a)pyrene	0.37/0.782	<0.040	<0.040	<0.040	0.067	<0.040	<0.040	<0.040	<0.040	<0.040
Benzo(b)fluoranthene		<0.10	<0.10	<0.10	0.15	<0.10	<0.10	<0.10	<0.10	<0.10
Benzo(g,h,i)perylene	0.17	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Benzo(k)fluoranthene	0.24	<0.040	<0.040	<0.040	0.122	<0.040	<0.040	<0.040	<0.040	<0.040
Chrysene	0.34/0.862	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dibenzo(ah)anthracene	0.06/0.135	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Fluoranthene	0.75/2.355	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Fluorene	0.19/0.144	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Indeno(1,2,3-cd)pyrene	0.2	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	<0.10	<0.10	<0.10
1-Methylnaphthalene	–	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
2-Methylnaphthalene	0.201	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Naphthalene	0.391	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Phenanthrene	0.56/0.515	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
Pyrene	0.49/0.875	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Quinoline		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total PAHs	4.0	<	<	<	0.46	<	<	<	<	<
Surrogate: 2-Fluorobiphenyl		111	97	92	91	95	96	89	105	113
Surrogate: p-Terphenyl d14		114	105	93	93	98	101	94	106	118
Polychlorinated Biphenyls	**LEL[b]**									
Aroclor 1242		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1248	0.03	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1254	0.06/0.340	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Aroclor 1260	0.005	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total PCBs	0.070.277	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Surrogate: d14-Terphenyl		114	86	102	99	103	106	96	106	123

[a] Lowest soil numerical level (fine grained) (CCME 2008)
[b] Lowest Effect Level (Fletcher et al. 2008)
[c] Probable Effect Level (CCME 2001)

Table 9. Probabilities of 2009 test sites belonging to Great Lakes faunal groups. The highest probability for each site is bolded.

Site	Probability of Great Lakes Reference Group Membership									
	Group 1		Group 2		Group 3		Group 4		Group 5	
	2009	2003	2009	2003	2009	2003	2009	2003	2009	2003
MS1	0.736	0.765	0.017	0.017	0.058	0.033	0.000	0.000	0.189	0.185
MWC	0.485	0.522	0.017	0.016	0.015	0.010	0.000	0.000	0.482	0.453
SRC09	0.520	0.506	0.016	0.019	0.034	0.018	0.000	0.000	0.430	0.456
SRC10	0.876	0.922	0.010	0.005	0.014	0.003	0.000	0.000	0.100	0.070
SRC11	0.846	0.862	0.010	0.009	0.012	0.007	0.000	0.000	0.131	0.122
SRC13	0.680	0.719	0.017	0.016	0.034	0.015	0.000	0.000	0.269	0.249
SRC17	0.786	0.850	0.016	0.010	0.033	0.021	0.000	0.000	0.166	0.119

Table 10. Mean abundance of prominent Reference Group 1 families (no. per 33 cm^2), taxon diversity, and BEAST difference-from-reference band for Spanish Harbour sites sampled in both 2009 and 2003. Families expected to be present at test sites that are absent are highlighted.

Family	Group 1 Mean	Occurrence in Gp 1 (%)	MWC		MS1		SRC09		SRC10		SRC11		SRC13		SRC17	
Year			2009	2003[a]	2009	2003	2009	2003	2009	2003	2009	2003	2009	2003	2009[a]	2003
No. Taxa (±2 SD)	8 (2 – 14)	-	4	5	8	6	5	4	6	8	7	4	8	5	11	5
Chironomidae	13.4	39.9	2.2	5.6	7.0	2.8	5.0	6.4	1.4	1.4	0.6	1.0	4.2	2.8	4.0	2.2
Tubificidae	5.6	16.7	2.6	2.5	10.0	0.6	24.2	38.4	1.2	1.2	1.4	1.0	3.2	4.6	2.1	0.4
Sphaeriidae	4.9	14.5	0.2	1.4	1.2	0.2	2.4	0.0	1.2	1.6	0.6	0.6	1.4	0.6	0. 7	1.2
Asellidae	1.8	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Naididae	1.4	4.3	0.0	2.8	1.6	0.2	2.6	0.0	0.0	0.0	0.4	0.0	1.2	0.6	0.3	0.4
Sabellidae	1.2	3.6	0.0	0.0	1.0	0.2	0.0	0.0	0.4	0.0	0.2	0.0	0.4	0.0	1.1	0.0
Pontoporeiidae	0.7	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Valvatidae	0.7	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dreissenidae	0.6	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gammaridae	0.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chaoboridae	0.2	0.7	2.0	3.3	6.6	25.0	2.8	13.4	0.0	1.0	1.2	5.2	1.8	8.8	2.4	12.2
BEAST BAND	-	-	1	1	1	3	1	2	1	1	2	2	1	2	1	2

[a] QA/QC site; value is the mean of three box core drops.

Table 11. Mean percent survival, growth (mg dry wt) and reproduction in 2009 and 2003 toxicity tests and BEAST difference-from-reference band. Toxicity, based on numerical guidelines, is highlighted red and potential toxicity is italicized. (Grey shading is for ease of comparison.)

Site	*Year*	*C. riparius* % survival	*C. riparius* growth	*H. azteca* % survival	*H. azteca* growth	*Hexagenia* % survival	*Hexagenia* growth	*T. tubifex* % survival	*T. tubifex* No. cocoons/ adult	*T. tubifex* No. cocoons hatched	*T. tubifex* No. young/ adult	BEAST Band
Reference Mean		87.1	0.35	85.6	0.50	96.2	3.03	97.9	9.9	57.0	29.0	
MWC	2009	81.3	0.33	1.3	0.01	96	1.34	100	9.6	62.8	19.6	4
	2003	93.3	0.41	0.0	0.00	98	0.54	100	10.0	76.3	28.9	4
MS1	2009	76.0	0.42	97.8	0.33	100	3.48	100	10.3	60.7	29.1	1
	2003	93.3	0.35	2.7	0.01	100	1.02	100	9.6	65.0	24.4	4
SRC09	2009	81.3	0.34	93.3	0.68	100	4.75	100	11.0	58.5	31.0	1
	2003	94.7	0.41	91.7	0.26	100	1.96	100	10.3	86.8	20. 5	2
SRC10	2009	82.7	0.30	60.0	0.22	100	2.09	100	10.6	57.6	30.1	2
	2003	92.0	0.40	0.0	0.00	90	-0.14	100	7.9	84.9	16.2	4
SRC11	2009	84.4	0.31	6.7	0.01	98	2.42	100	9.8	59.1	25.7	4
	2003	90.7	0.39	0.0	0.00	96	-0.13	100	10.8	85.7	23.9	4
SRC13	2009	82.7	0.33	0.0	0.00	92	2.15	100	10.3	62.8	27.9	4
	2003	93.3	0.37	0.0	0.00	88	-0.23	100	10.1	63.9	21.5	4
SRC17	2009	82.7	0.32	36.0	0.05	100	2.75	100	9.8	59.5	26.9	4
	2003	86.7	0.43	0.0	0.00	88	0.33	100	10.1	64.0	31.6	4
Non-toxic[a]	-	≥67.7	0.49 – 0.21	≥67.0	0.75 – 0.23	≥85.5	5.0 – 0.9	≥88.9	12.4 – 7.2	78.1 – 38.1	46.3 – 9.9	-
Potentially toxic	-	67.6 – 58.8	0.20 – 0.14	66.9 – 57.1	0.22 – 0.10	85.4 – 80.3	0.8 – 0	88.8 – 84.2	7.1 – 5.9	38.0 – 28.1	9.8 – 0.8	-
Toxic	-	< 58.8	< 0.14	< 57.1	< 0.10	< 80.3	-	< 84.2	< 5.9	< 28.1	< 0.8	-

[a]The upper limit for non-toxic category is set using 2 × SD of the mean and indicates excessive growth or reproduction.

Table 12. Decision matrix for weight-of-evidence categorization of Spanish Harbour sites based on three lines of evidence for 2009 sites. For the sediment chemistry column, sites with exceedences of the Severe Effect Level (SEL) or Probable Effect Level (PEL) are indicated by "■"; sites with exceedences of the Lowest Effect Level (LEL) by "▣". For the benthos alteration column, sites determined as different/very different from reference are indicated by "■"; sites determined as possibly different from reference by "▣". For the toxicity column, sites that had multiple endpoints exhibiting major toxicological effects are indicated by "■"; sites that had multiple endpoints exhibiting minor toxicological effect and/or one endpoint exhibiting a major effect by "▣". Sites with no Sediment Quality Guideline exceedences, no sediment toxicity, or benthic communities that are equivalent to reference conditions are indicated by "□". Substances exceeding SELs and PELs are listed. Results for 2003 sites are shown for comparison. (Grey shading is for ease of comparison.)

Site	Year	Sediment Chemistry	Toxicity	Benthos Alteration	> SEL / PEL	Assessment
MS1	2009	■	□	□	Mn, Ni, PCDD/F	No further actions needed
MS1	2003	■	■	■	Mn, Ni, -[a]	Management actions required
MWC	2009	■	■	□	Mn, Ni, Fe, PCDD/F	Determine reasons for sediment toxicity
MWC	2003	■	■	□	Mn, Ni, PCDD/F	Determine reasons for sediment toxicity
SRC09	2009	■	□	□	Mn, Ni, PCDD/F	No further actions needed
SRC09	2003	■	□	▣	Mn, Ni, PCDD/F	Determine reasons for benthos alteration
SRC10	2009	■	▣	□	Mn, Ni, Cu, Fe, PCDD/F	Determine reasons for sediment toxicity
SRC10	2003	■	■	□	Mn, Ni, Cu, Fe, PCDD/F	Determine reasons for sediment toxicity
SRC11	2009	■	■	▣	Mn, Ni, Cu, Fe, PCDD/F	Management actions required
SRC11	2003	■	■	▣	Mn, Ni, Cu, Fe, -[a]	Management actions required
SRC13	2009	■	■	□	Mn, Ni, PCDD/F	Determine reasons for sediment toxicity
SRC13	2003	■	■	▣	Mn, Ni, PCDD/F	Management actions required
SRC17	2009	■	■	□	Mn, Ni, Fe, PCDD/F	Determine reasons for sediment toxicity
SRC17	2003	■	■	■	Mn, Ni, Fe, -[a]	Management actions required
MSRM	2003	▣	▣	■[a]	-[a]	Determine reasons for sediment toxicity
EC10	2003	▣	□	■[a]	-[a]	No further actions needed
MAB	2003	■	■	□	Mn, Ni, -[a]	Determine reasons for sediment toxicity
MG1	2003	■	■	□	Mn, Ni, Fe, As, Cu, -[a]	Determine reasons for sediment toxicity
SRC03	2003	■	■	▣	Mn, Ni, Fe, As, PCDD/F	Determine reasons for sediment toxicity
SRC08	2003	▣	□	□	-[a]	No further actions needed
SRC16	2003	■	□	□	Ni, -[a]	No further actions needed
SRC26	2003	■	■	□	Mn, Ni, Fe, As, PCDD/F	Determine reasons for sediment toxicity

[a] dioxins/furans not analysed

APPENDIX A Invertebrate Family Counts

Table A1. Macroinvertebrate abundance counts (per 33 cm^2 – area of core tube).

	Site #-rep	MWC- I	MWC- II	MWC- III	MWC- Iv	MWC- v	SRC1700-I	SRC1700-II	SRC1700-III	SRC1700-Iv	SRC1700-v
Ephemeroptera	Ephemeridae	0	0	0	0	0	0	0	0	0	0
	Hexagenia limbata	0	0	0	0	0	1	0	1	0	1
	Hexagenia sp.	0	0	0	0	0	0	0	0	2	2
Diptera-Chironomidae	Ablabesmyia annulata	0	0	0	0	0	0	0	0	0	0
	Chironomini	0	0	0	0	0	0	0	0	0	0
	Chironomus sp.	1	0	0	1	1	0	0	0	0	0
	Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	0
	Coelotanypus sp.	0	0	0	0	0	0	0	0	0	0
	Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0
	Demicryptochironomus sp.	0	0	0	0	0	0	0	0	0	0
	Harnischia sp.	0	0	0	0	0	0	0	0	0	1
	Heterotrissocladius marcidus gr.	0	0	0	0	0	0	0	1	0	2
	Larsia sp.	0	0	0	0	0	0	0	1	0	0
	Orthocladiinae	0	0	0	0	0	0	0	0	0	0
	Pagastiella sp.	0	0	0	0	0	0	0	0	0	0
	Paralauterborniella nigrohalteralis	0	0	0	0	0	0	0	0	0	0
	Polypedilum fallax gr.	0	0	0	0	0	0	0	0	0	0
	Polypedilum scalaenum gr.	0	1	0	0	0	1	0	0	0	0
	Procladius sp.	4	2	0	0	0	2	2	1	3	4
	Tanytarsus sp.	0	1	0	1	0	0	0	0	0	0
Diptera	Chaoborus sp.	1	2	2	3	2	1	4	3	3	2
	Probezzia sp.	0	0	0	0	0	0	0	0	0	1
Trichoptera	Leptoceridae	0	0	0	0	0	0	0	0	0	0
	Oecetis sp.	0	0	0	0	0	2	0	0	0	0
	Phylocentropus sp.	0	0	0	0	0	0	0	0	0	0
Gastropoda	Hydrobiidae	0	0	0	0	0	0	0	0	0	0
Bivalvia	Pisidium sp.	0	0	0	0	0	0	0	0	0	0
	Sphaeriidae	0	0	0	0	1	2	0	0	0	0
Annelida	Arcteonais lomondi	0	0	0	0	0	1	1	0	1	0
	Aulodrilus americanus	0	0	0	0	0	0	0	0	0	0
	Aulodrilus limnobius	0	0	0	0	0	0	0	0	0	0
	Aulodrilus pigueti	0	0	0	0	0	0	0	0	0	0
	Aulodrilus pluriseta	0	0	0	0	0	0	0	0	0	0
	Manayunkia speciosa	0	0	0	0	0	2	0	0	1	0
	Piguetiella sp.	0	0	0	0	0	0	0	0	0	0
	Potamothrix vejdovskyi	0	0	0	0	0	0	0	0	0	0
	Quistadrilus multisetosus	0	0	0	0	0	0	0	0	0	0
	Slavina appendiculata	0	0	0	0	0	0	0	0	0	0
	Specaria josinae	0	0	0	0	0	0	0	0	0	0
	Tubificidae w/ cap setae	5	3	1	2	1	1	1	1	3	1
	Tubificidae w/o cap setae	1	0	0	0	0	0	2	1	1	2
	Vejdovskyella comata	0	0	0	0	0	0	0	0	0	0
Acari	Arrenurus sp.	0	0	0	0	0	0	0	0	0	0
	Hygrobates sp.	0	0	0	0	0	0	0	0	0	0
	Mideopsis sp.	0	0	0	0	0	0	0	0	0	0
Other Organisms	Turbellaria	0	0	0	1	0	0	0	0	0	0
	TOTAL	12	9	3	8	5	13	10	9	14	16

Table A1. Continued.

	Site #-rep	SRC1701-i	SRC1701-ii	SRC1701-iii & iv	SRC1701-v	SRC1702-i	SRC1702-ii	SRC1702-iii	SRC1702-iv	SRC1702-v
Ephemeroptera	Ephemeridae	0	0	0	0	0	0	0	0	0
	Hexagenia limbata	0	1	0	0	0	0	0	0	0
	Hexagenia sp.	0	0	0	0	1	2	0	2	1
Diptera-Chironomidae	Ablabesmyia annulata	0	0	0	0	1	0	0	0	0
	Chironomini	0	0	1	0	0	0	0	0	0
	Chironomus sp.	0	0	0	0	0	0	0	0	0
	Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0
	Coelotanypus sp.	0	0	0	0	0	0	0	0	0
	Cryptochironomus sp.	0	0	0	0	0	0	0	0	0
	Demicryptochironomus sp.	0	1	0	0	0	1	0	0	0
	Harnischia sp.	1	0	0	0	0	1	0	0	1
	Heterotrissocladius marcidus gr.	0	0	0	0	0	1	0	0	0
	Larsia sp.	0	2	0	0	1	1	1	0	0
	Orthocladiinae	0	0	0	1	0	1	0	0	0
	Pagastiella sp.	0	0	0	1	0	0	0	0	0
	Paralauterborniella nigrohalteralis	0	0	0	0	2	1	0	0	0
	Polypedilum fallax gr.	0	6	0	0	0	0	0	0	0
	Polypedilum scalaenum gr.	0	1	0	0	0	0	0	0	0
	Procladius sp.	2	0	4	5	4	2	3	0	4
	Tanytarsus sp.	0	0	0	0	0	0	0	0	1
Diptera	Chaoborus sp.	1	1	1	8	2	4	2	3	1
	Probezzia sp.	0	0	0	0	0	0	0	0	0
Trichoptera	Leptoceridae	1	0	0	0	0	0	0	0	0
	Oecetis sp.	0	1	1	1	0	0	0	2	1
	Phylocentropus sp.	0	0	0	0	1	0	0	0	0
Gastropoda	Hydrobiidae	0	0	0	0	1	0	0	0	0
Bivalvia	Pisidium sp.	0	0	0	0	0	0	0	0	0
	Sphaeriidae	0	2	0	1	2	2	1	0	0
Annelida	Arcteonais lomondi	0	0	1	0	0	0	0	0	0
	Aulodrilus americanus	0	0	0	0	0	0	0	0	0
	Aulodrilus limnobius	0	0	0	0	0	0	0	0	0
	Aulodrilus pigueti	0	0	0	0	0	0	0	0	0
	Aulodrilus pluriseta	0	0	0	0	0	0	0	0	0
	Manayunkia speciosa	3	1	1	1	3	2	0	0	3
	Piguetiella sp.	0	0	0	0	0	0	0	0	0
	Potamothrix vejdovskyi	0	0	0	0	1	0	0	0	0
	Quistadrilus multisetosus	0	0	0	0	0	0	0	0	0
	Slavina appendiculata	0	0	0	0	0	0	0	0	0
	Specaria josinae	0	0	0	0	0	0	0	0	0
	Tubificidae w/ cap setae	0	0	0	0	6	2	4	1	3
	Tubificidae w/o cap setae	1	0	0	0	0	0	0	0	0
	Vejdovskyella comata	0	0	0	0	0	0	0	0	0
Acari	Arrenurus sp.	0	0	0	0	0	0	1	0	0
	Hygrobates sp.	0	0	0	0	0	0	0	0	0
	Mideopsis sp.	0	0	0	0	0	0	0	0	0
Other Organisms	Turbellaria	0	0	0	0	0	0	1	0	0
	TOTAL	9	16	9	18	25	20	13	8	15

Table A1. Continued.

	Site #-rep	MS1-I	MS1-II	MS1-III	MS1-Iv	MS1-v	SRC13-I	SRC13-II	SRC13-III	SRC13-Iv	SRC13-v
Ephemeroptera	Ephemeridae	0	0	2	0	0	2	0	0	0	0
	Hexagenia limbata	1	0	0	0	0	0	0	0	0	0
	Hexagenia sp.	0	1	0	0	0	0	1	1	0	0
Diptera-Chironomidae	Ablabesmyia annulata	0	0	0	0	0	0	0	0	0	0
	Chironomini	0	0	0	0	0	0	0	0	0	0
	Chironomus sp.	0	0	0	0	0	0	0	0	0	0
	Cladotanytarsus sp.	0	0	0	0	0	0	0	0	0	0
	Coelotanypus sp.	0	0	0	0	0	0	0	0	0	0
	Cryptochironomus sp.	0	0	0	1	0	0	0	0	0	1
	Demicryptochironomus sp.	0	0	0	0	0	0	0	0	0	0
	Harnischia sp.	1	1	0	1	1	0	2	4	1	2
	Heterotrissocladius marcidus gr.	0	0	0	2	0	0	0	0	0	0
	Larsia sp.	1	1	0	1	0	1	0	0	0	0
	Orthocladiinae	0	0	0	0	0	0	0	0	0	0
	Pagastiella sp.	0	0	0	0	0	0	0	0	0	0
	Paralauterborniella nigrohalteralis	0	1	2	0	0	0	0	0	0	0
	Polypedilum fallax gr.	0	0	0	0	0	0	0	0	0	0
	Polypedilum scalaenum gr.	0	0	0	0	0	0	0	0	0	1
	Procladius sp.	6	5	3	4	1	3	1	0	0	2
	Tanytarsus sp.	1	0	1	1	0	0	0	2	1	1
Diptera	Chaoborus sp.	12	4	6	5	6	0	0	1	0	8
	Probezzia sp.	0	0	0	0	0	0	0	0	0	0
Trichoptera	Leptoceridae	0	0	0	0	0	0	0	0	0	0
	Oecetis sp.	0	0	0	0	2	0	0	0	1	0
	Phylocentropus sp.	0	0	0	0	0	0	0	0	0	0
Gastropoda	Hydrobiidae	0	0	0	0	0	0	0	0	0	0
Bivalvia	Pisidium sp.	0	0	0	0	0	0	0	0	0	1
	Sphaeriidae	1	2	1	1	1	3	1	0	1	1
Annelida	Arcteonais lomondi	0	0	2	1	0	0	0	0	0	0
	Aulodrilus americanus	0	0	0	0	0	0	0	0	2	0
	Aulodrilus limnobius	0	0	0	0	0	0	0	0	0	0
	Aulodrilus pigueti	0	0	0	2	0	0	0	0	0	0
	Aulodrilus pluriseta	0	0	0	0	0	0	0	0	0	0
	Manayunkia speciosa	0	2	1	2	0	0	0	1	1	0
	Piguetiella sp.	2	2	0	0	1	1	0	0	2	1
	Potamothrix vejdovskyi	4	6	7	3	5	1	2	0	1	0
	Quistadrilus multisetosus	0	0	0	0	0	0	0	0	0	0
	Slavina appendiculata	0	0	0	0	0	0	0	0	0	0
	Specaria josinae	0	0	0	0	0	1	0	0	0	1
	Tubificidae w/ cap setae	2	1	3	9	4	5	1	1	2	1
	Tubificidae w/o cap setae	0	2	0	1	1	0	0	0	0	0
	Vejdovskyella comata	0	0	0	0	0	0	0	0	0	0
Acari	Arrenurus sp.	0	0	0	0	0	0	0	0	0	0
	Hygrobates sp.	0	0	0	0	0	1	0	0	0	0
	Mideopsis sp.	0	0	0	0	0	0	0	0	0	0
Other Organisms	Turbellaria	1	0	0	0	0	0	0	0	0	0
	TOTAL	32	28	28	34	22	18	8	10	12	20

Table A1. Continued.

	Site #-rep	SRC11-i	SRC11-ii	SRC11-iii	SRC11-iv	SRC11-v	SRC10-i	SRC10-ii	SRC10-iii	SRC10-iv	SRC10-v
Ephemeroptera	Ephemeridae	0	0	0	0	0	0	0	1	0	0
	Hexagenia limbata	0	0	0	0	0	1	0	1	0	0
	Hexagenia sp.	0	1	0	0	0	1	2	2	0	2
Diptera-Chironomidae	Ablabesmyia annulata	0	0	0	0	0	0	0	0	1	0
	Chironomini	0	0	0	0	0	0	0	0	0	0
	Chironomus sp.	0	0	0	1	0	0	0	0	0	0
	Cladotanytarsus sp.	0	0	0	0	0	0	0	1	0	0
	Coelotanypus sp.	0	0	0	0	0	0	0	1	0	0
	Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0
	Demicryptochironomus sp.	0	0	0	0	0	0	0	0	0	0
	Harnischia sp.	0	0	0	0	0	0	0	0	0	0
	Heterotrissocladius marcidus gr.	0	0	0	0	0	0	0	0	0	0
	Larsia sp.	0	0	0	0	0	0	0	0	0	0
	Orthocladiinae	0	0	0	0	0	0	0	0	0	0
	Pagastiella sp.	1	0	0	0	0	0	0	1	0	1
	Paralauterborniella nigrohalteralis	0	0	0	0	0	0	0	0	0	0
	Polypedilum fallax gr.	0	0	0	0	0	0	0	0	0	0
	Polypedilum scalaenum gr.	0	1	0	0	0	0	0	0	0	0
	Procladius sp.	1	0	0	0	0	0	2	0	0	0
	Tanytarsus sp.	0	0	0	0	0	0	1	0	0	0
Diptera	Chaoborus sp.	0	0	0	2	4	0	0	0	0	0
	Probezzia sp.	0	0	0	0	0	0	0	0	0	0
Trichoptera	Leptoceridae	0	0	0	0	0	0	0	0	0	0
	Oecetis sp.	0	0	0	0	0	0	0	0	1	0
	Phylocentropus sp.	0	0	0	0	0	0	0	0	0	0
Gastropoda	Hydrobiidae	0	0	0	0	0	0	0	0	0	0
Bivalvia	Pisidium sp.	0	0	0	0	0	1	0	0	0	0
	Sphaeriidae	0	2	1	0	0	1	1	0	2	1
Annelida	Arcteonais lomondi	0	0	1	0	0	0	0	0	0	0
	Aulodrilus americanus	0	0	0	0	0	0	0	0	0	0
	Aulodrilus limnobius	0	0	1	0	0	0	0	0	0	0
	Aulodrilus pigueti	0	0	0	0	0	0	0	0	0	0
	Aulodrilus pluriseta	0	0	0	0	0	0	0	0	0	0
	Manayunkia speciosa	0	1	0	0	0	0	0	1	1	0
	Piguetiella sp.	0	0	0	0	0	0	0	0	0	0
	Potamothrix vejdovskyi	0	0	0	0	0	0	0	0	0	0
	Quistadrilus multisetosus	0	0	0	0	0	0	0	0	0	0
	Slavina appendiculata	0	0	0	0	0	0	0	0	0	0
	Specaria josinae	0	1	0	0	0	0	0	0	0	0
	Tubificidae w/ cap setae	0	1	1	1	2	0	2	2	1	1
	Tubificidae w/o cap setae	0	0	1	0	0	0	0	0	0	0
	Vejdovskyella comata	0	0	0	0	0	0	0	0	0	0
Acari	Arrenurus sp.	0	0	0	0	0	0	0	0	0	0
	Hygrobates sp.	0	0	0	0	0	0	0	0	0	0
	Mideopsis sp.	0	0	0	0	0	0	0	0	0	0
Other Organisms	Turbellaria	0	0	0	0	0	0	0	0	0	0
	TOTAL	2	7	5	4	6	4	8	10	6	5

Table A1. Continued.

	Site #-rep	SRC09-I	SRC09-II	SRC09-III	SRC09-IV	SRC09-V
Ephemeroptera	Ephemeridae	0	0	0	0	0
	Hexagenia limbata	0	0	0	0	0
	Hexagenia sp.	0	0	0	0	0
Diptera-Chironomidae	Ablabesmyia annulata	0	0	0	0	0
	Chironomini	0	0	0	0	0
	Chironomus sp.	1	1	1	0	3
	Cladotanytarsus sp.	0	0	0	0	0
	Coelotanypus sp.	0	0	0	0	0
	Cryptochironomus sp.	0	0	0	0	0
	Demicryptochironomus sp.	0	0	0	0	0
	Harnischia sp.	0	0	0	0	0
	Heterotrissocladius marcidus gr.	0	0	0	0	0
	Larsia sp.	0	0	0	0	1
	Orthocladiinae	0	0	0	0	0
	Pagastiella sp.	0	0	0	0	0
	Paralauterborniella nigrohalteralis	0	0	0	0	0
	Polypedilum fallax gr.	0	0	0	0	0
	Polypedilum scalaenum gr.	1	0	0	0	0
	Procladius sp.	6	2	2	3	3
	Tanytarsus sp.	0	1	0	1	0
Diptera	Chaoborus sp.	4	4	3	0	3
	Probezzia sp.	0	0	0	0	0
Trichoptera	Leptoceridae	0	0	0	0	0
	Oecetis sp.	0	0	0	0	0
	Phylocentropus sp.	0	0	0	0	0
Gastropoda	Hydrobiidae	0	0	0	0	0
Bivalvia	Pisidium sp.	0	0	0	0	0
	Sphaeriidae	2	4	0	0	6
Annelida	Arcteonais lomondi	0	0	0	0	0
	Aulodrilus americanus	0	0	0	0	0
	Aulodrilus limnobius	5	6	1	4	6
	Aulodrilus pigueti	4	2	2	0	2
	Aulodrilus pluriseta	6	1	0	0	1
	Manayunkia speciosa	0	0	0	0	0
	Piguetiella sp.	0	0	0	0	0
	Potamothrix vejdovskyi	0	0	0	0	0
	Quistadrilus multisetosus	7	2	1	3	3
	Slavina appendiculata	0	0	0	1	0
	Specaria josinae	3	1	0	0	0
	Tubificidae w/ cap setae	14	3	10	3	13
	Tubificidae w/o cap setae	7	2	4	2	7
	Vejdovskyella comata	5	1	0	1	1
Acari	Arrenurus sp.	0	0	0	0	0
	Hygrobates sp.	0	0	0	0	0
	Mideopsis sp.	0	1	0	0	0
Other Organisms	Turbellaria	0	0	0	0	0
	TOTAL	65	31	24	18	49

APPENDIX B Toxicity Tests Water Quality Parameters

Table B1. Water quality parameter measurements in 2009 toxicity tests. Low pH values (≤6) and high conductivity readings (>400μS/cm) are highlighted.

Chironomus riparius								
	Day 0				Day 10			
Site	pH	Conductivity	temp	D.O.	pH	Conductivity	temp	D.O.
2201	7.6	234-258	22.0-22.1	8.1-8.2	7.3-7.4	226-287	22.0-22.2	7.4-7.7
SRC09	7.5-7.6	277-300	21.9-22.0	8.0-8.1	7.1-7.3	307-350	22.1	7.4-7.5
SRC11	7.5-7.6	236-314	21.8-22.0	8.0-8.2	7.1-7.2	273-356	21.9-22.2	7.2-7.4
SRC17	7.6	256-264	21.6-22.1	8.0-8.1	7.2-7.3	281-295	22.0-22.1	7.1-7.4
SRC10	7.1-7.4	234-277	20.1-20.7	7.6-7.8	6.1-7.4	259-344	20.3-20.6	7.9-8.0
MWC	6.2-6.3	333-379	20.1-20.4	7.5-7.7	5.4-5.5	431-513	20.2-20.4	8.0-8.1
SRC13	5.6-5.9	319-348	20.6-20.7	7.6-8.3	5.5-5.6	366-437	20.3-20.6	7.6-8.0
MS1	6.2-6.5	265-309	20.5-20.6	7.7-8.1	6.7-6.9	321-357	20.2-20.4	7.5-8.0

Hyalella azteca								
	Day 0				Day 28			
Site	pH	Conductivity	temp	D.O.	pH	Conductivity	temp	D.O.
2201	7.8-8.0	169-268	20.8-20.9	7.4-7.5	6.9	178-307	21.0-21.5	8.3-8.5
SRC09	7.6-7.8	288-317	20.9-21.0	7.3-7.4	6.9-7.2	267-460	21.0-21.3	8.3-8.4
SRC11	7.4-7.7	238-357	20.8-21.0	7.4-7.5	5.0-5.4	266-357	21.1-21.4	8.2-8.4
SRC17	7.3-7.4	238-295	20.7-20.9	7.3-7.5	5.9-6.0	180-342	21.0-21.2	8.3-8.5
SRC10	6.5-6.7	229-286	21.0-21.3	7.6-7.8	7.1	301-362	21.3-21.5	8.0-8.3
MWC	6.5-6.6	340-376	20.8-21.0	7.8-8.1	6.2-6.3	481-524	21.1-21.3	8.0-8.1
SRC13	6.4-6.5	309-341	21.1-21.3	7.6-7.7	5.4-5.6	408-461	21.3-21.6	7.8-8.0
MS1	6.7-6.8	282-306	20.9-21.1	7.6-7.8	6.8-6.9	367-392	21.0-21.4	7.9-8.0

Hexagenia spp.								
	Day 0				Day 21			
Site	pH	Conductivity	temp	D.O.	pH	Conductivity	temp	D.O.
2201	7.8	219-277	21.9-22.1	7.8-8.1	6.2-6.4	232-404	21.8	7.6-7.7
SRC09	7.7-7.8	266-309	21.5-21.8	7.7-7.9	6.3-6.5	539-657	21.2-21.4	7.6-.7
SRC11	7.6	265-333	21.6-21.9	7.7-7.9	6.2-6.3	466-593	21.1-21.3	7.6-7.8
SRC17	7.5-7.6	255-272	21.6-21.8	7.8-7.9	6.2	404-485	21.3-21.5	7.4-7.5
SRC10	7.0-7.1	231-294	20.7-21.1	7.8-8.0	5.2-5.5	375-588	19.6-20.4	7.1-7.6
MWC	6.9	340-397	20.7-21.1	7.8-7.9	4.7	599-721	19.9-20.4	7.5-7.8
SRC13	7.0-7.1	318-364	20.7-21.1	7.8-8.0	5.2-5.3	560-645	20.0-20.4	7.6-7.9
MS1	5.6-5.7	453-523	20.0-20.6	7.5-7.7	5.6-5.7	453-523	20.0-20.6	7.5-7.7

Tubifex tubifex								
	Day 0				Day 28			
Site	pH	Conductivity	temp	D.O.	pH	Conductivity	temp	D.O.
2201	8.2	378-420	21.4-21.8	7.5-7.7	6.9-7.2	114-264	21.6-22.1	7.6-7.9
SRC09	8.2-8.3	224-247	21.4-21.8	7.6-7.9	6.9	319-387	21.6-22.1	7.7-7.9
SRC11	8.1	402-438	21.4-21.8	7.5-7.7	6.2-6.3	220-383	21.2-21.9	7.7-7.9
SRC17	8.2	355-432	21.1-21.5	7.6-8.0	6.2	298-352	21.6-22.1	7.7-7.9
SRC10	7.3-7.4	428-541	20.5-21.0	8.2-8.6	6.9-7.2	177-583	21.1-21.6	7.7-8.1
MWC	7.4	533-731	20.5-21.0	7.8-8.1	6.2-6.5	436-693	19.8-20.2	7.1-7.5
SRC13	7.2-7.3	511-668	20.5-20.9	8.1-8.3	6.4-6.6	484-690	20.9-21.5	7.9-8.1
MS1	7.5-7.7	521-594	20.4-20.9	8.2-8.4	6.7-6.8	263-543	21.1-21.3	7.9-8.1

Table B2. Total ammonia concentrations (mg/L) in 2009 toxicity tests. Values above zero are highlighted.

Site	*C. riparius*		*H. azteca*		*Hexagenia spp.*		*T. tubifex*	
	Day 0	Day 10	Day 0	Day 28	Day 0	Day 21	Day 0	Day 28
2201-1	0	0	0	0	0	0	0	0
2201-2	0	0	0	0	0	0	0	0
2201-3	0	0	0	0	0	0	0	0
2201-4	0	0	0	0	0	0	<0.5	0
2201-5	0	0	0	0	0	0	0	0
SRC09-1	0	0	0	0	0	0.5	0	0
SRC09-2	0	0	0	0	0	0.5	0	0
SRC09-3	0	0	0	0	0	0.5	0	0
SRC09-4	0	0	0	0	0	0.5	0	0
SRC09-5	0	0	0	0	0	0.5	0	0
SRC11-1	0	0	0	0.2	0	2.3	<0.5	0
SRC11-2	0	0	0	0.2	0	0.95	<0.5	0
SRC11-3	0	0	0	0.2	0	4.7	<0.5	0
SRC11-4	0	0	0	0.2	0	1.74	<0.5	0
SRC11-5	0	0	0	0.2	0	1.93	<0.5	0
SRC17-1	0	0	0	0	0	0	0	0
SRC17-2	0	0	0	0	0	0	0	0
SRC17-3	0	0	0	0	0	0	0	0
SRC17-4	0	0	0	0	0	0	0	0
SRC17-5	0	0	0	0	0	0	0	0
SRC10-1	0	0	0	0	0	0	0	0
SRC10-2	0	0	0	0	0	3.23	0	0
SRC10-3	0	0	0	0	0	0	0	0
SRC10-4	0	0	0	0	0	0	0	0
SRC10-5	0	0	0	0	0	0	0	0
MWC-1	0.5-1	0.5-1	1.2	0.5-1	2-3	3.73	0	<0.5
MWC-2	2-3	0.5-1	1.2	0.5-1	3-4	2.82	0	<0.5
MWC-3	2-3	0.5-1	0.5-1	0.5-1	0.5-1	2.0	0	<0.5
MWC-4	2-3	0.5-1	2-3	0.5-1	2-3	2.27	0	<0.5
MWC-5	2-3	0.5-1	0.5-1	0.5-1	0.5-1	2.75	0	<0.5
SRC13-1	0	1-2	0	0	0	3.16	0	0
SRC13-2	0	0.5-1	0	0	0	1.68	0	0.5-1
SRC13-3	0	0	0	0	0	0.755	0	0
SRC13-4	0	0.5-1	0	0	0	2.25	0	0
SRC13-5	0	0	0	0	0	2.05	0	0.5-1
MS1-1	0	0	0	0	0	0	0	0
MS1-2	0	0	0	0.5	0	0	0	0
MS1-3	0	0	0	0.5	0	0	0	0
MS1-4	0	0	0	0	0	0	0	0
MS1-5	0	0	0	0.5	0	0	0	0

APPENDIX C BEAST Toxicity Ordinations

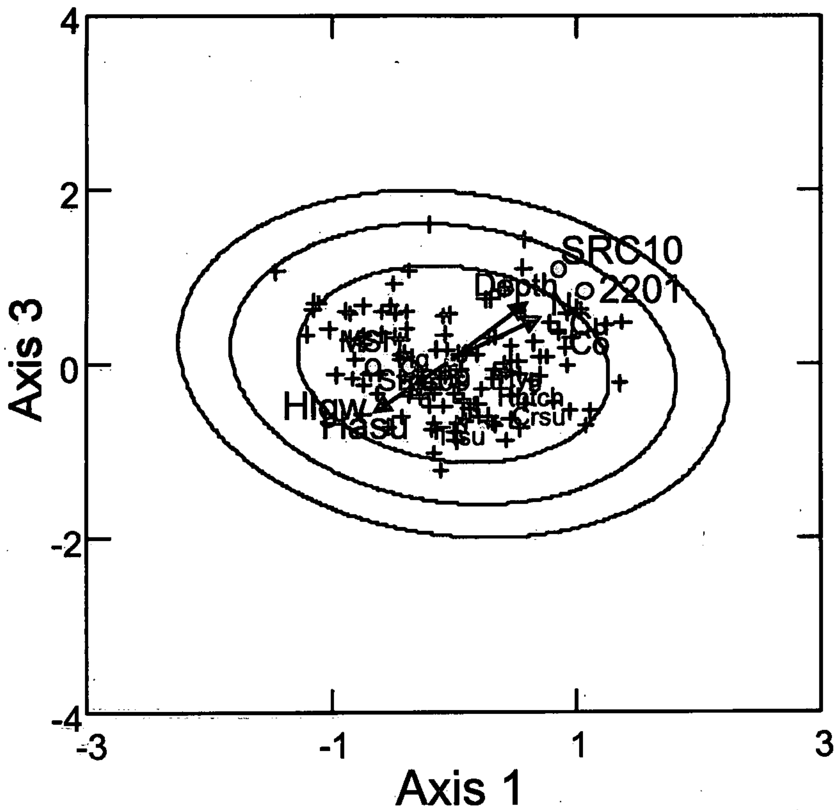

Figure C1. Assessment of a subset of 4 test sites (2009) using 10 toxicity test endpoints summarized on Axis 1 and 3, showing 90%, 99%, and 99.9% probability ellipses around reference sites (reference site are not shown as cross hairs). The contributions of toxicity endpoints and environmental variables that are along same vector line as sites are shown as vectors. *Hyalella* survival growth (Hasu), *Hexagenia* growth (Hlgw), *Chironomus* survival (Crsu) *Tubifex* survival, %cocoons hatched, young production (Ttsu, Tthtch, Ttyg). Endpoints not shown were not significant in the ordination. Stress level = 0.11.

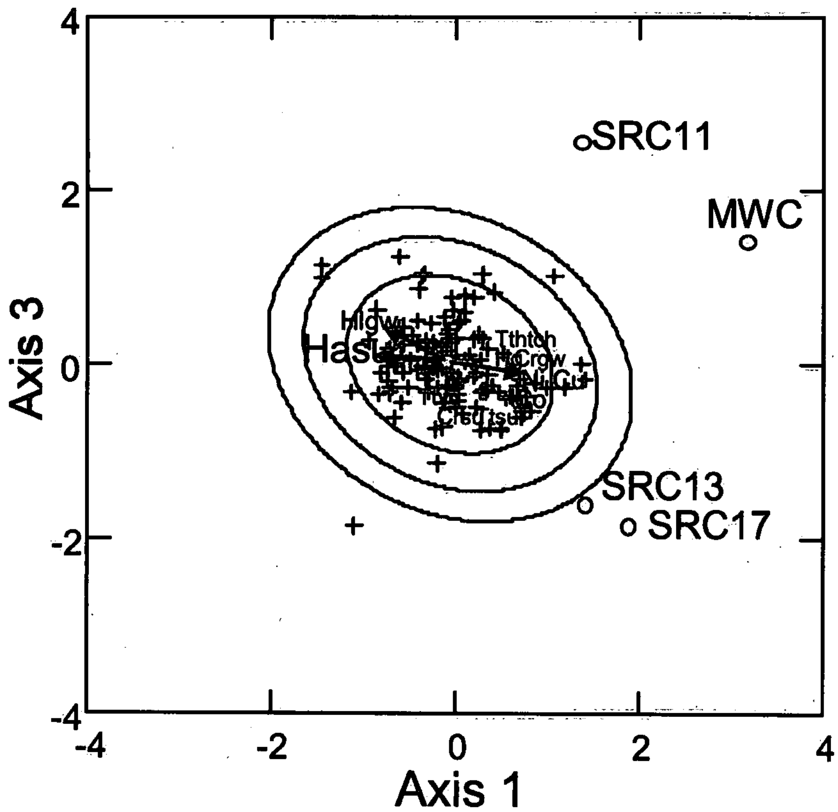

Figure C2. Assessment of a subset of 4 test sites (2009) using 10 toxicity test endpoints summarized on Axis 1 and 3, showing 90%, 99%, and 99.9% probability ellipses around reference sites (reference site are not shown as cross hairs). The contributions of toxicity endpoints and environmental variables that are along same vector line as sites are shown as vectors. *Hyalella* survival (Hasu), *Hexagenia* growth (Hlgw), *Chironomus* survival (Crsu) *Tubifex* survival, %cocoons hatched, young production (Ttsu, Tthtch, Ttyg). Endpoints not shown were not significant in the ordination. Stress level = 0.10.

APPENDIX D QA/QC

Table D1. Coefficients of variation (%) for 2009 field-replicated site SRC17.

	SRC17-1	SRC17-2	SRC17-3	CV
Aluminum	20000	20000	19000	2.9
Arsenic	20.8	19.9	20.6	2.3
Barium	151	152	153	0.7
Beryllium	0.7	0.7	0.7	0.0
Cadmium	1.6	1.6	1.6	0.0
Calcium	5990	5570	5750	3.7
Chromium	54	52	53	1.9
Cobalt	53	50	53	3.3
Copper	85	86	88	1.8
Iron	46000	45000	46000	1.3
Lead	52	52	53	1.1
Magnesium	7830	7640	7690	1.3
Manganese	2700	2400	2600	6.0
Mercury	0.147	0.15	0.154	2.3
Nickel	482	486	506	2.6
Phosphorus	1300	1200	1300	4.6
Potassium	1740	1640	1680	3.0
Silicon	215	184	203	7.8
Silver	0.4	0.3	0.4	15.7
Sodium	260	250	240	4.0
Strontium	28	26	27	3.7
Titanium	900	833	877	3.9
Vanadium	54	52	53	1.9
Yttrium	12.5	12.2	12.4	1.2
Zinc	224	220	226	1.4
Zirconium	0.5	0.9	0.4	44.1
Aluminum (Al2O3)	12.6	12.3	12.6	1.4
Barium (BaO)	0.06	0.06	0.06	0.0
Calcium (CaO)	2.06	2.14	2.10	1.9
Iron (Fe2O3)	7.22	6.81	7.39	4.2
Magnesium (MgO)	1.92	1.91	1.84	2.3
Manganese (MnO)	0.34	0.31	0.34	5.2
Potasium (K20)	1.86	1.95	1.99	3.4
Silica (SiO2)	55.6	52.8	52.8	3.0
Sodium (Na2O)	2.29	2.10	2.18	4.4
Titanium (TiO2)	0.52	0.48	0.5	4.0
Loss on Ignition	9.37	9.09	9.46	2.1
Whole Rock Total	93.9	90.0	91.3	2.2
Total Organic Carbon	2.1	2.0	2.4	9.6
Total Kjeldahl Nitrogen	2370	2280	2240	2.9
Phosphorus-Total	1380	1400	1330	2.6
			Mean	4.2
			Median	2.6
			Range	0 - 44.1%

Table D2. Relative percent difference (R.P.D.) for sample duplicates (Caducean Laboratories). (Note: site 2201 is a reference site in the North Channel sampled during the same trip.)

Parameter	Units	M.D.L.	Client ID: Reference Method	SRC11	SRC11 - Dup	R.P.D.	2201	2201 - Dup	R.P.D.
Aluminum	µg/g	10	EPA 6010	22000	22000	**0.0**	24000	23000	**4.3**
Antimony	µg/g	0.5	EPA 6020	0.6	0.6	**0.0**	0.7	0.7	**0.0**
Arsenic	µg/g	0.5	EPA 6020	23.2	23.3	**0.4**	41.2	40.1	**2.7**
Barium	µg/g	1	EPA 6010	272	273	**0.4**	291	282	**3.1**
Beryllium	µg/g	0.2	EPA 6010	0.9	0.9	**0.0**	0.9	0.9	**0.0**
Bismuth	µg/g	5	EPA 6010	< 5	< 5	**0.0**	< 5	< 5	**0.0**
Cadmium	µg/g	0.5	EPA 6010	2.6	2.5	**3.9**	2.3	2.4	**4.3**
Calcium	µg/g	10	EPA 6010	6210	6350	**2.2**	7020	6460	**8.3**
Chromium	µg/g	1	EPA 6010	56	57	**1.8**	58	56	**3.5**
Cobalt	µg/g	1	EPA 6010	76	76	**0.0**	74	72	**2.7**
Copper	µg/g	1	EPA 6010	123	124	**0.8**	122	120	**1.7**
Iron	µg/g	10	EPA 6010	53000	53000	**0.0**	54000	52000	**3.8**
Lead	µg/g	5	EPA 6010	76	79	**3.9**	87	85	**2.3**
Magnesium	µg/g	10	EPA 6010	7640	7720	**1.0**	8460	8090	**4.5**
Manganese	µg/g	1	EPA 6010	6200	6100	**1.6**	7300	7100	**2.8**
Mercury	µg/g	0.005	EPA 7471A	0.42	0.418	**0.5**	0.58	0.59	**1.5**
Molybdenum	µg/g	1	EPA 6010	< 1	< 1	**0.0**	1.000	< 1	**0.0**
Nickel	µg/g	1	EPA 6010	821	822	**0.1**	556	546	**1.8**
Phosphorus	µg/g	5	EPA 6010	2000	2000	**0.0**	2000	1900	**5.1**
Potassium	µg/g	30	EPA 6010	1800	1850	**2.7**	2190	1990	**9.6**
Silicon	µg/g	1	EPA 6010	161	143	**11.8**	130	145	**10.9**
Silver	µg/g	0.2	EPA 6010	0.6	0.5	**18.2**	0.5	0.5	**0.0**
Sodium	µg/g	20	EPA 6010	180	310	**53.1**	490	320	**42.0**
Strontium	µg/g	1	EPA 6010	31	32	**3.2**	37	34	**8.5**
Tin	µg/g	10	EPA 6010	< 10	< 10	**0.0**	< 10	< 10	**0.0**
Titanium	µg/g	1	EPA 6010	763	789	**3.4**	793	689	**14.0**
Vanadium	µg/g	1	EPA 6010	60	61	**1.7**	62	59	**5.0**
Yttrium	µg/g	0.5	EPA 6010	14.2	14.3	**0.7**	16.5	16.0	**3.1**
Zinc	µg/g	1	EPA 6010	303	306	**1.0**	295	288	**2.4**
Zirconium	µg/g	0.1	EPA 6010	< 0.1	< 0.1	**0.0**	< 0.1	< 0.1	**0.0**
Aluminum (Al2O3)	%	0.01	IN-HOUSE	11.70	11.80	**0.9**	12.5	12.4	**0.8**
Barium (BaO)	%	0.001	IN-HOUSE	0.07	0.07	**0.0**	0.07	0.08	**13.3**
Calcium (CaO)	%	0.01	IN-HOUSE	1.73	1.96	**12.5**	3.41	2.01	**51.7**
Chromium (Cr2O3)	%	0.01	IN-HOUSE	< 0.01	< 0.01	**0**	< 0.01	0.03	**0**
Iron (Fe2O3)	%	0.05	IN-HOUSE	8.01	7.91	**1.3**	8.12	8.05	**0.9**
Magnesium (MgO)	%	0.01	IN-HOUSE	1.77	1.84	**3.9**	2.14	1.96	**8.8**
Manganese (MnO)	%	0.01	IN-HOUSE	0.72	0.71	**1.4**	0.87	0.89	**2.3**
Phosphorus (P2O5)	%	0.03	IN-HOUSE	< 0.03	< 0.03	**0.0**	< 0.03	< 0.03	**0.0**
Potasium (K20)	%	0.01	IN-HOUSE	1.70	1.75	**2.9**	1.93	1.95	**1.0**
Silica (SiO2)	%	0.01	IN-HOUSE	50.3	50.9	**1.2**	55.6	55.0	**1.1**
Sodium (Na2O)	%	0.01	IN-HOUSE	< 0.01	< 0.01	**0.0**	< 0.01	< 0.01	**0.0**
Titanium (TiO2)	%	0.01	IN-HOUSE	0.47	0.47	**0.0**	0.48	0.48	**0.0**
Loss on Ignition	%	0.05	IN-HOUSE	13.1	13.2	**0.8**	11.4	11.4	**0.0**
Whole Rock Total	%		IN-HOUSE	89.5	90.6	**1.2**	96.6	94.3	**2.4**
Total Organic Carbon	% by wt	0.1	LECO	3.5	3.5	**0.0**	2.6	2.7	**3.8**
Total Kjeldahl Nitrogen	µg/g	0.05	EPA 351.2	3470	3290	**5.3**	3180	3360	**5.5**
Phosphorus-Total	µg/g	0.01	EPA 365.4	2080	1930	**7.5**	1990	2140	**7.3**
					Mean	3.2		Mean	5.2
					Median	0.9		Median	2.7
					Range	0 - 53.1%		Range	0 - 51.7%

Table D3. Quality control sample percent recoveries for reference standards (Caducean Laboratories).

PARAMETERS	QC Sample Recovery Calculation				
	Raw Data (µg/g)			QC Sample Recovery	
LKSD-3 (23-Mar-10)	QC Result	Reference Value	Lab Mean	% Recovery	Control Limits
Silver	2.5	2.4		103	50 - 117
Antimony	1.0	1.0		100	75 - 125
Arsenic	23.2	23		101	83 - 121
Barium	160	N/A	169	95	81 - 118
Beryllium	0.6	N/A	0.5	120	47 - 153
Cobalt	28.2	30		94	51 - 114
Chromium	48.1	51		94	54 - 125
Copper	32.3	34		95	79 - 116
Iron	28777	35000		82	74 - 102
Manganese	1200	1220		98	76 - 124
Molybdenum	0.59	2		30	0 - 260
Nickel	42.0	44.0		95	75 - 125
Lead	24	26		92	72 - 107
Strontium	25.7	N/A	25.4	101	76 - 124
Titanium	1040	N/A	980	106	49 - 151
Vanadium	48.9	55		89	63 - 113
Zinc	129	139		93	76 - 124
SS-1 (23-Mar-10)					
Silver	1.7	1.9		89	50 - 117
Aluminum	9210	9518		97	34 - 166
Arsenic	18	18		100	72 - 128
Barium	91.9	102		90	68 - 132
Cadmium	30.2	34		89	71 - 129
Cobalt	29.6	28		106	68 - 132
Chromium	44.3	64		69	20 - 180
Copper	725	690		105	73 - 127
Iron	19600	20406		96	62 - 138
Lithium	10.9	11		99	27 - 173
Magnesium	5963	6088		98	65 - 135
Manganese	398	425		94	76 - 124
Molybdenum	4.1	5		82	40 - 160
Nickel	212	231		92	68 - 132
Phosphorus	1102	1070		103	78 - 122
Lead	207	233		89	65 - 135
Strontium	183	202		91	84 - 116
Titanium	236	248		95	75 - 125
Vanadium	17.2	19		91	42 - 158
Yttrium	7.9	8		99	70 - 130
Zinc	6498	6775		96	75 - 125
LKSD-2 (23-Mar-10)					
Mercury	0.167	0.160	0.144	104	77 - 122
WH89-1 (01-Apr-10)					
Aluminum (Al_2O_3)	11.5	12.1	11.6	95	75 - 125
Barium (BaO)	0.27	0.29	0.28	93	75 - 125
Calcium (CaO)	4.76	5.9	5.7	81	75 - 125
Chromium (Cr_2O_3)	0.02	0.03	0.03	67	50 - 150
Iron (Fe_2O_3)	6.72	6.9	6.62	97	75 - 125
Magnesium (MgO)	2.97	3.5	3.4	85	75 - 125
Manganese (MnO)	0.09	0.14	0.13	64	60 - 140
Phosphorus (P_2O_5)	0.39	0.4	0.4	98	75 - 125
Potasium (K_2O)	2.12	2.5	2.2	85	75 - 125
Silica (SiO_2)	55.6	60.5	59	92	75 - 125
Sodium (Na_2O)	1.98	2.0		99	75 - 125
Titanium (TiO_2)	0.83	1.0		83	75 - 125
D053-542 (16-Mar-10)					
Total Kjeldahl Nitrogen	1787	1300	1372	130	57 - 143
Phosphorus-Total	1087	811	939	116	53 - 147
TOC QC (03-Feb-10)					
TOC	4.60	4.84		95	91 - 109
			Mean	93	
			Median	95	
			Range	30 - 130%	

Table D4. Relative percent difference (RPD) for sample replicates (ALS Laboratory Group).

Sample ID	Matrix	ALS ID	Analyte	Replicate 1	Replicate 2	Units	RPD	RPD Limit	Diff	Diff Limit
Physical Tests										
Anonymous	Soil	WG1023169-3	% Moisture	32.9	32.3	%	1.8	26	-	-
L831113-21	Soil	WG1023282-3	% Moisture	66.9	66.5	%	0.63	26	-	-
L831113-42	Soil	WG1023286-3	% Moisture	55.5	54.3	%	2.1	26	-	-
L831113-63	Soil	WG1023288-3	% Moisture	56.5	57.0	%	0.88	26	-	-
Aggregate Organics										
L831113-1	Soil	WG1029191-4	Oil and Grease, Total	4500	4760	mg/kg	-	-	260	2000
WG1029191-2	Soil	WG1029191-3	Oil and Grease, Total	98	93	%	4.8	45	-	-
WG1030476-2	Soil	WG1030476-3	Oil and Grease, Total	94	97	%	4.0	45	-	-
WG1030479-2	Soil	WG1030479-3	Oil and Grease, Total	90	89	%	0.67	45	-	-
L831113-21	Soil	WG1030476-4	Oil and Grease, Total	12800	11000	mg/kg	15	57	-	-
L831113-41	Soil	WG1030479-4	Oil and Grease, Total	<500	<500	mg/kg	N/A	57	-	-
Volatile Organic Compounds										
L831113-30	Soil	WG1023028-2	Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-50	Soil	WG1023032-2	Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-70	Soil	WG1023035-2	Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023040-2	Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1022767-4	Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-30	Soil	WG1023028-2	Ethyl Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-50	Soil	WG1023032-2	Ethyl Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-70	Soil	WG1023035-2	Ethyl Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023040-2	Ethyl Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1022767-4	Ethyl Benzene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-30	Soil	WG1023028-2	Toluene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-50	Soil	WG1023032-2	Toluene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-70	Soil	WG1023035-2	Toluene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023040-2	Toluene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1022767-4	Toluene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-30	Soil	WG1023028-2	o-Xylene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-50	Soil	WG1023032-2	o-Xylene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-70	Soil	WG1023035-2	o-Xylene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023040-2	o-Xylene	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1022767-4	o-Xylene	<0.050	<0.050	mg/kg	N/A	50	-	-
L831113-30	Soil	WG1023028-2	m+p-Xylenes	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-50	Soil	WG1023032-2	m+p-Xylenes	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-70	Soil	WG1023035-2	m+p-Xylenes	<0.10	<0.10	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023040-2	m+p-Xylenes	<0.10	<0.10	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1022767-4	m+p-Xylenes	<0.10	<0.10	mg/kg	N/A	50	-	-

Table D4. Continued.

Sample ID	Matrix	ALS ID	Analyte	Replicate 1	Replicate 2	Units	RPD	RPD Limit	Diff	Diff Limit
Polycyclic Aromatic Hydrocarbons										
L831113-1	Soil	WG1025657-4	Acenaphthene	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Acenaphthene	98	95	%	3.4	50	-	-
WG1023664-2	Soil	WG1023664-3	Acenaphthene	83	85	%	1.6	50	-	-
WG1025465-2	Soil	WG1025465-3	Acenaphthene	97	104	%	7.2	50	-	-
WG1026349-2	Soil	WG1026349-3	Acenaphthene	98	113	%	14	50	-	-
WG1027104-2	Soil	WG1027104-3	Acenaphthene	95	93	%	2.8	50	-	-
WG1027627-2	Soil	WG1027627-3	Acenaphthene	97	93	%	4.4	50	-	-
WG1027719-2	Soil	WG1027719-3	Acenaphthene	91	86	%	5.9	50	-	-
L831113-71	Soil	WG1027719-4	Acenaphthene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Acenaphthylene	0.20	0.18	mg/kg	-	-	0.02	0.4
WG1023287-2	Soil	WG1023287-3	Acenaphthylene	93	93	%	0.54	50	-	-
WG1023664-2	Soil	WG1023664-3	Acenaphthylene	70	77	%	9.9	50	-	-
WG1025465-2	Soil	WG1025465-3	Acenaphthylene	90	95	%	5.8	50	-	-
WG1026349-2	Soil	WG1026349-3	Acenaphthylene	88	88	%	0.27	50	-	-
WG1027104-2	Soil	WG1027104-3	Acenaphthylene	94	91	%	3.7	50	-	-
WG1027627-2	Soil	WG1027627-3	Acenaphthylene	96	93	%	4.1	50	-	-
WG1027719-2	Soil	WG1027719-3	Acenaphthylene	89	84	%	6	50	-	-
L831113-71	Soil	WG1027719-4	Acenaphthylene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Acridine	<1.6	<1.6	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Acridine	101	97	%	3.9	50	-	-
WG1023664-2	Soil	WG1023664-3	Acridine	86	94	%	8.4	50	-	-
WG1025465-2	Soil	WG1025465-3	Acridine	102	108	%	5.8	50	-	-
WG1026349-2	Soil	WG1026349-3	Acridine	96	95	%	1.1	50	-	-
WG1027104-2	Soil	WG1027104-3	Acridine	99	100	%	5.6	50	-	-
WG1027627-2	Soil	WG1027627-3	Acridine	99	97	%	1.8	50	-	-
WG1027719-2	Soil	WG1027719-3	Acridine	99	93	%	6.5	50	-	-
L831113-71	Soil	WG1027719-4	Acridine	<1.6	<1.6	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Anthracene	0.22	0.22	mg/kg	-	-	0.00	0.4
WG1023287-2	Soil	WG1023287-3	Anthracene	94	91	%	3.8	50	-	-
WG1023664-2	Soil	WG1023664-3	Anthracene	78	87	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	Anthracene	90	95	%	5.1	50	-	-
WG1026349-2	Soil	WG1026349-3	Anthracene	91	88	%	3.1	50	-	-
WG1027104-2	Soil	WG1027104-3	Anthracene	94	91	%	3.6	50	-	-
WG1027627-2	Soil	WG1027627-3	Anthracene	96	90	%	5.8	50	-	-
WG1027719-2	Soil	WG1027719-3	Anthracene	89	81	%	9.1	50	-	-
L831113-71	Soil	WG1027719-4	Anthracene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Benzo(a)anthracene	0.77	0.79	mg/kg	-	-	0.02	0.4
WG1023287-2	Soil	WG1023287-3	Benzo(a)anthracene	108	102	%	6	50	-	-
WG1023664-2	Soil	WG1023664-3	Benzo(a)anthracene	87	98	%	12	50	-	-
WG1025465-2	Soil	WG1025465-3	Benzo(a)anthracene	101	105	%	3.5	50	-	-
WG1026349-2	Soil	WG1026349-3	Benzo(a)anthracene	88	87	%	1.2	50	-	-
WG1027104-2	Soil	WG1027104-3	Benzo(a)anthracene	93	90	%	2.5	50	-	-
WG1027627-2	Soil	WG1027627-3	Benzo(a)anthracene	96	94	%	1.8	50	-	-
WG1027719-2	Soil	WG1027719-3	Benzo(a)anthracene	95	87	%	8.6	50	-	-
L831113-71	Soil	WG1027719-4	Benzo(a)anthracene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Benzo(a)pyrene	0.777	0.800	mg/kg	3.0	50	-	-
WG1023287-2	Soil	WG1023287-3	Benzo(a)pyrene	107	103	%	3.6	50	-	-
WG1023664-2	Soil	WG1023664-3	Benzo(a)pyrene	87	98	%	12	50	-	-
WG1025465-2	Soil	WG1025465-3	Benzo(a)pyrene	106	113	%	6.4	50	-	-
WG1026349-2	Soil	WG1026349-3	Benzo(a)pyrene	106	105	%	1.1	50	-	-
WG1027104-2	Soil	WG1027104-3	Benzo(a)pyrene	101	100	%	18	50	-	-
WG1027627-2	Soil	WG1027627-3	Benzo(a)pyrene	103	101	%	2	50	-	-
WG1027719-2	Soil	WG1027719-3	Benzo(a)pyrene	107	100	%	6.9	50	-	-
L831113-71	Soil	WG1027719-4	Benzo(a)pyrene	<0.040	<0.040	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Benzo(b)fluoranthene	0.92	0.89	mg/kg	-	-	0.03	0.4
WG1023287-2	Soil	WG1023287-3	Benzo(b)fluoranthene	91	88	%	4.1	50	-	-
WG1023664-2	Soil	WG1023664-3	Benzo(b)fluoranthene	77	85	%	10	50	-	-
WG1025465-2	Soil	WG1025465-3	Benzo(b)fluoranthene	101	104	%	2.7	50	-	-
WG1026349-2	Soil	WG1026349-3	Benzo(b)fluoranthene	86	84	%	2.4	50	-	-
WG1027104-2	Soil	WG1027104-3	Benzo(b)fluoranthene	90	88	%	15	50	-	-
WG1027627-2	Soil	WG1027627-3	Benzo(b)fluoranthene	84	83	%	1	50	-	-
WG1027719-2	Soil	WG1027719-3	Benzo(b)fluoranthene	83	78	%	5.4	50	-	-
L831113-71	Soil	WG1027719-4	Benzo(b)fluoranthene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Benzo(g,h,i)perylene	0.55	0.54	mg/kg	-	-	0.00	0.4
WG1023287-2	Soil	WG1023287-3	Benzo(g,h,i)perylene	89	87	%	2.5	50	-	-
WG1023664-2	Soil	WG1023664-3	Benzo(g,h,i)perylene	72	81	%	12	50	-	-
WG1025465-2	Soil	WG1025465-3	Benzo(g,h,i)perylene	90	97	%	7.1	50	-	-
WG1026349-2	Soil	WG1026349-3	Benzo(g,h,i)perylene	95	97	%	2.4	50	-	-
WG1027104-2	Soil	WG1027104-3	Benzo(g,h,i)perylene	91	89	%	3.8	50	-	-
WG1027627-2	Soil	WG1027627-3	Benzo(g,h,i)perylene	93	92	%	1.1	50	-	-
WG1027719-2	Soil	WG1027719-3	Benzo(g,h,i)perylene	99	96	%	2.6	50	-	-
L831113-71	Soil	WG1027719-4	Benzo(g,h,i)perylene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Benzo(k)fluoranthene	0.591	0.611	mg/kg	3.3	50	-	-
WG1023287-2	Soil	WG1023287-3	Benzo(k)fluoranthene	82	80	%	1.7	50	-	-
WG1023664-2	Soil	WG1023664-3	Benzo(k)fluoranthene	76	88	%	15	50	-	-
WG1025465-2	Soil	WG1025465-3	Benzo(k)fluoranthene	78	87	%	11	50	-	-
WG1026349-2	Soil	WG1026349-3	Benzo(k)fluoranthene	109	108	%	0.81	50	-	-
WG1027104-2	Soil	WG1027104-3	Benzo(k)fluoranthene	94	95	%	1.5	50	-	-
WG1027627-2	Soil	WG1027627-3	Benzo(k)fluoranthene	97	100	%	2.3	50	-	-
WG1027719-2	Soil	WG1027719-3	Benzo(k)fluoranthene	89	84	%	6.6	50	-	-
L831113-71	Soil	WG1027719-4	Benzo(k)fluoranthene	<0.040	<0.040	mg/kg	N/A	50	-	-

Table D4. Continued.

Sample ID	Matrix	ALS ID	Analyte	Replicate 1	Replicate 2	Units	RPD	RPD Limit	Diff	Diff Limit
L831113-1	Soil	WG1025657-4	Chrysene	0.76	0.77	mg/kg	-	-	0.01	0.4
WG1023287-2	Soil	WG1023287-3	Chrysene	90	86	%	4.3	50	-	-
WG1023664-2	Soil	WG1023664-3	Chrysene	78	86	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	Chrysene	91	96	%	5.1	50	-	-
WG1026349-2	Soil	WG1026349-3	Chrysene	96	93	%	3.5	50	-	-
WG1027104-2	Soil	WG1027104-3	Chrysene	92	92	%	1.3	50	-	-
WG1027627-2	Soil	WG1027627-3	Chrysene	97	93	%	3.5	50	-	-
WG1027719-2	Soil	WG1027719-3	Chrysene	90	85	%	6.5	50	-	-
L831113-71	Soil	WG1027719-4	Chrysene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Dibenzo(ah)anthracene	0.11	0.11	mg/kg	-	-	0.00	0.4
WG1023287-2	Soil	WG1023287-3	Dibenzo(ah)anthracene	97	94	%	3.4	50	-	-
WG1023664-2	Soil	WG1023664-3	Dibenzo(ah)anthracene	79	89	%	12	50	-	-
WG1025465-2	Soil	WG1025465-3	Dibenzo(ah)anthracene	100	105	%	4.9	50	-	-
WG1026349-2	Soil	WG1026349-3	Dibenzo(ah)anthracene	89	89	%	0.48	50	-	-
WG1027104-2	Soil	WG1027104-3	Dibenzo(ah)anthracene	94	92	%	5.5	50	-	-
WG1027627-2	Soil	WG1027627-3	Dibenzo(ah)anthracene	97	95	%	2.2	50	-	-
WG1027719-2	Soil	WG1027719-3	Dibenzo(ah)anthracene	98	96	%	1.5	50	-	-
L831113-71	Soil	WG1027719-4	Dibenzo(ah)anthracene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Fluoranthene	1.07	1.13	mg/kg	5.2	50	-	-
WG1023287-2	Soil	WG1023287-3	Fluoranthene	95	91	%	4	50	-	-
WG1023664-2	Soil	WG1023664-3	Fluoranthene	78	87	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	Fluoranthene	91	96	%	5.2	50	-	-
WG1026349-2	Soil	WG1026349-3	Fluoranthene	89	88	%	1.3	50	-	-
WG1027104-2	Soil	WG1027104-3	Fluoranthene	92	89	%	4.9	50	-	-
WG1027627-2	Soil	WG1027627-3	Fluoranthene	93	92	%	1.2	50	-	-
WG1027719-2	Soil	WG1027719-3	Fluoranthene	93	87	%	6.5	50	-	-
L831113-71	Soil	WG1027719-4	Fluoranthene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Fluorene	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Fluorene	99	95	%	3.4	50	-	-
WG1023664-2	Soil	WG1023664-3	Fluorene	79	86	%	8.8	50	-	-
WG1025465-2	Soil	WG1025465-3	Fluorene	95	99	%	3.7	50	-	-
WG1026349-2	Soil	WG1026349-3	Fluorene	89	100	%	11	50	-	-
WG1027104-2	Soil	WG1027104-3	Fluorene	94	91	%	3.7	50	-	-
WG1027627-2	Soil	WG1027627-3	Fluorene	96	91	%	4.4	50	-	-
WG1027719-2	Soil	WG1027719-3	Fluorene	89	84	%	6	50	-	-
L831113-71	Soil	WG1027719-4	Fluorene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Indeno(1,2,3-cd)pyrene	0.69	0.70	mg/kg	-	-	0.01	0.4
WG1023287-2	Soil	WG1023287-3	Indeno(1,2,3-cd)pyrene	118	104	%	13	50	-	-
WG1023664-2	Soil	WG1023664-3	Indeno(1,2,3-cd)pyrene	81	91	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	Indeno(1,2,3-cd)pyrene	106	109	%	3.1	50	-	-
WG1026349-2	Soil	WG1026349-3	Indeno(1,2,3-cd)pyrene	89	87	%	2.2	50	-	-
WG1027104-2	Soil	WG1027104-3	Indeno(1,2,3-cd)pyrene	90	85	%	16	50	-	-
WG1027627-2	Soil	WG1027627-3	Indeno(1,2,3-cd)pyrene	90	86	%	4.3	50	-	-
WG1027719-2	Soil	WG1027719-3	Indeno(1,2,3-cd)pyrene	107	106	%	1.6	50	-	-
L831113-71	Soil	WG1027719-4	Indeno(1,2,3-cd)pyrene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	1-Methylnaphthalene	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	1-Methylnaphthalene	104	102	%	1.9	50	-	-
WG1023664-2	Soil	WG1023664-3	1-Methylnaphthalene	81	91	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	1-Methylnaphthalene	95	100	%	5.4	50	-	-
WG1026349-2	Soil	WG1026349-3	1-Methylnaphthalene	78	109	%	33	50	-	-
WG1027104-2	Soil	WG1027104-3	1-Methylnaphthalene	96	94	%	1.7	50	-	-
WG1027627-2	Soil	WG1027627-3	1-Methylnaphthalene	99	95	%	4.3	50	-	-
WG1027719-2	Soil	WG1027719-3	1-Methylnaphthalene	89	83	%	7	50	-	-
L831113-71	Soil	WG1027719-4	1-Methylnaphthalene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	2-Methylnaphthalene	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	2-Methylnaphthalene	106	103	%	3.1	50	-	-
WG1023664-2	Soil	WG1023664-3	2-Methylnaphthalene	79	96	%	19	50	-	-
WG1025465-2	Soil	WG1025465-3	2-Methylnaphthalene	93	100	%	8.2	50	-	-
WG1026349-2	Soil	WG1026349-3	2-Methylnaphthalene	90	77	%	15	50	-	-
WG1027104-2	Soil	WG1027104-3	2-Methylnaphthalene	94	91	%	2.9	50	-	-
WG1027627-2	Soil	WG1027627-3	2-Methylnaphthalene	94	92	%	2.7	50	-	-
WG1027719-2	Soil	WG1027719-3	2-Methylnaphthalene	88	83	%	5.5	50	-	-
L831113-71	Soil	WG1027719-4	2-Methylnaphthalene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Naphthalene	0.511	0.436	mg/kg	16	50	-	-
WG1023287-2	Soil	WG1023287-3	Naphthalene	95	91	%	4	50	-	-
WG1023664-2	Soil	WG1023664-3	Naphthalene	76	92	%	19	50	-	-
WG1025465-2	Soil	WG1025465-3	Naphthalene	96	103	%	7.2	50	-	-
WG1026349-2	Soil	WG1026349-3	Naphthalene	105	64	%	48	50	-	-
WG1027104-2	Soil	WG1027104-3	Naphthalene	95	92	%	3.2	50	-	-
WG1027627-2	Soil	WG1027627-3	Naphthalene	98	95	%	2.2	50	-	-
WG1027719-2	Soil	WG1027719-3	Naphthalene	87	83	%	4.1	50	-	-
L831113-71	Soil	WG1027719-4	Naphthalene	<0.020	<0.020	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Phenanthrene	0.521	0.536	mg/kg	-	-	0.014	0.24
WG1023287-2	Soil	WG1023287-3	Phenanthrene	91	89	%	2.5	50	-	-
WG1023664-2	Soil	WG1023664-3	Phenanthrene	78	88	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	Phenanthrene	90	95	%	6.0	50	-	-
WG1026349-2	Soil	WG1026349-3	Phenanthrene	95	94	%	1.1	50	-	-
WG1027104-2	Soil	WG1027104-3	Phenanthrene	96	93	%	3.2	50	-	-
WG1027627-2	Soil	WG1027627-3	Phenanthrene	93	93	%	0.89	50	-	-
WG1027719-2	Soil	WG1027719-3	Phenanthrene	91	85	%	7.1	50	-	-
L831113-71	Soil	WG1027719-4	Phenanthrene	<0.060	<0.060	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Pyrene	0.89	0.93	mg/kg	-	-	0.04	0.4
WG1023287-2	Soil	WG1023287-3	Pyrene	96	92	%	4.2	50	-	-
WG1023664-2	Soil	WG1023664-3	Pyrene	79	88	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	Pyrene	92	97	%	5.5	50	-	-
WG1026349-2	Soil	WG1026349-3	Pyrene	91	89	%	1.7	50	-	-
WG1027104-2	Soil	WG1027104-3	Pyrene	93	90	%	5.8	50	-	-
WG1027627-2	Soil	WG1027627-3	Pyrene	96	93	%	2.5	50	-	-
WG1027719-2	Soil	WG1027719-3	Pyrene	95	89	%	6.4	50	-	-
L831113-71	Soil	WG1027719-4	Pyrene	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1025657-4	Quinoline	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Quinoline	113	111	%	2.1	50	-	-
WG1023664-2	Soil	WG1023664-3	Quinoline	94	104	%	11	50	-	-
WG1025465-2	Soil	WG1025465-3	Quinoline	106	120	%	12	50	-	-
WG1026349-2	Soil	WG1026349-3	Quinoline	113	159	%	34	50	-	-
WG1027104-2	Soil	WG1027104-3	Quinoline	109	107	%	2.1	50	-	-
WG1027627-2	Soil	WG1027627-3	Quinoline	109	107	%	1.7	50	-	-
WG1027719-2	Soil	WG1027719-3	Quinoline	100	96	%	4.1	50	-	-
L831113-71	Soil	WG1027719-4	Quinoline	<0.10	<0.10	mg/kg	N/A	50	-	-

Table D4. Continued.

Sample ID	Matrix	ALS ID	Analyte	Replicate 1	Replicate 2	Units	RPD	RPD Limit	Diff	Diff Limit
Polychlorinated Biphenyls										
L831113-1	Soil	WG1023287-4	Aroclor 1242	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Aroclor 1242	80	83	%	4.5	45	-	-
WG1023664-2	Soil	WG1023664-3	Aroclor 1242	70	81	%	15	45	-	-
WG1025465-2	Soil	WG1025465-3	Aroclor 1242	101	98	%	2.3	45	-	-
WG1026349-2	Soil	WG1026349-3	Aroclor 1242	91	83	%	9.9	45	-	-
WG1027104-2	Soil	WG1027104-3	Aroclor 1242	85	88	%	3.4	45	-	-
WG1027627-2	Soil	WG1027627-3	Aroclor 1242	93	92	%	0.45	45	-	-
WG1027719-2	Soil	WG1027719-3	Aroclor 1242	86	86	%	0.0	45	-	-
L831113-71	Soil	WG1027719-4	Aroclor 1242	<0.10	<0.10	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023664-4	Aroclor 1242	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1025465-4	Aroclor 1242	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1026349-4	Aroclor 1242	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1027104-4	Aroclor 1242	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1027627-4	Aroclor 1242	<0.12	<0.12	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1023287-4	Aroclor 1248	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Aroclor 1248	89	89	%	0.0	45	-	-
WG1023664-2	Soil	WG1023664-3	Aroclor 1248	81	81	%	0.0	45	-	-
WG1025465-2	Soil	WG1025465-3	Aroclor 1248	98	98	%	0.0	45	-	-
WG1026349-2	Soil	WG1026349-3	Aroclor 1248	94	94	%	0.0	45	-	-
WG1027104-2	Soil	WG1027104-3	Aroclor 1248	90	90	%	0.0	45	-	-
WG1027627-2	Soil	WG1027627-3	Aroclor 1248	93	93	%	0.0	45	-	-
WG1027719-2	Soil	WG1027719-3	Aroclor 1248	85	85	%	0.0	45	-	-
L831113-71	Soil	WG1027719-4	Aroclor 1248	<0.10	<0.10	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023664-4	Aroclor 1248	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1025465-4	Aroclor 1248	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1026349-4	Aroclor 1248	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1027104-4	Aroclor 1248	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1027627-4	Aroclor 1248	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1023287-4	Aroclor 1254	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Aroclor 1254	75	78	%	3.8	45	-	-
WG1023664-2	Soil	WG1023664-3	Aroclor 1254	67	80	%	18	45	-	-
WG1025465-2	Soil	WG1025465-3	Aroclor 1254	97	93	%	4.2	45	-	-
WG1026349-2	Soil	WG1026349-3	Aroclor 1254	87	81	%	7.3	45	-	-
WG1027104-2	Soil	WG1027104-3	Aroclor 1254	81	83	%	2.6	45	-	-
WG1027627-2	Soil	WG1027627-3	Aroclor 1254	90	92	%	1.5	45	-	-
WG1027719-2	Soil	WG1027719-3	Aroclor 1254	87	86	%	1.1	45	-	-
L831113-71	Soil	WG1027719-4	Aroclor 1254	<0.10	<0.10	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023664-4	Aroclor 1254	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1025465-4	Aroclor 1254	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1026349-4	Aroclor 1254	0.012	0.011	mg/kg	-	-	0.001	0.004
Anonymous	Soil	WG1027104-4	Aroclor 1254	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1027627-4	Aroclor 1254	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1023287-4	Aroclor 1260	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Aroclor 1260	78	79	%	2.6	45	-	-
WG1023664-2	Soil	WG1023664-3	Aroclor 1260	70	83	%	18	45	-	-
WG1025465-2	Soil	WG1025465-3	Aroclor 1260	94	93	%	0.56	45	-	-
WG1026349-2	Soil	WG1026349-3	Aroclor 1260	87	82	%	6.3	45	-	-
WG1027104-2	Soil	WG1027104-3	Aroclor 1260	79	83	%	5.3	45	-	-
WG1027627-2	Soil	WG1027627-3	Aroclor 1260	94	94	%	0.66	45	-	-
WG1027719-2	Soil	WG1027719-3	Aroclor 1260	91	89	%	2	45	-	-
L831113-71	Soil	WG1027719-4	Aroclor 1260	<0.10	<0.10	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023664-4	Aroclor 1260	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1025465-4	Aroclor 1260	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1026349-4	Aroclor 1260	0.019	0.016	mg/kg	-	-	0.003	0.004
Anonymous	Soil	WG1027104-4	Aroclor 1260	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1027627-4	Aroclor 1260	<0.10	<0.10	mg/kg	N/A	50	-	-
L831113-1	Soil	WG1023287-4	Total PCBs	<0.10	<0.10	mg/kg	N/A	50	-	-
WG1023287-2	Soil	WG1023287-3	Total PCBs	80	82	%	2.7	45	-	-
WG1023664-2	Soil	WG1023664-3	Total PCBs	72	82	%	13	45	-	-
WG1025465-2	Soil	WG1025465-3	Total PCBs	97	96	%	1.8	45	-	-
WG1026349-2	Soil	WG1026349-3	Total PCBs	90	85	%	5.7	45	-	-
WG1027104-2	Soil	WG1027104-3	Total PCBs	84	86	%	2.7	45	-	-
WG1027627-2	Soil	WG1027627-3	Total PCBs	93	93	%	0.097	45	-	-
WG1027719-2	Soil	WG1027719-3	Total PCBs	87	87	%	0.79	45	-	-
L831113-71	Soil	WG1027719-4	Total PCBs	<0.10	<0.10	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1023664-4	Total PCBs	<0.050	<0.050	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1025465-4	Total PCBs	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1026349-4	Total PCBs	0.031	0.027	mg/kg	-	-	0.004	0.04
Anonymous	Soil	WG1027104-4	Total PCBs	<0.010	<0.010	mg/kg	N/A	50	-	-
Anonymous	Soil	WG1027627-4	Total PCBs	<0.12	<0.12	mg/kg	N/A	50	-	-

Table D5. Percent recovery of analytes in laboratory control sample (LCS) and method blank (MB) (ALS Laboratory Group).

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits
Physical Tests									
Soil	LCS	% Moisture	WG1023169-2		044665012	10.0	%	100	79-120
Soil	LCS	% Moisture	WG1023282-2		063738671	10.0	%	96	79-120
Soil	LCS	% Moisture	WG1023286-2		5078101681	10.0	%	97	79-120
Soil	LCS	% Moisture	WG1023288-2		594059405	10.0	%	101	79-120
Soil	MB	% Moisture	WG1023169-1		<0.10	<0.1	%	-	0.1
Soil	MB	% Moisture	WG1023282-1		<0.10	<0.1	%	-	0.1
Soil	MB	% Moisture	WG1023286-1		<0.10	<0.1	%	-	0.1
Soil	MB	% Moisture	WG1023288-1		<0.10	<0.1	%	-	0.1
Aggregate Organics									
Soil	LCS	Oil and Grease, Total	WG1029191-2		0.00000000	10000	mg/kg	98	60-120
Soil	LCS	Oil and Grease, Total	WG1030476-2		0.00000000	10000	mg/kg	94	60-120
Soil	LCS	Oil and Grease, Total	WG1030479-2		9.99999999	10000	mg/kg	90	60-120
Soil	MB	Oil and Grease, Total	WG1029191-1		<500	<500	mg/kg	-	500
Soil	MB	Oil and Grease, Total	WG1030476-1		<500	<500	mg/kg	-	500
Soil	MB	Oil and Grease, Total	WG1030479-1		<500	<500	mg/kg	-	500
Volatile Organic Compounds									
Soil	MB	Benzene	WG1022767-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Ethyl Benzene	WG1022767-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Toluene	WG1022767-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	o-Xylene	WG1022767-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	m+p-Xylenes	WG1022767-1		<0.10	<0.1	mg/kg	-	0.1
Soil	MB	Benzene	WG1023028-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Ethyl Benzene	WG1023028-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Toluene	WG1023028-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	o-Xylene	WG1023028-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	m+p-Xylenes	WG1023028-1		<0.10	<0.1	mg/kg	-	0.1
Soil	MB	Benzene	WG1023032-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Ethyl Benzene	WG1023032-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Toluene	WG1023032-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	o-Xylene	WG1023032-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	m+p-Xylenes	WG1023032-1		<0.10	<0.1	mg/kg	-	0.1
Soil	MB	Benzene	WG1023035-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Ethyl Benzene	WG1023035-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Toluene	WG1023035-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	o-Xylene	WG1023035-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	m+p-Xylenes	WG1023035-1		<0.10	<0.1	mg/kg	-	0.1
Soil	MB	Benzene	WG1023040-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Ethyl Benzene	WG1023040-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Toluene	WG1023040-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	o-Xylene	WG1023040-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	m+p-Xylenes	WG1023040-1		<0.10	<0.1	mg/kg	-	0.1

Table D5. Continued.

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits
Polycyclic Aromatic Hydrocarbons									
Soil	LCS	Acenaphthene	WG1023664-2		.66552	0.800	mg/kg	83	60-140
Soil	LCS	Acenaphthylene	WG1023664-2		.5573	0.800	mg/kg	70	60-140
Soil	LCS	Acridine	WG1023664-2		1.36368	1.58	mg/kg	86	50-140
Soil	LCS	Anthracene	WG1023664-2		.62318	0.800	mg/kg	78	60-140
Soil	LCS	Benzo(a)anthracene	WG1023664-2		.69906	0.800	mg/kg	87	60-140
Soil	LCS	Benzo(a)pyrene	WG1023664-2		.69286	0.800	mg/kg	87	50-130
Soil	LCS	Benzo(b)fluoranthene	WG1023664-2		.61254	0.800	mg/kg	77	50-140
Soil	LCS	Benzo(g,h,i)perylene	WG1023664-2		.57592	0.800	mg/kg	72	60-140
Soil	LCS	Benzo(k)fluoranthene	WG1023664-2		.6063	0.800	mg/kg	76	50-150
Soil	LCS	Chrysene	WG1023664-2		.6213	0.800	mg/kg	78	60-140
Soil	LCS	Dibenzo(ah)anthracene	WG1023664-2		.63354	0.800	mg/kg	79	50-140
Soil	LCS	Fluoranthene	WG1023664-2		.62024	0.800	mg/kg	78	60-140
Soil	LCS	Fluorene	WG1023664-2		.6331	0.800	mg/kg	79	50-140
Soil	LCS	Indeno(1,2,3-cd)pyrene	WG1023664-2		.65142	0.800	mg/kg	81	50-140
Soil	LCS	1-Methylnaphthalene	WG1023664-2		.65014	0.800	mg/kg	81	50-130
Soil	LCS	2-Methylnaphthalene	WG1023664-2		.6343	0.800	mg/kg	79	60-130
Soil	LCS	Naphthalene	WG1023664-2		.60778	0.800	mg/kg	76	50-130
Soil	LCS	Phenanthrene	WG1023664-2		.62658	0.800	mg/kg	78	50-140
Soil	LCS	Pyrene	WG1023664-2		.6292	0.800	mg/kg	79	60-140
Soil	LCS	Quinoline	WG1023664-2		.81578	0.870	mg/kg	94	50-140
Soil	LCS	Acenaphthene	WG1025465-2		.77512	0.800	mg/kg	97	60-140
Soil	LCS	Acenaphthylene	WG1025465-2		.72034	0.800	mg/kg	90	60-140
Soil	LCS	Acridine	WG1025465-2		1.61034	1.58	mg/kg	102	50-140
Soil	LCS	Anthracene	WG1025465-2		.71922	0.800	mg/kg	90	60-140
Soil	LCS	Benzo(a)anthracene	WG1025465-2		.80748	0.800	mg/kg	101	60-140
Soil	LCS	Benzo(a)pyrene	WG1025465-2		.8451	0.800	mg/kg	106	50-130
Soil	LCS	Benzo(b)fluoranthene	WG1025465-2		.81078	0.800	mg/kg	101	50-140
Soil	LCS	Benzo(g,h,i)perylene	WG1025465-2		.72364	0.800	mg/kg	90	60-140
Soil	LCS	Benzo(k)fluoranthene	WG1025465-2		.62334	0.800	mg/kg	78	50-150
Soil	LCS	Chrysene	WG1025465-2		.73048	0.800	mg/kg	91	60-140
Soil	LCS	Dibenzo(ah)anthracene	WG1025465-2		.8022	0.800	mg/kg	100	50-140
Soil	LCS	Fluoranthene	WG1025465-2		.7267	0.800	mg/kg	91	60-140
Soil	LCS	Fluorene	WG1025465-2		.7623	0.800	mg/kg	95	50-140
Soil	LCS	Indeno(1,2,3-cd)pyrene	WG1025465-2		.84864	0.800	mg/kg	106	50-140
Soil	LCS	1-Methylnaphthalene	WG1025465-2		.75748	0.800	mg/kg	95	50-130
Soil	LCS	2-Methylnaphthalene	WG1025465-2		.7405	0.800	mg/kg	93	60-130
Soil	LCS	Naphthalene	WG1025465-2		.76492	0.800	mg/kg	96	50-130
Soil	LCS	Phenanthrene	WG1025465-2		.71754	0.800	mg/kg	90	50-140
Soil	LCS	Pyrene	WG1025465-2		.73418	0.800	mg/kg	92	60-140
Soil	LCS	Quinoline	WG1025465-2		.92198	0.870	mg/kg	106	50-140
Soil	LCS	Acenaphthene	WG1025657-2		.8606	0.800	mg/kg	108	60-140
Soil	LCS	Acenaphthylene	WG1025657-2		.68108	0.800	mg/kg	85	60-140
Soil	LCS	Acridine	WG1025657-2		1.49792	1.58	mg/kg	95	50-140
Soil	LCS	Anthracene	WG1025657-2		.72054	0.800	mg/kg	90	60-140
Soil	LCS	Benzo(a)anthracene	WG1025657-2		.74474	0.800	mg/kg	93	60-140
Soil	LCS	Benzo(a)pyrene	WG1025657-2		.825	0.800	mg/kg	103	50-130
Soil	LCS	Benzo(b)fluoranthene	WG1025657-2		.66514	0.800	mg/kg	83	50-140
Soil	LCS	Benzo(g,h,i)perylene	WG1025657-2		.74066	0.800	mg/kg	93	60-140
Soil	LCS	Benzo(k)fluoranthene	WG1025657-2		.77782	0.800	mg/kg	97	50-150
Soil	LCS	Chrysene	WG1025657-2		.7406	0.800	mg/kg	93	60-140
Soil	LCS	Dibenzo(ah)anthracene	WG1025657-2		.722	0.800	mg/kg	90	50-140
Soil	LCS	Fluoranthene	WG1025657-2		.71696	0.800	mg/kg	90	60-140
Soil	LCS	Fluorene	WG1025657-2		.76266	0.800	mg/kg	95	50-140
Soil	LCS	Indeno(1,2,3-cd)pyrene	WG1025657-2		.75072	0.800	mg/kg	94	50-140
Soil	LCS	1-Methylnaphthalene	WG1025657-2		.75134	0.800	mg/kg	94	50-130
Soil	LCS	2-Methylnaphthalene	WG1025657-2		.62014	0.800	mg/kg	78	60-130
Soil	LCS	Naphthalene	WG1025657-2		.62876	0.800	mg/kg	79	50-130
Soil	LCS	Phenanthrene	WG1025657-2		.73564	0.800	mg/kg	92	50-140
Soil	LCS	Pyrene	WG1025657-2		.7166	0.800	mg/kg	90	60-140
Soil	LCS	Quinoline	WG1025657-2		1.23122	0.870	mg/kg	142	50-140
Soil	LCS	Acenaphthene	WG1026349-2		.78478	0.800	mg/kg	98	60-140
Soil	LCS	Acenaphthylene	WG1026349-2		.70412	0.800	mg/kg	88	60-140
Soil	LCS	Acridine	WG1026349-2		1.51972	1.58	mg/kg	96	50-140
Soil	LCS	Anthracene	WG1026349-2		.72504	0.800	mg/kg	91	60-140
Soil	LCS	Benzo(a)anthracene	WG1026349-2		.70226	0.800	mg/kg	88	60-140
Soil	LCS	Benzo(a)pyrene	WG1026349-2		.84776	0.800	mg/kg	106	50-130
Soil	LCS	Benzo(b)fluoranthene	WG1026349-2		.69032	0.800	mg/kg	86	50-140
Soil	LCS	Benzo(g,h,i)perylene	WG1026349-2		.75648	0.800	mg/kg	95	60-140
Soil	LCS	Benzo(k)fluoranthene	WG1026349-2		.86896	0.800	mg/kg	109	50-150

Table D5. Continued.

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits
Soil	LCS	Chrysene	WG1026349-2		.76962	0.800	mg/kg	96	60-140
Soil	LCS	Dibenzo(ah)anthracene	WG1026349-2		.7117	0.800	mg/kg	89	50-140
Soil	LCS	Fluoranthene	WG1026349-2		.71136	0.800	mg/kg	89	60-140
Soil	LCS	Fluorene	WG1026349-2		.71546	0.800	mg/kg	89	50-140
Soil	LCS	Indeno(1,2,3-cd)pyrene	WG1026349-2		.7087	0.800	mg/kg	89	50-140
Soil	LCS	1-Methylnaphthalene	WG1026349-2		.625	0.800	mg/kg	78	50-130
Soil	LCS	2-Methylnaphthalene	WG1026349-2		.72166	0.800	mg/kg	90	60-130
Soil	LCS	Naphthalene	WG1026349-2		.84044	0.800	mg/kg	105	50-130
Soil	LCS	Phenanthrene	WG1026349-2		.75768	0.800	mg/kg	95	50-140
Soil	LCS	Pyrene	WG1026349-2		.72708	0.800	mg/kg	91	60-140
Soil	LCS	Quinoline	WG1026349-2		.98202	0.870	mg/kg	113	50-140
Soil	LCS	Acenaphthene	WG1027104-2		.76142	0.800	mg/kg	95	60-140
Soil	LCS	Acenaphthylene	WG1027104-2		.75394	0.800	mg/kg	94	60-140
Soil	LCS	Acridine	WG1027104-2		1.57302	1.58	mg/kg	99	50-140
Soil	LCS	Anthracene	WG1027104-2		.75346	0.800	mg/kg	94	60-140
Soil	LCS	Benzo(a)anthracene	WG1027104-2		.74446	0.800	mg/kg	93	60-140
Soil	LCS	Benzo(a)pyrene	WG1027104-2		.81022	0.800	mg/kg	101	50-130
Soil	LCS	Benzo(b)fluoranthene	WG1027104-2		.7182	0.800	mg/kg	90	50-140
Soil	LCS	Benzo(g,h,i)perylene	WG1027104-2		.7284	0.800	mg/kg	91	60-140
Soil	LCS	Benzo(k)fluoranthene	WG1027104-2		.75506	0.800	mg/kg	94	50-150
Soil	LCS	Chrysene	WG1027104-2		.7393	0.800	mg/kg	92	60-140
Soil	LCS	Dibenzo(ah)anthracene	WG1027104-2		.7523	0.800	mg/kg	94	50-140
Soil	LCS	Fluoranthene	WG1027104-2		.73612	0.800	mg/kg	92	60-140
Soil	LCS	Fluorene	WG1027104-2		.7551	0.800	mg/kg	94	50-140
Soil	LCS	Indeno(1,2,3-cd)pyrene	WG1027104-2		.71846	0.800	mg/kg	90	50-140
Soil	LCS	1-Methylnaphthalene	WG1027104-2		.76416	0.800	mg/kg	96	50-130
Soil	LCS	2-Methylnaphthalene	WG1027104-2		.74994	0.800	mg/kg	94	60-130
Soil	LCS	Naphthalene	WG1027104-2		.7616	0.800	mg/kg	95	50-130
Soil	LCS	Phenanthrene	WG1027104-2		.7657	0.800	mg/kg	96	50-140
Soil	LCS	Pyrene	WG1027104-2		.74152	0.800	mg/kg	93	60-140
Soil	LCS	Quinoline	WG1027104-2		.94824	0.870	mg/kg	109	50-140
Soil	LCS	Acenaphthene	WG1027627-2		.38963	0.400	mg/kg	97	60-140
Soil	LCS	Acenaphthylene	WG1027627-2		.38591	0.400	mg/kg	96	60-140
Soil	LCS	Acridine	WG1027627-2		.78094	0.79	mg/kg	99	50-140
Soil	LCS	Anthracene	WG1027627-2		.38311	0.400	mg/kg	96	60-140
Soil	LCS	Benzo(a)anthracene	WG1027627-2		.38452	0.400	mg/kg	96	60-140
Soil	LCS	Benzo(a)pyrene	WG1027627-2		.41298	0.400	mg/kg	103	50-130
Soil	LCS	Benzo(b)fluoranthene	WG1027627-2		.33607	0.400	mg/kg	84	50-140
Soil	LCS	Benzo(g,h,i)perylene	WG1027627-2		.37162	0.400	mg/kg	93	60-140
Soil	LCS	Benzo(k)fluoranthene	WG1027627-2		.38959	0.400	mg/kg	97	50-150
Soil	LCS	Chrysene	WG1027627-2		.38619	0.400	mg/kg	97	60-140
Soil	LCS	Dibenzo(ah)anthracene	WG1027627-2		.38953	0.400	mg/kg	97	50-140
Soil	LCS	Fluoranthene	WG1027627-2		.37375	0.400	mg/kg	93	60-140
Soil	LCS	Fluorene	WG1027627-2		.38234	0.400	mg/kg	96	50-140
Soil	LCS	Indeno(1,2,3-cd)pyrene	WG1027627-2		.35962	0.400	mg/kg	90	50-140
Soil	LCS	1-Methylnaphthalene	WG1027627-2		.39503	0.400	mg/kg	99	50-130
Soil	LCS	2-Methylnaphthalene	WG1027627-2		.37761	0.400	mg/kg	94	60-130
Soil	LCS	Naphthalene	WG1027627-2		.39039	0.400	mg/kg	98	50-130
Soil	LCS	Phenanthrene	WG1027627-2		.37358	0.400	mg/kg	93	50-140
Soil	LCS	Pyrene	WG1027627-2		.38239	0.400	mg/kg	96	60-140
Soil	LCS	Quinoline	WG1027627-2		.47348	0.430	mg/kg	109	50-140
Soil	LCS	Acenaphthene	WG1027719-2		.73174	0.800	mg/kg	91	60-140
Soil	LCS	Acenaphthylene	WG1027719-2		.71068	0.800	mg/kg	89	60-140
Soil	LCS	Acridine	WG1027719-2		1.56544	1.58	mg/kg	99	50-140
Soil	LCS	Anthracene	WG1027719-2		.70884	0.800	mg/kg	89	60-140
Soil	LCS	Benzo(a)anthracene	WG1027719-2		.75872	0.800	mg/kg	95	60-140
Soil	LCS	Benzo(a)pyrene	WG1027719-2		.8569	0.800	mg/kg	107	50-130
Soil	LCS	Benzo(b)fluoranthene	WG1027719-2		.66104	0.800	mg/kg	83	50-140
Soil	LCS	Benzo(g,h,i)perylene	WG1027719-2		.78852	0.800	mg/kg	99	60-140
Soil	LCS	Benzo(k)fluoranthene	WG1027719-2		.71388	0.800	mg/kg	89	50-150
Soil	LCS	Chrysene	WG1027719-2		.7239	0.800	mg/kg	90	60-140
Soil	LCS	Dibenzo(ah)anthracene	WG1027719-2		.78268	0.800	mg/kg	98	50-140
Soil	LCS	Fluoranthene	WG1027719-2		.74364	0.800	mg/kg	93	60-140
Soil	LCS	Fluorene	WG1027719-2		.71532	0.800	mg/kg	89	50-140
Soil	LCS	Indeno(1,2,3-cd)pyrene	WG1027719-2		.85864	0.800	mg/kg	107	50-140
Soil	LCS	1-Methylnaphthalene	WG1027719-2		.71296	0.800	mg/kg	89	50-130
Soil	LCS	2-Methylnaphthalene	WG1027719-2		.70214	0.800	mg/kg	88	60-130
Soil	LCS	Naphthalene	WG1027719-2		.69302	0.800	mg/kg	87	50-130
Soil	LCS	Phenanthrene	WG1027719-2		.72894	0.800	mg/kg	91	50-140
Soil	LCS	Pyrene	WG1027719-2		.75814	0.800	mg/kg	95	60-140
Soil	LCS	Quinoline	WG1027719-2		.8648	0.870	mg/kg	100	50-140

Table D5. Continued.

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits
Soil	MB	Acenaphthene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthylene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acridine	WG1023664-1		<0.80	<0.8	mg/kg	-	0.8
Soil	MB	Anthracene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)anthracene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)pyrene	WG1023664-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Benzo(b)fluoranthene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(g,h,i)perylene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(k)fluoranthene	WG1023664-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Chrysene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Dibenzo(ah)anthracene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluoranthene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluorene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Indeno(1,2,3-cd)pyrene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	1-Methylnaphthalene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	2-Methylnaphthalene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Naphthalene	WG1023664-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Phenanthrene	WG1023664-1		<0.030	<0.03	mg/kg	-	0.03
Soil	MB	Pyrene	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Quinoline	WG1023664-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthylene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acridine	WG1025465-1		<0.80	<0.8	mg/kg	-	0.8
Soil	MB	Anthracene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)anthracene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)pyrene	WG1025465-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Benzo(b)fluoranthene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(g,h,i)perylene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(k)fluoranthene	WG1025465-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Chrysene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Dibenzo(ah)anthracene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluoranthene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluorene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Indeno(1,2,3-cd)pyrene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	1-Methylnaphthalene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	2-Methylnaphthalene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Naphthalene	WG1025465-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Phenanthrene	WG1025465-1		<0.030	<0.03	mg/kg	-	0.03
Soil	MB	Pyrene	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Quinoline	WG1025465-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthylene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acridine	WG1025657-1		<0.80	<0.8	mg/kg	-	0.8
Soil	MB	Anthracene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)anthracene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)pyrene	WG1025657-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Benzo(b)fluoranthene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(g,h,i)perylene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(k)fluoranthene	WG1025657-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Chrysene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Dibenzo(ah)anthracene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluoranthene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluorene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Indeno(1,2,3-cd)pyrene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	1-Methylnaphthalene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	2-Methylnaphthalene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Naphthalene	WG1025657-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Phenanthrene	WG1025657-1		<0.030	<0.03	mg/kg	-	0.03
Soil	MB	Pyrene	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Quinoline	WG1025657-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthylene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acridine	WG1026349-1		<0.80	<0.8	mg/kg	-	0.8
Soil	MB	Anthracene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)anthracene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)pyrene	WG1026349-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Benzo(b)fluoranthene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(g,h,i)perylene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(k)fluoranthene	WG1026349-1		<0.020	<0.02	mg/kg	-	0.02

Table D5. Continued.

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits
Soil	MB	Chrysene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Dibenzo(ah)anthracene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluoranthene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluorene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Indeno(1,2,3-cd)pyrene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	1-Methylnaphthalene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	2-Methylnaphthalene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Naphthalene	WG1026349-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Phenanthrene	WG1026349-1		<0.030	<0.03	mg/kg	-	0.03
Soil	MB	Pyrene	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Quinoline	WG1026349-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthylene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acridine	WG1027104-1		<0.80	<0.8	mg/kg	-	0.8
Soil	MB	Anthracene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)anthracene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)pyrene	WG1027104-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Benzo(b)fluoranthene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(g,h,i)perylene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(k)fluoranthene	WG1027104-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Chrysene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Dibenzo(ah)anthracene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluoranthene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluorene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Indeno(1,2,3-cd)pyrene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	1-Methylnaphthalene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	2-Methylnaphthalene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Naphthalene	WG1027104-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Phenanthrene	WG1027104-1		<0.030	<0.03	mg/kg	-	0.03
Soil	MB	Pyrene	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Quinoline	WG1027104-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthylene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acridine	WG1027627-1		<0.80	<0.8	mg/kg	-	0.8
Soil	MB	Anthracene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)anthracene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)pyrene	WG1027627-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Benzo(b)fluoranthene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(g,h,i)perylene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(k)fluoranthene	WG1027627-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Chrysene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Dibenzo(ah)anthracene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluoranthene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluorene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Indeno(1,2,3-cd)pyrene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	1-Methylnaphthalene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	2-Methylnaphthalene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Naphthalene	WG1027627-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Phenanthrene	WG1027627-1		<0.030	<0.03	mg/kg	-	0.03
Soil	MB	Pyrene	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Quinoline	WG1027627-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acenaphthylene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Acridine	WG1027719-1		<0.80	<0.8	mg/kg	-	0.8
Soil	MB	Anthracene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)anthracene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(a)pyrene	WG1027719-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Benzo(b)fluoranthene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(g,h,i)perylene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Benzo(k)fluoranthene	WG1027719-1		<0.020	<0.02	mg/kg	-	0.02
Soil	MB	Chrysene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Dibenzo(ah)anthracene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluoranthene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Fluorene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Indeno(1,2,3-cd)pyrene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	1-Methylnaphthalene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	2-Methylnaphthalene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Naphthalene	WG1027719-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Phenanthrene	WG1027719-1		<0.030	<0.03	mg/kg	-	0.03
Soil	MB	Pyrene	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05
Soil	MB	Quinoline	WG1027719-1		<0.050	<0.05	mg/kg	-	0.05

Table D5. Continued.

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits
Polychlorinated Biphenyls									
Soil	LCS	Aroclor 1242	WG1023287-2		.15954	0.200	mg/kg	80	65-130
Soil	LCS	Aroclor 1248	WG1023287-2		.17738	0.200	mg/kg	89	65-130
Soil	LCS	Aroclor 1254	WG1023287-2		.15032	0.200	mg/kg	75	65-130
Soil	LCS	Aroclor 1260	WG1023287-2		.15298	0.200	mg/kg	76	65-130
Soil	LCS	Total PCBs	WG1023287-2		.64022	0.800	mg/kg	80	60-130
Soil	LCS	Aroclor 1242	WG1023664-2		.14004	0.200	mg/kg	70	65-130
Soil	LCS	Aroclor 1248	WG1023664-2		.16236	0.200	mg/kg	81	65-130
Soil	LCS	Aroclor 1254	WG1023664-2		.13364	0.200	mg/kg	67	65-130
Soil	LCS	Aroclor 1260	WG1023664-2		.13924	0.200	mg/kg	70	65-130
Soil	LCS	Total PCBs	WG1023664-2		.57528	0.800	mg/kg	72	60-130
Soil	LCS	Aroclor 1242	WG1025465-2		.20108	0.200	mg/kg	101	65-130
Soil	LCS	Aroclor 1248	WG1025465-2		.19648	0.200	mg/kg	98	65-130
Soil	LCS	Aroclor 1254	WG1025465-2		.1943	0.200	mg/kg	97	65-130
Soil	LCS	Aroclor 1260	WG1025465-2		.18702	0.200	mg/kg	94	65-130
Soil	LCS	Total PCBs	WG1025465-2		.77888	0.800	mg/kg	97	60-130
Soil	LCS	Aroclor 1242	WG1026349-2		.18228	0.200	mg/kg	91	65-130
Soil	LCS	Aroclor 1248	WG1026349-2		.188	0.200	mg/kg	94	65-130
Soil	LCS	Aroclor 1254	WG1026349-2		.17402	0.200	mg/kg	87	65-130
Soil	LCS	Aroclor 1260	WG1026349-2		.17414	0.200	mg/kg	87	65-130
Soil	LCS	Total PCBs	WG1026349-2		.71844	0.800	mg/kg	90	60-130
Soil	LCS	Aroclor 1242	WG1027104-2		.16958	0.200	mg/kg	85	65-130
Soil	LCS	Aroclor 1248	WG1027104-2		.17932	0.200	mg/kg	90	65-130
Soil	LCS	Aroclor 1254	WG1027104-2		.16158	0.200	mg/kg	81	65-130
Soil	LCS	Aroclor 1260	WG1027104-2		.15836	0.200	mg/kg	79	65-130
Soil	LCS	Total PCBs	WG1027104-2		.66884	0.800	mg/kg	84	60-130
Soil	LCS	Aroclor 1242	WG1027627-2		.09285	0.100	mg/kg	93	65-130
Soil	LCS	Aroclor 1248	WG1027627-2		.09311	0.100	mg/kg	93	65-130
Soil	LCS	Aroclor 1254	WG1027627-2		.09041	0.100	mg/kg	90	65-130
Soil	LCS	Aroclor 1260	WG1027627-2		.09417	0.100	mg/kg	94	65-130
Soil	LCS	Total PCBs	WG1027627-2		.37054	0.400	mg/kg	93	60-130
Soil	LCS	Aroclor 1242	WG1027719-2		.17292	0.200	mg/kg	86	65-130
Soil	LCS	Aroclor 1248	WG1027719-2		.17068	0.200	mg/kg	85	65-130
Soil	LCS	Aroclor 1254	WG1027719-2		.17388	0.200	mg/kg	87	65-130
Soil	LCS	Aroclor 1260	WG1027719-2		.18224	0.200	mg/kg	91	65-130
Soil	LCS	Total PCBs	WG1027719-2		.69972	0.800	mg/kg	87	60-130
Soil	MB	Aroclor 1242	WG1023287-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1248	WG1023287-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1254	WG1023287-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1260	WG1023287-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Total PCBs	WG1023287-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1242	WG1023664-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1248	WG1023664-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1254	WG1023664-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1260	WG1023664-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Total PCBs	WG1023664-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1242	WG1025465-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1248	WG1025465-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1254	WG1025465-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1260	WG1025465-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Total PCBs	WG1025465-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1242	WG1026349-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1248	WG1026349-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1254	WG1026349-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1260	WG1026349-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Total PCBs	WG1026349-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1242	WG1027104-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1248	WG1027104-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1254	WG1027104-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1260	WG1027104-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Total PCBs	WG1027104-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1242	WG1027627-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1248	WG1027627-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1254	WG1027627-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1260	WG1027627-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Total PCBs	WG1027627-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1242	WG1027719-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1248	WG1027719-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1254	WG1027719-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Aroclor 1260	WG1027719-1		<0.010	<0.01	mg/kg	-	0.01
Soil	MB	Total PCBs	WG1027719-1		<0.010	<0.01	mg/kg	-	0.01

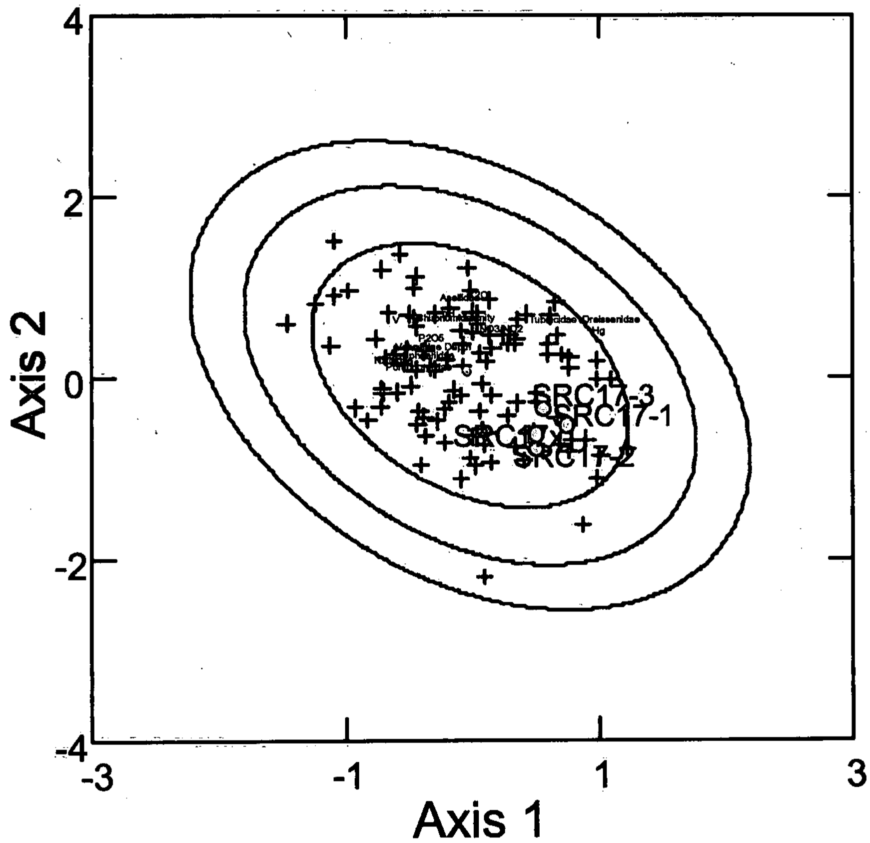

Figure D1. Assessment of field-replicated QA/QC site SRC17 (Aird Bay). Three separate box cores were taken at the site, indicated by SRC17-1, SRC17-2, and SRC17-3 and the mean of the three box cores by SRC17x.

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