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REPORT ON

NIAGARA RIVER AREA OF CONCERN
CONTAMINATED SEDIMENT
SITE ASSESSMENT
PHASE III

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EXECUTIVE SUMMARY

The Phase I/II study identified three areas within the Niagara Area of Concern (AOC) where contaminated sediment concerns warranted detailed assessment of potential impacts on biota:

- Lyon's Creek West, due to contamination of sediments and stream bank soils by arsenic, zinc and PCBs;
- Welland River, where elevated levels of copper, chromium, nickel and PAHs occurred; and
- Frenchman's Creek due to cadmium and chromium in the southwest branch of the creek and dioxins and furans in the southeast branch.

In addition, elevated levels of copper in the Welland River near Thompson's Creek in 2003, and in earlier studies by Environment Canada in 1996, warranted additional investigation of sediments in Thompson's Creek. Therefore, this site was included for sediment assessment and possible biological assessment in order to determine whether further consideration of remediation would be warranted. The basis of the Phase III investigation was the assessment of biological effects, since only where contaminants are resulting in adverse effects on biota would there be a likely benefit to the environment from remediation. These sites are the basis of the Phase III investigation that forms the subject of this report.

Lyon's Creek West

The potential effects of contaminants in Lyon's Creek West were investigated through additional soil and sediment sampling in order to gain a broader understanding of the distribution of contaminants on site, and through measurement of tissue residues of arsenic, zinc and PCB concentrations in biota relevant to the site. Vegetation (grasses and leaves) and soil invertebrates (earthworms) were analyzed for tissue residues of selected COCs, and were used to estimate exposure of terrestrial mammals, including mice, shrews and the red fox that feed upon these species to estimate exposure through consumption of food (for the compounds of concern, exposure via food was considered the most significant pathway). Tissue residues in aquatic vegetation (cattails) were used to estimate exposure to those species that feed on cattails, such as muskrats. Tissue residues from Lyon's Creek East were used to calculate BSAFs (Biota Sediment Accumulation Factors) for PCB (total and coplanar and mono-ortho PCB congeners) accumulation in benthos and fish, which were subsequently used to estimate exposure to sediments in Lyon's Creek West.

A conservative approach was taken in assessing potential risks. Since the degree of contamination by the individual COCs was highly variable across the site, the site was sub-divided into 5 smaller areas (identified as Areas A through E), that corresponded with natural habitat areas of the site. Since these areas were generally larger than the identified home ranges of most of the receptors considered in the risk assessment, the assessment proceeded through consideration of risks to the receptors assuming that they fed entirely within the sub-areas. For those receptors, such as the red fox, that feed in much broader areas than the site, the exposure was considered across the entire site. This approach ensured that for those species with small home ranges, the potential effects were not diluted in the risk assessment through consideration of nearby, uncontaminated areas. The approach thereby maximized potential exposures to those species that would be expected to spend their entire life cycle on the site.

Soil and sediment sampling revealed that high concentrations of arsenic, zinc and PCBs occurred in the stream and wetland sediments, and extended to the tops of adjacent banks, but did not extend to upland terrestrial areas. The distribution appears to be confined to those areas that would have experienced flooding during spring snow-melt and rainfall runoff events. Concentrations of the COCs in some areas of the site, such as the wetland, the remnant ditch at the northwest end, and the main stem of the creek upstream of the Canal By-Pass, exceeded screening criteria for vegetation, indicating that potential adverse effects could occur. Soil concentrations in these areas also exceeded screening concentrations for earthworms, and indicated that potential adverse effects could occur primarily due to arsenic concentrations in the soil.

Tissue residues of the COCs in terrestrial and aquatic vegetation were typically low, and BSAFs for vegetation species were typically in the order of 0.01. Since small rodents such as the deer mouse spend most of their time foraging in upland grassy areas, their exposure to the COCs was minimal. However, the relatively high concentrations of the COC in some parts of the site resulted in potential risks to some biota due to consumption of PCB and arsenic contaminated vegetation. In particular, risks were identified to the muskrat through consumption of cattails due to both arsenic and PCBs.

Tissue residues in earthworms resulted in levels of PCB that were approximately 3-fold higher than soil concentrations. This resulted in potential risks to the shrew due to PCB accumulation through feeding on earthworms. As well, since earthworms accumulated tissue residues of arsenic, these also resulted in potential risks to shrews in the wetland area, and the remnant ditch.

No effects were predicted on larger predators that would only make occasional use of the site, such as the red fox. The limited exposure to the site would likely mitigate any adverse effects.

The toxic effects of the COCs on benthic organisms was assessed directly through laboratory sediment bioassay tests using site sediments. Acute toxicity was not observed in any of the tests, and chronic effects, measured as reduction in growth, were observed only in the mayfly at one of the downstream sites where zinc and PCB concentrations were elevated. Bioaccumulation of PCBs was assessed through estimation of tissue residues using data from Lyon's Creek East.

Predicted tissue residues indicated that benthic organisms could attain tissue levels of PCBs that have been associated with chronic effects, including growth impairment.

Fish tissue residues of PCBs were also estimated using data from Lyon's Creek East. Fish were predicted to attain tissue residues that could pose a concern to fish-eating birds and mammals. However, the open water areas of the site are very limited, and fish habitat in the area is confined to small, shallow areas, that would not likely support sizable populations of fish. As well, the area is heavily overgrown with little open water, which would serve to severely restrict the use of this habitat by birds and mammals. Therefore, exposure of fish-eating bird and mammals is likely to be minimal, despite the high predicted tissue residues of PCBs in fish and benthos.

The number of receptors in which potential effects were predicted to occur for both arsenic and PCBs, and to a lesser degree, for zinc, indicates that risks to a number of species are present on this site. As such, a review of applicable remedial options would be warranted for this site to assess whether these could reduce the potential risks to acceptable levels.

Welland River

The assessment of contaminant effects in the Welland River was limited to determination of toxicity in sediment bioassay tests, since the compounds of concern (copper, chromium and nickel) are not known to bioaccumulate and biomagnify. Therefore, the effects would be limited to toxic effects on those organisms that are most likely to be directly exposed to contaminants in sediments. The assessment is based on the understanding that if there are no adverse effects on benthic organisms, that are directly exposed to the contaminants, effects on other organisms such as fish are highly unlikely.

Sediment bioassay testing showed no acute toxicity at any of the test sites in the Welland River, and indicated that chronic effects on both the mayfly and the chironomid occurred at only one location, located downstream of the Cytec site, but upstream of Thompson's Creek. Sediment concentrations of all three COCs were highest at this location. Comparison with other sites indicates that effects typically occur at higher concentrations of the COCs than were recorded at this site. However, studies using spiked sediment toxicity tests indicated that under the conservative conditions under which these tests are conducted, growth impairment could occur in some species. Therefore, in order to maintain a conservative approach it was concluded that the results of the bioassay testing could indicate that the combined effects of the COC may be resulting in some growth impairment. The limited nature of this area suggests that effects on benthic species would be limited, and no effects would likely occur at the population level, since the other areas tested yielded no adverse effects.

Additional sediment testing for PAHs yielded low concentrations in all samples, and suggest that the high concentration obtained in 2003 under the Phase I/II sampling could be due to isolated occurrences, that would likely have very limited impacts.

Sediment assessment in Thompson's Creek yielded only one location with elevated levels of contaminants (i.e., copper). Concentrations at this location were below effects levels from other sites in Ontario, and the high TOC concentration of these sediments is likely to result in minimal availability and hence limited impacts to benthic organisms. However, this should be verified through additional field investigations and biological testing.

Frenchman's Creek

Sediment bioassay testing in the southwest branch of the creek yielded no acute or chronic toxicity at sediment cadmium concentrations of 21 ug/g. This was lower than the concentration obtained in the Phase I/II study in 2003, and the results indicate that the distribution of cadmium in these sediments is variable (the bioassay sediments are collected over a larger area and therefore represent a mean concentration). Under the exposure conditions assessed the sediments are unlikely to result in adverse effects, but the presence of higher concentrations of cadmium locally in the sediments suggests that there may be potential risks to biota, and follow-up investigations would be warranted at this site.

Additional dioxin and furan analysis on the southeast tributary indicated that concentrations and TEQs, were lower than noted in the single sample collected under the Phase I/II studies. Total TEQs were elevated in the upper reaches, but did not reach concentrations that would be associated with potential adverse effects. Concentrations in the lower reaches were near detection limits, and were undetectable in the main branch of Frenchman's Creek, below the confluence of the tributary. The results suggest that there is little transport of dioxins and furans from this area to the main creek.

Conclusions

The study indicated that the only site where risks to biota were present was Lyon's Creek West. The remaining sites indicated marginal risks to biota, and the results suggest that additional investigation would be warranted before any decisions on remedial actions are undertaken.

The risks on the Lyon's Creek West site to biota suggest that adverse effects on some organisms are likely due to existing concentrations of PCB and arsenic in sediments, and secondarily due to the elevated zinc concentrations. As such, methods to reduce these risks, including potential remediation of the site, should be considered to determine whether these can effectively reduce the risks to biota.

TABLE OF CONTENTS

SECTION PAGE

LIST OF PHOTOS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

In support of the Niagara River RAP, a review of sediment conditions in 12 sites within the Area of Concern was undertaken as a move towards de-listing the area. The review comprised Phase I/II of the Niagara AOC study. The focus of the study was to determine whether additional investigation was needed at any of the sites with a view towards identifying those areas where remediation may be required. These would be assessed in further detail in the Phase III study. Since the areas included in the list represented diverse contaminant conditions, an additional aim of the Phase I/II study was to identify those sites where contaminant concerns were not substantiated and further investigation was considered to be unwarranted. Those areas could then be removed from further consideration.

The sites had been prioritised into Level 1, 2 and 3 sites by the Niagara River RAP. Level 1 sites were those where a contaminant concern had been identified, usually through significant exceedance of one or more guideline values such as the Ontario Ministry of the Environment (MOE) Severe Effect Level (SEL). Level 2 sites were those where a potential concern existed due to exceedance of guidelines such as the MOE Lowest Effect Level (LEL), while Level 3 sites were those where a marginal exceedance of LEL guidelines and/or a lack of recent information indicated that a concern may exist.

The concerns at each of the sites were assessed through a review of the contaminant history of the site, a review of the processes and operations at the site, the potential contaminants of concern (COCs) produced, and the history of monitoring at the sites. The information was summarized and was used to derive a list of potential COCs for each of the sites. This list formed the basis for developing a monitoring plan for sediments adjacent to and downstream of each site that focussed on the particular COCs. At some sites, recent studies had been undertaken and there was no identified need to undertake additional investigations.

The sites included in the assessment, and the potential contaminant concerns identified at each of the sites, were:

Location	Potential COCs
Level 1 Sites	
Lyons Creek, west of the Welland Canal By-Pass	PCBs
Welland River, Port Robinson to Chippawa Power Canal	Metals (Cr, Cu, Ni), PAHs, PCBs
Level 2 Sites	
Sir Adam Beck Reservoir	Metals
Thompson's Creek	Metals
Frenchman's Creek	Metals, dioxins/furans
Level 3 Sites	
Welland River at Oxy Vinyl (Geon)	Metals, dioxins/furans

Location	Potential COCs
Black Creek Mouth	Metals (arsenic)
Pell Creek Mouth	Metals, PAHs, PCBs
Chippawa Creek	Metals, PAHs, PCBs
Chippawa Power Canal	Metals
Niagara River at Queenston	Metals, dioxins/furans
Niagara River at Niagara-on-the-Lake	Metals, dioxins/furans

A sediment sampling program to address the COCs at each of the sites was carried out during the first week of November, 2003.

A two-step screening process was developed to identify potential concerns at each of the sites. The MOE has developed a process for evaluating sediment quality and determining when additional investigations would be warranted. The Provincial Sediment Quality Guidelines (PSQGs) are the first step in this process and are used to initially screen sediment concentrations.

Under the MOE process, where concentrations of a COC exceed the LEL, additional investigation is recommended to assess the biological significance of the exceedance. Where an SEL is exceeded, additional investigation to assess biological effects and determine the need for remedial action is typically required. This is based on the understanding that elevated levels of contaminants can occur, but through lack of biological availability, which can be mediated by a number of sediment constituents, are not resulting in adverse effects on biota. While sediment concentrations may exceed established guidelines at some sites, the approach implicitly recognizes that the guidelines are based on conservative assumptions regarding availability and toxicity, and would not be applicable to all sites. As such, the guidelines are not identified for use as cleanup targets, but merely serve to trigger additional biological investigation (Persaud *et al.* 1993, Jaagumagi and Persaud 1996). The guidance provided by the MOE (Jaagumagi and Persaud 1996) explicitly notes that remedial action should not be considered simply on the basis of exceedance of the guideline levels without further assessment of biological effects. Only where there are demonstrated adverse effects of contaminants is there a justification for consideration of intervention options.

Comparison with the MOE guidelines was conducted through a risk quotient approach:

- the maximum concentration of each parameter was considered relative to the MOE LEL and a risk quotient (RQ_L) was calculated for each parameter. This level indicated negligible risk to biota.
- Where the RQ_L > 1, concentrations were evaluated relative to the SEL. Where the RQ_S > 1, potential risks to biota were identified, and the site was considered a candidate for detailed assessment under Phase III.

Bioaccumulative substances, such as polychlorinated biphenyls (PCBs), dioxins and furans, and mercury were considered as special cases. For these compounds, the calculation of Risk Quotients based on MOE PSQGs or on toxicological testing may not be protective against the effects of bioaccumulation and biomagnification, and the following approach was used:

- the maximum concentration of each parameter was considered relative to the MOE LEL and a risk quotient (RQ_L) was calculated for each parameter. This level indicated negligible risk to biota.
- Where the RQ_L > 1, or, in the case of dioxins and furans, RQ_{PEL} > 1 (MOE guidelines were not available for these compounds and the CCME PEL was used as the benchmark), the existing concentrations were evaluated relative to a screening level risk assessment. Where risks were identified, the site was considered a candidate for detailed assessment under Phase III.

Based on the above review, three sites were identified where contaminants exceeded the screening criteria, and adverse effects on biota could potentially occur: Lyon’s Creek West; Welland River – Pt. Robinson to Chippawa Power Canal; and Frenchman’s Creek. The three sites are shown on Figure 1.

Lyon's Creek West

Contaminant concerns at Lyon's Creek West have historically centred around PCB contamination. Previous sampling at the site has revealed that the highest PCB contamination occurred in the northern section of the site, where elevated concentrations typically occurred down to depths of 30 cm (and up to 3 m in some disturbed areas). In the southern section of the site, PCBs were detected at much lower concentrations, and only in the surficial sediments.

Additional sampling for PCBs and metals indicated that potential risks exist for humans and non-human biota on the northern section of the site due to PCBs, and that additional investigation would be warranted, particularly since the risk assessment was undertaken using conservative assumptions. Exceedance of the SELs for arsenic and zinc also indicated the need for additional investigation of these COCs due to potential risks to biota.

Welland River - Pt Robinson to Chippawa Power Canal

Historical studies on the Welland River have identified metals and polycyclic aromatic hydrocarbon (PAH) compounds as the potential COCs. In particular, chromium, copper and nickel were elevated in sediments in previous studies. Both chromium and nickel appear to originate from sources upstream of this area while elevated copper concentrations appeared to be due to sources local to this reach.

Sampling results indicated that these three metals continued to be present at levels above MOE SEL guidelines and that additional assessment is warranted under Phase III. Localized occurrences of PCBs, mercury and PAH above guidelines were also noted. Exceedance of the LEL guidelines for PCBs and mercury prompted additional evaluation with respect to potential bioaccumulation. Risks to water column organisms such as fish were predicted to be low due to the low concentrations and the small areas affected.

<u>Welland River - Thompson's Creek</u>

Thompson’s Creek is a tributary of the Welland River, thus this study area was considered to be a subsection of Welland River. The Niagara River RAP identified the concerns in Thompson's Creek to be primarily due to concentrations of some metals in excess of the MOE LELs. The available information was more than 10 years old, and consequently additional sampling was undertaken at this site.

<u>Frenchman's Creek</u>

Industries along Frenchman's Creek have been associated with elevated levels of metals (mainly chromium and lead) and dioxins and furans. As a result, additional sampling focussed on these parameters, but also included both PCBs and PAHs.

Sampling results indicated that both chromium and cadmium were elevated at some locations. Concentrations of both of these metals were in excess of the MOE SEL guidelines, and would warrant additional investigation under Phase III. Elevated levels of dioxins and furans in excess of the CCME PELs indicated a potential risk to biota. Given the high uncertainty surrounding the results, this site was recommended for additional assessment under Phase III.

Based on the outcome of the initial investigation, three areas were identified where risks to biota indicated the need for more detailed assessment under Phase III:

- Lyon's Creek West, for investigation of potential effects due to PCBs, arsenic and zinc;
- Welland River, for investigation of potential effects due to chromium, copper and nickel, and at one site, PAHs; and
- Frenchman's Creek, for investigation of potential effects due to dioxins and furans in the southeast tributary, and cadmium and chromium in the southwest tributary.

In addition to these sites, sediment investigation was considered warranted in Thompson’s Creek due to elevated levels of copper in sediments at the mouth of the creek. The outcome of the sediment investigation would determine the need for any additional biological testing at this site.

2.0 STUDY APPROACH

2.1 Study Plan

2.1.1 Lyon’s Creek West

The Phase I/II study identified three concerns in Lyon's Creek West:

- contamination by PCB compounds, which was confined mainly to the northern section of the site;
- contamination by arsenic, which was confined mainly to the southeast and central section of the site; and
- contamination by zinc, which was also confined mainly to the northern section of the site.

While there is evidence to suggest there are different sources for some of the contaminants, all three contaminant concerns overlap in the wetland area, and therefore the assessment of effects considered the combined effects of the COCs in part of the study area.

The Lyon’s Creek site is unique as a contaminated sediment site in an Area of Concern since typically these sites do not include terrestrial environments. While the site was initially included in the list of sites as a result of sediment contamination, changes to the site drainage have resulted in some areas of contaminated sediment being exposed as terrestrial areas. As well, the presence of PCBs in soils in some upland areas along the banks suggests that PCBs were likely transported to the wetland during higher flows, and that ponding on the site resulted in local flooding, with deposition of suspended materials contaminated with PCBs, arsenic and zinc on the banks. Due to subsequent alteration of the drainage pattern, these areas have since remained as exposed upland areas.

As a result, terrestrial ecological pathways and exposure were considered and were targeted for additional assessment. Since the human health concerns are assessed through a separate study, the Phase III study addresses both the PCB contamination and metals contamination for ecological receptors. The selection of ecological receptors considered both terrestrial and aquatic habitats, since both sediments and soils are contaminated with, in some cases, high concentrations of arsenic, zinc and PCBs.

The Phase I/II study identified arsenic, zinc and PCBs as the contaminants of concern due to elevated concentrations in soils and sediments. However, the available data did not provide a sufficiently detailed understanding of the effects of contamination on the site on non-human biota in order to provide guidance on management actions. Therefore, the Phase III studies included methods to assess the effects of the COCs on locally relevant receptors. Some of the COCs identified on the site, such as arsenic and zinc, do not biomagnify, and the effects of these can be assessed through toxicity tests on those organisms that are directly exposed to soils and sediments, such as invertebrates. However, with PCBs, there is concern that adverse effects could occur on organisms at higher trophic levels that prey on the soil and sediment organisms, at concentrations that are well below concentrations that would be toxic to the prey organism. Therefore, toxicity tests are not sufficiently protective for assessing the effects of PCBs. As a result, the study plan developed for the site included direct assessment of the effects of arsenic and zinc through toxicity assessment as well as prediction of effects to other trophic levels through bioaccumulation measurements combined with food web modelling for PCBs.

While extensive data exist for soil and sediment contamination on-site, a number of data gaps were identified in the Phase I/II study. The extent of contamination in upland areas of the site by the COCs was largely unknown, since much of the previous sampling on-site had been concentrated in the creek channel. In particular, it was not known how far up the banks the contamination extends. Available data indicated that much of the contamination was confined to the existing creek channels, but some of the previous data suggested that the bank soils may also be contaminated. In order to characterize risks, it was necessary to understand the lateral extent of contamination in the terrestrial areas.

The second issue concerned the biological availability of the COCs from the soil and sediment matrix, since it is the bioavailable component that is of major concern regarding toxicity and bioaccumulation/biomagnification by biota. This is best determined on a site-specific basis since the type of soil/sediment can influence the availability (usually through the strength of binding to soil constituents) and therefore, availability can vary with soil type. As a result, a number of components were included in the Phase III assessment that were designed to provide a more realistic estimate of availability through direct measurement of COC uptake by biota, which would provide availability factors that could then be used to predict effects across the site.

Finally, a number of studies have noted that the toxicity of PCB compounds can vary significantly. While PCBs as a group have been considered as toxic, studies have found that only a limited number of the 209 possible congeners are toxic. As well, the effects on receptors have been found to vary with the types of PCB compounds. For example, those PCBs that resemble the dioxins in structure (the co-planar and mono-ortho PCBs that for ease of reference are referred to collectively as “dioxin-like” congeners in this report) have been associated with effects in mammals that include chlor-acne, dermal lesions, weight loss, immuno-supression, hepatotoxicity, reproductive and developmental toxicity and endocrine disruption. The non-dioxin-like PCBs (mainly the *ortho*-substituted nonplanar congeners) have been associated mainly with neurotoxicity, carcinogenicity and endocrine disruption (Giesy and Kannan 1998).

Therefore, the assessment of PCBs is made with respect to total PCBs, which usually means the technical mixtures or Aroclors (which includes all of the possible 209 PCB congeners), and with respect to dioxin equivalents through the TEQ approach (i.e., the toxic equivalency of the 12 coplanar and mono-*ortho*-substituted PCB that have been found to resemble dioxins in both structure and effects, with respect to the toxicity of 2,3,7,8-TCDD). Both assessments have been included since the available information indicates that specific types of effects are associated with each group.

Since the coplanar and mono-ortho-substituted PCBs are structurally similar to dioxins, their mode of action is also similar and accordingly, the toxicity of these congeners has been assessed relative to 2,3,7,8-TCDD (which has been identified as the most toxic of the dioxins and furans). The Phase III study, therefore, additionally focused on the dioxin-like PCB congeners in the expectation that measurement of these would permit assessment of potential effects relative to established toxicity benchmarks for the dioxins and furans.

PCBs

The potential exposure of organisms to PCBs in soils and sediments on the site is shown graphically in the Conceptual Site Model (CSM) (Figure 2). While the CSM includes organisms at higher trophic levels (e.g., top predators such as the red fox), it is often not possible to assess the effects of contaminants on these organisms directly. Therefore, the effects of biomagnifying compounds are assessed through risk modelling. In order for the modelling to be indicative of site conditions, and thereby a reliable tool for site management, empirical data from the site are necessary to conduct exposure and uptake modelling. Exposure of organisms at higher trophic levels, such as predators, is based primarily on the ingestion pathway, since this would constitute the single largest route of exposure. Therefore, by concentrating on those organisms that reside in this pathway, and are potential food items for the predators, the effects of contaminated sediments can be assessed directly on the lower trophic levels through empirical studies, and on higher trophic levels through modeling and risk estimation. Since PCBs are highly hydrophobic and are rarely detected in water samples, the effects of water exposure are considered negligible in comparison with the food sources, and therefore, the lack of water quality data is not considered a concern.

The studies conducted to date have identified potential contaminant concerns in both aquatic and terrestrial habitats. The Phase I/II study showed that elevated levels of PCBs occur in sediments in the wetland and in the remnant stream, as well as in upland areas of the site. Since all of the site is relatively low lying, it is likely that in the past, runoff events, particularly in the spring during snow melt, have resulted in the deposition of contaminated materials within the flooded areas. In addition, as a result of re-routing of the storm water ditch around the wetland area by the City of Welland, parts of the site that were previously considered as aquatic habitat have subsequently become terrestrial. Consequently, both terrestrial and aquatic receptors have been included in the assessment.

The identified receptors for assessing aquatic effects focuses on benthic organisms and fish, and through modelling, on those organisms that feed on benthos and fish, assuming the latter are present on the site. As well, since some receptors, such as aquatic mammals (e.g., muskrat) feed on aquatic vegetation, potential accumulation of the COCs by vegetation was also assessed.

Terrestrial receptors include vegetation, which may accumulate PCBs directly from soils via root uptake, and also via PCB contaminated dust that settles on plant surfaces. Local vegetation, in turn, will be an important pathway for primary consumers, including insects, small mammals, and birds (via seeds). Invertebrates, such as earthworms, may also accumulate PCBs directly from soils, and may provide a pathway by which higher trophic level organisms, such as insectivorous mammals (e.g., shrews) and birds (e.g., robins), may be exposed to elevated levels of PCBs that could affect reproduction or survival.

Since it was not considered practical to measure all possible food sources for all potential receptors, those receptors that were considered to be most at risk, due to their feeding habits, or habitat preferences, were selected for the assessment and these are included in Figure 2

Metals (Arsenic and Zinc)

The Phase I/II review has identified elevated levels of arsenic and zinc in sediments on the site. However, only a very limited number of areas were sampled. In addition, there is no current or historical soils data for arsenic and zinc and the distribution of these COCs is poorly defined relative to the current understanding of PCB distribution on the site. The assessment of ecological effects therefore, included both a better spatial understanding of arsenic and zinc distribution on the site, as well as an assessment of the ecological impacts on the site due to elevated concentrations.

The primary concern regarding arsenic and zinc is with direct toxicity to organisms, since neither element has been shown to bioaccumulate and biomagnify through trophic levels. Therefore, only those organisms directly exposed to arsenic or zinc in soils, sediment or food are likely to be at risk.

Consequently, biological assessment of the effects of arsenic and zinc in soils and sediments concentrated on measurement of toxicity to exposed organisms within these media. The effects of sediment arsenic and zinc concentrations were assessed through toxicity tests with both lethal and sublethal endpoints. Both soils and sediment testing used those organisms that, through ingestion, were most likely to be exposed to elevated levels of arsenic or zinc. In the case of soils, this focused on earthworms, since by ingesting soil, these organisms are most likely to accumulate arsenic or zinc residues and suffer potential adverse effects. As well, this facilitated assessment of potential exposure of both birds and mammals to dietary arsenic or zinc, based on measured tissue residues in vegetation and invertebrates.

2.1.2 Welland River

The Phase I and II study identified a number of locations in the Welland River where sediment metals concentrations exceeded the MOE SEL. Chromium and nickel exceeded the SEL at most of the sites sampled and appeared to be related to historical discharges from upstream sources, such as the Atlas Steel site. As well, elevated PAHs below the Oxy Vinyl site and elevated copper concentrations adjacent to and downstream of the Cytec site, including the mouth of Thompson's Creek, were also noted. None of the identified concerns in the Welland River are related to human health issues and therefore, only ecological assessment was considered in Phase III.

Since the metals of concern are potentially toxic to aquatic life, but are not known to biomagnify at higher trophic levels, the assessment was limited to determining potential toxicity to sediment-dwelling organisms, since these would be the most highly exposed receptors. Therefore, the assessment focused on bioassay testing, which was to be supplemented with benthic community assessment if adverse effects were identified in the toxicity testing. Bioassay tests measured both lethal and sublethal endpoints in mayflies and chironomids in accordance with MOE test protocols (Bedard *et al*., 1992)

2.1.3 Frenchman's Creek

The Phase I/II study identified potential concerns with dioxins and furans in the southeast tributary of Frenchman's Creek that drains from the area of Fort Erie occupied by CanOxy and Gould. Minor risks to sensitive biota were identified on the basis of the results of a single sediment sample from the creek. In addition, concentrations of cadmium and chromium in the southwest branch that drains from the Fleet site were above the SEL, and warranted additional investigation.

Since concentrations of cadmium and chromium were above the MOE SEL below the Fleet site, sediment bioassay testing was undertaken at a single site on this branch. The expected response due to cadmium would relate to toxicity, and therefore a bioaccumulation component was not proposed for investigation of this compound of concern.

Dioxins and furans in the southeast branch were assessed in a two-phased approach. Initial investigation concentrated on defining the distribution of PCDD/Fs in sediments in this branch. If consistently elevated levels of PCDD/Fs were determined, then bioassay testing would be undertaken at two of the sites for bioaccumulation testing. (An additional location was included upstream of both tributaries on the main branch of the creek to serve as a control).

Given the intermittent flows in this tributary creek, there is currently no concern with human consumption of fish from the creek and therefore a human health component was not included in the study plan.

2.2 Methods

2.2.1 Lyon's Creek West

The Phase III study was designed to address the ecological risks that were identified in Lyon's Creek West in the Phase I/II studies. The locations sampled and the details of the sampling program are summarized in Table 1.

2.2.1.1 Ecological Risk Assessment

The ecological risk assessment of Lyon's Creek West was originally designed to include both terrestrial and aquatic pathways of exposure since the contamination affected both soils and sediments on the site. Those organisms most likely to reside in these pathways, either through direct observation on-site, or through a reasonable prediction of their presence on the site (i.e., if suitable habitat was present and the area was within the typical range of the species in southern Ontario), were considered as potential receptors. Therefore, in order to estimate transfer and exposure of organisms at different trophic levels to the contaminants, on-site sampling was undertaken to quantify existing concentrations of PCBs, arsenic and zinc in site soils and sediments, and biota. This would provide site-specific transfer factors, that in turn would provide a more realistic estimate of potential effects or risks to resident biota.

The initial sampling plan included the following components:

- Vegetation sampling (terrestrial and aquatic);
- Soil invertebrates (earthworms);
- Benthic invertebrates;
- Small mammalian herbivores; and
- Fish.

The data were collected to provide site-specific values for use in the risk assessment model, which in turn was used to estimate the effects of exposure on other, higher trophic levels, as outlined in the CSM in Figure 2. The assessment assumes that the primary route of uptake in organisms is through ingestion, and that exposure through inhalation and dermal contact is negligible.

Soils and Sediments

Much of the existing data has focused on characterising the sediments within the creek bed while some additional sampling was undertaken by the St. Lawrence Seaway Authority in adjacent bank and upland areas. However, large areas of the site had not been characterised with respect to PCB concentrations. As well, the distribution of arsenic and zinc in both soils and sediments was largely unknown.

Accordingly, additional samples were collected at 38 sites, as shown on Figure 3. Sampling was conducted during two separate sampling periods. An initial sampling for soils only was conducted on July 14-15, 2004, and was limited to defining the lateral extent of contamination by arsenic, zinc and PCBs. The samples were confined to areas at the tops of the banks along both of the creek channels. Sampling results indicated that in two areas soils were contaminated above applicable guidelines and additional soil samples further back from the creek would need to be collected in order to define the limits of contamination. The additional soil samples were collected during the second sampling period in October 2004, and included additional stations at T12-N, T8-N and T10-S (Figure 3). As well, since high concentrations of the COCs were noted along the bank of the north ditch/remnant stream at T12-N, two additional transects, T-13 and T-14, located to the west of T-12, were sampled during October 6, 2004.

The soil and sediment samples consisted of composites of the top 5 cm, since this is the soil/sediment section to which most receptors would be exposed. Chemical analysis included arsenic, zinc, total PCBs and TOC at all 38 sites. At 11 of the sites (5 soil sampling sites and 6 sediment sampling sites), the soil/sediment sample was split, with one half submitted for total PCB analysis and the other half for analysis of coplanar and mono-ortho PCBs. The sites were selected such that the PCB concentrations covered a gradient from <1 µg/g to >50 µg/g (four of these sites coincided with the detailed biological assessments described in the following sections). Soil and sediment samples were analyzed by Philip Analytical Services for arsenic, zinc and total PCBs. In addition, selected soil samples were analyzed for the WHO list of 12 dioxin-like PCB congeners (i.e., the coplanar and mono-ortho PCBs), while selected sediment samples were analysed by the MOE Laboratory Services Branch for 55 PCB congeners, which included the 12 dioxin-like PCB congeners.

Vegetation

Terrestrial vegetation was sampled at 4 locations for total PCBs, arsenic and zinc during the initial sampling period in July 2004 (Table 1). Soil-vegetation transfer factors reported in the literature are in the range of 0.37 which indicates a low potential for uptake of PCBs by vegetation. Sampling in terrestrial environments concentrated on grasses and shrubs. The locations were selected such that a range of PCB concentrations would be included, from sites where PCB concentrations are <10 µg/g to those where concentrations are >50 µg/g. Sampling locations are shown on Figure 3. Leaf samples from locally occurring shrubs were collected at these locations for analysis of arsenic, zinc and total PCBs in order to determine whether there is potential for toxicity or contaminant transfer to herbivores, such as deer. At each site, a single composite sample of stem and/or leaf tissues for terrestrial plants was collected for analysis of total PCBs. Grasses were sampled as the total growth above the soil surface and did not include roots since most receptors were considered to be minimally exposed to the roots.

Sampling was also undertaken for aquatic plants, and focused on cattails, which were analyzed for arsenic and total PCBs, again across a gradient of sediment arsenic and PCB concentrations, since the species is known to be an efficient accumulator of contaminants. Cattails were sampled by selecting a 30 cm section of stem beginning at the soil/sediment/water surface. This section was selected since this is the most likely to be consumed by local herbivorous mammals such as muskrats (muskrat tracks were noted in the area during field collection). Cattails have also been found to concentrate some compounds in other studies and are also abundant in the more contaminated areas of the site. Therefore, cattails would be the most likely vegetation species to accumulate contaminants from the sediments to which aquatic herbivores would be exposed.

Sampling was conducted in two phases. Initial soil and vegetation sampling on the site was conducted in July 2004. Results of the initial sampling suggested elevated levels of arsenic occurred in tissues of some plants, and indicated that additional samples would be warranted at transect T-12, where elevated levels of arsenic, zinc and PCBs were found in bank soils. Bank vegetation consisted primarily of small shrubs in this area, with the result that collection of vegetation samples was conducted in the dried out creek bed (T12-M) on October 6, 2004. This area was densely vegetated by grasses, and therefore was considered as typical habitat for local herbivores.

Soil Invertebrates

Earthworms were collected at 2 locations that coincided with soil sampling and vegetation sampling during the October 2004 field investigations (Table 1). Due to the low density of earthworms, in order to obtain sufficient mass of material, at both T1 and T12 an area of approximately 1 m x 3 m was sampled. Worms were submitted for analysis of arsenic and total PCBs.

Small Mammals

During the initial planning for Phase III, collection of small mammals such as deer mice, voles or shrews was planned using live traps. The intent was to analyze whole body tissue residues since these represent the dose of PCBs that would potentially be available to a predator. However, the results of the initial sampling phase indicated that lateral dispersion of COCs was limited to areas within the banks. Concentrations of COCs across much of the upland areas of the site, therefore, were below detection limits, and only the area at the junction of the two branches of the creek had elevated levels of the COCs. Since this area was limited in size, it was felt that the effects on wildlife would similarly be limited, with only those mammals resident in the immediate area potentially exposed. As a result, sampling was confined to two locations: the area at the junction of the two branches which showed the highest soil contamination by all three COCs, and a control area near the south end of the wetland, where sampling during the initial sampling period in July, 2004 indicated levels of all COCs were low.

Rodents were not obtained at either of the sites within the contaminated areas of the wetland, though a rodent (deer mouse) was obtained in the upland, grassed area. The results indicated that while mice did inhabit the site, they appeared to make minimal use of the bank areas, and were primarily in the open fields adjacent to the wetland. As such, their exposure would primarily be limited to the consumption of vegetation in the open field, and possibly in the bank and drier parts of the wetland areas as well.

Benthic Invertebrates

The very limited nature of the benthic habitat in the creeks and wetland areas precluded benthic community assessment at this site. For example, permanent water was noted at only one of the sampling sites. Therefore, the effects on the benthic community were assessed through sediment bioassay testing. The test procedure followed the MOE protocol (Bedard *et al.* 1992), and included both mayflies (*Hexagenia* spp.) and chironomids (*Chironomus riparius*). Sediments were collected at 3 test sites (T1-M, T7-M and T9-M) in October, 2004. Sediment bioassay testing was undertaken by Stantec.

Fish

Due to the small size of the open water habitats on the site, which was limited to a small open pool area at the northwest end of the wetland, estimated at approximately 200 m^2, and the shallow nature of the creek from the wetland, (approximately 1 m wide and 200 m long), the habitat appeared suitable only for limited number of small forage fish (minnows). As a result of the logistical difficulties in sampling fish in the shallow, heavily vegetated areas, fish sampling was not undertaken, and fish tissue residues were estimated from sediment concentrations and benthic organism tissue residues.

2.2.2 Welland River

Additional assessment of Welland River sediments focused on assessment of ecological effects due to contamination by copper, chromium and nickel at all sites and PAHs at one site. Since the potential ecological effects were likely to be confined to, and most pronounced on, those organisms that are in direct contact with the contaminated sediments, the assessment of the

Welland River focused on toxicity to benthic organisms. Since the COCs identified are not known to biomagnify through trophic levels, and release of metals from sediments to the water column is considered to be minor (due to the organic nature of the sediments and the high TOC), only benthic organisms and bottom-feeding fish are considered to be at potential risk. Consequently, the Phase III assessment focussed on direct toxicity to benthic organisms.

Concerns in the Welland River were focused around the elevated levels of chromium and nickel at nearly all sites, as well as copper at a number of sites adjacent to and downstream of the Cytec Welland plant. As well, one area adjacent to the Oxy Vinyl site had elevated PAH concentrations in sediments. Since both chromium and nickel occur at all sampling sites, a practical approach was followed in the study plan that confined sampling and analysis to a few representative locations. Sampling locations are shown on Figure 4.

To address the metals contamination due to copper, chromium and nickel, sediment bioassay tests using mayflies and chironomids were conducted at four of the sites. Two of these coincided with elevated copper levels, which would therefore be assessed concurrently. As well, the one PAH site identified as a potential concern in the Phase I/II study was included in the sediment bioassay testing. Since the primary concern with these COCs is direct toxicity to aquatic organisms, and biomagnification is not a concern with these substances, additional testing using fathead minnows was not included. The bioassay testing measures both lethality and growth effects (i.e., sublethal endpoints).

A two-phased approach was adopted for the Welland River sites. If bioassay testing indicated that there was a concern with potential toxicity, additional assessment using benthic community assessment would be undertaken.

In addition to sampling in the Welland River, sediment samples were collected in Thompson's Creek, a tributary of the Welland River, at 3 locations as marked on Figure 4. These focused on metals, since these were the COCs that have been identified at this site. Since previous studies had shown that copper concentrations in Welland River sediments increased at those locations adjacent to, and downstream of, the Cytec site, an additional sample was collected from the small tributary that drains to the river east of the Cytec cite (shown as TC-4 on Figure 4).

2.2.3 Frenchman's Creek

Additional studies in Frenchman's Creek under Phase III concentrated on assessment of ecological effects due to metals (cadmium and chromium) in the southwest branch and dioxins and furans in the southeast branch.

Sediments

The identification of dioxins and furans as a potential concern in the southeast branch is based on a single sample collected as part of the Phase I/II investigations, and therefore, before additional biological investigations were undertaken it was determined that the results of the Phase I/II sampling should be confirmed. As a first step, sampling at additional sites was undertaken to further map the extent of sediment contamination by PCDD/Fs. Based on these results, the need for biological assessment would be determined.

Additional sediment samples for PCDD/F were collected at four locations in the tributary and one location in the main branch immediately below the confluence of the tributary for a total of 5 samples (Figure 5). Samples were collected as surficial grabs (top 5 cm).

Separate sediment analysis for cadmium and chromium in sediments in the southwest tributary was not undertaken, since sediment analysis for these elements was included in the bioassay testing as described in the following section.

Biota

Given the relatively low concentrations of dioxins and furans in creek sediments, additional biological testing was not planned unless elevated levels of dioxins and furans were confirmed. It was expected that if elevated concentrations of PCDD/Fs were found in creek sediments, these could be addressed through a risk modelling approach using appropriate transfer factors for biota.

Toxicity of cadmium in the southwest branch was assessed using bioassay tests under the MOE protocol for the mayfly and chironomid tests (Bedard *et al*., 1992). Sediments were collected from below the Fleet site and at an upstream control (the control site sampled in the Phase I/II study) (Figure 5). Lethality and growth were assessed in the exposed sites relative to the control and a negative control according to the MOE sediment bioassay protocol (Bedard *et al*., 1992).

3.0 LYON’S CREEK WEST PHASE III SITE ASSESSMENT

3.1 Soils and Sediments

Results of the soil and sediment sampling are compiled in Table 2 for arsenic, Table 3 for zinc, Table 4 for PCBs in sediments, Table 5 for PCBs in soils and Table 6 for total coplanar and mono-ortho PCB congeners. For ease of assessment, the site has been sub-divided into a number of sub-areas. These are shown on Figure 11 and represent a more or less natural division of the site based on habitat types. PCB congener analysis for sediments was undertaken by MOE and included a total of 55 congeners, though individual results for only the 12 dioxin-like PCBs (i.e., the coplanar and mono-ortho PCBs) are presented in Table 7. Laboratory reports are provided in Appendix A for all samples. The distributions of arsenic, zinc and total PCBs on the Lyon’s Creek West site are shown on Figures 7, 9, and 3 respectively .

3.1.1 Soils

The results of the soil sample analysis indicate that elevated levels of arsenic, zinc and PCBs are confined primarily to the existing creek bed, and only in the area where the two branches join (Area C, Figure 11) is there contamination in soils to the tops of the banks (Figures 6, 8 and 10). This area is at a slightly lower elevation than the remainder of the site, and it appears that during high water, flooding could result in inundation of this area.

Areas along the banks of the creek and wetland typically had low concentrations of arsenic and zinc, and non-detectable levels of PCBs. Elevated levels were noted in a few areas, such as T12-N (Area D), T8-N (Area E) and for arsenic, T6-N (Area B). All of these sampling locations are in lower areas than the adjacent banks, and re-sampling in these areas further upslope resulted in either low or non-detectable levels of the three COCs (Tables 2, 3, and 5, and Figures 7, 9 and 3). Therefore, it seems reasonable to conclude the contamination on site is confined within the high water mark for the creek and wetland.

In addition to total PCBs, the 12 dioxin-like congeners were also analysed in soils and sediments (Table 7). Since only a limited number of samples were collected, the distribution of total dioxin-like PCB congeners is estimated for the remainder of the site, and these data were subsequently used to estimate exposure of biota.

Dioxin-like PCB congeners in soils at the 6 sites analyzed were summed, and the ratio of total PCBs to total dioxin-like PCB congeners was calculated. The mean ratio of total PCB to the total of the dioxin-like congeners was used to estimate dioxin-like congener concentrations at the remainder of the sample points. Since insufficient matching results for total PCB concentrations vs. dioxin-like congeners were obtained (concentrations were below the detection limits at 3 of the sites) a relationship could not be calculated, and the mean values were used to derive a simple ratio instead. Since the Phase I/II study suggested that there had been little degradation or loss of PCBs from the site (surficial concentrations in 2003 and 2004 were similar to earlier samples in the same areas), the entire dataset from 1991 to 2004 was used to develop a detailed understanding of PCB distribution, and potential exposure to biota, on the site. The results are provided in Table 6.

3.1.2 Sediments

Arsenic concentrations show a generally decreasing trend from the southwest end of the site (T1 – Area A) towards the discharge at the canal (T11 – Area E) (Figure 6). The sampling results indicate that the contribution of arsenic from the north ditch appears to be minor. The high concentration at the southwest end of the wetland (station T3-M) suggests that the main source has likely been from the southwest via this branch, with much of the contamination contained at this end of the wetland (i.e., where the flow dissipates and any suspended sediment load would be expected to settle). The distribution of arsenic across the site is shown graphically on Figure 6. Distributions are mapped on Figure 7 and suggest transport during higher flows with subsequent deposition in the wetland as the most likely means of dispersion.

Zinc distribution on the site indicates that the north branch has been the major route for zinc entering the site (Figure 8) since concentrations were highest in this area (Area D). Concentrations in the remnant stream were much higher than in other areas of the site (zinc distributions are mapped on Figure 9). Sediment in the southwest branch (Area A) had much lower levels of zinc, though elevated concentrations at the southwest end of the wetland (station T4-M) indicate that zinc contamination has reached this area, possibly through flooding back of the wetland during periods of higher flow. The highest zinc concentration occurred along the low banks in the area of T12-N (Area D), and suggest deposition has occurred during high water periods when flows in the ditch would be higher due to higher runoff volumes within the catchment area.

PCB contamination on the site yielded the highest levels in the area of the north ditch (Area D), and in the main stem below the wetland (Area E). A trend towards increasing concentrations was apparent from the southwest to the northeast (Figures 3 and 10), with lower concentrations in the wetland (Area B), and low concentrations in the south branch (Area A). The data suggest that the bulk of the PCB contamination on the site likely entered via the north ditch.

Within the north ditch, concentrations in sediments upstream of the berm that was installed in 1994 to re-route the ditch to the north, were much lower. As noted in the Phase I/II study, this area was remediated by the City of Welland in 1991.

Similar to the approach used for site soils, the measured concentrations of dioxin-like PCB congeners in sediments were used to estimate the concentrations of total dioxin-like PCB congeners at the remaining sediment sites through calculation of simple ratios (Table 7). The results indicate that the distribution of total dioxin-like congeners relative to total PCBs was very similar in both soils and sediments (0.05, or 5% of the total PCB was comprised of the 12 dioxin-like congeners), which would be expected if both originated from the same source.

The 2004 Phase III sampling confirmed that high concentrations similar to those collected in the 1990's persist in sediments, and that the lower banks (likely those areas that were periodically inundated) also contain elevated levels of PCBs. The areas at higher elevations appear to be largely unaffected, with the result that concentrations of PCBs in the upland areas were typically low.

3.2 Assessment of Potential Effects/Risks

The effects of elevated levels of COCs in soils and sediments were assessed directly through toxicity testing, and indirectly through screening values obtained from the scientific literature. Risk/effects estimates in this section are based as much as possible on site-specific data, and include soil/sediment concentrations, tissue residues in vegetation, and tissue residues in terrestrial invertebrates. Tissue residues in aquatic invertebrates and fish are estimated based on data from Lyon's Creek East collected by the MOE and Environment Canada.

The potential receptors considered as suitable candidates for the risk assessment were:

- Deer Mouse (herbivores, feeding primarily on grasses and seeds):
- Short-tailed Shrew (feed on earthworms);
- Robin (feed on earthworms);
- Muskrat (herbivores, feed on cattails);
- Fish (feed on small invertebrates);
- Waterfowl (feed on fish and invertebrates); and
- Red Fox (preys on small mammals such as mice and shrews).

Larger herbivores, such as deer, were considered, but were not evaluated further. In the course of completing the risk calculations for the small herbivores, such as the deer mouse, it became apparent that there were minimal risks due to exposure to COCs in food (i.e., grass) for animals that spend their entire life within the contaminated areas. As well, the calculated accumulation factors for leaves (i.e., leaf-soil BSAFs) were lower than the accumulation factors for grasses, such that potential exposure to the COCs through consumption of leaves would be expected to be lower. Therefore, it became apparent that large herbivores that feed over a much larger home range than the site and would be expected to spend only a small fraction of time feeding on the site would not be significantly exposed.

The area of the site is calculated as approximately 120,000 m^2 (or 12 ha), and includes the area from the property boundaries of the lots to the west of the site, east to the canal service road, and from Humberstone Road north to the creek outlet at the canal. In the exposure calculations, it is anticipated that the area of the site will be greater than the home range of some of the receptors, and the site has been divided into a number of sub-areas (Figure 11). An attempt has been made in the delineation of sub-areas to include similar types of habitats, to the greatest extent possible. Therefore, the southwest branch to the upstream end of the wetland has been considered as one area (Area A). This area is characterized by open grassy lawn that appears to be frequently trimmed, with only the creek area containing emergent vegetation, such as shrubs (Photo 1). The area of the creek bed itself is approximately 0.5 m below the level of the adjacent area, is narrow (approximately 1 m across), and is heavily vegetated with cattails.

The wetland (Area B) consists of exposed, though often damp soils and is heavily overgrown with *Phragmites*. In specific areas surface water occurs, though typically to shallow depths of less than 0.5 m, and these areas bear significant stands of cattails (Photo 2). Sediments range from highly organic mats of decaying matter in the open water areas, to firm, black soils in the drier areas.

Area C is the short segment of creek between the wetland and the north ditch and is mainly a transition from the wider wetland area to the narrower creek bed that characterizes the area downstream of the wetland, and is perhaps the most arbitrary of the sub-divisions.

The north ditch, from the berm constructed in 1994 to the confluence with the branch from the wetland is Area D, and is characterized by dried out creek bed that has become heavily overgrown with young trees and shrubs. The former creek bed is vegetated with grasses, and while damp and wet in places, is mainly dry land (Photo 6).

The main branch below the north ditch and wetland down to the canal is Area E and is characterized by higher banks that slope back gradually along the west side, but rise steeply along the east side. There are narrow terraces along both creek banks that are indicative of erosion during high flow periods. The upland areas are characterized by tall grasses and weeds, interspersed with shrubs and trees (Photo 3). The creek bed is comprised of very soft fine sediments with decaying organic detritus, with a narrow channel of open water (Photo 4). Cattails line the margins along both sides of the creek. Open water is present only at the downstream end of the creek, above the culverts to the Canal, where it is fed by water from the 1994 diversion of the ditch (Photo 5).

Where the home range of the receptor coincides with the size of these sub-areas, it is assumed in the exposure estimates that 100% of the exposure occurs within the sub-area.

The potential receptors are identified in Figure 2. Fish-eating birds in the aquatic environment are not assessed directly due to the lack of suitable habitat at the site which in turn is a function of the low water within the system. The low water levels are related to the re-routing of the north ditch around the existing wetland area in 1994, which, given the current volume of water in the ditch, diverted a substantial amount of water from the wetland area. As a result, there has been a reduction in available habitat for fish and waterfowl, such that few receptors are currently present on the site. The lack of sizable fish habitat within the wetland means that currently there is very limited potential for exposure of fish-eating wildlife. Similarly, the use of the wetland by waterfowl would be very limited due to the small areas of open water.

Open water areas existed as a small pool near the northeast end of the wetland at the location of station T5-M. This area consisted of open areas of surface water with isolated patches of cattails, indicating shallow depth. The area measured approximately 20 m x 10 m. A small area of open water existed in the bed of the creek from approximately the downstream end of the wetland to the discharge at the canal, a distance of approximately 200 m, which was typically 0.5 m wide in the upper and middle sections, and approximately 1 m wide in the lower 20 m section. During both the July and October site visits there was no open water connection between the ponded area and the creek. The water depth in the ponded area was less than 0.5 m, while water depth in the creek was up to 1 m in the area below the confluence of the two branches, and decreased to approximately 0.1 m in the lower section, upstream of the by-pass ditch. Therefore, the total area of available habitat for waterfowl is approximately 300 m^2. No waterfowl were observed in the area during any of the site visits.

The wetland area itself is approximately 200 m x 30 m, and the creek bottom is approximately 2 m wide for the 200 m length from the lower end of the wetland to the discharge, for a total approximate area of 6800 m^2. Based on these estimates, open water areas suitable for fish or waterfowl use would be limited to approximately 5% of the wetland area. The rest of the wetland is dominated by dense growths of *Phragmites*, with little or no surface water, and would generally be inaccessible to waterfowl. Fish habitat is limited by the size and depth of surface water on the site, and would be limited to minnows and other small fish species. However, MNR has recorded smallmouth bass from the wetland area in the early1990s prior to re-routing of the ditch, which suggests that this area has provided suitable fish habitat in the past.

Based on the above observations, waterfowl use of the area is expected to be minimal, particularly with large expanses of wetlands nearby in the Welland River and Lyon’s Creek East that would provide more suitable habitat. Exposure of wildlife through consumption of fish is, therefore, expected to be negligible.

The exposure of wildlife is based on the generic equations provided in the CCME guidance (CCME 1996):

$$ADD_{pot} = \sum_{k=1}^{m}(C_k \times FR_k \times NIR_k \qquad \text{(Equation 1)}$$

where: ADD_{pot} = potential average daily dose (mg/kg)
C_k = average contaminant concentration in the k[th] type of food (mg/kg w.w)
FR_k = Fraction of the intake of the k[th] food type that is contaminated
NIR_k = Normalized ingestion rate of the k[th] food type (w.w.)
m = number of contaminated food types.

Similarly, soil or sediment ingestion is estimated by the following equation from CCME (1996):

$$ADD_{pot} = \left[\sum_{k=1}^{m}(C_k \times FS \times IR_{total} \times FR_k)\right] / BW \qquad \text{(Equation 2)}$$

where: ADD_{pot} = potential average daily dose (µg/g)
C_k = average contaminant concentration in soil in k[th] foraging area (µg/g d.w.)
FS = fraction of soil in diet
IR_{total} = Food ingestion rate (kg/day d.w.)
FR_k = fraction of total food intake from the k[th] foraging area
BW = body weight (kg)
m = total number of foraging areas.

Total exposure is then estimated on the basis of exposure via food, and exposure via incidental ingestion of soil as the sum of Equations 1 and 2.

Exposure to PCB congeners was also estimated from soil. In order to estimate the concentration of dioxin-like congeners on the site, the ratio of total PCBs to the total for the 12 dioxin-like congeners was calculated for each of the sample results where congeners were analyzed. A mean ratio was then calculated to derive a conversion factor (Equation 3).

$$CF_{con} = \sum_{N} \frac{\left(\frac{[tPCB_{con}]_n}{[tPCB]_n}\right)}{N} \qquad \text{(Equation 3)}$$

where: CF_{con} = Conversion factor for estimating congener concentration;
$[tPCB_{con}]_n$ = sum of PCB toxic congener concentrations in the n[th] sample;
$[tPCB]_n$ = total PCB concentration in the n[th] sample; and
N = number of samples

This ratio was applied to the remaining total PCB concentrations in soil to obtain an estimated concentration of PCB congeners. Subsequently, in order to estimate total PCB TEQs, the ratio of total dioxin-like congeners to total TEQ (using the WHO TEFs for mammals) was calculated for the samples collected on site (Equation 4).

$$CF_{TEQ} = \sum_{N} \frac{\left(\frac{[tPCB_{TEQ}]_n}{[tPCB_{con}]_n} \right)}{N} \qquad \text{(Equation 4)}$$

where: CF_{TEQ} = conversion factor for estimating total mammalian TEQ;
$[tPCB_{TEQ}]_n$ = concentration of total TEQ in n^{th} sample;
$[tPCB_{con}]_n$ = concentration of total dioxin-like congeners in the n^{th} sample; and
N = total number of samples.

Based on this conversion factor, a TEQ was estimated for the remaining sample sites in order to calculate the mean and upper 95% C.L. (confidence limit) for TEQs.

Since PCB congeners were not analyzed in grass or earthworm samples, PCB congeners were estimated in grasses and earthworms by applying the BSAF for uptake of total PCBs calculated from site data for grasses and earthworms respectively to the estimated toxic congener concentration in soil. The assumption is made that the ratio in which the dioxin-like congeners occur in soil also applies to the uptake of the dioxin-like congeners in plants and earthworms, and that these organisms would accumulate the dioxin-like congeners in the same ratio at which they occur in the soil. This is likely an overestimate, since the MOE young-of-the-year fish data from Lyon's Creek East (discussed in Section 3.2.7) indicates that uptake is variable, and not all of the dioxin-like congeners are accumulated equally. However, the mean BSAF for accumulation of PCB congeners from sediment by oligochaetes in the MOE data was calculated as 3.84, which is higher than the calculated earthworm BSAF of 2.35 for total PCBs that was used in estimating uptake of the dioxin-like congeners from soil by earthworms. However, the MOE estimates are based on total PCB calculated as the sum of 55 PCB congeners and not total PCBs, and therefore the MOE estimate may be overly conservative. Nonetheless, the comparison indicates that the BSAFs upon which the estimates are based are reasonable approximations of availability of PCBs from soil.

Finally, the TEQ was estimated by first calculating the total mammalian TEQ for the soil samples, then determining the ratio of the concentration of the dioxin-like PCB congeners to the total TEQ, and applying this ratio to the estimated concentration of dioxin-like PCB congeners in the soil. For the grass and earthworm TEQ concentration estimates, the ratio of Total Toxic (dioxin-like) PCB Congeners:Total TEQ (Equation 4) as calculated from the soil samples was applied to the estimated tissue residues of PCB congeners.

3.2.1 Terrestrial Vegetation

Initial screening of potential risks to vegetation was undertaken using phytotoxicity screening values from the literature. These are concentrations of the contaminants of concern in soils that have been shown in toxicity tests to result in measurable effects on plants, usually measured as effects on growth (i.e., chronic or sublethal effects). The screening values are typically based on spiked soil/sediment tests, and as such, represent conservative estimates.

The reported No Observed Adverse Effect Levels (NOAELs) for soil for the protection of plant species from Sample *et al.* (1996) were 10 µg/g for arsenic, 40 µg/g for zinc and 40 µg/g for PCBs. The CCME (1996) guidance for the protection of vegetation provides guidelines of 20 µg/g for arsenic, 600 µg/g for zinc and 0.5 µg/g for PCBs. Since the value for zinc provided by Sample *et al.* (1996) is lower than the background zinc concentrations at the site, the values provided by Sample *et al.* are considered as overly conservative, and comparison is made to the CCME guidelines for the COCs. For each location, a risk quotient (RQ_{Veg}) was calculated for each of the COCs, based on the CCME guidance. A potential risk is identified where the $RQ_{Veg} > 1$, with the risk potential increasing with increasing RQ_{Veg} values.

The screening concentrations represent conservative values that are based on the most sensitive receptor, similar to the methods used to derive guidelines. As such, they will not necessarily represent conditions that would occur at the site, i.e., a $RQ_{Veg} > 1$ does not necessarily mean that an adverse effect will occur. The ratio merely indicates a greater potential for risks as the value increases above unity. Nonetheless, the risk quotient method provides a means by which concentrations of COCs can be screened to assess potential risks.

The RQ_{Veg} values calculated from the soil and sediment sampling results are presented in Table 2 for arsenic, Table 3 for zinc and Tables 4 and 5 for PCBs in sediments and soils respectively.

In addition to simple comparison with calculated screening levels, tissue residue results were considered as a measure of the potential availability of the COC from soils and sediments. Since a limited number of sites were sampled for vegetation analysis, the results from these are calculated as mean BSAF values for each plant species from which the potential concentrations are estimated for the remainder of the site. BSAFs are calculated as the concentration in the soil or sediments and the concentration in plant tissue as:

$$BSAF = \frac{[biota]\ \mu g/g\ wet\ weight}{[soil/sediment]\ \mu g/g\ dry\ weight} \qquad \text{(Equation 5)}$$

Calculation of the BSAF on a dry weight soil to wet weight tissue permits estimation of the wet weight concentration in plant tissues. The results were used to estimate potential uptake from soils, and can be considered as a measure of potential availability of the COC. As well, the tissue residues provided a measure of potential exposure of various herbivorous receptors on the site, and thereby provided base data for use in modeling exposure of higher trophic levels.

Measured and estimated BSAFs in the plant species tested are provided in Table 2 for arsenic, Table 3 for zinc and Tables 4 and 5 for PCBs in sediments and soils respectively.

Arsenic

The results of vegetation sampling for arsenic are presented in Table 2. In general, uptake of arsenic by plants was very low. In aquatic species, the highest accumulation factor (ratio of arsenic in cattail tissue vs. concentration in sediment) was 0.02 at station T9-M. Among terrestrial species, the highest ratio of uptake (BSAF) for arsenic was 0.14 at station T6-N in the grasses, while the highest ratio of uptake (BSAF) in leaf tissues occurred at station T1-N. In general, plants appeared to accumulate low concentrations of the COC.

In bank or upland areas, based on a simple comparison of concentrations on-site to the CCME screening values, three areas along the banks, T6-N (Area B), T12-N (Area D) and T10-S (Area E), exceeded these values for arsenic and resulted in RQ_{veg} values ranging up to 2.3. Additional sampling further up the banks at T12-N+15 and T10-S+5 yielded soil concentrations below this benchmark, and indicate that potential risks to vegetation are confined to limited areas of the banks.

In contrast to the bank soils, the majority of the wetland soils/sediments exceeded the screening values for arsenic, with concentrations up to 24 times higher at station T3-M (i.e., a RQ_{veg} of 24). The distribution of arsenic in wetland soils/sediments indicates that most of the potential risk is confined to the southern end of the wetland and the southwest ditch (T1-M to T6-M (Areas A and B)), with localized areas of higher risk in the main stem below the wetland area (T8-M (Area E)). Risk quotients ranged from a low of 1.7 at T8-M downstream of the wetland, to a high of 24 at the south end of the wetland. While the screening values are necessarily conservative, the areas with greatest exceedances of the screening concentrations can be considered as presenting potential risks to plant growth.

Zinc

Comparison with the CCME screening value for zinc in soil of 600 µg/g w.w. indicates that exceedances occurred primarily in the north ditch (T13-S, 12-N and T7-N (Area D)) where RQ_{veg} values ranged up to 6.9, and in the main stem below the wetland (T10-S (Area E)). In some cases, such as T12-N, zinc concentrations were well above the screening values (up to 6.9 times at T12-N).

Zinc concentrations in sediments exceeded the CCME screening criteria predominantly in the north branch (Area D) and in the north end of the wetland (Area B). Calculated risk quotients (Table 3) were relatively low at most sites (RQ_{veg} values ranged up to 4.9), and may indicate some risks to vegetation at the mouth of the north ditch (Area D).

PCBs

PCB concentrations in bank soils exceeded the CCME screening values at limited locations in the north ditch and in the main stem below the wetland. As with zinc, potential risks, assessed as RQ_{veg}, were only identified in isolated locations in the north ditch (T12-N and T7-N (Area D)), and in the main stem (T8-N, T8-S, T9-N and T10-S (Area E)). However, RQ_{veg} values in this area ranged up to 173 and suggest adverse effects are likely in this area.

The accumulation of PCBs was assessed in both grasses and leaves. Uptake factors ($BSAF_{grass}$) in grasses were 0.01 (Table 5), and are considered low.

PCB concentrations in sediments are considered to present potential risks to vegetation at concentrations above 0.5 µg/g w.w. (CCME 1999). RQ_{veg} values ranged up to 164, and nearly all sites in the wetland (Area B), the north ditch (Area D) and the main stem (Area E) exceeded the screening level, often by significant amounts. PCB uptake factors for cattails ($BSAF_{cattails}$), based on the ratio of wet weight PCB in tissue to a dry weight of PCB in sediment, was 0.009 (Table 4).

As noted earlier, the screening values are based on toxicity tests using spiked soils. As a result, bioavailability would be expected to be higher in these tests than would occur from natural soils where weathering would favour formation of complexes that would limit uptake and toxicity. Under field conditions therefore, toxicity would be expected to occur at higher concentrations of the PCBs than is indicated by the screening level.

Summary

PCB concentrations in soils/sediments indicate that higher potential risks occur in the north ditch (Area D), the north end of the wetland (Areas B and C), and in the main stem below the wetland (Area E). The majority of the sampling sites in these areas significantly exceeded the RQ_{veg} values and indicate potential risks to vegetation could occur. (Studies conducted under Phase I and II indicated little change in PCB concentrations has occurred on the site since the early 1990s, and that PCB concentrations in 2003 were comparable to the concentrations obtained during previous sampling. Therefore, it is concluded that exposure could still occur to these levels, and accordingly they have been included in the dataset).

Limited risks were also identified due to elevated levels of arsenic and zinc, mainly in the southwest ditch (Area A) and wetland (Area B) for arsenic and in the north ditch (Area D) and main stem (Area E) due to zinc.

3.2.2 Terrestrial Invertebrates

Concentrations of arsenic and PCBs were measured in terrestrial invertebrates (earthworms) at two of the sites. Sampling locations were selected such that they would provide low and high concentrations of each contaminant. Since the distribution of arsenic and PCBs indicated that the two did not co-occur at elevated concentrations except in the wetland (Area B), the station selected for the higher arsenic exposure (T1-M) was also the location for the lowest PCB exposure, while the station for PCB exposure (T12-M) had relatively low arsenic concentrations. Concentration factors for arsenic ranged from 0.31 at station T1-M to 0.13 at station T12-M and indicate that bioaccumulation may be concentration dependent. Concentration factors for PCBs ranged from a nominal value of 1.0 at station T1-M (sediment concentrations were below the detection limit of 0.05 µg/g) to 2.35 at station T12-M. In order to assess exposure and calculate potential uptake, the higher values are used for each since this would represent the most conservative approach.

The measured tissue residues of arsenic and PCBs were used to estimate tissue residues across all sampling locations in order to provide a base from which to predict exposure of those species, such as shrews, that feed on earthworms. Earthworm tissue residues were estimated based on calculated BSAFs as shown in Equation 5. Since worms were collected at station T1 in the ditch immediately adjacent to open water, the sediment concentrations have been included in the estimation of tissue residues in the expectation that earthworms would inhabit the bank areas adjacent to sediment sampling areas. It is also assumed that soil concentrations in immediately adjacent areas would be similar to sediment concentrations, and that the estimation of earthworm tissue concentrations on the basis of sediment concentrations would provide a realistic estimate of exposure through bank soils. Bank soils immediately adjacent to the creek bed were sampled only in the north ditch (Area D), and indicate that the concentrations of COCs were similar to the creek sediments, and that this is, therefore, a reasonable assumption.

<u>Arsenic</u>

Screening levels for arsenic for the protection of soil invertebrates are based on the reported values from the literature. Efroymson *et al.* (1997) report a value of 60 ppm (µg/g) for screening of soils for effects on earthworms. This value is based on a study in *Eisenia fetida* in which earthworms were exposed to 68 ppm (µg/g) potassium arsenate in soil (Fischer and Koszorus, 1992). Earthworms experienced a 56% reduction in the number of cocoons produced per worm at this exposure concentration, which was the most sensitive endpoint. Based on this screening value, a limited number of specific locations on the site would present potential risks to earthworms, and include two locations in the southwest ditch (stations LC-1 (2003) and T2-M (2004) (Area A)), the south and north ends of the wetland (stations T3-M and T6-M (Area B)), and the main creek stem below the wetland (station LC-8 (2003) (Area E)). However, none of the mean values for the sub-areas resulted in exceedances of the screening criteria.

Zinc

The screening levels for zinc for the protection of soil invertebrates are based on values from Efroymson *et al.* 1997, who reported a value of 100 µg/g for screening soils for potential effects on earthworms. The screening benchmark is based on two studies in which *Eisenia fetida* were exposed to zinc in soil. In the first, cocoon production was reduced in two artificial soils containing 136 µg/g and 142 µg/g (Spurgeon and Hopkin, 1996); in the second, the LC50 of zinc for *Eisenia fetida* was divided by 5 to result in an effect concentration of 132 µg/g (Neuhauser *et al*., 1985). Based on this screening value, virtually all areas of the site exceed the screening value, including sampling sites in Area A, which have no indication of local sources of zinc, and suggest that this screening value is likely set too low.

PCBs

The tissue residues of PCBs at the two sites sampled permitted an estimation of potential tissue residues in worms from other areas of the site, based on the calculated BSAFs. The mean BSAF of 2.35 was used to estimate tissue residues in the remainder of the site based on soil concentrations (the predicted tissue residues are provided in Table 5 and are broken down by area). No studies directly relating toxicity of total PCBs to earthworms could be found. Therefore, toxicity is assessed relative to TEQ (WHO, 1997) estimated on the basis of BSAFs. The CCME guidelines report a single study regarding dioxin/furan toxicity to earthworms. The lethal concentration in soil ranged from 5-10 mg/kg 2,3,7,8-TCDD (5-10 mg/kg TEQ). Estimated TEQ values in soil at Lyon’s Creek West ranged up to 2.1 ng/g (Table 7), which is well below the effects level cited in CCME (1999). Therefore, PCBs are unlikely to exert a toxic effect on earthworms, and the primary concern will be with bioaccumulation of PCBs to higher trophic levels.

Summary

Only limited areas of the site were identified with potential risks to earthworms due to arsenic contamination. While risks were identified from exposure to zinc relative to screening concentrations from the literature in all areas of the site, these include those areas with no identified sources of zinc, and suggest that the available screening concentrations are set too low.

PCB TEQs, were below screening benchmarks and suggest there is no likely toxic effect on earthworms from current levels on-site. However, earthworms have accumulated PCBs in tissues to concentrations higher than in sediments, and the potential effects of bioaccumulation and biomagnification of PCBs through consumption of earthworms by some receptors is a concern. These issues are addressed in the appropriate areas of the following sections.

3.2.3 Terrestrial Herbivores

The deer mouse is considered the most likely terrestrial herbivore to be present on the site. The deer mouse is the most common rodent in eastern Canada (Banfield 1974), and is ubiquitous in grasslands and open fields, feeding on vegetation, of which grasses comprise a significant fraction of their diet. A single specimen was caught on the site, but in the upland areas away from the creek banks; no specimens were caught in the bank or former creek bed areas. Since soil concentrations of the COC were low in the upland areas, tissue analysis for the specimen caught in this area was not undertaken since this would not be representative of exposure in the more contaminated areas of the site.

The following assessment of exposure is based on estimates of feeding in different areas of the site. This is necessarily a conservative approach, and may overestimate exposure in some areas where the home range of the mouse overlaps one or more sub-areas with different contaminant concentrations. The exposure estimates are based on the following assumptions:

- Since each of the sub-areas is larger than the estimates for the home range (see table below), the mouse is assumed to feed entirely within each sub-area;
- The dietary exposure to the COCs consists of exposure through food, assuming that 48% of the diet consists of grasses;
- Since some soil is typically ingested during feeding, the incremental additional exposure through soil ingestion is estimated using standard equations (see below) and the soil ingestion rate provided in the table below;

The exposure is calculated as a daily dose of the COC based on the equations given below, and these are compared to the screening benchmarks as provided in the table below.

Model Parameters for Estimating Exposure To Deer Mouse

Parameter	Value	Units	Ref
Body weight	0.022	kg	Sample *et al.* 1996
Food ingestion rate	0.0034	kg/d	Sample *et al*. 1996
Fraction of food comprised of grasses	<48%		Sample *et al.* 1996
Soil ingestion rate	0.000068	kg/d	Sample *et al.* 1996
Home range	0.059	ha	EPA 1993
Fraction of time on site	1.0		Assumption
Arsenic Screening concentration (NOAEL)	0.136	mg/kg-bw/day	Sample *et al.* 1996

Parameter	Value	Units	Ref
Arsenic Screening concentration (food)	0.88	mg/kg-bw/day	Sample *et al.* 1996
Zinc Screening concentration (NOAEL)	319.5	mg/kg-bw/day	Sample *et al*. 1996
Zinc Screening concentration (food)	2067.6	mg/kg-bw/day	Sample *et al*. 1996
PCB Screening concentration (NOAEL)	0.06	mg/kg-bw/day	Sample *et al*. 1996
PCB Screening concentration (food)	0.39	mg/kg-bw/day	Sample *et al.* 1996

For the exposure calculations, PCB accumulation through the ingestion of water is assumed to be negligible.

Since the wetland area consisted of damp soil or localized areas with surface water, and was vegetated exclusively with *Phragmites* or cattails, it is assumed that mice would not feed in this area due to the unsuitable nature of the habitat. Therefore, the exposure calculations do not include the wetland area.

Assessment of potential effects on the deer mouse is based upon vegetation tissue residue data for arsenic, zinc and PCBs. Measured concentrations in grasses from the site are used as the sources of exposure through food. Other reference values are taken from Sample *et al.* (1996). Since PCBs do not partition to any substantial degree to water, the water concentration is assumed to be negligible, and most of the daily intake of water is assumed to be through the food. Therefore, exposure through consumption of food is calculated through the following equation:

$$ADD_{grass} = [COC]_{grass} \times FR_{grass} \times IR \qquad \text{(Equation 6)}$$

where:
- ADD_{grass} = average daily dose
- $[COC]_{grass}$ = concentration of COC in grass
- FR_{grass} = fraction of diet comprised of grass
- IR = ingestion rate.

Incidental soil ingestion was estimated using the following equation:

$$ADD_{soil} = [COC]_{soil} \times IR_{soil} \qquad \text{(Equation 7)}$$

where:
- ADD_{soil} = average daily dose from sediment ingestion
- $[COC]_{soil}$ = concentration of COC in sediment
- IR_{soil} = ingestion rate of sediment.

Total exposure through ingestion was calculated as:

$$ADD_{total} = ADD_{grass} + ADD_{soil} \qquad \text{(Equation 8)}$$

Exposures are based on the measured concentrations in soil and grasses at each sample site. The BSAF for transfer from soil to grass is calculated based on the measured data in Tables 2 to 6. A mean BSAF for the site for each COC is used to estimate tissue residues in grasses at the remaining sample locations (i.e., the locations where vegetation samples were not collected). This is based on the assumption that the BSAFs at all sites will be within the defined range for BSAFs and that this range is adequately described by the mean BSAF for the site.

For PCBs, historical data from the site are included in the exposure estimates. Studies conducted under Phase I and II indicated little change in PCB concentrations has occurred on the site since the early 1990s, and PCB concentrations in 2003 were comparable to the concentrations obtained during previous sampling. Therefore, it is concluded that exposure could still occur to these levels, and accordingly they have been included in the dataset.

Exposure of the mouse to the COCs is then calculated using the estimated tissue residues for grasses at each location, with the estimated exposures for all stations within a specific sub-area then averaged to obtain an average daily dose for each sub-area.

Arsenic

Sample *et al*. (1996) estimate a NOAEL of 0.126 mg/kg-bw/day for arsenic based on reproductive effects (embryo development). Reported average weight of mice is provided in Sample *et al*. (1996) as 0.022 kg, with a reported food intake rate of 0.0034 kg/d for an estimated NOAEL of 0.136 mg/kg-bw/day. The mean concentration of arsenic in grasses on the site was calculated from BSAFs for the sites where concentrations in grasses were measured and these are provided in Table 2. Estimated exposures calculated on the basis of mean BSAFs for the four areas are presented in Table 2.

Only one area, the North Ditch (Area D), resulted in estimated exposures above the NOAEL of 0.136 mg/kg-bw/day, and only a slight risk was identified based on a comparison of the estimated mean daily dose of 0.142 mg/kg-bw/day with the screening value of 0.136 mg/kg-bw/day. Given that laboratory-based tests are usually more conservative, this difference is likely negligible. The screening level based on food consumption was 0.88 mg/kg-bw/day, and therefore, mean estimated exposure concentrations in the different sub-areas were all below the screening concentration. The results indicate that no risks are likely to the deer mouse due to consumption of arsenic through food.

Zinc

Zinc concentrations were estimated in a similar manner using the NOAEL of 319.5 mg/kg-bw/day, and resulted in no identified risks for any of the areas (Table 3). Predicted exposure concentrations were well below the NOAEL in all areas of the site.

PCBs

Toxicity reference values for PCBs were obtained from SRS (1999), and provide a NOAEL of 0.068 mg/kg-bw/day for a mouse of body weight of 0.014kg. Based on the above reported weight for the deer mouse, this results in an estimated NOAEL of 0.06 mg/kg-bw/day. The results (Table 5) indicate that exposure of the deer mouse to concentrations in excess of this benchmark are not likely to occur in any of the areas on the site and there are no predicted risks due to PCBs.

Exposure to PCB congeners was compared to published data on TCDD toxicity through comparison of TEQs. The CCME (1999) reports a number of studies that calculated NOAELs for small mammals. The reported NOAELs ranged from 0.0007 µg TCDD/kg/day (0.0007 µg/kg/day TEQ) to 600 µg TCDD/kg/day (600 µg/kg/day). Average daily doses to the deer mouse in Area D (the north ditch) are at the lower end of this range (Table 6; 1.829 ng/kg/day or 0.0018 µg/kg/day) and identify low potential risks. Since the predicted exposure is at the low end of the range, and the screening criteria represent a conservative approach, this suggests that effects due to PCB would be low.

Summary

Risks to the deer mouse through exposure to the COCs were negligible in the majority of the site, and only minor potential risks were identified in the area of the North Ditch (Area D) due to exposure to PCB congeners.

3.2.4 Terrestrial Insectivore

Both the shrew and robin were considered as potential receptors for assessing exposure to on-site contaminants via ingestion of invertebrates since earthworms are known to comprise significant portions of the diet of each. The robin, however, is likely to feed only in open upland areas of the site. Since the more contaminated areas, particularly the north ditch, are in areas of densely vegetated scrub, the robin is unlikely to be present and feeding in these areas. As well, the home range of the robin is larger than the site and therefore, the exposure of the robin to on-site contaminants is likely to be lower than the shrew. In order to ensure that a conservative approach was followed, the shrew was selected as the most suitable receptor.

Shrews, while not recorded from the site, are considered to be potentially present on the site since there is available habitat, and shrews are ubiquitous in southern Ontario (Banfield 1974). Shrews were used to estimate risks since they typically have a smaller habitat range than avian receptors, such as robins, and are likely to inhabit and feed in the more contaminated areas of the site. Therefore, exposure and risk are assessed on the basis of sub-areas within the site.

The exposure is calculated as a daily dose of the COC based on the equations given below, and these are compared to the screening benchmarks as provided in the table below.

Model Parameters for Estimating Exposure To Short-Tailed Shrew

Parameter	Value	Units	Reference
Body weight	0.015	kg	Sample *et al*. 1996
Food ingestion rate	0.009	kg/d	Sample *et al.* 1996
Fraction of food comprised of earthworms	31.4%		Sample *et al.* 1996
Soil ingestion rate	0.00117	kg/d	Sample *et al.* 1996
Home range	0.39	ha	EPA 1993
Fraction of time on site	1.0		
Arsenic Screening concentration (NOAEL)	0.15	mg/kg-bw/day	Sample *et al*. 1996
Arsenic Screening Concentration (food)	0.25	mg/kg-bw/day	Sample *et al*. 1996
Zinc Screening Concentration (NOAEL)	351.7	mg/kg-bw/day	Sample *et al.* 1996
Zinc Screening Concentration (food)	586.1	mg/kg-bw/day	Sample *et al.* 1996
PCB Screening Concentration (NOAEL)	0.066	mg/kg-bw/day	Sample *et al.* 1996
PCB Screening Concentration (food)	0.111	mg/kg-bw/day	Sample *et al.* 1996

For the above calculations, water ingestion rate is assumed to be negligible.

The size of the site is estimated at 12 ha, and as shown in the table above, the home range of this species is much smaller than the site. As with the deer mouse, exposure estimates are based on division of the site into a number of sub-areas. These are included in Tables 2 to 6, and are shown on Figure 11.

Earthworm tissue residue concentrations across the site were predicted on the basis of calculated BSAFs for the two sites where worms were obtained. The mean BSAF was calculated for each site and earthworm tissue residues were estimated for the remaining sample sites based on the mean BSAF and measured sediment concentrations.

The following assessment is based on estimates of feeding in different areas of the site. The exposure estimates are based on the following assumptions:

- Since each of the sub-areas is larger than the estimates for the home range (see table above), the shrew is assumed to feed entirely within each area;
- The dietary exposure to the COCs consists of exposure through food, assuming that 60% of the diet consists of earthworms;
- Since some soil is typically ingested during feeding, the incremental additional exposure through soil ingestion is estimated using standard equations (see below) and the soil ingestion rate provided in the table above;
- Since earthworms occurred in bank soils immediately adjacent to open water, the shrew is assumed to feed within the wetland area since large areas of the wetland did not contain surface water;
- Since earthworms were obtained from bank soils immediately adjacent to the creek, the sediment concentrations of the COCs are assumed to be representative of these soils, and were used in the estimates of exposure; and
- For PCBs, historical data from the site are included in the exposure estimates. Studies conducted under Phase I and II indicated little change in PCB concentrations has occurred on the site since the early 1990s, and PCB concentrations in 2003 were comparable to the concentrations obtained during previous sampling. Therefore, it is concluded that exposure could still occur to these levels, and accordingly they have been included in the dataset.

Estimates of exposure to the COCs through exposure via food (earthworms) is calculated using the following equation:

$$ADD_{earthworms} = [COC]_{earthworms} \times FR_{earthworms} \times IR \qquad \text{(Equation 9)}$$

where: $ADD_{earthworms}$ = average daily dose
$[COC]_{earthworms}$ = concentration of the COC in earthworms
$FR_{earthworms}$ = fraction of diet comprised of earthworms
IR = ingestion rate.

Incidental soil ingestion was estimated using the following equation:

$$ADD_{soil} = [COC]_{soil} \times IR_{soil} \qquad \text{(Equation 10)}$$

where: ADD_{soil} = average daily dose from sediment ingestion
$[COC]_{soil}$ = concentration of COC in sediment
IR_{soil} = ingestion rate of sediment.

Total exposure through ingestion was calculated as:

$$ADD_{total} = ADD_{earthworms} + ADD_{soil} \qquad \text{(Equation 11)}$$

The exposure estimate does not consider other potential sources of the COCs, though these are likely to result in minor additional doses compared to ingestion of food.

Arsenic

The results of the exposure estimates are presented in Table 2. In Table 2, the estimated daily doses were averaged over each of the sub-areas to obtain an average daily dose for that sub-area.

Comparison with the NOAEL levels in the table above indicates that there are potential risks to the shrew in all areas of the site, with the highest risks in the North Ditch (Area D) and in the wetland (Area B). All areas had elevated soil/sediment concentrations of arsenic, and tissue residue data showed accumulation of arsenic in earthworm tissues. Comparison with the food screening criteria in the table above of 0.25 mg/kg-bw/day indicates that all areas would also exceed this criterion and that potential risks are present.

Zinc

Risks to shrews from consumption of earthworms were not calculated, since earthworm tissues were not analyzed for zinc.

PCBs

Based on the calculations in Table 5, exposure of shrews to PCBs through consumption of earthworms is expected to significantly exceed the screening concentration of 0.066 mg/kg-bw/day (the screening value has been derived from the NOAEL for the mouse using the conversions provided in Sample *et al*. (1996)) in the North Ditch (Area D), and in the main stem below the wetland (Area E) (Table 5).

Dietary exposure of the shrew in the area of the north ditch (Area D) is expected to result in an average daily dose of 8.7 mg/kg-bw/day (Table 5), which is 126-times higher than the NOAEL screening value of 0.15 mg/kg-bw/day, and 80-times higher than the screening criterion for food of 0.111 mg/kg-bw/day. Therefore, adverse effects on reproduction, and potentially other effects as well, could be anticipated on shrews in this area.

In the main stem from the wetland to the canal (Area E), average estimated daily doses in this area were calculated as 0.70 mg/kg-bw/day, which is 10-fold higher than the screening concentration of 0.066. Therefore, adverse effects could be expected in shrews feeding in this area as well.

Exposure to PCB congeners (Table 6) was compared to published data on TCDD toxicity through comparison of TEQs. The CCME (1999) reports a number of studies that calculated NOAELs for small mammals. The reported NOAELs ranged from 0.0007 µg 2,3,7,8-TCDD/kg/day (0.0007 µg/kg/day TEQ based on a TEF of 1 for 2,3,7,8-TCDD) to 600 µg TCDD/kg/day (600 µg/kg/day TEQ). Average daily doses to the shrew in Area D (the north ditch) and Area E (Table 6) fall within this range and suggest that toxic effects due to exposure to the dioxin-like PCB congeners could occur. Estimated mean TEQ in Area D was 275.5 ng/kg-b.w/day (0.276 µg/kg-bw/day), and in Area E was 22.2 ng/kg-bw/day (0.022 µg/kg-bw/day).

<u>Summary</u>

Potential risks to the shrew were identified in all areas of the site due to arsenic contamination through consumption of food. As well, potential risks were identified in two areas of the site, and could be considered as significant risks that could interfere with reproductive success. As such, these effects could be expressed at the community or population level through reductions in local populations. Since earthworms accumulated relatively high levels of both arsenic and PCBs, and earthworms comprise a major part of the diet of shrews, feeding preferences and contamination of food items could account for the greater potential risks to shrews as compared to the deer mouse.

3.2.5 Terrestrial Carnivore

The fox is considered the most likely receptor to occur on the site. Foxes are significant predators on rodents and are known to consume large quantities of mice and shrews (Banfield 1974). The fox has been selected, rather than an avian raptor, since they are likely to be exposed to a larger selection of mice and shrews across the site. Raptors will typically be confined to feeding in open areas. As noted earlier, the open grassland areas of the site are typically lower in contaminant levels. Foxes are likely to feed on shrews and other rodents in the more densely vegetated areas, where higher soil and sediment levels of the COCs have been recorded, and therefore are likely to be exposed to higher concentrations.

The exposure is calculated as a daily dose of the COC based on the equations given below, and these are compared to the screening benchmarks as provided in the table below.

Model Parameters for Estimating Exposure To Red Fox

Parameter	Value	Units	Ref
Body weight	5.25	kg	Sample *et al.* 1996
Food ingestion rate	0.45	kg/d	Sample *et al.* 1996
Fraction of food comprised of rodents	68.8%		Sample *et al*. 1996

Soil ingestion rate	0.0126	kg/d	Sample *et al*. 1996
Home range	699	ha	EPA 1993
Fraction of time on site	0.1		
PCB Screening Concentration (NOAEL)	0.016	mg/kg-bw/day	Sample *et al.* 1996
PCB Screening Concentration (food)	0.16	mg/kg-bw/day	Sample *et al*. 1996

For the above calculations, water ingestion of COCs is assumed to be negligible.

The following assessment is based on estimates of feeding in different area of the site. The exposure estimates are based on the following assumptions:

- Since each of the sub-areas is smaller than the estimated home range of the fox (see table above), the fox is assumed to feed across the entire site;
- For the purposes of calculating potential exposure, the fox is assumed to feed on a diet consisting of 50% mice and 50% shrews;
- Tissue residues in mice and shrews are based on average expected life spans for each. The fox is assumed to feed on mature adults, which would have accumulated maximum estimated tissue residues;
- The dietary exposure to the COCs consists of exposure through food, assuming that 68.8% of the diet consists of mice and shrews;
- Since some soil is typically ingested during feeding, the incremental additional exposure through soil ingestion is estimated using standard equations (see below) and the soil ingestion rate provided in the table above; and
- Since risks were not identified for zinc, and only minor risks were identified for arsenic, and since neither is known to biomagnify through trophic levels, only risks due to PCBs are estimated.

Estimates of exposure to PCBs through exposure via food (mice and shrews) is calculated using the following equation:

$$ADD_{rodents} = [PCB]_{rodents} \times FR_{rodents} \times IR \qquad \text{(Equation 12)}$$

where: $ADD_{rodents}$ = average daily dose
$[COC]_{rodents}$ = concentration of PCBs in rodents
$FR_{rodents}$ = fraction of diet comprised of rodents
IR = ingestion rate.

Incidental soil ingestion was estimated using the following equation:

$$ADD_{soil} = [PCB]_{soil} \times IR_{soil} \qquad \text{(Equation 13)}$$

where: ADD_{soil} = average daily dose from sediment ingestion
$[COC]_{soil}$ = concentration of PCBs in sediment
IR_{soil} = ingestion rate of sediment.

Total exposure through ingestion was calculated as:

$$ADD_{total} = ADD_{rodents} + ADD_{soil} \qquad \text{(Equation 14)}$$

The exposure estimate does not consider other potential sources of PCBs, though these are likely to result in minor additional doses compared to ingestion of mice and shrews from the site.

Tissue residues in mice and shrews were estimated on the basis of the average daily dose and the typical life span of the animal. Since tissue residues for mice and shrews from the site were not available, these are estimated based on conservative assumptions. The rodents are assumed to have a life span of 10 months for the deer mouse and 18 months for the shrew (Banfield 1974). Consumption is assumed to be at the given rate during the adult stage, and is assumed to be 50% of the adult consumption rate during the juvenile stage. Maturity is based on the time to sexual maturity, which in the deer mouse is given as 35 days and in the shrew as up to 60 days (Banfield 1974). Therefore, the tissue residue estimates in Table 6 for the deer mouse and shrew are based on a life span of 300 days for the deer mouse, of which 35 days are spent as juveniles, and 460 days for the shrew, of which 60 days are spent as juveniles. Tissue accumulation of PCBs is assumed to occur at a constant rate over the life span of the animal, and for PCBs, depuration is assumed to be negligible due to the long half-life of the compounds and the short life span of the rodents. The estimates of tissue residues are based on the following equation:

$$\left[PCB_{prey}\right] = \left(\left[PCB_{\exp}\right] \times \left({t_m}/{2}\right)\right) + \left(\left[PCB_{\exp}\right] \times \left(t_{LE} - t_m\right)\right) \qquad \text{(Equation 15)}$$

where: $[PCB_{prey}]$ = predicted tissue residue in prey at full maturity (mg/kg);
$[PCB_{exp}]$ = expected daily dose in mg/kg-bw/day, as calculated in Table 6;
t_{LE} = life expectancy in days;
t_m = time to maturity, in days.

PCBs

Since the home range of the fox is considerably larger than the site (699 ha compared to 12 ha), it is estimated that the fox would only spend approximately 1.7% of the time feeding in this area. Therefore the estimated exposures in Table 5 for each of the sub-areas include a correction factor of 0.017 that is applied to adjust for the home range size. Since foxes would be expected to feed across the site, the average concentration for the entire site is taken as the most likely exposure concentration. Based on these calculations, there are no identified risks to foxes.

Summary

No risks to the red fox were identified through the consumption of rodents from the site. However, this would not preclude a smaller predator, that feeds preferentially in some of the sub-areas of the site, to be exposed to higher concentrations than are predicted in this study.

3.2.6 Benthic Invertebrates

Arsenic

Effects of contaminants in sediments on benthic invertebrates were assessed directly through sediment toxicity tests. The test results indicate that at the arsenic concentrations tested (41.2 µg/g) there were no indications of increased mortality on either test organism. There were no significant differences in growth in the chironomids at this concentration, while the mayflies exhibited higher growth than in the controls, which may be a reflection of the higher organic matter content (and nutrient content) of the sediments in Lyon's Creek relative to the controls. However, mean concentrations in sediments in both Area A (86.8 µg/g d.w.) and Area B (163.2 µg/g d.w.) were substantially higher than the maximum concentration tested, and does not preclude some adverse effects on benthic organisms.

Therefore, comparison is made with effects concentrations from other studies. MOE studies in the Porcupine River (Jaagumagi and Bedard 2001), showed no growth impairment or mortality in either mayflies or chironomids in sediment with 500 µg/g d.w. of arsenic, and also did not show any effects on benthic community structure at locations where sediment arsenic was elevated. While studies in the Moira River (Golder 2000) did not provide bioassay results, no effects on benthic community structure were noted in sediments with up to 600 µg/g d.w. of arsenic. These results suggest that under *in situ* conditions, effects on benthic communities are limited, and that elevated levels of arsenic can occur without significant effects on sediment-dwelling biota. These studies further indicate that the results of the sediment bioassay tests in Lyon's Creek West are consistent with the findings of similar tests in other areas with arsenic contamination. Since mean concentrations in Areas A and B were well below these levels, effects on benthos are not anticipated due to arsenic.

Zinc

Effects of contaminants in sediments were assessed directly through toxicity tests. The test results indicate that at the zinc concentrations tested (up to 2680 µg/g) there were no indications of increased mortality on either test organism. There were no significant differences in growth in the chironomids at this concentration, while the mayflies exhibited higher growth than in the controls, which may be a reflection of the higher organic matter content (and nutrient content) of the sediments in Lyon's Creek, relative to the controls. Since the maximum concentration tested is much higher than the mean concentrations in sediments in any of the sub-areas (Table 3), there would be no anticipated effects on benthic organisms in any of the sub-areas.

PCBs

The toxicity of PCBs was assessed directly through toxicity tests. The test results indicate that at the PCB concentration tested (25 µg/g dw), there were no indications of increased mortality on either test organism. There were no significant differences in growth in the chironomids at this concentration, while the mayflies exhibited a reduction in growth relative to the controls (station T7-M – Table 10). Since the highest mean concentration of PCBs in the sub-areas was 26 µg/g d.w. in Area C and E, it is possible that elevated levels of PCBs could result in chronic effects on some benthic organisms at this location.

Tissue residues of PCBs in benthic invertebrates could not be obtained from the mayflies at the end of bioassay tests due to accidental loss of the samples. Therefore, tissue residues in benthic invertebrates were estimated using data collected in Lyon's Creek East by the MOE and Environment Canada in 2002 and 2003 (R. Fletcher, Pers. Comm 2005).

The benthic organism tissue concentrations of PCB dioxin-like congeners in Table 7 were estimated using MOE and Environment Canada tissue residue data for a range of benthic organisms in Lyon's Creek East. For each benthic species represented in the MOE-EC database for Lyon's Creek East, matching sediment concentrations (top 10 cm) and benthic tissue residue concentrations were used to derive a BSAF specific to each congener and for each species by calculating first, individual BSAFs for each sample set, and then calculating a mean BSAF for the congener and for each organism across all sample sites using the equation below.

$$BSAF_{cong} = \frac{\sum_n \left(\frac{[PCB_{benth}]}{[PCB_{sed}]} \right)_n}{N} \qquad \text{(Equation 16)}$$

where: $BSAF_{cong}$ = BSAF for the specific congener;
$[PCB_{benth}]$ = PCB congener concentration in the specific organism in the n^{th} sample;
$[PCB_{sed}]$ = corresponding sediment PCB congener concentration in the n^{th} sample;
N = number of samples.

The mean value derived is provided in Table 9, and this value was used to estimate tissue residues at Lyon's Creek West using the following equation.

$$TR = \lfloor PCB_{cong} \rfloor_{sed} \times BSAF_{cong} \qquad \text{(Equation 17)}$$

where: TR = estimated tissue residue
$[PCB_{cong}]_{sed}$ = PCB congener concentration in sediment in Lyon's Creek West (Table 4)
$BSAF_{cong}$ = the BSAF calculated from equation 16 above.

BSAFs for the invertebrates were calculated using tissue residue data and corresponding sediment concentrations of the 12 dioxin-like PCB congeners for the sites in Lyon's Creek East (Table 8). Predicted tissue residues for Lyon's Creek West sites are presented in Table 7. While tissue residues in Lyon's Creek West were estimated based on concentrations in the top 5 cm, the limited number of core samples collected in 2003 indicates that concentrations in the 0-5 cm and 5-10 cm sections are similar. For example, PCB concentrations at station LC-6 in 2003 were 11.6 ug/g and 11.0 ug/g in the 0-5 cm and 5-10 cm sections respectively, and suggest that there is little change in the distribution of PCBs in the top 10 cm. Therefore, the BSAFs derived from Lyon's Creek East that are based on sediment concentrations in the top 10 cm are likely representative of exposure in Lyon's Creek West

The MOE-EC data for Lyon's Creek East indicated that only a limited number of congeners were detected in organism tissues. Therefore, only selected dioxin-like PCB congeners are likely to be accumulated in benthic invertebrate tissues in Lyon's Creek West. Of the four organisms for which estimates are made (based on the organisms collected in Lyon's Creek East) (Table 7), the oligochaetes are predicted to accumulate the highest tissue residues while predicted tissue residues in the odonates (1^{st} order predators) were the lowest. Since oligochaetes feed by ingesting sediment, it is not surprising that they accumulated the highest tissue residues.

While studies on the toxicity of PCBs to benthic organisms are few, toxicity testing conducted by Borgmann *et al.* (1990) assessed tissue residues of PCBs (as Aroclor 1242) in relation to chronic toxicity in the amphipod *Hyalella azteca*. Borgmann *et al.* (1990) noted that body burdens of 30 µg/g w.w to 180 µg/g w.w of Aroclor 1242 were associated with chronic toxicity. Since this provides a suitable benchmark for benthic organisms, tissue residues in amphipods were estimated in Lyon's Creek West based on measured sediment concentration and the mean BSAF calculated for amphipods in Lyon's Creek East. The calculated mean BSAF of 1.57 (Table 9) was applied to the sediment concentrations in Lyon's Creek West, and the results are provided in Table 5 for each of the areas (Area D was excluded since this area is no longer aquatic habitat). The results indicate that tissue residues greater than 30 µg/g w.w. are predicted in amphipods in both the wetland (Area B), the area immediately below the wetland (Area C) and in the main creek below the wetland (Area E), and indicate that chronic effects could occur on sensitive benthic organisms. It is not known how sensitive other benthic species may be to PCBs. However, since the sediment bioassay tests noted growth reduction in the mayflies in sediments from this area (station T7-M, Table 10), at a sediment PCB concentration of 25 µg/g d.w.

(Table 11), the results suggest that the observed toxicity in the bioassay tests could be due to elevated levels of PCBs in the sediments.

Since Aroclors are complex mixtures of individual PCB congeners, with the final two digits denoting the percent by weight of PCBs in the mixture (i.e., 42% in Aroclor 1242), the presence of Aroclors 1254 and 1260 (54% and 60% PCB respectively) in Lyon’s Creek West indicates that these mixture should be at least as toxic to benthic organisms as Aroclor 1242.

The highest predicted tissue residues occurred in sediments collected from station T7-M. Bioassay tests showed that the only location in Lyon’s Creek West where growth reduction was apparent was in the mayflies at station T7-M. Therefore, while direct correlation of toxicity test results and predicted tissue residues of the dioxin-like PCB congeners is not possible with the data available, the co-occurrence of high predicted accumulation and growth reduction in the mayfly may indicate the potential for adverse effects due to PCBs in sediments.

It should be noted that these are general estimates only. BSAFs in Lyon’s Creek East varied over a wide range for identical organisms (e.g., from 0.008 to 8.52 in oligochaetes), and suggest other factors (such as the concentration of organic carbon) can influence local availability and, therefore, tissue residues. However, by calculating a mean value from the Lyon’s Creek East data, a reasonable approximation of expected tissue residues can be obtained. With a larger dataset, including TOC concentrations, development of a predictable relationship may be possible that would provide better predictive ability.

Summary

The study results indicate that effects on benthos could potentially occur due to elevated arsenic levels in Area A and Area B, since concentrations in these areas were higher than the concentration tested in the bioassay tests. However, the remaining areas had lower average concentrations of arsenic in sediments than the bioassay test sediments and are unlikely to result in adverse effects on benthos.

Concentrations of zinc were at or below the levels tested in the bioassay tests, and are expected to result in negligible effects on benthic organisms, though they could be contributing to growth effects in Area D (Station T7-M).

PCB concentrations are sufficiently high, relative to results from other studies, to suggest that some growth impairment could result in some species. The tissue residues would also be of concern with regard to potential transfer and biomagnification of PCBs in higher trophic levels, such as fish.

3.2.7 Fish

Effects on fish were considered on the basis of direct toxicity through exposure to the COCs, and the potential for contaminant transfer, and hence exposure to those species that feed on fish. Fish tissue residues were not measured directly but were estimated using data from Lyon's Creek East.

Arsenic

The lack of adverse effects in the bioassay tests with sediment organisms suggests that there are no likely effects on fish from arsenic concentrations in the sediments. A number of bioassay tests conducted by the MOE were reviewed (Jaagumagi and Bedard 1991, 1995, 2001a, 2001b) , and in all cases, fathead minnows were less sensitive to metals in sediments than benthic organisms.

Zinc

The lack of adverse effects in the bioassay tests with sediment organisms suggests that there are no likely effects on fish from zinc concentrations in the sediments.

PCBs

Fish exposure is estimated from existing studies on PCB uptake from sediments in bioassay tests, and also on the basis of values reported in the literature. Direct toxicity is considered unlikely, since previous studies (Bedard and Petro, 1997) noted no mortality in fish in bioassay tests due to PCB exposure. BSAFs for PCBs are computed from previous studies in Lyon's Creek (Bedard and Petro, 1997) and are provided in the table below.

Medium	T1 (1992)	T3 (1992)	T5 (1992)	Stn 4 (1992)	Stn 5 (1992)	T3 (1996)	T5 (1996)	Mean
Sediment (ng/g d.w.)	240	600	3080	6040	1040	2400	780	
Minnows (ng/g w.w.)	200	630	1890	2480	1420	1400	660	
BSAF	0.8	1.05	0.6	0.4	1.4	0.6	0.85	0.8

The mean BSAF from the above studies is 0.8 for accumulation of total PCBs by fish from sediments. In those areas where there is currently standing water that could be considered fish habitat, the estimated tissue concentrations of total PCBs in fish tissue, using the BSAF of 0.8, are presented in Table 5. This value is likely an underestimate of accumulation by fish, as is demonstrated by the MOE young-of-the-year fish data (Tables 8 and 9), which showed that a much higher average accumulation of PCBs (BSAFs ranged from 2.31 in golden shiners to 5.61 in bluntnose minnows) would be anticipated. As well, Ankley *et al*. (1992) noted that fathead minnows accumulated less PCBs than other species, and they noted that use of fathead minnows in laboratory tests may significantly under predict exposure of fish.

Since fish tissues were not analyzed for concentrations of the dioxin-like PCB congeners directly, these are estimated from sediment concentrations. The estimates are based on measured concentrations in sediments and biota from studies conducted by the MOE on Lyon's Creek East. This is based on the assumption that the sources and therefore, types of PCBs, on the east side are similar to those on the west side and therefore, that accumulation of PCBs by fish on the west side would be similar to accumulation by fish on the east side. The calculation of estimates proceeded through a number of steps as described below.

The BSAF (accumulation from sediments to fish) (Table 9) was calculated from MOE tissue residue data for young-of-the-year (YOY) fish (2002-2003) for each of the 12 congeners (Equation 18) for which detectable levels were present in both fish and sediments (Table 8) and is similar to the method used to estimate benthic organism tissue residues (Section 3.2.6). BSAFs were not estimated if the concentrations in either fish or sediments were below detection limits.

$$BSAF_{cong} = \frac{\sum_{n} \left(\frac{\lfloor PCB_{fish} \rfloor}{\lfloor PCB_{sed} \rfloor} \right)_n}{N} \qquad \text{(Equation 18)}$$

where: $BSAF_{cong}$ = BSAF for the specific congener;
$[PCB_{fish}]$ = PCB congener concentration in fish in the n^{th} sample;
$[PCB_{sed}]$ = corresponding sediment PCB congener concentration in the n^{th} sample;
N = number of samples.

The calculated BSAF was used to estimate the concentration of dioxin-like PCB congeners in fish in Lyon's Creek West by multiplying the sediment concentration for each congener by the respective BSAF for that congener (Table 7), as shown in Equation 19 below.

$$TR = \lfloor PCB_{cong} \rfloor_{sed} \times BSAF_{cong} \qquad \text{(Equation 19)}$$

where: TR = estimated tissue residue
$[PCB_{cong}]_{sed}$ = PCB congener concentration in sediment in Lyon's Creek West (Table 4)
$BSAF_{cong}$= the BSAF calculated from equation 18 above.

The total TEQ was calculated from the estimated concentrations of dioxin-like PCB congeners (Table 7). The estimated congener concentration derived through Equation 19 was multiplied by the WHO fish TEF, and the results summed to provide a total TEQ.

Since the MOE data for Lyon's Creek East indicated that not all congeners are accumulated to a similar degree, this approach is believed to provide a more realistic estimate of total TEQ.

Predicted fish tissue residues (Table 7) were compared to CCME guidelines for the protection of fish-eating birds and mammals (CCME 2001). The CCME guidelines for total TEQ for mammalian and avian consumers of aquatic life are 0.79 ng TEQ/kg diet w.w. and 2.4 ng TEQ/kg diet w.w. respectively. Total estimated dioxin-like PCB congeners in young fish resulted in estimated TEQs in mammals (based on the mammalian TEFs) of up to 523 ng TEQ/kg diet in Area C and up to 360 ng TEQ/kg diet w.w. in Area E. Potential TEQs that fish-eating birds could be exposed to ranged up to 864 ng TEQ/kg diet w.w in Area C and 510 ng TEQ/kg diet w.w in Area E. The results are 662 times and 360 times the CCME criteria for fish-eating mammals and birds respectively, and indicate that significant risks of exposure to fish-eating birds and mammals could result from feeding on fish from these areas.

Summary

Adverse effects on fish are not predicted to occur due to exposure to arsenic or zinc in sediments, based on the outcomes of the bioassay tests for benthic organisms. However, significant accumulation of PCBs is considered likely by fish, to levels that are well above the CCME guidelines for tissue residues in aquatic organisms. As a result, while usage of the area by fish-eating birds and mammals is likely to be minor, there are potential risks to birds and mammals from the consumption of fish. Given the persistent nature of PCB congeners, there could be risk from even occasional exposure due to the cumulative characteristics of these compounds in tissues.

3.2.8 Aquatic Herbivore

The muskrat is considered the most likely aquatic mammalian receptor to occur on-site. While individuals were not observed during site visits, tracks were observed, indicating that the species is present in the area. Muskrats typically feed on aquatic vegetation, including the stems of cattails which comprise a substantial fraction of their diet.

The exposure is calculated as a daily dose of the COC based on the equations given below, and these are compared to the screening benchmarks as provided in the table below. The parameters used to estimate exposure to the COC are also provided in the table below.

Model Parameters for Estimating Exposure To Muskrat

Parameter	Value	Units	Ref
Body weight	1.2	kg	EPA 1993
Food ingestion rate	0.116	kg/d	EPA 1993
Fraction of food comprised of aquatic vegetation	100%		EPA 1993

Soil ingestion rate	0.004	kg/d	EPA 1993
Home range	0.17	ha	EPA 1993
Fraction of time on site	1.0		EPA 1993
Arsenic Screening concentration (NOAEL)	0.049	mg/kg-bw/day	Sample *et al* 1996
Zinc Screening concentration (NOAEL)	115.8	mg/kg-bw/day	Sample *et al* 1996
PCB Screening concentration (NOAEL)	0.022	mg/kg-bw/day	Sample *et al* 1996

Note: yearly estimates indicate that cattails comprise approx. 50-60% of the diet.

- Since each of the sub-areas is larger than the estimates for the home range (see table above), the muskrat is assumed to feed entirely within each area;
- Only those areas where aquatic vegetation (mainly cattails) were observed during the site visits are included in the exposure estimates. Exposure was not estimated for the north ditch (Area D) since this area currently does not constitute muskrat habitat, and does not support the growth of aquatic vegetation;
- The dietary exposure to the COCs consists of exposure through food, assuming that 100% of the diet consists of aquatic vegetation of which 60% consists of cattails;
- Since some soil/sediment is typically ingested during feeding, the incremental additional exposure through soil/sediment ingestion is estimated using standard equations (see below) and the soil/sediment ingestion rate provided in the table above; and
- For PCBs, historical data from the site are included in the exposure estimates. Studies conducted under Phase I and II indicated little change in PCB concentrations has occurred on the site since the early 1990s, and PCB concentrations in 2003 were comparable to the concentrations obtained during previous sampling. Therefore, it is concluded that exposure could still occur to these levels, and accordingly they have been included in the dataset.

Risks to the muskrat were considered through consumption of contaminated food and the incidental ingestion of contaminated sediments using the following equation:

$$ADD = [COC]_{cattails} \times FR_{cattails} \times IR \qquad \text{(Equation 20)}$$

where: ADD = average daily dose
$[COC]_{cattails}$ = concentration of COC in cattails
$FR_{cattails}$ = fraction of diet comprised of cattails
IR = ingestion rate.

Incidental sediment ingestion was estimated using the following equation:

$$ADD_{sed} = [COC]_{sed} \times IR_{sed} \qquad \text{(Equation 21)}$$

where: ADD_{sed} = average daily dose from sediment ingestion

$[COC]_{sed}$ = concentration of COC in sediment
IR_{sed} = ingestion rate of sediment.

Total exposure through ingestion was calculated as:

$$ADD_{total} = ADD_{cattails} + ADD_{sed} \quad \text{(Equation 22)}$$

Cattails were selected as the primary food source since they are abundant on the site, and muskrats have been recorded has obtaining a significant portion of their diet from consumption of cattails (60%).

Arsenic

The results of the exposure estimates are presented in Table 2. The estimates of exposure were compared to the NOAEL screening concentration listed in the table above (a food-based screening criterion was not found), and potential risks were identified in the southwest branch upstream of the wetland (Area A), in the wetland area (Area B), and in the main stem downstream of the wetland (Area E). The highest risks were identified in the wetland area, and coincided with the highest concentrations of arsenic in sediment and vegetation.

Zinc

The effects of zinc were not assessed in muskrats, since tissue residue data were not collected for cattails. The low risks identified for other receptors due to zinc indicated that assessment would likely not identify risks to muskrats.

PCBs

Exposure to PCBs was based on the tissue residues of PCBs in cattails. However, the stations at the southeast end of the north ditch (MOE 1991 stations K and J) were included in the area between the downstream end of the wetland and the north ditch (Area C), since this represents one contiguous habitat area suitable for muskrats.

The results of the exposure estimates are presented in Table 4.

Comparison of the results with the screening concentration of 0.022 mg/kg-bw/day (table containing muskrat model parameters above) indicates the highest risk was in the area between the downstream end of the wetland and the north ditch (Area C) (Risk Quotient of 6 – i.e., estimated exposure is 6-times higher than the benchmark). The creek section below the wetland area to the canal (Area E) had the second highest risk factor (RF of 4.6). Potential risks were present in the wetland area (RF of 3.5). In contrast, risks were not identified in the section upstream of the wetland.

Summary

Risks to the muskrat were identified through consumption of vegetation for both arsenic and PCBs in the wetland and downstream areas. Exposure to PCBs in cattail tissues is predicted to result in exposure of muskrats to concentration that could result in adverse effects.

3.3 Summary of Potential Risks to Ecological Receptors

The exposure estimates indicate that risks are present for a variety of receptors due to elevated levels of arsenic, zinc and PCBs in soils and sediments. As noted earlier, these are based on conservative estimates, but are consistent with MOE guidance (MOE 1996). Potential risks were identified for the following receptors and locations:

- Vegetation in the north ditch (Area D), the main stem (Area E) and the wetland (Area B) due to arsenic, zinc and PCBs;
- Soil invertebrates (earthworms) in limited areas in the southwest ditch (Area A), the south and north ends of the wetland (Area B), and the main creek stem below the wetland (Area E) due to arsenic;
- Deer mouse in the north ditch (Area D) due to exposure to PCB congeners;
- Shrews in all areas of the site due to arsenic (the highest risks were in the north ditch (Area D) and the wetland (Area B)), and in the north ditch (Area D) and the main creek stem below the wetland (Area E) due to total PCBs and PCB congeners;
- Benthic invertebrates in the north end of the wetland (Areas B and C) and in the main stem (Area E) due to PCBs;
- Fish in Areas C and E, due to predicted accumulation of PCB congeners to concentrations that would present potential risks to mammalian and avian consumers of fish; and
- Muskrats in the wetland (Area B), the area between the downstream end of the wetland and the north ditch (Area C) and the creek stem below the wetland (Area E) due to arsenic and PCBs.

While additive risks are not evaluated due to the lack of suitable benchmarks, the assessment of risks indicates that there would be combined risks to biota due to the co-occurrence of arsenic, zinc and PCBs in some areas of the site. Combined risks due to arsenic, zinc and PCBs were identified for vegetation in Areas B, D and E. Risks to shrews were identified in Areas D and E from both arsenic and PCBs, and for muskrat in Areas B and E from both arsenic and PCBs.

Acceptable risks were identified for carnivorous mammals (e.g. red fox) due to the relatively small amount of the total food consumption that would originate from the site. While fish-eating wildlife were not directly assessed due to a lack of suitable habitat for waterfowl, the elevated tissue residues predicted in fish could also pose a risk to fish-eating wildlife, based on the CCME tissue residue guidelines for PCBs. While currently not a concern under the existing low water levels, if water levels should change in the future that would promote greater use of the site by waterfowl, potential risks would likely be present.

4.0 WELLAND RIVER PHASE III SITE ASSESSMENT

4.1 Welland River

4.1.1 Sediment Assessment

Based on results from the Phase I/II study, elevated levels of copper, chromium and nickel occurred at a number of locations along the Welland River, and additional bioassay testing was undertaken at these locations. As well, since elevated levels of PAHs were detected at one location, sediment samples were collected for analysis of PAHs.

The results of the PAH analysis (Table 12) show low concentration of PAH compounds at all sample sites. Concentrations were low in all samples, and PAH concentrations, as total PAH (sum of the 16 priority PAH compounds) did not exceed the MOE LEL of 4.0 µg/g. The results from the Phase I/II study, therefore, may represent an isolated occurrence of elevated PAHs, and suggest that any impacts that may occur would be limited to the localized area of occurrence. Therefore, no risks due to PAH contamination are identified.

4.1.2 Sediment Bioassay Testing

Sediment samples for bioassay testing were prepared and conducted by Stantec according to standard MOE protocols. Since the compounds of concern were not bioaccumulative, testing was conducted only on benthic invertebrates (Bedard *et al*., 1992). Samples were sieved to remove coarse materials, and a subsample of the sieved sediment at each location was submitted for chemical analysis for metals, nutrients and grain size. The results of the chemical analysis are presented in Table 11 and show that chromium, copper and nickel all exceeded the MOE SEL at three of the stations. Sediments at the Control, located upstream, and at the mouth of Thompson's Creek exceeded the LEL but did not exceed the SEL.

Sediment bioassay test results for the Welland River are presented in Table 10 (details are provided in Appendix B). Biota test results indicate that none of the sediments tested from the 4 locations resulted in lethality in either the mayflies or chironomids. In all test replicates for both organisms, survival was greater than 90%, and did not differ significantly from mortality in the control sediments.

Mayfly growth was reduced in two of the samples: T7-N and T1-M (Table 10 - see Figure 4 for locations). Growth of nymphs in these sediments was approximately 50% of the growth in the control sediments and was statistically significantly different from the other locations (Appendix B). Growth in the other sediments was similar to controls and showed no adverse effects on the biota tested.

Chironomid growth was reduced only in sediments from station T7-N. Growth in these sediments was approximately 60% of the growth in the control sediments. Growth in sediments from station T1-M was similar to growth in the controls.

The bioassay results show sediments from only one location, T7-N, resulted in reduced growth in both test organisms. Chemical analysis shows copper, chromium and nickel levels elevated at this location (Table 11).

Mayfly growth showed weak negative correlations (Pearson Product Moment) (r^2 = -0.5) with copper, chromium and nickel concentrations in sediment, and poor correlations with sand and TOC, suggesting that no strong relationship exists between sediment metals concentrations, sediment characteristics and mayfly growth. However, the small data series makes this analysis uncertain at best. Therefore, while supported only weakly by statistics, the distribution of mayfly growth appears to be inversely related to elevated concentrations of copper, nickel and chromium in sediments. It should be noted that both nickel and chromium were strongly correlated (r^2 = 0.97), as would be expected given that these metals are believed to originate from a common source. Since mayfly growth was higher in those sediments where nickel and chromium concentrations exceeded the concentrations encountered at station T7-N (i.e., the location where growth impairment occurred), the results suggest that the higher copper concentrations may have played a role in the decreased growth at this location. However, while copper concentrations were low at station T1-M, both chromium and nickel concentrations were elevated at this location and were in fact the highest concentrations tested. Therefore, the results indicate that toxicity may be due to combined effects of these three metals.

Review of the recent literature indicates that in spiked sediment bioassay tests, copper affected growth at a concentration of 38 µg/g d.w. (Milani *et al.*, 2003), with lethality, measured as LC_{50}, at a concentration of 93 µg/g d.w. Nickel in sediments resulted in toxicity at 452 µg/g d.w. (LC_{50}) for the mayfly (Hexagenia) and 665 µg/g d.w. (LC50) in the chironomid (Chironomus riparius). Reduced growth (as IC25) was calculated at 83 µg/gd.w. for the mayfly and 146 µg/g d.w. for the chironomid (Milani *et al.*, 2003) (bioassay results were not available for chromium for comparison). Since metals in spiked sediment tests are considered more bioavailable than would be the case in natural sediments, acute lethality would not be expected at the reported LC_{50}s, but growth effects could occur due to concentrations of both metals. As well, these tests were conducted in sediments with low TOC (0.5%), which would be expected to additionally heighten availability. However, Borgmann and Norwood (1997) in spiked sediment tests with copper, calculated toxicity to benthic organisms occurred in the range of 330 µg/g d.w. for mayflies (IC25 affecting growth) and 997 µg/g (LC25), which is considerably higher than the concentrations recorded in the Welland River. Previous studies in the Welland River found no lethality or growth effects at sediment concentrations of 330 µg/g d.w for copper, 1300 µg/g d.w. for chromium and 2000 µg/g d.w. for nickel.

The reduction in chironomid growth at station T7-N similarly appears to correspond to elevated levels of copper in sediments. Correlation of copper concentrations with chironomid growth yielded coefficients of r^2= -0.87 for copper. Comparison of copper toxicity results with spiked sediment bioassay tests (Milani *et al*., 2003) indicate that chironomids are less sensitive to copper than mayflies, with growth impairment measured at 78 µg/g (IC_{25}) and lethality estimated at 402 µg/g (as LC_{50}). However, tests with in-situ sediments indicate that copper concentrations can be considerably higher before adverse effects are noted. In samples from Porcupine Lake (Jaagumagi and Bedard 2001), a copper concentration of 1800 µg/g d.w. did not result in an increase in mortality in chironomids.

Therefore, the results indicate that elevated concentrations of copper, chromium and nickel could have resulted in some growth reduction in both mayflies and chironomids. As noted earlier, bioassay tests tend to augment the effects of contaminants through alteration of sediment conditions, particularly through release of metals through changes in redox, with the result that responses in field populations tend to be less pronounced than in laboratory tests.

Ultimately the test is whether the effect could result in changes at the population or ecosystem level. It is not expected that a 50% reduction in growth at this location would result in measurable changes to local populations of either mayflies or chironomids. Growth reduction in individuals at this site may affect their survival and reproductive potential, and this area of the river may produce fewer breeding individuals as a result, but the bioassay test results indicate this reduction is likely to be confined to certain areas.

The lack of effects at the other stations tested suggests that benthic organisms in only limited areas are potentially affected. Comparison of sediment contaminant distributions with previous studies shows much lower concentrations of copper at station WR-7 during this period than in the fall of 2003 (i.e., 271 µg/g Cu compared to 45 µg/g), indicating that copper in sediments occurs in discontinuous patches (the similarity in sediment concentrations at station T7-N in 2004 and WR7-N in 2003 (sampled at the same location) indicates that the majority of sediments are stable, and the differences in contaminant concentrations are likely due to differential accumulation in adjacent areas). As such, the effects on organisms would be expected to be localized, and are not expected to result in changes at the population level, since adjacent areas would be expected to produce reproductively healthy adults.

4.2 Thompson’s Creek

Sediment samples from Thompson’s Creek showed elevated concentrations of copper (357 µg/g) at station TC-2 (see Figure 4 for location), which is located below the Cytec site. Concentrations downstream at Chippawa Creek Road were much lower (17 ug/g), and suggest that the copper contamination does not occur throughout the creek but is limited to the reach below the Cytec site.

The copper concentration in the sediment at TC-2 was higher than recorded in the bioassay sediments in the Welland River, suggesting that some growth effects could occur. However, the Welland River bioassay results suggest that due to the lack of other co-occurring contaminants in Thompson's Creek, the elevated copper concentration alone may not result in lethal effects, particularly at the high TOC concentration in sediments at this location. The correlation analysis undertaken for the Welland River sediments suggests that the observed growth effects were due to the combined effects of the three metals, copper, chromium and nickel. As well, Borgmann and Norwood (1997) in laboratory spiked sediment tests with copper, found toxicity to benthic organisms occurred in the range of 330 µg/g for chronic toxicity (IC25, as effects on growth) to 997 µg/g d.w. for acute toxicity (LC25). While availability of metals is typically higher in spiked sediment toxicity tests due to the solubilized form in which the metal is introduced and the absence of suitable diagenetic processes, these concentrations are within the range of concentrations recorded in Thompson's Creek. However, MOE studies conducted in both the Porcupine River and Junction Creek (Jaagumagi and Bedard 2001a, 2001b) found no effects on survival or growth on mayflies and chironomids due to copper at concentrations of 1800 µg/g d.w. and 390 µg/g d.w. respectively, and suggest that under natural conditions, toxicity of sediment-bound copper can be significantly lower than is indicated by laboratory tests with spiked sediments. These studies suggest that uncertainty regarding potential toxicity exists at the copper concentrations measured in Thompson's Creek, despite indications that copper toxicity typically has occurred at higher copper concentrations than were measured in Thompson's Creek sediments. Therefore, in order to ensure that adverse effects are not occurring at the measured concentrations, additional bioassay testing would be warranted in Thompson's Creek.

5.0 FRENCHMAN'S CREEK PHASE III SITE ASSESSMENT

5.1 Sediment Bioassay Testing

Sediment bioassay testing below the branch from Fleet Aerospace showed no differences in growth or survival relative to controls in either of the test organisms at concentrations of cadmium in sediments up to 13.7 µg/g and 346 ug/g of chromium. The cadmium concentration in the test sediments is lower than the concentration of 33 µg/g obtained in 2003 at this location, and likely reflects the uneven distribution of cadmium in sediments. The bioassay test sediments were collected over a larger area than the sediment samples collected in 2003, due to the larger volume of material required for the bioassay tests. As such, sediments with various concentrations of cadmium would have been combined to result in an average concentration for the approximately 2 m^2 area from which bioassay sediments were collected. The results indicate that adverse effects are unlikely over a larger area, but this does not guarantee that smaller areas which have higher cadmium concentrations may not result in some adverse effects. While effects at the population or community level are expected to be low, these should be verified through additional testing.

The lack of a response in the test organisms at the chromium concentration of 346 ug/g suggests that effects due to chromium in sediment are likely to be low.

Results were also compared with the test results from other areas, in order to ensure that the above interpretation is sufficiently protective. Milani *et al*. (2003), using laboratory spiked sediments, found growth inhibition (as IC25) in the mayfly occurred at 14 µg/g d.w. cadmium, while the corresponding concentration for chironomid growth inhibition was 16 u/g/ d.w. Acute concentrations (LC50s) for the mayfly and chironomid were calculated as 815 µg/g d.w. and 39 µg/g d.w., which are considerably higher than the concentrations noted in Frenchman's Creek. As well, TOC in the test sediments used by Milani *et al.* (2003) were significantly lower (0.5%) than sediments in Frenchman's Creek (3.1%) (D. Milani, Pers. Comm. 2005) and could enhance availability of cadmium. Finally, the spiking procedure tends to augment the biological availability of metals, and the above test results may significantly over-estimate actual growth effects and toxicity in field sediments. Field studies in the Porcupine River system, undertaken by MOE (Jaagumagi and Bedard 2001a), found no growth effects or effects on survival of either mayflies or chironomids at a cadmium concentration of 86 µg/g d.w. However, Borgmann *et al.* (2004), found significant changes in benthic community structure in lakes in the Rouyn-Noranda region of Quebec, and acute toxicity (51%) in amphipods at an average cadmium sediment concentration of 38 µg/g. Therefore, the bioassay tests for Frenchman's Creek sediments suggest that effects on biota are unlikely to occur at the concentrations measured in the Phase III studies, but that there is potential for effects at higher concentrations, such as the 33 ug/g measured in 2003 in the Phase I/II studies. Therefore, follow-up studies to monitor this area would be warranted.

5.2 Additional Sediment Assessment

Additional sediment sampling in the small east tributary from the Durez site for dioxins and furans yielded low TEQs. As shown in Table 14, concentrations in the upper reaches were in the order of 6 pg/g total TEQ and decreased to 0.03 pg/g TEQ just above the confluence with the main branch. The results indicated a progressive decrease from the upper reaches of the tributary. There was a slight increase at station FC-5C, which was in the upper end of a small wetland area, and this location appears to have trapped some of the materials. The creek bed at the time of sampling was dry, and the stream appears to flow intermittently. For example, during the 2003 sampling, a small trickle of water was observed in the ditch, which was after a period of steady rainfall, whereas in 2004, no standing water was observe at any of the sampling points in this tributary.

Concentrations in the main branch below this tributary were very low, with total TEQ of 0.013 pg/g. Based on the NOAEC screening criteria developed for the Phase I/II assessment of 5.0 pg/g for lake trout eggs, which were considered to be the most sensitive receptor, the estimated exposures (based on a BSAF of 0.148 derived from Cook *et al.* 2003) at all sites are well below this value and resulted in a maximum total TEQ of 1.1, which is well below the screening criterion.

The results suggest that there is little loss of sediments to the main branch, and exposure of fish within Frenchman's Creek is likely to be low. Similarly, the result indicate that locally elevated concentrations of PCDD/Fs may occur, but that these are not broadly distributed and are likely to result in minimal exposure of sensitive aquatic species.

6.0 CONCLUSIONS

1. Elevated risks to vegetation and terrestrial and aquatic biota were determined in Lyon's Creek West due to PCBs, arsenic, and zinc in both soils and sediments. Risks were particularly high for some organisms due to PCB contamination.

2. Concentrations of the COCs in Welland River sediments indicate localized growth impairment in some benthic organisms due to copper, chromium and nickel in sediments. However, the absence of acute effects suggests that remedial actions would achieve marginal benefits.

3. PAH concentrations in Welland River sediments were all low and are unlikely to result in adverse effects. The lack of consistence with samples collected in 2003 under the Phase I/II study indicate the distribution of elevated levels is highly localized, and unlikely to have significant impacts on local communities or population of invertebrates or fish.

4. Concentrations of copper in Thompson's Creek sediments were above existing guidelines and above background concentrations, and while not anticipated to result in adverse effects to aquatic biota, would require additional testing to confirm that there are no adverse effects.

5. Cadmium and chromium concentrations in Frenchman's Creek sediments, while elevated, did not result in adverse effects in benthic organisms in bioassay tests. However, since the concentration of cadmium tested in the bioassay tests was lower than the maximum recorded in the creek sediments, there is potential for adverse effects in localized areas and follow-up investigations at this site would be warranted.

6. PCDD/F concentrations in Frenchman's Creek sediments are contained within the intermittent stream, and have not resulted in measurable contamination in the main branch of the creek. The distribution indicates that concentrations are relatively low, and that the highest concentrations are contained within the upper reaches of the tributary. Risks of exposure are therefore likely to be low.

7.0 RECOMMENDATIONS

1. Due to elevated risks identified in Lyon's Creek West to a number of organisms, consideration of remedial options for this site would be warranted to determine whether these could reduce risks to acceptable levels.

2. Bioassay testing in Thompson's Creek, below the Cytec site, would be warranted, given the higher copper concentrations in the sediments at this site.

3. While bioassay testing in Frenchman's Creek indicated that the potential for risks was low, the maximum cadmium concentrations recorded were not obtained during the current sampling round. Therefore, since the effects of locally higher cadmium concentrations in sediments are uncertain, follow-up investigations at this site would be warranted.

LIMITATIONS

The findings of this report are based on conditions as they were observed at the time of the investigation. No assurance is made regarding changed conditions subsequent to the time of the investigation.

This report was prepared by Golder Associates for the Niagara Peninsula Conservation Authority (NPCA). The material in it reflects Golder's best judgement in light of the information available to Golder at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third parties as a result of decisions made or actions taken based on this report.

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Site Photos

Photo 1: Area A, view upstream towards Southworth Ave.

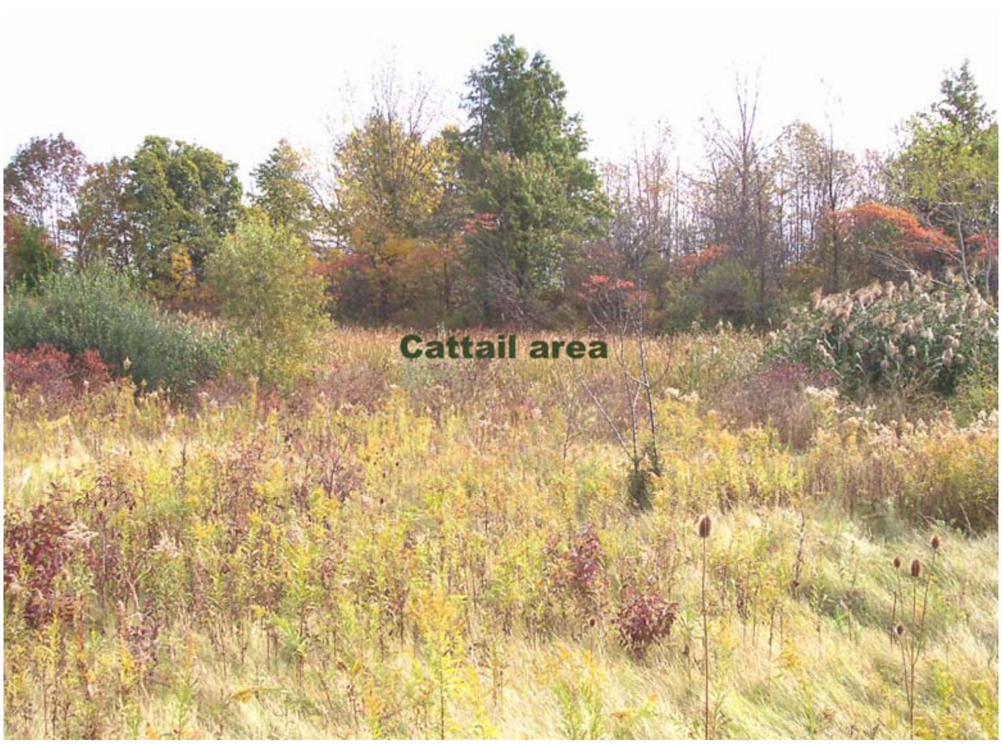


Photo 2: Central Area of wetland (Area B) (area of Station 5 on Figure 3)

Photo 3: Downstream of wetland (Area E), view upstream to wetland.

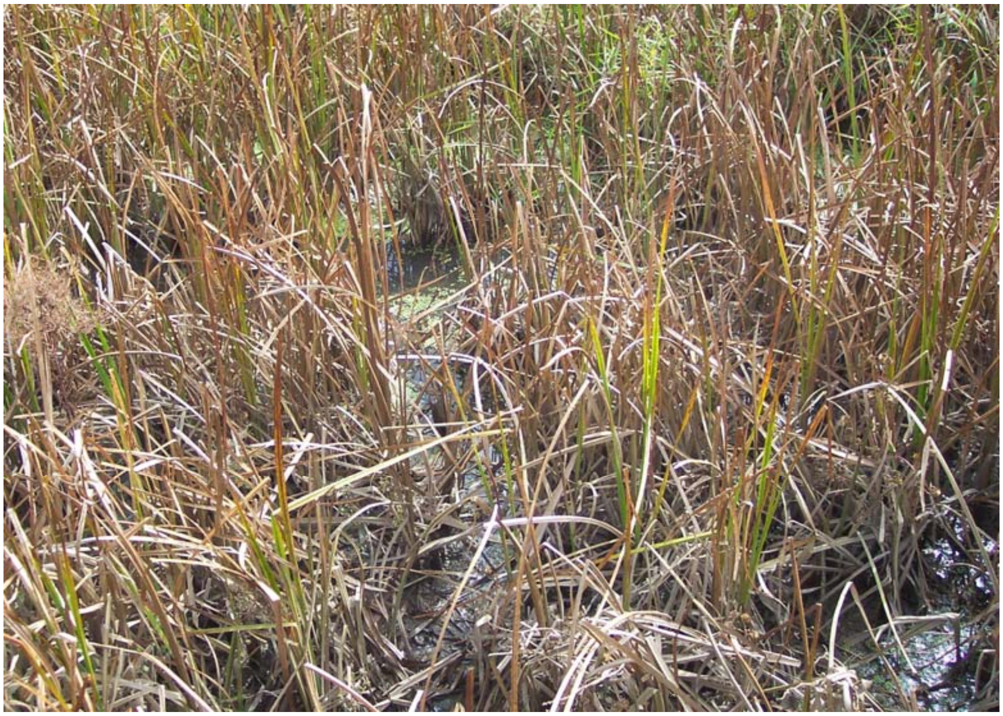


Photo 4: Creek in upstream area of Area E, showing dense vegetation growth.

Photo 5: Downstream section of Area E, showing ponded area above outlet to the Canal.

Photo 6: North ditch (Area D), view of former creek bed.

TABLE 1:
Phase III Study Locations and Study Components

Station	Location	Description	Georeference	Date sampled	COC	Study Components			
						Soils	Sediments	Vegetation	Invertebrates
Lyon's Creek West									
T1-N	SW end of site, north bank	At top of bank. Brown clayey soil, dense grass cover.	10 17 643891 4758175	July 14-15, 2004	As, PCBs	As, PCB (total & congener)		Weeds, leaves for total PCB	Earthworm tissue - PCBs & As
T1-M	SW end of site, in creek	in creek, <3 m wide, shallow (<6 cm), light brown silty sediments. Dense cattail growth at margins.	10 17 643896 4758177	Oct. 6, 2004	As, PCBs		As, PCBs (total and congener)	cattails for PCBs	Benthos - bioassays
T1-S	SW end of site, south bank	At top of bank. Brown clayey soil, dense grass cover.	10 17 643889 4758172	July 14-15, 2004	As, PCBs	As, PCBs			
T2-N	SW end of wetland, ~150m from T1 - on north bank	At top of bank. Brown clayey soil, dense grass cover.	10 17 644232 4758261	July 14-15, 2004	As, PCBs	As, PCB			
T2-M	SW end of wetland, in wetland	Black organic soil/sediment in dense Phragmites stand. Sediment damp, no surface water.	10 17 644223 4758183	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs		
T3-N	South half of wetland, north bank, ~50m NW of T2	At top of bank. Brown clayey soil with gravel, dense grass cover. Very dry soil	10 17 644341 4758339	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T3-M	As above, in wetland	Black organic soil/sediment. Small area of cattails in dense Phragmites stand. Sediment damp, no surface water.	10 17 644278 4758249	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs		
T4-N	Approximate middle of wetland, ~50m from T3. North bank	At top of bank. Brown clayey soil with gravel, dense grass cover. Very dry soil	10 17 644375 4758406	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T4-M	As above, in wetland	Black organic soil/sediment in dense Phragmites stand. Sediment damp, no surface water.	10 17 644316 4758308	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs		
T5-N	Approximately 50 m from T4, north bank.	At top of bank. Brown clayey soil with gravel, dense grass cover. Very dry soil	10 17 644387 4758434	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs (total and congener)		Weeds, leaves for total PCB	
T5-M	As above, in wetland	Black organic sediment in small open water area with cattails.	10 17 644357 4758363	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs	Cattails or Fragmites for PCB	

TABLE 1:
Phase III Study Locations and Study Components

Station	Location	Description	Georeference	Date sampled	COC	Study Components			
						Soils	Sediments	Vegetation	Invertebrates
T5-S	As above, south bank	In woods, dark brown organic soil.	10 17 644443 4758431	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T6-N	N. end of wetland, ~20m s. of remnant branch. North bank	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644386 4758475	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs		Weeds, leaves for total PCB	
T6-M	As above, in stream	In middle of wetland (narrowed section). Damp sediment, no standing water. Black organic sediment (silt and detritus)	10 17 644399 4758396	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs	Cattails or Fragmites for PCB	
T6-S	As above, south bank	In woods, dark brown organic soil.	10 17 644459 4758467	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T7-N	Remnant stream, near mouth. North bank	Dark brown organic soil in thicket. Very dry.	10 17 644415 4758477	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			Earthworms - tissue analysis for PCBs and
T7-M	As above, in stream	In middle of remnant channel. Wet sediment (no surface water) with dense grasses. In small (<30 cm) channel.	10 17 644425 4758501	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs		Sediment bioassay
T8-N	Creek, ~40m below remnant stream, north bank	Brown organic soil with dense weed growth.	10 17 644447 4758499	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T8-N+5	As above, 5 m north of T8-N	Brown organic soil with dense weed growth.	10 17 644441 4758548	Oct. 6, 2004		As, Zn, PCBs			
T8-M	As above, in creek	Brown to black silt with organic detritus.	10 17 644494 4758539	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs		
T8-S	As above, south bank	Brown organic soil with dense weed growth.	10 17 644463 4758503	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T9-N	Apporx. 40m below T8, north bank	Brown organic soil with dense weed growth.	10 17 644475 4758563	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T9-M	As above, in creek	Brown to black silt with organic detritus.	10 17 644522 4758564	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs	Cattails or Fragmites for PCB	Sediment bioassay
T9-S	As above, south bank	Brown organic soil with dense weed growth.	10 17 644517 4758536	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs		Weeds, leaves for total PCB	
T10-N	Approx. 20m upstream of new ditch, north bank	Brown organic soil with dense weed growth.	10 17 644533 4758576	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			

TABLE 1:
Phase III Study Locations and Study Components

Station	Location	Description	Georeference	Date sampled	COC	Study Components			
						Soils	Sediments	Vegetation	Invertebrates
T10-S	As above, south bank	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644534 4758554	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T10-S+5	As above, 5 m south of T10-S	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644520 4758540	Oct. 6, 2004		As, Zn, PCBs			
T11-N	Below City ditch, north bank	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644555 4758568	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T11-M	As above, in creek	Brown to black silt with organic detritus.	10 17 644555 4758567	Oct. 6, 2004	As, Zn, PCBs		As, Zn, PCBs		
T11-S	As above, south bank	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644556 4758548	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T12-N	Remnant stream, ~50m below cuttoff. North bank	Brown organic soil with dense weed growth.	10 17 644391 4758504	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs		grasses and weeds for As, Zn, PCBs	
T12-N+15	As above, 15 m north of T12-N	Brown organic soil with dense weed growth.	10 17 644374 4758528	Oct. 6, 2004		As, Zn, PCBs			
T12-M	Remnant stream, in creek	Brown clayey soil with dense grasses.	10 17 644379 4758497	Oct. 6, 2004		As, Zn, PCBs			
T12-S	As above, south bank	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644370 4758491	July 14-15, 2004	As, Zn, PCBs	As, Zn, PCBs			
T13-N	Remnant stream, ~20m w. of T-12. North bank.	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644343 4758521	Oct. 6, 2004		As, Zn, PCBs			
T13-S	Remnant stream, ~20m w. of T-12. South bank.	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644345 4758500	Oct. 6, 2004		As, Zn, PCBs			
T14-N	City ditch, below culvert. North bank	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644318 4758513	Oct. 6, 2004		As, Zn, PCBs			
T14-S	City ditch, below culvert. South bank	At top of bank. Brown clayey soil with gravel, dense grass and weed cover. Very dry soil	10 17 644317 4758495	Oct. 6, 2004		As, Zn, PCBs			
Frenchman's Creek									

TABLE 1:
Phase III Study Locations and Study Components

Station	Location	Description	Georeference	Date sampled	COC	Study Components			
						Soils	Sediments	Vegetation	Invertebrates
Control	Wetland on main branch below QEW	Brown organic sediments	10 17 666225 4753923	Oct. 7, 2004	Cd, Cr, Diox		PSQG metals in bioassay sediments		Sediment bioassay
FC-2	Below Fleet at Gilmer Road	Brown organic sediments and clay.	10 17 667293 4753947	Oct. 7, 2004	Cd, Cr.		PSQG metals in bioassay sediments		Sediment bioassay
FC-5A	Upstream end of tributary below Durez site.	Black organic soil. Damp but no surface water.	10 17 668693 4754404	Oct. 7, 2004	Diox		Dioxins & furans		
FC-5B	Approx. midway bewteen FC-5A and FC-5.	Black organic soil. Damp but no surface water.	10 17 668643 4754395	Oct. 7, 2004	Diox		Dioxins & furans		
FC-5C	Tributary from Durez, upstream of wetland	Black organic soil. Damp but no surface water. Dense weed growth.	10 17 668407 4754515	Oct. 7, 2004	Diox		Dioxins & furans		
FC-5D	In tributary from Durez, approx. 10m upstream of main branch	Mainly clay sediments.	10 17 668134 4754559	Oct. 7, 2004	Diox		Dioxins & furans		
FC-5E	In main branch below se. tributaries	Brown silt with sand and clay	10 17 668127 4754573	Oct. 7, 2004	Diox		Dioxins & furans		
Welland River									
Control	Upstream of Atlas Steel site.	Brown silty sediments.	10 17 642985 4761715	Oct. 5, 2004	Cu, Cr, Ni, PAH		Cu, Cr, Ni, PAH		Sediment bioassay
WR-1M	Below Canal By-Pass, in middle of channel	Brown silty sediments mixed with clay.	10 17 646341 4766290	Oct. 5, 2004	Cu, Cr, Ni		Cu, Cr, Ni		Sediment bioassay
WR-4N	At Oxy Vinyl	Brown silty sediments with organic detritus.	10 17 648809 4767186	Oct. 5, 2004	Cu, Cr, Ni		Cu, Cr, Ni, PAH		Sediment bioassay
WR-7N	Below Cytec	Brown silty sediments with organic detritus.	10 17 651507 4767510	Oct. 5, 2004	Cu, Cr, Ni		Cu, Cr, Ni, PAH		Sediment bioassay
WR-11	At mouth of Thompson's Creek	Brown silty sediments with organic detritus.	10 17 653633 4767433	Oct. 5, 2004	Cu, Cr, Ni		Cu, Cr, Ni, PAH		Sediment bioassay

TABLE 1:
Phase III Study Locations and Study Components

Station	Location	Description	Georeference	Date sampled	COC	Study Components			
						Soils	Sediments	Vegetation	Invertebrates
Thompson's Creek									
TC-1	In creek near mouth. Upstream side of bridge at Chippawa Creek Rd.	Brown silty sediments with organic detritus.	10 17 652072 4768105	Oct. 13, 2004	Cu		PSQG Metals		
TC-2	Trib from Cytec, above confluence. Approx.200' below road	Brown silty sediments with organic detritus.	10 17 650587 4768248	Oct. 13, 2004	Cu		PSQG Metals		
TC-3	North tributary, approx. 50' upstream of road.	Brown silty sediments with organic detritus and clay.	10 17 650436 4768961	Oct. 13, 2004	Cu		PSQG Metals		
TC-4	Small tributary to Welland River, approx. 300m east of road to Cytec at Chippawa Creek Rd.	Brown silty sediments with organic detritus.	10 17 650846 4767306	Oct. 13, 2004	Cu		PSQG Metals		

TABLE 2:
Lyon's Creek West:
Arsenic in Soil, Sediment and Biota. 2003 - 2004

Sample	Date	Arsenic															Deer Mouse - Exposure Estimates					Short-tailed Shrew - Exposure Estimates					Muskrat - Exposure Estimates				
		Soil ug/g	Sediment ug/g d.w.	RQ_{Veg}	Leaf ug/g w.w	$BSAF_{leaf}$	$Leaf_{est}$ ug/g w.w	Grass ug/g w.w.	$BSAF_{Gr}$	$Grass_{est}$ ug/g w.w.	Cattails ug/g w.w.	$BSAF_{cat}$	$Cattail_{est}$ ug/g w.w.	Earth-worm ug/g w.w.	$BSAF_{worm}$	$Earth\text{-}worm_{est}$ ug/g w.w	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of grasses	average daily dose (mg/kg b.w./day)	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of earth-worms	average daily dose (mg/kg b.w./day)	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of cattails	average daily dose (mg/kg b.w./day)
Area A: Upstream of wetland on south branch (Area = ~360 m²)																															
T1-N	2004	3.2		0.2	0.40	0.13	0.26	0.20	0.06	0.33						0.71	0.022	0.0034	6.8E-05	0.48	0.035	0.015	0.009	0.00117	0.314	0.383					
T1-M	2004		53.0	2.7							0.70	0.01	0.41	16.57	0.312642	16.57											1.2	0.116	0.004	0.6	0.200
T1-S	2004	2.8		0.1			0.22			0.29						0.88	0.022	0.0034	6.8E-05	0.48	0.030	0.015	0.009	0.00117	0.314	0.383					
LC-1	2003		167.0	8.4									1.28			52.21											1.2	0.116	0.004	0.6	0.631
LC-2	2003		47.0	2.4									0.36			14.69											1.2	0.116	0.004	0.6	0.178
T2-N	2004	3.7		0.2			0.30			0.38						1.16	0.022	0.0034	6.8E-05	0.48	0.040	0.015	0.009	0.00117	0.314	0.507					
T2-M	2004		80.2	4.0									0.61			25.07											1.2	0.116	0.004	0.6	0.303
Mean		***3.23***	***86.80***				***0.26***			***0.34***			***0.67***			***15.90***					***0.035***					***0.424***					***0.328***
Standard Deviation		***0.45***	***55.38***				***0.04***			***0.05***			***0.42***			***18.61***					***0.00***					***0.07***					***0.21***
95% C.L. (+/-)		***0.51***	***54.28***				***0.04***			***0.05***			***0.42***			***13.79***					***0.01***					***0.08***					***0.21***
Upper 95% C.L.		***3.74***	***141.08***				***0.30***			***0.39***			***1.08***			***29.69***					***0.04***					***0.50***					***0.53***
Area B: Wetland (Area = ~8000 m²)																															
T3-N	2004	2.6		0.1			0.21			0.27						0.81	0.022	0.0034	6.8E-05	0.48	0.028	0.015	0.009	0.00117	0.314	0.356					
T3-M	2004		480.0	24.0							4.10	0.01	3.68			150.07											1.2	0.116	0.004	0.6	1.813
T4-N	2004	3.2		0.2			0.26			0.33						1.00	0.022	0.0034	6.8E-05	0.48	0.035	0.015	0.009	0.00117	0.314	0.438					
T4-M	2004		19.0	1.0									0.15			5.94											1.2	0.116	0.004	0.6	0.072
T5-N	2004	2.4		0.1	< 0.10		0.19	0.30	0.13	0.25						0.75	0.022	0.0034	6.8E-05	0.48	0.026	0.015	0.009	0.00117	0.314	0.329					
T5-M	2004		58.7	2.9							0.40	0.01	0.45			18.35											1.2	0.116	0.004	0.6	0.222
T5-S	2004	5.2		0.3			0.42			0.54						1.63	0.022	0.0034	6.8E-05	0.48	0.056	0.015	0.009	0.00117	0.314	0.712					
T6-N	2004	23.9		1.2	0.90	0.04	1.91	3.30	0.14	2.49						7.47	0.022	0.0034	6.8E-05	0.48	0.258	0.015	0.009	0.00117	0.314	3.272					
T6-M	2004		95.2	4.8							0.20	0.00	0.73			29.76											1.2	0.116	0.004	0.6	0.360
T6-S	2004	2.3		0.1			0.18			0.24						0.72	0.022	0.0034	6.8E-05	0.48	0.025	0.015	0.009	0.00117	0.314	0.315					
Mean		***6.6***	***163.2***				***0.5***			***0.7***			***1.3***			***21.7***					***0.1***					***0.9***					***0.6***
Standard Deviation		***8.54***	***213.46***				***0.68***			***0.89***			***1.64***			***46.13***					***0.09***					***1.17***					***0.81***
95% C.L. (+/-)		***6.84***	***209.19***				***0.55***			***0.71***			***1.31***			***28.59***					***0.07***					***0.94***					***0.79***
Upper 95% C.L.		***13.44***	***372.42***				***1.07***			***1.40***			***2.56***			***50.24***					***0.15***					***1.84***					***1.41***
Area D: North ditch from berm at Bradley Ave to wetland (Area = ~320m²)																															
LC-10	2003		5.5	0.3									0.04			1.72											1.2	0.116	0.004	0.6	0.021
T-14-N	2004	5.2		0.3			0.42			0.54						1.63	0.022	0.0034	6.8E-05	0.48	0.056	0.015	0.009	0.00117	0.314	0.712					
T14-S	2004	6.6		0.3			0.53			0.69							0.022	0.0034	6.8E-05	0.48	0.071	0.015	0.009	0.00117	0.314	0.515					
T13-N	2004	5.0		0.3			0.40			0.52						1.56	0.022	0.0034	6.8E-05	0.48	0.054	0.015	0.009	0.00117	0.314	0.685					
T-13-S	2004	8.4		0.4			0.67			0.87						2.63	0.022	0.0034	6.8E-05	0.48	0.091	0.015	0.009	0.00117	0.314	1.150					
T12-N	2004	45.7		2.3			3.66			4.75						14.29	0.022	0.0034	6.8E-05	0.48	0.494	0.015	0.009	0.00117	0.314	6.256					
T12-N+15	2004	7.8		0.4			0.62	0.70	0.09	0.81						2.44	0.022	0.0034	6.8E-05	0.48	0.084	0.015	0.009	0.00117	0.314	1.068					
T12-M	2004	16.0	16.0	0.8			1.28			1.66				2.1	0.13125	5.00	0.022	0.0034	6.8E-05	0.48	0.173	0.015	0.009	0.00117	0.314	2.190					
T12-S	2004	4.8		0.2			0.38			0.50						1.50	0.022	0.0034	6.8E-05	0.48	0.052	0.015	0.009	0.00117	0.314	0.657					
T7-N	2004	18.5		0.9			1.48			1.92						5.78	0.022	0.0034	6.8E-05	0.48	0.200	0.015	0.009	0.00117	0.314	2.533					
T7-M	2004		13.8	0.7									0.11			4.31											1.2	0.116	0.004	0.6	0.052
LC-13	2003		14.3	0.7									0.11			4.47											1.2	0.116	0.004	0.6	0.054
Mean		***13.1***	***12.4***				***1.0***			***1.4***			***0.1***			***4.1***					***0.1***					***1.8***					***0.042***
Standard Deviation		***13.18***	***4.70***				***1.05***			***1.37***						***3.71***					***0.14***					***1.83***					***0.019***
95% C.L. (+/-)		***8.61***	***4.60***				***0.69***			***0.90***						***2.19***					***0.09***					***1.20***					***0.026***
Upper 95% C.L.		***21.72***	***17.00***				***1.74***			***2.26***						***6.31***					***0.23***					***2.95***					***0.068***
Area E: Main stem, North ditch to mouth (Area = ~400 m²)																															
T8-N	2004	11.0		0.6			0.88			1.14						3.44	0.022	0.0034	6.8E-05	0.48	0.119	0.015	0.009	0.00117	0.314	1.506					
T8-N+5	2004	5.3		0.3			0.42			0.55						1.66	0.022	0.0034	6.8E-05	0.48	0.057	0.015	0.009	0.00117	0.314	0.726					
T8-M	2004		33.9	1.7									0.26			10.60						0.015	0.009	0.00117	0.314	4.641	1.2	0.116	0.004	0.6	0.128
LC-8	2003		71.1	3.6									0.55			22.23						0.015	0.009	0.00117	0.314	9.734	1.2	0.116	0.004	0.6	0.269

TABLE 2:
Lyon's Creek West:
Arsenic in Soil, Sediment and Biota. 2003 - 2004

Sample	Date	Arsenic															Deer Mouse - Exposure Estimates					Short-tailed Shrew - Exposure Estimates					Muskrat - Exposure Estimates				
		Soil ug/g	Sediment ug/g d.w.	RQ_{Veg}	Leaf ug/g w.w	$BSAF_{leaf}$	$Leaf_{est}$ ug/g w.w	Grass ug/g w.w.	$BSAF_{Gr}$	$Grass_{est}$ ug/g w.w.	Cattails ug/g w.w.	$BSAF_{cat}$	$Cattail_{est}$ ug/g w.w.	Earth-worm ug/g w.w.	$BSAF_{worm}$	$Earthworm_{est}$ ug/g w.w	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of grasses	average daily dose (mg/kg b.w./day)	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of earth-worms	average daily dose (mg/kg b.w./day)	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of cattails	average daily dose (mg/kg b.w./day)
T8-S	2004	3.9		0.2			0.31			0.41						1.22	0.022	0.0034	6.8E-05	0.48	0.042	0.015	0.009	0.00117	0.314	0.534					
T9-N	2004	3.1		0.2			0.25			0.32						0.97	0.022	0.0034	6.8E-05	0.48	0.033	0.015	0.009	0.00117	0.314	0.424					
T9-M	2004		16.8	0.8							0.30	0.02	0.13			5.25						0.015	0.009	0.00117	0.314	2.300	1.2	0.116	0.004	0.6	0.063
T9-S	2004	2.8		0.1	< 0.10		0.22	< 0.10		0.29						0.88	0.022	0.0034	6.8E-05	0.48	0.030	0.015	0.009	0.00117	0.314	0.383					
LC-6	2003		8.2	0.4									0.06			2.56						0.015	0.009	0.00117	0.314	1.123	1.2	0.116	0.004	0.6	0.031
T10-N	2004	2.9		0.1			0.23			0.30						0.91	0.022	0.0034	6.8E-05	0.48	0.031	0.015	0.009	0.00117	0.314	0.397					
T10-S	2004	24.5		1.2			1.96			2.55						7.66	0.022	0.0034	6.8E-05	0.48	0.265	0.015	0.009	0.00117	0.314	3.354					
T10-S+5	2004	4.5		0.2			0.36			0.47						1.41	0.022	0.0034	6.8E-05	0.48	0.049	0.015	0.009	0.00117	0.314	0.616					
T11-N	2004	2.9		0.1			0.23			0.30						0.91	0.022	0.0034	6.8E-05	0.48	0.031	0.015	0.009	0.00117	0.314	0.397					
T11-M	2004		8.6	0.4									0.07			2.69						0.015	0.009	0.00117	0.314	1.177	1.2	0.116	0.004	0.6	0.032
T11-S	2004	2.4		0.1			0.19			0.25						0.75	0.022	0.0034	6.8E-05	0.48	0.026	0.015	0.009	0.00117	0.314	0.329					
Mean		***6.3***	***27.7***				***0.5***			***0.7***			***0.2***			***4.2***					***0.068***					***1.843***					***0.105***
Standard Deviatio		***6.86***	***26.39***				***0.55***			***0.71***			***0.20***			***5.75***					***0.07***					***2.52***					***0.10***
95% C.L. (+/-)		***4.25***	***23.13***				***0.34***			***0.44***			***0.18***			***2.91***					***0.05***					***1.27***					***0.09***
Upper 95% C.L.		***10.58***	***50.85***				***0.85***			***1.10***			***0.39***			***7.12***					***0.11***					***3.12***					***0.19***
Mean						0.08			0.10			0.01			0.22																

RQ_{Veg} - Calculated as the concentration in soil or sediment/screening concentration of 20 ug/g

$BSAF_{leaf}$ - Calculated as concentration in the leaf samples/ concentration in the soil samples.

$Leaf_{est}$ - Calculated as the concentration in soil x $BSAF_{leaf}$

$BSAF_{Gr}$ - Calculated as the concentration in the grass samples/concentration in the soil samples.

$Grass_{est}$ - Calcualted as the concentration in soil x $BSAF_{Gr}$

$BSAF_{cat}$ - Calculated as the concentration in cattail smaples/concentration in the sediment samples.

$Cattail_{est}$ - Calculated as the concentration in the sediment x $BSAF_{cat}$

$BSAF_{worm}$ - Calculated as the concentration in earthworm tissues/concentration in the soil samples

$Earthworm_{est}$ - Calculated as the concentration in soil x $BSAF_{worm}$

TABLE 3:
Lyon's Creek West:
Zinc in Soil, Sediment and Biota. 2003 - 2004

Sample		Zinc												Deer Mouse - Exposure Estimates					Muskrat - Exposure Estimates				
		Soil ug/g d.w.	Sediment ug/g d.w.	RQ_{Veg}	Leaf ug/g w.w.	BSAF	$Leaf_{est}$ ug/g w.w.	Grass ug/g w.w.	BSAF	$Grass_{est}$ ug/g w.w.	Cattails ug/g w.w.	$BSAF_{cat}$	$Cattail_{est}$ ug/g w.w.	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of	average daily dose (mg/kg	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of	average daily dose (mg/kg
Area A: Upstream of wetland on south branch (Area = ~360 m²)																							
T1-N	2004	101		0.17	20.8	0.2	14.8	12.5	0.1	34.4				0.022	0.0034	0.000068	0.48	2.861					
T1-M	2004		516	0.86							23.5	0.05	21.5						1.2	0.116	0.004	0.6	1.720
T1-S	2004	109		0.18			16.0			37.1				0.022	0.0034	0.000068	0.48	3.087					
LC-1	2003		970	1.62									40.4						1.2	0.116	0.004	0.6	3.233
LC-2	2003		397	0.66									16.5						1.2	0.116	0.004	0.6	1.323
T2-N	2004	184		0.31			27.1			62.6				0.022	0.0034	0.000068	0.48	5.211					
T2-M	2004		515	0.86									21.4						1.2	0.116	0.004	0.6	1.717
Mean		***131***	***600***				***19***			***45***			***25***					***3.720***					***1.998***
Standard Deviation		***45.79***	***253.24***				***6.73***			***15.57***			***10.55***					***1.30***					***0.84***
95% C.L. (+/-)		***51.81***	***248.17***				***7.62***			***17.62***			***10.33***					***1.47***					***0.83***
Upper 95% C.L.		***183.14***	***847.67***				***26.93***			***62.29***			***35.30***					***5.19***					***2.83***
Area B: Wetland (Area = ~8000 m²)																							
T3-N	2004	78		0.13			11.5			26.5				0.022	0.0034	0.000068	0.48	2.209					
T3-M	2004		462	0.77							38.8	0.08	19.2						1.2	0.116	0.004	0.6	1.540
T4-N	2004	172		0.29			25.3			58.5				0.022	0.0034	0.000068	0.48	4.872					
T4-M	2004		1010	1.68									42.1						1.2	0.116	0.004	0.6	3.367
T5-N	2004	185		0.31	13.7	0.1	27.2	25.3	0.1	62.9				0.022	0.0034	0.000068	0.48	5.240					
T5-M	2004		1340	2.23							20.6	0.02	55.8						1.2	0.116	0.004	0.6	4.467
T5-S	2004	140		0.23			20.6			47.6				0.022	0.0034	0.000068	0.48	3.965					
T6-N	2004	167		0.28	26.9	0.2	24.6	38.0	0.2	56.8				0.022	0.0034	0.000068	0.48	4.730					
T6-M	2004		1130	1.88							24.5	0.02	47.1						1.2	0.116	0.004	0.6	3.767
T6-S	2004	93		0.16			13.7			31.6				0.022	0.0034	0.000068	0.48	2.634					
Mean		***139***	***986***				***20***			***47***			***41***					***3.942***					***3.285***
Standard Deviation		***44.33***	***374.70***				***6.52***			***15.08***			***15.60***					***1.26***					***1.25***
95% C.L. (+/-)		***35.47***	***367.20***				***5.22***			***12.07***			***15.29***					***1.00***					***1.22***
Upper 95% C.L.		***174.64***	***1352.70***				***25.68***			***59.40***			***56.33***					***4.95***					***4.51***
Area D: North ditch from berm at Bradley Ave to wetland (Area = ~320m²)																							
LC-10	2003		211	0.35									8.8						1.2	0.116	0.004	0.6	0.703
T-14-N	2004	94		0.16			13.8			32.0				0.022	0.0034	0.000068	0.48	2.662					
T14-S	2004	273		0.46			40.1			92.9				0.022	0.0034	0.000068	0.48	7.732					
T13-N	2004	165		0.28			24.3			56.1				0.022	0.0034	0.000068	0.48	4.673					
T-13-S	2004	900		1.50			132.3			306.1				0.022	0.0034	0.000068	0.48	25.491					
T12-N	2004	4120		6.87			605.7			1401.4				0.022	0.0034	0.000068	0.48	116.690					
T12-N+15	2004	149		0.25			21.9	130.0	0.9	50.7				0.022	0.0034	0.000068	0.48	4.220					
T12-M	2004	2110		3.52			310.2			717.7				0.022	0.0034	0.000068	0.48	53.239					
T12-S	2004	176		0.29			25.9			59.9				0.022	0.0034	0.000068	0.48	4.985					
T7-N	2004	2260		3.77			332.3			768.7				0.022	0.0034	0.000068	0.48	64.010					
T7-M	2004		2070	3.45									86.2						1.2	0.116	0.004	0.6	6.900
LC-13	2003		2920	4.87									121.6						1.2	0.116	0.004	0.6	9.733
Mean		***1139***	***1734***				***167***			***387***			***72***					***31.523***					***5.779***
Standard Deviation		***1407.17***	***1385.46***				***206.89***			***478.63***			***57.70***					***39.35***					***4.62***
95% C.L. (+/-)		***919.34***	***1567.77***				***135.16***			***312.70***			***65.29***					***25.71***					***5.23***
Upper 95% C.L.		***2057.89***	***3301.44***				***302.56***			***699.96***			***137.49***					***57.23***					***11.00***
Area E: Main stem, North ditch to mouth (Area = ~400 m²)																							
T8-N	2004	848		1.41			124.7			288.4				0.022	0.0034	0.000068	0.48	24.018					
T8-N+5	2004	121		0.20			17.8			41.2				0.022	0.0034	0.000068	0.48	3.427					
T8-M	2004		2970	4.95									123.7						1.2	0.116	0.004	0.6	9.900
LC-8	2003		4280	7.13									178.2						1.2	0.116	0.004	0.6	14.267
T8-S	2004	150		0.25			22.1			51.0				0.022	0.0034	0.000068	0.48	4.248					
T9-N	2004	101		0.17			14.8			34.4				0.022	0.0034	0.000068	0.48	2.861					
T9-M	2004		2760	4.60							108.0	0.04	114.9						1.2	0.116	0.004	0.6	9.200
T9-S	2004	88		0.15	50.1	0.6	12.9	9.7	0.1	29.9				0.022	0.0034	0.000068	0.48	2.492					

TABLE 3:
Lyon's Creek West:
Zinc in Soil, Sediment and Biota. 2003 - 2004

Sample		Zinc												Deer Mouse - Exposure Estimates					Muskrat - Exposure Estimates				
		Soil ug/g d.w.	Sediment ug/g d.w.	RQ_{Veg}	Leaf ug/g w.w.	BSAF	$Leaf_{est}$ ug/g w.w.	Grass ug/g w.w.	BSAF	$Grass_{est}$ ug/g w.w.	Cattails ug/g w.w.	$BSAF_{cat}$	$Cattail_{est}$ ug/g w.w.	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of	average daily dose (mg/kg	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of	average daily dose (mg/kg
LC-6	2003		1440	2.40									60.0						1.2	0.116	0.004	0.6	4.800
T10-N	2004	96		0.16			14.1			32.7				0.022	0.0034	0.000068	0.48	2.719					
T10-S	2004	2290		3.82			336.7			778.9				0.022	0.0034	0.000068	0.48	64.859					
T10-S+5	2004	98		0.16			14.4			33.3				0.022	0.0034	0.000068	0.48	2.776					
T11-N	2004	120		0.20			17.6			40.8				0.022	0.0034	0.000068	0.48	3.399					
T11-M	2004		1940	3.23									80.8						1.2	0.116	0.004	0.6	6.467
T11-S	2004	90		0.15			13.2			30.6				0.022	0.0034	0.000068	0.48	2.549					
Mean		***400***	***2678***				***59***			***136***			***112***					***11.335***					***8.927***
Standard Deviation		***703.80***	***1088.08***				***103.48***			***239.39***			***45.31***					***19.93***					***3.63***
95% C.L. (+/-)		***436.21***	***953.73***				***64.13***			***148.37***			***39.72***					***12.35***					***3.18***
Upper 95% C.L.		***836.41***	***3631.73***				***122.97***			***284.49***			***151.24***					***23.69***					***12.11***
Column Mean						0.1			0.3			0.04											

RQ_{Veg} - Calculated as the concentration in soil or sediment/screening concentration of 600 ug/g

$BSAF_{leaf}$ - Calculated as concentration in the leaf samples/ concentration in the soil samples.

$Leaf_{est}$ - Calculated as the concentration in soil x $BSAF_{leaf}$

$BSAF_{Gr}$ - Calculated as the concentration in the grass samples/concentration in the soil samples.

$Grass_{est}$ - Calcualted as the concentration in soil x $BSAF_{Gr}$

$BSAF_{cat}$ - Calculated as the concentration in cattail smaples/concentration in the sediment samples.

$Cattail_{est}$ - Calculated as the concentration in the sediment x $BSAF_{cat}$

TABLE 4:
Lyon's Creek West:
Total PCB in Sediment and Biota. 1991-2004

Sample Id	Date	Depth cm	PCBs: Sediment ug/g d.w. (measured)	Total coplanar PCBs ug/g	Ratio (coplanars to total)	Estimated $[PCB_{congener}]^1$ ug/g d.w.	RQ_{Veg}	Cattail ug/g w.w. (measured)	BSAF	$Cattail_{est}$ ug/g w.w.	Amphipod $[PCB_{est}]^6$	Muskrat - Exposure Estimates: body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of cattails	average daily dose (mg/kg b.w./day)	Fish - Exposure Estimates: $BSAF_{Fish}^2$	[PCB] in fish (estimated) ug/g w.w.	$BSAF_{conplanar}^3$	Estimated $[congeners]^4$ ug/g w.w.	Estimated TEQ $(pg/g)^5$
Area A: Upstream of wetland on south branch (Area = ~360 m^2)																					
T1-M	2004	0-5	< 0.05					< 0.05		0.00		1.2	0.116	0.004	0.6	0.0002	0.80	< 0.04	2.57		
T2-M	2004	0-5	0.05			0.003	0.10			0.00	0.08	1.2	0.116	0.004	0.6	0.0002	0.80	0.04		0.00	0.00
LC-2	2003	0-5	< 0.03							0.00		1.2	0.116	0.004	0.6	0.0001	0.80	0.02		0.00	0.00
LC-3	2003	0-5	0.08			0.004	0.16			0.00	0.13	1.2	0.116	0.004	0.6	0.0003	0.80	0.06		0.00	0.00
LC-4	2003	0-5	< 0.03							0.00		1.2	0.116	0.004	0.6	0.0001	0.80	0.02		0.00	0.00
LC-5	2003	0-5	0.04			0.002	0.08			0.00	0.06	1.2	0.116	0.004	0.6	0.0002	0.80	0.03		0.00	0.00
Mean			***0.05***			***0.003***										***0.0002***		***0.04***		***0.00***	***0.00***
Standard Deviation			***0.02***			***0.001***															
95% C.L. (+/-)			***0.01***			***0.001***															
Upper 95% C.L.			***0.06***			***0.004***															
Area B: Wetland (Area = ~8000 m^2)																					
T3-M	2004	0-5	0.22	0.017	0.077	0.012	0.44	< 0.05		0.00	0.35	1.2	0.116	0.004	0.6	0.0009	0.80	0.18	2.57	0.03	0.02
SLSA-79A	1991	0-16	24.40			1.298	48.80			0.24	38.31	1.2	0.116	0.004	0.6	0.0955	0.80	19.52	2.57	3.34	1.67
T4-M	2004	0-5	5.83			0.310	11.66			0.06	9.15	1.2	0.116	0.004	0.6	0.0228	0.80	4.66	2.57	0.80	0.40
SLSA-78A	1991	0-20	11.80			0.628	23.60			0.12	18.53	1.2	0.116	0.004	0.6	0.0462	0.80	9.44	2.57	1.61	0.81
SLSA-77A	1991	0-19	44.80			2.384	89.60			0.45	70.34	1.2	0.116	0.004	0.6	0.1753	0.80	35.84	2.57	6.13	3.06
T5-M	2004	0-5	4.16	0.215	0.052	0.221	8.32	< 0.05		0.04	6.53	1.2	0.116	0.004	0.6	0.0163	0.80	3.33	2.57	0.57	0.28
SLSA-76A	1991	0-20	7.23			0.385	14.46			0.07	11.35	1.2	0.116	0.004	0.6	0.0283	0.80	5.78	2.57	0.99	0.49
SLSA-59	1991	0-16	41.70			2.219	83.40			0.42	65.47	1.2	0.116	0.004	0.6	0.1632	0.80	33.36	2.57	5.70	2.85
T6-M	2004	0-5	10.50			0.559	21.00	< 0.05		0.11	16.49	1.2	0.116	0.004	0.6	0.0411	0.80	8.40	2.57	1.44	0.72
LC-14	2003	0-5	11.50			0.612	23.00			0.12	18.06	1.2	0.116	0.004	0.6	0.0450	0.80	9.20	2.57	1.57	0.79
SLSA-58A	1991	0-20	4.30			0.229	8.60			0.04	6.75	1.2	0.116	0.004	0.6	0.0168	0.80	3.44	2.57	0.59	0.29
SLSA-89A	1991	0-23	40.40			2.150	80.80			0.40	63.43	1.2	0.116	0.004	0.6	0.1581	0.80	32.32	2.57	5.52	2.76
SLSA-90A	1991	0-17	10.80			0.575	21.60			0.11	16.96	1.2	0.116	0.004	0.6	0.0423	0.80	8.64	2.57	1.48	0.74
SLSA-91A	1991	0-19	2.48			0.132	4.96			0.02	3.89	1.2	0.116	0.004	0.6	0.0097	0.80	1.98	2.57	0.34	0.17
SLSA-75A	1991	0-20	82.10			4.368	164.20			0.82	128.90	1.2	0.116	0.004	0.6	0.3213	0.80	65.68	2.57	11.23	5.61
Mean			***20.15***			***1.07***				***0.20***	***31.63***					***0.08***		***16.12***		***2.76***	***1.38***
Standard Deviation			***22.76***			***1.21***				***0.23***	***35.73***					***0.09***					***1.56***
95% C.L. (+/-)			***11.52***			***0.61***				***0.12***	***18.08***					***0.05***					***0.79***
Upper 95% C.L.			***31.67***			***1.68***				***0.32***	***49.71***					***0.12***					***2.17***
Area C: Creek from north end of wetland to North ditch																					
SLSA-80A	1991	0-16	17.60			0.936	35.20			0.18	27.63	1.2	0.116	0.004	0.6	0.0689	0.80	14.08	2.57	2.41	1.20
SLSA-88A	1991	0-22	68.00			3.618	136.00			0.68	106.76	1.2	0.116	0.004	0.6	0.2661	0.80	54.40	2.57	9.30	4.65
SLSA-81A	1991	0-23	9.40			0.500	18.80			0.09	14.76	1.2	0.116	0.004	0.6	0.0368	0.80	7.52	2.57	1.29	0.64
SLSA-74A	1991	0-23	9.40			0.500	18.80			0.09	14.76	1.2	0.116	0.004	0.6	0.0368	0.80	7.52	2.57	1.29	0.64
MOE-K1	1991	0-20	34.00			1.809	68.00			0.34	53.38	1.2	0.116	0.004	0.6	0.1331	0.80	27.20	2.57	4.65	2.32
MOE-J1	1991	0-20	65.00			3.459	130.00			0.65	102.05	1.2	0.116	0.004	0.6	0.2544	0.80	52.00	2.57	8.89	4.44
Mean			***26.10***			***1.39***				***0.26***	***40.98***					***0.10***		***27.1200***		***4.6356***	***1.78***
Standard Deviation			***26.82***			***1.43***				***0.27***	***42.11***					***0.10***					***1.83***
95% C.L. (+/-)			***21.46***			***1.14***				***0.21***	***33.69***					***0.08***					***1.47***
Upper 95% C.L.			***47.56***			***2.53***				***0.48***	***74.67***					***0.19***					***3.25***
Area D: North ditch from berm at Bradley Ave to wetland (Area = ~320m^2)																					
MOE-P1	1991	0-20	5.10			0.271	10.20										0.80	4.08	2.57	0.70	0.35
LC-12	2003	0-5	0.52			0.028	1.04										0.80	0.42	2.57	0.07	0.04
MOE-O1	1991	0-20	7.70			0.410	15.40										0.80	6.16	2.57	1.05	0.53
T12-M	2004	0-5	6.26	0.432	0.069	0.333	12.52										0.80	5.01	2.57	0.86	0.43
LC-11	2003	0-5	0.41			0.022	0.82										0.80	0.33	2.57	0.06	0.03
MOE-M1	1991	0-20	15.00			0.798	30.00										0.80	12.00	2.57	2.05	1.03

TABLE 4:
Lyon's Creek West:
Total PCB in Sediment and Biota. 1991-2004

Sample Id	Date	Depth cm	PCBs: Sediment ug/g d.w. (measured)	Total coplanar PCBs ug/g	Ratio (coplanars to total)	Estimated [$PCB_{congener}$][1] ug/g d.w.	RQ_{Veg}	Cattail ug/g w.w. (measured)	BSAF	$Cattail_{est}$ ug/g w.w.	Amphipod [PCB_{est}][6]	Muskrat - Exposure Estimates: body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of cattails	average daily dose (mg/kg b.w./day)	Fish - Exposure Estimates: $BSAF_{Fish}$[2]	[PCB] in fish (estimated) ug/g w.w.	$BSAF_{conplanar}$[3]	Estimated [congeners][4] ug/g w.w.	Estimated TEQ (pg/g)[5]
MOE-N1	1991	0-20	42.00			2.235	84.00										0.80	33.60	2.57	5.74	2.87
SLSA-87	1991	0-20	8.59			0.457	17.18										0.80	6.87	2.57	1.17	0.59
T7-M	2004	0-5	40.50	1.347	0.033	2.155	81.00										0.80	32.40	2.57	5.54	2.77
MOE-L1	1991	0-20	6.30			0.335	12.60										0.80	5.04	2.57	0.86	0.43
LC-13	2003	0-5	12.20			0.649	24.40										0.80	9.76	2.57	1.67	0.83
Mean			***13.14***			***0.70***												***10.51***		***1.80***	***0.90***
Standard Deviation			***14.55***			***0.77***															***0.99***
95% C.L. (+/-)			***8.60***			***0.46***															***0.59***
Upper 95% C.L.			***21.74***			***1.16***															***1.49***
Area E: Main stem, North ditch to mouth (Area = ~400 m^2)																					
T8-M	2004	0-5	22.60	0.899	0.040	1.203	45.20			0.23	35.48	1.2	0.116	0.004	0.6	0.0884	0.80	18.08	2.57	3.09	1.55
LC-8	2003	0-5	27.30			1.453	54.60			0.27	42.86	1.2	0.116	0.004	0.6	0.1068	0.80	21.84	2.57	3.73	1.87
LC-7	2003	0-5	18.60			0.990	37.20			0.19	29.20	1.2	0.116	0.004	0.6	0.0728	0.80	14.88	2.57	2.54	1.27
MOE-F1	1991	0-20	6.50			0.346	13.00			0.07	10.21	1.2	0.116	0.004	0.6	0.0254	0.80	5.20	2.57	0.89	0.44
MOE-G1	1991	0-20	11.00			0.585	22.00			0.11	17.27	1.2	0.116	0.004	0.6	0.0430	0.80	8.80	2.57	1.50	0.75
MOE-H1	1991	0-20	16.00			0.851	32.00			0.16	25.12	1.2	0.116	0.004	0.6	0.0626	0.80	12.80	2.57	2.19	1.09
MOE-I1	1991	0-20	40.00			2.128	80.00			0.40	62.80	1.2	0.116	0.004	0.6	0.1565	0.80	32.00	2.57	5.47	2.73
SLSA-71A	1991	0-16	21.80			1.160	43.60			0.22	34.23	1.2	0.116	0.004	0.6	0.0853	0.80	17.44	2.57	2.98	1.49
SLSA-85A	1991	0-22	25.10			1.336	50.20			0.25	39.41	1.2	0.116	0.004	0.6	0.0982	0.80	20.08	2.57	3.43	1.72
SLSA-72A	1991	0-19	64.10			3.411	128.20			0.64	100.64	1.2	0.116	0.004	0.6	0.2508	0.80	51.28	2.57	8.77	4.38
SLSA-86A	1991	0-20	43.90			2.336	87.80			0.44	68.92	1.2	0.116	0.004	0.6	0.1718	0.80	35.12	2.57	6.00	3.00
SLSA-73A	1991	0-22	27.80			1.479	55.60			0.28	43.65	1.2	0.116	0.004	0.6	0.1088	0.80	22.24	2.57	3.80	1.90
T9-M	2004	0-5	9.03			0.480	18.06	0.08	0.01	0.09	14.18	1.2	0.116	0.004	0.6	0.0353	0.80	7.22	2.57	1.23	0.62
LC-6	2003	0-5	11.60			0.617	23.20			0.12	18.21	1.2	0.116	0.004	0.6	0.0454	0.80	9.28	2.57	1.59	0.79
MOE-C1	1991	0-20	14.00			0.745	28.00			0.14	21.98	1.2	0.116	0.004	0.6	0.0548	0.80	11.20	2.57	1.91	0.96
MOE-D1	1991	0-20	6.70			0.356	13.40			0.07	10.52	1.2	0.116	0.004	0.6	0.0262	0.80	5.36	2.57	0.92	0.46
MOE-E1	1991	0-20	32.00			1.703	64.00			0.32	50.24	1.2	0.116	0.004	0.6	0.1252	0.80	25.60	2.57	4.38	2.19
SLSA-70A	1991	0-22	71.20			3.788	142.40			0.71	111.78	1.2	0.116	0.004	0.6	0.2786	0.80	56.96	2.57	9.74	4.87
SLSA-84A	1991	0-22	72.60			3.863	145.20			0.73	113.98	1.2	0.116	0.004	0.6	0.2841	0.80	58.08	2.57	9.93	4.96
T11-M	2004	0-5	3.42	0.165	0.048	0.182	6.84			0.03	5.37	1.2	0.116	0.004	0.6	0.0134	0.80	2.74	2.57	0.47	0.23
MOE-A1	1991	0-20	32.00			1.703	64.00			0.32	50.24	1.2	0.116	0.004	0.6	0.1252	0.80	25.60	2.57	4.38	2.19
SLSA-67A	1991	0-23	35.00			1.862	70.00			0.35	54.95	1.2	0.116	0.004	0.6	0.1370	0.80	28.00	2.57	4.79	2.39
MOE-B1	1991	0-20	3.30			0.176	6.60			0.03	5.18	1.2	0.116	0.004	0.6	0.0129	0.80	2.64	2.57	0.45	0.23
SLSA-68A	1991	0-21	0.04			0.002	0.08			0.00	0.06	1.2	0.116	0.004	0.6	0.0002	0.80	0.03	2.57	0.01	0.00
SLSA-69A	1991	0-20	17.60			0.936	35.20			0.18	27.63	1.2	0.116	0.004	0.6	0.0689	0.80	14.08	2.57	2.41	1.20
SLSA-83A	1991	0-19	45.00			2.394	90.00			0.45	70.65	1.2	0.116	0.004	0.6	0.1761	0.80	36.00	2.57	6.15	3.08
Mean			***26.08***			***1.39***				***0.26***	***40.95***					***0.10***		***20.87***		***3.57***	***1.78***
Standard Deviation			***20.27***			***1.08***				***0.20***	***31.83***					***0.08***					***1.39***
95% C.L. (+/-)			***7.79***			***0.41***				***0.08***	***12.23***					***0.03***					***0.53***
Upper 95% C.L.			***33.88***			***1.80***				***0.34***	***53.19***					***0.13***					***2.32***
Column mean					0.053																

[1] Calculated as [total PCB] in sediment x mean ratio of [total PCB] to [total coplanar PCBs]
[2] BSAF calculated from MOE bioassay data with fathead minnows, 1992 and 1996 (Bedard and Petro 1998)
[3] BSAF calculated from MOE 2002-2003 data for Lyon's Creek East (R. Fletcher, Pers. Comm. 2005)
[4] Calculated as [PCB congeners] in sediment samples x average BSAF for PCB coplanar congeners in young-of-the-year fish, as calcualted from the MOE data for Lyon's Creek East.
[5] Estimated total TEQ_{fish} calculated as estimated [PCB congeners] x conversion factor (0.000005) for TEQ_{fish} which is calculated as the ratio between [PCBcongeners] in fish and [total TEQ] in fish from the MOE data for Lyon's Creek East
[6] Estimate based on mean BSAF of 1.57 calculated for Lyon's Creek East (Table 9)

TABLE 5:
Lyon's Creek West:
Total PCB in Soil and Biota. 1991-2004

Station	Depth	Date	PCBs Soil ug/g d.w.	Sediment ug/g d.w.	RQ_{Veg}	Grass ug/g w.w.	BSAF	$Grass_{est}$ ug/g w.w.	Earthworms ug/g w.w.	BSAF	$Worm_{est}$ ug/g w.w.	TOC Soil %	Deer mouse body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of grasses	average daily dose (mg/kg b.w./day)	Short-tailed shrew body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of earthworms	average daily dose (mg/kg b.w./day)	Red Fox [PCB] in Deer Mouse[1]	[PCB] in shrew [2]	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of rodents	average daily dose (mg/kg b.w./day)[3]
Area A: Upstream of wetland on south branch (Area = ~360 m²)																													
T1-N	0-5	2004	< 0.05				0.01	0.000	0.06	2.40	0.06	5.08	0.022	0.0034	6.8E-05	0.48	0.0002	0.015	0.009	0.00117	0.314	0.015	0.049	6.50	5.25	0.45	0.0126	0.688	0.003
T1-M				< 0.05			0.01	0.001			0.12		0.022	0.0034	6.8E-05	0.48	0.0002	0.015	0.009	0.00117	0.314	0.026	0.054	11.32	5.25	0.45	0.0126	0.688	0.006
T1-S	0-5	2004	< 0.05				0.01	0.000			0.06	7.09	0.022	0.0034	6.8E-05	0.48	0.0002	0.015	0.009	0.00117	0.314	0.015	0.049	6.50	5.25	0.45	0.0126	0.688	0.003
T2-N	0-5	2004	< 0.05				0.01	0.000			0.06	5.31	0.022	0.0034	6.8E-05	0.48	0.0002	0.015	0.009	0.00117	0.314	0.015	0.049	6.50	5.25	0.45	0.0126	0.688	0.003
T2-M				0.05			0.01	0.001			0.12																		
LC-2	2003	0-5																											
LC-3	2003	0-5																											
LC-4	2003	0-5																											
LC-5	2003	0-5																											
Mean			***0.05***								***0.08***	***5.83***					***0.0002***					***0.018***							***0.004***
Standard Deviation																													
95% C.L. (+/-)																													
Upper 95% C.L.																													
Area B: Wetland (Area = ~8000 m²)																													
T3-N	0-5	2004	< 1.00				0.01					3.14																	
T3-M	2004	0-5		0.22			0.01	0.002			0.52		0.022	0.0034	6.8E-05	0.48	0.0008												
SLSA-79A	1991	0-16		24.40			0.01	0.244			58.07		0.022	0.0034	6.8E-05	0.48	0.0935												
T4-N	0-5	2004	< 1.00				0.01					3.91																	
T4-M	2004	0-5		5.83			0.01	0.058			13.88		0.022	0.0034	6.8E-05	0.48	0.0223												
SLSA-78A	1991	0-20		11.80			0.01	0.118			28.08		0.022	0.0034	6.8E-05	0.48	0.0452	0.015	0.009	0.00117	0.314	6.211	12.776	2670.91	5.25	0.45	0.0126	0.688	1.346
SLSA-77A	1991	0-19		44.80			0.01	0.448			106.62		0.022	0.0034	6.8E-05	0.48	0.1717	0.015	0.009	0.00117	0.314	23.582	48.507	10140.42	5.25	0.45	0.0126	0.688	5.109
T5-N	0-5	2004	< 1.00				0.01					4.67																	
T5-S	0-5	2004	< 1.00				0.01					6.14																	
T6-N	0-5	2004	< 1.00				0.01					4.08																	
T6-M	2004	0-5		10.50			0.01	0.105			24.99		0.022	0.0034	6.8E-05	0.48	0.0402	0.015	0.009	0.00117	0.314	5.527	11.369	2376.66	5.25	0.45	0.0126	0.688	1.197
T6-S	0-5	2004	< 0.05				0.01				0.06	4.47						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
SLSA-05A	0-17	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-07	0	1991	< 0.03				0.01				0.04							0.015	0.009	0.00117	0.314	0.009	0.000	3.90	5.25	0.45	0.0126	0.688	0.002
SLSA-09	0-20	1991	< 0.02				0.01				0.02							0.015	0.009	0.00117	0.314	0.006	0.000	2.60	5.25	0.45	0.0126	0.688	0.001
SLSA-10	0-20	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-11	0-20	1991	0.08		0.16		0.01	0.001			0.19		0.022	0.0034	6.8E-05	0.48	0.0003	0.015	0.009	0.00117	0.314	0.042	0.087	18.11	5.25	0.45	0.0126	0.688	0.009
SLSA-13	0	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-17	0-10	1991	< 0.03				0.01				0.04							0.015	0.009	0.00117	0.314	0.009	0.000	3.90	5.25	0.45	0.0126	0.688	0.002
SLSA-18	0-18	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-19A	0-20	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-21	0-20	1991	0.22		0.44		0.01	0.002			0.52		0.022	0.0034	6.8E-05	0.48	0.0008	0.015	0.009	0.00117	0.314	0.116	0.238	49.80	5.25	0.45	0.0126	0.688	0.025
SLSA-23	0-20	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-24	0-21	1991	< 0.02				0.01				0.02							0.015	0.009	0.00117	0.314	0.006	0.000	2.60	5.25	0.45	0.0126	0.688	0.001
SLSA-25	0-14	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-26A	0-13	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-28A	0-19	1991	0.04		0.08		0.01	0.000			0.10		0.022	0.0034	6.8E-05	0.48	0.0002	0.015	0.009	0.00117	0.314	0.021	0.043	9.05	5.25	0.45	0.0126	0.688	0.005
SLSA-31A	0-15	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-32	0-20	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-36A	0-20	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-36B	0-40	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-38	0-20	1991	0.02		0.04		0.01	0.000			0.05		0.022	0.0034	6.8E-05	0.48	0.0001	0.015	0.009	0.00117	0.314	0.011	0.022	4.53	5.25	0.45	0.0126	0.688	0.002
SLSA-40	0-20	1991	0.40		0.80		0.01	0.004			0.95		0.022	0.0034	6.8E-05	0.48	0.0015	0.015	0.009	0.00117	0.314	0.211	0.433	90.54	5.25	0.45	0.0126	0.688	0.046
SLSAC-62	0-20	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-63	0-20	1991	0.02		0.04		0.01	0.000			0.05		0.022	0.0034	6.8E-05	0.48	0.0001	0.015	0.009	0.00117	0.314	0.011	0.022	4.53	5.25	0.45	0.0126	0.688	0.002

TABLE 5:
Lyon's Creek West:
Total PCB in Soil and Biota. 1991-2004

			PCBs									TOC	Deer mouse					Short-tailed shrew					Red Fox						
Station	Depth	Date	Soil ug/g d.w.	Sediment ug/g d.w.	RQ_{Veg}	Grass ug/g w.w.	BSAF	$Grass_{est}$ ug/g w.w.	Earthworms ug/g w.w.	BSAF	$Worm_{est}$ ug/g w.w.	Soil %	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of grasses	average daily dose (mg/kg b.w./day)	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of earthworms	average daily dose (mg/kg b.w./day)	[PCB] in Deer Mouse[1]	[PCB] in shrew [2]	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of rodents	average daily dose (mg/kg b.w./day)[3]
Mean			***0.21***	***16.26***				***0.08***			***7.81***	***4.40***					***0.0314***					***1.327***							***0.287***
Standard Deviation				***16.12***				***0.14***			***22.37***						***0.05***					***4.71***							***1.021***
95% C.L. (+/-)				***12.90***				***0.08***			***8.01***						***0.03***					***1.78***							***0.385***
Upper 95% C.L.				***29.16***				***0.16***			***15.82***						***0.06***					***3.10***							***0.673***
Area D: North ditch from berm at Bradley Ave to wetland (Area = ~320m^2)																													
T-14-N	0-5	2004	< 0.05				0.01				0.06	2.27						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
T14-S	0-5	2004	< 1.00				0.01					6.38																	
T13-N	0-5	2004	0.20		0.40		0.01	0.002			0.48	5.23	0.022	0.0034	6.8E-05	0.48	0.0008	0.015	0.009	0.00117	0.314	0.105	0.217	45.27	5.25	0.45	0.0126	0.688	0.023
T-13-S	0-5	2004	0.11		0.22		0.01	0.001			0.26	6.71	0.022	0.0034	6.8E-05	0.48	0.0004	0.015	0.009	0.00117	0.314	0.058	0.119	24.90	5.25	0.45	0.0126	0.688	0.013
T12-N	0-5	2004	75.20		150.40		0.01	0.752			178.98	8.47	0.022	0.0034	6.8E-05	0.48	0.2882	0.015	0.009	0.00117	0.314	39.585	81.422	17021.41	5.25	0.45	0.0126	0.688	8.576
T12-N+15	0-5	2004	< 0.05				0.01				0.06	4.91						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
T12-M	0-5	2004	6.26		12.52		0.01	0.438	14.70	2.35	14.90	9.31	0.022	0.0034	6.8E-05	0.48	0.0519	0.015	0.009	0.00117	0.314	3.295	14.649	1416.94	5.25	0.45	0.0126	0.688	0.718
T12-S	0-5	2004	0.30		0.60		0.01	0.003			0.71	5.56	0.022	0.0034	6.8E-05	0.48	0.0011	0.015	0.009	0.00117	0.314	0.158	0.325	67.90	5.25	0.45	0.0126	0.688	0.034
LC-11	2003	0-5		0.41			0.01	0.004			0.98		0.022	0.0034	6.8E-05	0.48	0.0016	0.015	0.009	0.00117	0.314	0.216	0.444	92.80	5.25	0.45	0.0126	0.688	0.047
MOE-M1	1991	0-20		15.00			0.01	0.150			35.70		0.022	0.0034	6.8E-05	0.48	0.0575	0.015	0.009	0.00117	0.314	7.896	16.241	3395.23	5.25	0.45	0.0126	0.688	1.711
MOE-N1	1991	0-20		42.00			0.01	0.420			99.96		0.022	0.0034	6.8E-05	0.48	0.1610	0.015	0.009	0.00117	0.314	22.108	45.475	9506.64	5.25	0.45	0.0126	0.688	4.790
T7-N	0-5	2004	11.40		22.80		0.01	0.114			27.13	11.00	0.022	0.0034	6.8E-05	0.48	0.0437	0.015	0.009	0.00117	0.314	6.001	12.343	2580.37	5.25	0.45	0.0126	0.688	1.300
T7-M	0-5	2004	40.50		81.00		0.01	0.405			96.39	3.31	0.022	0.0034	6.8E-05	0.48	0.1552	0.015	0.009	0.00117	0.314	21.319	43.851	9167.12	5.25	0.45	0.0126	0.688	4.619
SLSA-87	1991	0-20		8.59			0.01	0.086			20.44		0.022	0.0034	6.8E-05	0.48	0.0329	0.015	0.009	0.00117	0.314	4.522	9.301	1944.33	5.25	0.45	0.0126	0.688	0.980
SLSA-41	0-20	1991	2.98		5.96		0.01	0.030			7.09		0.022	0.0034	6.8E-05	0.48	0.0114	0.015	0.009	0.00117	0.314	1.569	3.227	674.52	5.25	0.45	0.0126	0.688	0.340
SLSA-42	0-20	1991	19.90		39.80		0.01	0.199			47.36		0.022	0.0034	6.8E-05	0.48	0.0763	0.015	0.009	0.00117	0.314	10.475	21.547	4504.34	5.25	0.45	0.0126	0.688	2.269
SLSA-44A	0-22	1991	0.56		1.12		0.01	0.006			1.33		0.022	0.0034	6.8E-05	0.48	0.0021	0.015	0.009	0.00117	0.314	0.295	0.606	126.76	5.25	0.45	0.0126	0.688	0.064
SLSA-45A	0-20	1991	21.00		42.00		0.01	0.210			49.98		0.022	0.0034	6.8E-05	0.48	0.0805	0.015	0.009	0.00117	0.314	11.054	22.738	4753.32	5.25	0.45	0.0126	0.688	2.395
SLSA-48	0-17	1991	0.11		0.22		0.01	0.001			0.26		0.022	0.0034	6.8E-05	0.48	0.0004	0.015	0.009	0.00117	0.314	0.058	0.119	24.90	5.25	0.45	0.0126	0.688	0.013
SLSA-50	0-20	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-51A	0-18	1991	86.90		173.80		0.01	0.869			206.82		0.022	0.0034	6.8E-05	0.48	0.3331	0.015	0.009	0.00117	0.314	45.743	94.091	19669.69	5.25	0.45	0.0126	0.688	9.910
SLSA-53	0-20	1991	< 0.02				0.01				0.02							0.015	0.009	0.00117	0.314	0.006	0.000	2.60	5.25	0.45	0.0126	0.688	0.001
SLSA-54	0-24	1991	55.60		111.20		0.01	0.556			132.33		0.022	0.0034	6.8E-05	0.48	0.2131	0.015	0.009	0.00117	0.314	29.267	60.201	12584.98	5.25	0.45	0.0126	0.688	6.341
SLSA-55	0-19	1991	< 0.01				0.01				0.01							0.015	0.009	0.00117	0.314	0.003	0.000	1.30	5.25	0.45	0.0126	0.688	0.001
SLSA-56	0-18	1991	26.00		52.00		0.01	0.260			61.88		0.022	0.0034	6.8E-05	0.48	0.0997	0.015	0.009	0.00117	0.314	13.686	28.151	5885.06	5.25	0.45	0.0126	0.688	2.965
SLSA-57	0-19	1991	0.03		0.06		0.01	0.000			0.07		0.022	0.0034	6.8E-05	0.48	0.0001	0.015	0.009	0.00117	0.314	0.016	0.032	6.79	5.25	0.45	0.0126	0.688	0.003
Mean			***15.83***	***16.50***				***0.23***			***39.33***	***6.32***					***0.0805***					***8.699***							***1.885***
Standard Deviation			***25.93***	***18.02***				***0.27***			***59.23***						***0.100***					***13.10***							***2.84***
95% C.L. (+/-)			***10.84***	***17.66***				***0.12***			***23.22***						***0.044***					***5.14***							***1.11***
Upper 95% C.L.			***26.66***	***34.16***				***0.34***			***62.55***						***0.124***					***13.83***							***3.00***
Area E: Main stem, North ditch to mouth (Area = ~400 m^2)																													
T8-N	0-5	2004	6.19		12.38		0.01	0.062			14.73	4.29	0.022	0.0034	6.8E-05	0.48	0.0237	0.015	0.009	0.00117	0.314	3.258	6.702	1401.10	5.25	0.45	0.0126	0.688	0.706
T8-N+5	0-5	2004	< 1.00				0.01				1.19	4.77																	
T8-S	0-5	2004	0.15		0.30		0.01	0.002			0.36	4.46	0.022	0.0034	6.8E-05	0.48	0.0006	0.015	0.009	0.00117	0.314	0.079	0.162	33.95	5.25	0.45	0.0126	0.688	0.017
SLSA-71A	1991	0-16		21.80			0.01	0.218			51.88		0.022	0.0034	6.8E-05	0.48	0.0836	0.015	0.009	0.00117	0.314	11.475	23.604	4934.40	5.25	0.45	0.0126	0.688	2.486
SLSA-85A	1991	0-22		25.10			0.01	0.251			59.74		0.022	0.0034	6.8E-05	0.48	0.0962	0.015	0.009	0.00117	0.314	13.212	27.177	5681.35	5.25	0.45	0.0126	0.688	2.862
SLSA-72A	1991	0-19		64.10			0.01	0.641			152.56		0.022	0.0034	6.8E-05	0.48	0.2457	0.015	0.009	0.00117	0.314	33.742	69.404	14508.94	5.25	0.45	0.0126	0.688	7.310
SLSA-86A	1991	0-20		43.90			0.01	0.439			104.48		0.022	0.0034	6.8E-05	0.48	0.1683	0.015	0.009	0.00117	0.314	23.109	47.533	9936.70	5.25	0.45	0.0126	0.688	5.006
SLSA-73A	1991	0-22		27.80			0.01	0.278			66.16		0.022	0.0034	6.8E-05	0.48	0.1065	0.015	0.009	0.00117	0.314	14.634	30.100	6292.49	5.25	0.45	0.0126	0.688	3.170
T9-N	0-5	2004	0.13		0.26		0.01	0.001			0.31	3.60	0.022	0.0034	6.8E-05	0.48	0.0005	0.015	0.009	0.00117	0.314	0.068	0.141	29.43	5.25	0.45	0.0126	0.688	0.015
T9-S	0-5	2004	< 0.05				0.01				0.06	3.17						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
T10-N	0-5	2004	< 0.05				0.01				0.06	2.02						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
T10-S	0-5	2004	5.36		10.72		0.01	0.054			12.76	12.10	0.022	0.0034	6.8E-05	0.48	0.0205	0.015	0.009	0.00117	0.314	2.821	5.804	1213.23	5.25	0.45	0.0126	0.688	0.611
T10-S+5	0-5	2004	< 0.05				0.01				0.06	3.78						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
SLSA-70A	1991	0-22		71.20			0.01	0.712			169.46		0.022	0.0034	6.8E-05	0.48	0.2729	0.015	0.009	0.00117	0.314	37.479	77.091	16116.02	5.25	0.45	0.0126	0.688	8.120

TABLE 5:
Lyon's Creek West:
Total PCB in Soil and Biota. 1991-2004

Station	Depth	Date	PCBs Soil ug/g d.w.	Sediment ug/g d.w.	RQ$_{Veg}$	Grass ug/g w.w.	BSAF	Grass$_{est}$ ug/g w.w.	Earthworms ug/g w.w.	BSAF	Worm$_{est}$ ug/g w.w.	TOC Soil %	Deer mouse body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of grasses	average daily dose (mg/kg b.w./day)	Short-tailed shrew body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of earthworms	average daily dose (mg/kg b.w./day)	Red Fox [PCB] in Deer Mouse[1]	[PCB] in shrew [2]	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of rodents	average daily dose (mg/kg b.w./day)[3]
SLSA-84A	1991	0-22		72.60			0.01	0.726			172.79		0.022	0.0034	6.8E-05	0.48	0.2783	0.015	0.009	0.00117	0.314	38.216	78.607	16432.91	5.25	0.45	0.0126	0.688	8.279
T11-N	0-5	2004	< 0.05				0.01				0.06	3.97						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
T11-S	0-5	2004	< 0.05				0.01				0.06	4.11						0.015	0.009	0.00117	0.314	0.015	0.000	6.50	5.25	0.45	0.0126	0.688	0.003
SLSA-68A	1991	0-21		0.04			0.01	0.000			0.10		0.022	0.0034	6.8E-05	0.48	0.0002	0.015	0.009	0.00117	0.314	0.021	0.043	9.05	5.25	0.45	0.0126	0.688	0.005
SLSA-69A	1991	0-20		17.60			0.01	0.176			41.89		0.022	0.0034	6.8E-05	0.48	0.0675	0.015	0.009	0.00117	0.314	9.264	19.056	3983.73	5.25	0.45	0.0126	0.688	2.007
SLSA-83A	1991	0-19		45.00			0.01	0.450			107.10		0.022	0.0034	6.8E-05	0.48	0.1725	0.015	0.009	0.00117	0.314	23.688	48.724	10185.69	5.25	0.45	0.0126	0.688	5.132
Mean			***1.31***	***46.64***				***0.308***			***47.45***	***4.63***					***0.1179***					***11.136***							***2.413***
Standard Deviation			***2.38***	***22.46***				***0.28***			***63.98***						***0.11***					***14.36***							***3.111***
95% C.L. (+/-)			***1.48***	***13.92***				***0.28***			***28.04***						***0.06***					***6.46***							***1.399***
Upper 95% C.L.			***2.78***	***60.56***				***0.58***			***75.49***						***0.17***					***17.59***							***3.811***
Mean										***2.38***																			

[1] Based on life span of 300 days, of which 35 days immature and feeding at on-half the normal rate
[2] Based on life span of 460 days, of which 60 days immature and feeding at one-half adult rate
[3] Exposure caclulated as average daily dose as a fraction of the time spent of site (based on a home range of 699 ha).

TABLE 6:
Lyon's Creek West: Coplanar and Mono-Ortho PCBs in Soil and Biota. 1991-2004

Station	Depth	Date	PCBs: Soil* ug/g d.w.	PCBs: Soil* ng/g d.w.	PCBs: PCB Congeners ng/g d.w.	PCBs: Estimated PCB congeners ng/g d.w.[1]	Soil: Est TEQ pg/g	BSAF Grass	Grass$_{est}$ ng/g	Grass$_{est}$ TEQ pg/g	BSAF Worm	Worm$_{est}$ ng/g w.w.	Worm TEQ pg/g	Deer Mouse - Exposure Estimates: body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of grasses	average daily dose (ng/kg b.w./day TEQ)	Short-tailed Shrew - Exposure Estimates: body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of earthworms	average daily dose (ng/kg b.w./day TEQ)
Area A: Upstream of wetland on south branch (Area = ~360 m^2)																							
T1-N	0-5	2004	< 0.05	50.00	0.68	2.75		0.01	0.03	0.011	2.35	3.23	1.293	0.022	0.0034	6.8E-05	0.48	0.0008	0.015	0.009	0.00117	0.314	0.244
T1-S	0-5	2004	< 0.05	50.00		2.75		0.01	0.03	0.011		3.23	1.293	0.022	0.0034	6.8E-05	0.48	0.0008	0.015	0.009	0.00117	0.314	0.244
T2-N	0-5	2004	< 0.05	50.00		2.75		0.01	0.03	0.011		3.23	1.293	0.022	0.0034	6.8E-05	0.48	0.0008	0.015	0.009	0.00117	0.314	0.244
Mean			***0.05***									***3.23***						***0.0008***					***0.244***
Standard Deviation																							
95% C.L. (+/-)																							
Upper 95% C.L.																							
Area B: Wetland (Area = ~8000 m^2)																							
T3-N	0-5	2004	< 1.00	1000.00		< 55.00	< 22.00	0.01	0.55	0.220		64.63	25.850										
T3-M	0-5	2004	*0.22*	220.00		12.10																	
T4-N	0-5	2004	< 1.00	1000.00		< 55.00	< 22.00	0.01	0.55	0.220		64.63	25.850										
T4-M	0-5	2004	*5.83*	*5830.00*		320.65													0.015	0.009	0.00117	0.314	0.000
T5-N	0-5	2004	< 1.00	1000.00	5.69	< 55.00	< 22.00	0.01	0.55	0.220		64.63	25.850										
T5-S	0-5	2004	< 1.00	1000.00		< 55.00	< 22.00	0.01	0.55	0.220		64.63	25.850										
T6-N	0-5	2004	< 1.00	1000.00	165.60	< 55.00	< 22.00	0.01	0.55	0.220		64.63	25.850										
T6-M	0-5	2004	*10.50*	*10500.00*		577.50	231.00					1357.13	542.850						0.015	0.009	0.00117	0.314	120.291
T6-S	0-5	2004	< 0.05	50.00		< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
SLSA-05A	0-17	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-07	0	1991	< 0.03	30.00		< 1.65	< 0.66	0.01	0.02	0.007		1.94	0.776						0.015	0.009	0.00117	0.314	0.198
SLSA-09	0-20	1991	< 0.02	20.00		< 1.10	< 0.44	0.01	0.01	0.004		1.29	0.517						0.015	0.009	0.00117	0.314	0.132
SLSA-10	0-20	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-11	0-20	1991	0.08	80.00		4.40	1.76	0.01	0.04	0.018		10.34	4.136	0.022	0.0034	6.8E-05	0.48	0.0067	0.015	0.009	0.00117	0.314	0.917
SLSA-13	0	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-17	0-10	1991	< 0.03	30.00		< 1.65	< 0.66	0.01	0.02	0.007		1.94	0.776						0.015	0.009	0.00117	0.314	0.198
SLSA-18	0-18	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-19A	0-20	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-21	0-20	1991	0.22	220.00		12.10	4.84	0.01	0.12	0.048		28.44	11.374	0.022	0.0034	6.8E-05	0.48	0.0186	0.015	0.009	0.00117	0.314	2.520
SLSA-23	0-20	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-24	0-21	1991	< 0.02	20.00		< 1.10	< 0.44	0.01	0.01	0.004		1.29	0.517						0.015	0.009	0.00117	0.314	0.132
SLSA-25	0-14	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-26A	0-13	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-28A	0-19	1991	0.04	40.00		2.20	0.88	0.01	0.02	0.009		5.17	2.068	0.022	0.0034	6.8E-05	0.48	0.0034	0.015	0.009	0.00117	0.314	0.458
SLSA-31A	0-15	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-32	0-20	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-36A	0-20	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-36B	0-40	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-38	0-20	1991	0.02	20.00		1.10	0.44	0.01	0.01	0.004		2.59	1.034	0.022	0.0034	6.8E-05	0.48	0.0017	0.015	0.009	0.00117	0.314	0.229
SLSA-40	0-20	1991	0.40	400.00		22.00	8.80	0.01	0.22	0.088		51.70	20.680	0.022	0.0034	6.8E-05	0.48	0.0337	0.015	0.009	0.00117	0.314	4.583
SLSAC-62	0-20	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-63	0-20	1991	0.02	20.00		1.10	0.44	0.01	0.01	0.004		2.59	1.034	0.022	0.0034	6.8E-05	0.48	0.0017	0.015	0.009	0.00117	0.314	0.229
Mean			***0.71***	***706.56***		***38.86***	***12.14***			***0.046***		***59.97***						***0.0110***					***5.041***
Standard Deviation												***246.24***						***0.01***					***23.53***
95% C.L. (+/-)												***98.52***						***0.01***					***9.04***
Upper 95% C.L.												***158.49***						***0.02***					***14.08***
Area D: North ditch from berm at Bradley Ave to wetland (Area = ~320m^2)																							
T-14-N	0-5	2004	< 0.05	50.00		< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
T14-S	0-5	2004	< 1.00	1000.00		< 55.00	< 22.00	0.01	0.55	0.220			0.000										
T13-N	0-5	2004	0.20	200.00		11.00	4.40	0.01	0.11	0.044		25.85	10.340	0.022	0.0034	6.8E-05	0.48	0.0169	0.015	0.009	0.00117	0.314	2.291
T-13-S	0-5	2004	0.11	110.00		6.05	2.42	0.01	0.06	0.024		14.22	5.687	0.022	0.0034	6.8E-05	0.48	0.0093	0.015	0.009	0.00117	0.314	1.260
T12-N	0-5	2004	75.20	75200.00		4136.00	1654.40	0.01	41.36	16.544		9719.60	3887.840	0.022	0.0034	6.8E-05	0.48	6.3409	0.015	0.009	0.00117	0.314	861.512

TABLE 6:
Lyon's Creek West: Coplanar and Mono-Ortho PCBs in Soil and Biota. 1991-2004

			PCBs			Soil									Deer Mouse - Exposure Estimates					Short-tailed Shrew - Exposure Estimates				
Station	Depth	Date	Soil* ug/g d.w.	Soil* ng/g d.w.	PCB Congeners ng/g d.w.	Estimated PCB congeners ng/g d.w.[1]	Est TEQ pg/g	BSAF Grass	$Grass_{est}$ ng/g	$Grass_{est}$ TEQ pg/g	BSAF Worm	$Worm_{est}$ ng/g w.w.	Worm TEQ pg/g	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of grasses	average daily dose (ng/kg b.w./day TEQ)	body weight (kg)	food ingestion rate (kg/day)	soil ingestion rate (kg/day)	% diet comprised of earthworms	average daily dose (ng/kg b.w./day TEQ)
T12-N+15	0-5	2004	< 0.05	50.00		< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
T12-M	0-5	2004	6.26	6260.00		344.30	137.72	0.01	3.44	1.377		809.11	323.642	0.022	0.0034	6.8E-05	0.48	0.5278	0.015	0.009	0.00117	0.314	71.716
T12-S	0-5	2004	0.30	300.00	16.40	16.50	6.60	0.01	0.17	0.066		38.78	15.510	0.022	0.0034	6.8E-05	0.48	0.0253	0.015	0.009	0.00117	0.314	3.437
LC-11	0-5	2003	*0.41*	*410.00*		22.55	9.02					52.99	21.197						0.015	0.009	0.00117	0.314	4.697
MOE-M1	0-20	1991	*15.00*	*15000.00*		825.00	330.00					1938.75	775.500						0.015	0.009	0.00117	0.314	171.844
MOE-N1	0-20	1991	*42.00*	*42000.00*		2310.00	924.00					5428.50	2171.400						0.015	0.009	0.00117	0.314	481.164
T7-N	0-5	2004	11.40	11400.00	649.30	627.00	250.80	0.01	6.27	2.508		1473.45	589.380	0.022	0.0034	6.8E-05	0.48	0.9612	0.015	0.009	0.00117	0.314	130.602
T7-M	0-5	2004	40.50	40500.00		2227.50	891.00	0.01	22.28	8.910		5234.63	2093.850	0.022	0.0034	6.8E-05	0.48	3.4150	0.015	0.009	0.00117	0.314	463.979
SLSA-87	0-20	1991	*8.59*	*8590.00*		472.45	188.98					1110.26	444.103						0.015	0.009	0.00117	0.314	98.409
SLSA-41	0-20	1991	2.98	2980.00		163.90	65.56	0.01	1.64	0.656		385.17	154.066	0.022	0.0034	6.8E-05	0.48	0.2513	0.015	0.009	0.00117	0.314	34.140
SLSA-42	0-20	1991	19.90	19900.00		1094.50	437.80	0.01	10.95	4.378		2572.08	1028.830	0.022	0.0034	6.8E-05	0.48	1.6780	0.015	0.009	0.00117	0.314	227.980
SLSA-44A	0-22	1991	0.56	560.00		30.80	12.32	0.01	0.31	0.123		72.38	28.952	0.022	0.0034	6.8E-05	0.48	0.0472	0.015	0.009	0.00117	0.314	6.416
SLSA-45A	0-20	1991	21.00	21000.00		1155.00	462.00	0.01	11.55	4.620		2714.25	1085.700	0.022	0.0034	6.8E-05	0.48	1.7707	0.015	0.009	0.00117	0.314	240.582
SLSA-48	0-17	1991	0.11	110.00		6.05	2.42	0.01	0.06	0.024		14.22	5.687	0.022	0.0034	6.8E-05	0.48	0.0093	0.015	0.009	0.00117	0.314	1.260
SLSA-50	0-20	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-51A	0-18	1991	86.90	86900.00		4779.50	1911.80	0.01	47.80	19.118		11231.83	4492.730	0.022	0.0034	6.8E-05	0.48	7.3274	0.015	0.009	0.00117	0.314	995.551
SLSA-53	0-20	1991	< 0.02	20.00		< 1.10	< 0.44	0.01	0.01	0.004		1.29	0.517						0.015	0.009	0.00117	0.314	0.132
SLSA-54	0-24	1991	55.60	55600.00		3058.00	1223.20	0.01	30.58	12.232		7186.30	2874.520	0.022	0.0034	6.8E-05	0.48	4.6882	0.015	0.009	0.00117	0.314	636.969
SLSA-55	0-19	1991	< 0.01	10.00		< 0.55	< 0.22	0.01	0.01	0.002		0.65	0.259						0.015	0.009	0.00117	0.314	0.066
SLSA-56	0-18	1991	26.00	26000.00		1430.00	572.00	0.01	14.30	5.720		3360.50	1344.200	0.022	0.0034	6.8E-05	0.48	2.1923	0.015	0.009	0.00117	0.314	297.863
SLSA-57	0-19	1991	0.03	30.00		1.65	0.66	0.01	0.02	0.007		3.88	1.551	0.022	0.0034	6.8E-05	0.48	0.0025	0.015	0.009	0.00117	0.314	0.344
Mean			***15.93***	***15930.38***		***876.17***	***350.47***			***3.482***		***2135.83***	***821.47***					***1.8290***					***189.318***
Standard Deviation			***24.57***									***3216.78***	***1271.80***					***2.395***					***285.12***
95% C.L. (+/-)			***10.27***									***1344.18***	***531.44***					***1.174***					***111.77***
Upper 95% C.L.			***26.20***									***3480.01***	***1352.92***					***3.003***					***301.08***
Area E: Main stem, North ditch to mouth (Area = ~400 m^2)																							
T8-N	0-5	2004	6.19	6190.00		340.45	136.18	0.01	3.40	1.362		800.06	320.023	0.022	0.0034	6.8E-05	0.48	0.1010	0.015	0.009	0.00117	0.314	70.914
T8-N+5	0-5	2004	< 1.00	1000.00		< 55.00	< 22.00	0.01	0.55	0.220		64.63	25.850						0.015	0.009	0.00117	0.314	6.586
T8-S	0-5	2004	0.15	150.00		8.25	3.30	0.01	0.08	0.033		19.39	7.755	0.022	0.0034	6.8E-05	0.48	0.0024	0.015	0.009	0.00117	0.314	1.718
SLSA-71A	0-16	1991	*21.80*	*21800.00*		1199.00	479.60					2817.65	1127.060						0.015	0.009	0.00117	0.314	249.747
SLSA-85A	0-22	1991	*25.10*	*25100.00*		1380.50	552.20					3244.18	1297.670						0.015	0.009	0.00117	0.314	287.553
SLSA-72A	0-19	1991	*64.10*	*64100.00*		3525.50	1410.20					8284.93	3313.970						0.015	0.009	0.00117	0.314	734.348
SLSA-86A	0-20	1991	*43.90*	*43900.00*		2414.50	965.80					5674.08	2269.630						0.015	0.009	0.00117	0.314	502.931
SLSA-73A	0-22	1991	*27.80*	*27800.00*		1529.00	611.60					3593.15	1437.260						0.015	0.009	0.00117	0.314	318.485
T9-N	0-5	2004	0.13	130.00		7.15	2.86	0.01	0.07	0.029		16.80	6.721	0.022	0.0034	6.8E-05	0.48	0.0021	0.015	0.009	0.00117	0.314	1.489
T9-S	0-5	2004	< 0.05	50.00	7.30	< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
T10-N	0-5	2004	< 0.05	50.00		< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
T10-S	0-5	2004	5.36	5360.00		294.80	117.92	0.01	2.95	1.179		692.78	277.112	0.022	0.0034	6.8E-05	0.48	0.0875	0.015	0.009	0.00117	0.314	61.406
T10-S+5	0-5	2004	< 0.05	50.00		< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
SLSA-70A	0-22	1991	*71.20*	*71200.00*		3916.00	1566.40					4601.30	1840.520						0.015	0.009	0.00117	0.314	468.933
SLSA-84A	0-22	1991	*72.60*	*72600.00*		3993.00	1597.20					4691.78	1876.710						0.015	0.009	0.00117	0.314	478.154
T11-N	0-5	2004	< 0.05	50.00		< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
T11-S	0-5	2004	< 0.05	50.00		< 2.75	< 1.10	0.01	0.03	0.011		3.23	1.293						0.015	0.009	0.00117	0.314	0.329
SLSA-68A	0-21	1991	*0.04*	*40.00*		2.20	0.88					2.59	1.034						0.015	0.009	0.00117	0.314	0.263
SLSA-69A	0-20	1991	*17.60*	*17600.00*		968.00	387.20					1137.40	454.960						0.015	0.009	0.00117	0.314	115.916
SLSA-83A	0-19	1991	*45.00*	*45000.00*		2475.00	990.00					2908.13	1163.250						0.015	0.009	0.00117	0.314	296.376
Mean			***20.11***	***20111.00***		***1106.11***	***442.44***			***0.288***		***2030.40***	***812.16***					***0.0483***					***187.289***
Standard Deviation			***26.86***							***0.52***		***2579.20***	***1031.68***					***0.05***					***237.14***
95% C.L. (+/-)			***16.64***							***0.51***		***1598.57***	***639.43***					***0.05***					***103.93***
Upper 95% C.L.			***36.76***							***0.80***		***3628.98***	***1451.59***					***0.10***					***291.22***

* - "sediment" concentrations shown in italics

[1] Calculated using a Mean BSAF = 0.055

TABLE 7:
Coplanar and Mono-Orth PCBs in Soil and Sediment and Estimated Concentrations in Benthos and Young-of-the-Year Fish. 2004

All values in ng/g d.w.	3,3',4,4'-TeCB	3,4,4',5-TeCB	2,3,3',4,4'-PeCB	2,3,4,4',5-PeCB	2,3',4,4',5-PeCB	2',3,4,4',5-PeCB	3,3',4,4',5-PeCB	2,3,3',4,4',5-HxCB	2,3,3',4,4',5'-HxCB	2,3',4,4',5,5'-HxCB	3,3',4,4',5,5'-HxCB	2,3,3',4,4',5,5'-HpCB	Total toxic PCB congeners	total PCB ng/g	Ratio - Total Congerners: Total TEQ	Ratio- Total Congeners: Total PCB
IUPAC No.	**77**	**81**	**105**	**114**	**118**	**123**	**126**	**156**	**157**	**167**	**169**	**189**	ng/g			
TEF_{fish}	0.0001	0.0005	0.000005	0.000005	0.000005	0.000005	0.005	0.000005	0.000005	0.000005	0.00005	0.000005				
TEF_{birds}	0.05	0.1	0.0001	0.0001	0.00001	0.00001	0.1	0.0001	0.0001	0.00001	0.001	0.00001				
TEQ_{mamm}	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.1	0.0005	0.0005	0.00001	0.01	0.0001				
Concentration in soil (ng/g d.w.)																
T1-N	0.031	0.002	0.17	0.007	0.29	0.008	0.006	0.063	0.063	0.028 <	0.004	0.009	0.681	<50		
T5-N	0.48	0.023	1.5	0.055	2.8	0.081	0.018	0.3	0.3	0.094 <	0.007	0.031	5.689	<100		
T6-N	16	0.44	45	1.6	85	2.4	0.34	6.2	6.2	1.8 <	0.15	0.43	165.560	<100		
T7-N	53 <	0.51	110	1.9	390	16	1.7	29	29	14 <	0.82	3.5	649.430	11400		0.05696754
T7-N TEQ	0.0053	0.000051	0.011	0.00095	0.039	0.0016	0.17	0.0145	0.0145	0.00014	0.0082	0.00035	0.266		0.00040896	
T9-S	0.38 <	0.01	1.3	0.018	4.2	0.25	0.016	0.43	0.43	0.19 <	0.006	0.043	7.273	<0.05		
T12-S	0.82	0.025	3	0.11	6.1	0.14	0.052	2.2	2.2	0.95 <	0.095	0.74	16.432	300		0.05477333
T12-S TEQ	0.000038	0.000001	0.00013	0.000009	0.00042	0.000025	0.0016	0.000215	0.000215	0.0000019	0.00006	0.0000043	0.003		0.0001655	
Concentration in sediment (ng/g d.w.)																
T3-M	0.2 <W	4	3	1	4	3 MPC	0.1 <W	0.2 <W	0.2 <W	0.2 <W	2	0.2 <W	17	167.2		
T5-M	2	0.5 <W	52	3	120	12 MPC	0.1 <W	8	0.2 <W	3	14	1	215	3732.6		0.0576006
T7-M	13	0.5 <W	340	16	730	99 MPC	0.1 <W	38	0.2 <W	16	90	5	1347	25320.9		0.05319716
T8-M	7	0.5 <W	250	11	480	45 MPC	0.1 <W	29	0.2 <W	10	65	2	899	14157		0.06350215
T11-M	1	0.5 <W	43	4	85	10 MPC	0.1 <W	6	0.2 <W	2	13	1	165	2993.4		0.05512127
T12-M	3	0.5 <W	22	6	310	41 MPC	0.1 <W	13	0.2 <W	5	30	2	432	9212		0.04689535
Estimated Concentration in Amphipods (ng/g w.w)																
BSAF	N.A.	N.A.	1.74	1.82	1.94	1.48	N.A.	1.34	N.A.	0.09	N.A.	N.A.				
T3-M			5.22	1.82	7.76	4.44							19.24			
T5-M			90.48	5.46	232.8	17.76		10.72		0.27			357.49			
T7-M			591.6	29.12	1416.2	146.52		50.92		1.44			2235.8			
T8-M			435	20.02	931.2	66.6		38.86		0.9			1492.58			
T11-M			74.82	7.28	164.9	14.8		8.04		0.18			270.02			
T12-M			38.28	10.92	601.4	60.68		17.42		0.45			729.15			
Estimated Concentration in Chironomids (ng/g w.w.)																
BSAF	N.A.	N.A.	1.88	3.12	3.17	1.52	N.A.	2.48	N.A.	0.09	N.A.	N.A.				
T3-M			5.64	3.12	12.68	4.56							26			
T5-M			97.76	9.36	380.4	18.24		19.84		0.27			525.87			
T7-M			639.2	49.92	2314.1	150.48		94.24		1.44			3249.38			
T8-M			470	34.32	1521.6	68.4		71.92		0.9			2167.14			
T11-M			80.84	12.48	269.45	15.2		14.88		0.18			393.03			
T12-M			41.36	18.72	982.7	62.32		32.24		0.45			1137.79			
Estimated Concentration in Oligochaetes (ng/g w.w.)																
BSAF	N.A.	N.A.	7.5	4.33	5.7	0.22	N.A.	4.25	N.A.	0.09	N.A.	N.A.				
T3-M			22.5	4.33	22.8	0.66							50.29			
T5-M			390	12.99	684	2.64		34		0.27			1123.9			
T7-M			2550	69.28	4161	21.78		161.5		1.44			6965			
T8-M			1875	47.63	2736	9.9		123.25		0.9			4792.68			
T11-M			322.5	17.32	484.5	2.2		25.5		0.18			852.2			
T12-M			165	25.98	1767	9.02		55.25		0.45			2022.7			
Estimated Concentration in Odonates (ng/g w.w.)																
BSAF	N.A.	N.A.	0.32	0.02	0.24	0.02	N.A.	0.65	N.A.	0.09	N.A.	N.A.				
T3-M			0.96	0.02	0.96	0.06							2			
T5-M			16.64	0.06	28.8	0.24		5.2		0.27			51.21			
T7-M			108.8	0.32	175.2	1.98		24.7		1.44			312.44			
T8-M			80	0.22	115.2	0.9		18.85		0.9			216.07			
T11-M			13.76	0.08	20.4	0.2		3.9		0.18			38.52			

TABLE 7:

Coplanar and Mono-Orth PCBs in Soil and Sediment and Estimated Concentrations in Benthos and Young-of-the-Year Fish. 2004

All values in ng/g d.w.	3,3',4,4'-TeCB	3,4,4',5-TeCB	2,3,3',4,4'-PeCB	2,3,4,4',5-PeCB	2,3',4,4',5-PeCB	2',3,4,4',5-PeCB	3,3',4,4',5-PeCB	2,3,3',4,4',5-HxCB	2,3,3',4,4',5'-HxCB	2,3',4,4',5,5'-HxCB	3,3',4,4',5,5'-HxCB	2,3,3',4,4',5,5'-HpCB	Total toxic PCB congeners	total PCB ng/g	Ratio - Total Congerners: Total TEQ	Ratio- Total Congeners: Total PCB
IUPAC No.	**77**	**81**	**105**	**114**	**118**	**123**	**126**	**156**	**157**	**167**	**169**	**189**	ng/g			
TEF_{fish}	0.0001	0.0005	0.000005	0.000005	0.000005	0.000005	0.005	0.000005	0.000005	0.000005	0.00005	0.000005				
TEF_{birds}	0.05	0.1	0.0001	0.0001	0.00001	0.00001	0.1	0.0001	0.0001	0.00001	0.001	0.00001				
TEQ_{mamm}	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.1	0.0005	0.0005	0.00001	0.01	0.0001				
T12-M			7.04	0.12	74.4	0.82		8.45		0.45			91.28			
MOE $BSAF_{yoy}$	0.97	N.A.	5.58	3.77	2.58	3.81	N.A.	3.99	N.A.	5.28	(0)	6				
Estimated fish tissue residues (ng/g w.w)																
T3-M	0.194		16.74	3.77	10.32	11.43							42.454			
T5-M	1.94		290.16	11.31	309.6	45.72		31.92		1.056		0	691.706			
T7-M	12.61		1897.2	60.32	1883.4	377.19		151.62		15.84		0	4398.18			
T8-M	6.79		1395	41.47	1238.4	171.45		115.71		84.48		0	3053.3			
T11-M	0.97		239.94	15.08	219.3	38.1		23.94		52.8		0	590.13			
T12-M	2.91		122.76	22.62	799.8	156.21		51.87		10.56		0	1166.73			
Estimated fish TEQs (ng/g w.w) based on fish TEF																
T3-M	0.0000194		0.0000837	0.00001885	0.0000516	0.00005715							0.0002307			
T5-M	0.000194		0.0014508	0.00005655	0.001548	0.0002286		0.0001596		0.00000528		0	0.00364283			
T7-M	0.001261		0.009486	0.0003016	0.009417	0.00188595		0.0007581		0.0000792		0	0.02318885			
T8-M	0.000679		0.006975	0.00020735	0.006192	0.00085725		0.00057855		0.0004224		0	0.01591155			
T11-M	0.000097		0.0011997	0.0000754	0.0010965	0.0001905		0.0001197		0.000264		0	0.0030428			
T12-M	0.000291		0.0006138	0.0001131	0.003999	0.00078105		0.00025935		0.0000528		0	0.0061101			
Estimated fish TEQs (ng/g w.w) based on mammalian TEF																
T3-M	0.0000194		0.001674	0.001885	0.001032	0.001143							0.0057534			
T5-M	0.000194		0.029016	0.005655	0.03096	0.004572		0.01596		0.00001056			0.08636756			
T7-M	0.001261		0.18972	0.03016	0.18834	0.037719		0.07581		0.0001584			0.5231684			
T8-M	0.000679		0.1395	0.020735	0.12384	0.017145		0.057855		0.0008448			0.3605988			
T11-M	0.000097		0.023994	0.00754	0.02193	0.00381		0.01197		0.000528			0.069869			
T12-M	0.000291		0.012276	0.01131	0.07998	0.015621		0.025935		0.0001056			0.1455186			
Estimated fish TEQs (ng/g w.w) based on avian TEF																
T3-M	0.0097		0.001674	0.000377	0.0001032	0.0001143							0.0119685			
T5-M	0.097		0.029016	0.001131	0.003096	0.0004572		0.003192		0.00001056			0.13390276			
T7-M	0.6305		0.18972	0.006032	0.018834	0.0037719		0.015162		0.0001584			0.8641783			
T8-M	0.3395		0.1395	0.004147	0.012384	0.0017145		0.011571		0.0008448			0.5096613			
T11-M	0.0485		0.023994	0.001508	0.002193	0.000381		0.002394		0.000528			0.079498			
T12-M	0.1455		0.012276	0.002262	0.007998	0.0015621		0.005187		0.0001056			0.1748907			

Mean ratio [total TEQ] in fish to [total PCB coplanar congeners] in fish = 0.000005

TABLE 8:
MOE Lyon's Creek East Sediment and Biota Tissue Residues and Calculated BSAFs

Station	Sample Type	Species	%Lipid	3,3',4,4'-tetrachloro-biphenyl ng/g 77	3,4,4',5-tetrachloro-biphenyl ng/g 81	2,3,3'4,4'-pentachloro-biphenyl ng/g 105	2,3,4,4',5-pentachloro-biphenyl ng/g 114	2,3',4,4',5-pentachloro-biphenyl ng/g 118	2',3,4,4',5-pentachloro-biphenyl ng/g 123	3,3',4,4',5-pentachloro-biphenyl ng/g 126	2,3,3',4,4'5-hexachloro-biphenyl ng/g 156	2,3,3',4,4',5'-hexachloro-biphenyl ng/g 157	2,3',4,4',5,5'-hexachloro-biphenyl ng/g 167	3,3'4,4'5,5'-hexachloro-biphenyl ng/g 169	2,3,3',4,4,'5,5'-heptachloro-biphenyl ng/g 189	Mean
03LC16*	Sediment			6.40	0.50 <=W	5.80	1.20	37.00	7.20 MPC	0.10 <=W	0.60	0.20 <=W	1.00	0.10 <=W	0.20 <=W	
	Biota	Bluntnosed Minnow	2.60	3.00	0.00	18.00	2.00	37.00	7.00	0.00	3.00	2.00	0.00	0.00	0.00	
		Bluntnosed Minnow	3.30	2.00	0.00	46.00	5.00	78.00	15.00	1.00	5.00	6.00	3.00	0.00	0.00	
		Bluntnosed Minnow	1.90	2.00	0.00	46.00	2.00	80.00	14.00	1.00	5.00	5.00	3.00	0.00	0.00	
		Bluntnosed Minnow	1.90	4.00	0.00	8.00	2.00	34.00	7.00	0.00	2.00	2.00	0.00	0.00	0.00	
		Mean		2.75	0.00	29.50	2.75	57.25	10.75	0.50	3.75	3.75	1.50	0.00	0.00	
		BSAF		*0.43*		*5.09*	*2.29*	*1.55*	*1.49*		*6.25*		*1.50*			***2.66***
		Golden Shiner	2.40	4.00	0.00	5.00	3.00	51.00	8.00	0.00	3.00	1.00	0.00	0.00	0.00	
		Golden Shiner	2.10	5.00	0.00	23.00	2.00	59.00	9.00	0.00	3.00	1.00	0.00	0.00	0.00	
		Golden Shiner	2.10	4.00	0.00	24.00	3.00	66.00	10.00	0.00	3.00	3.00	0.00	0.00	0.00	
		Golden Shiner	2.40	2.00	0.00	25.00	4.00	84.00	13.00	0.00	4.00	2.00	0.00	0.00	0.00	
		Mean		3.75		19.25	3.00	65.00	10.00		3.25		0.00			
		BSAF		*0.59*		*3.32*	*2.50*	*1.76*	*1.39*		*5.42*					***2.49***
		Mean YOY BSAF		0.51		4.20	2.40	1.65	1.44		5.83		1.50			2.58
03LC17	Sediment			2.00	0.50 <=W	4.40	0.51	19.00	1.80	0.10 <=W	1.80	0.20 <=W	1.20	0.10 <=W	0.20 <=W	
	Biota	Bluntnosed Minnow	2.80	5.00	0.00	26.00	2.00	53.00	9.00	6.00	4.00	3.00	2.00	0.00	0.00	
		Bluntnosed Minnow	2.60	2.00	0.00	32.00	3.00	85.00	13.00	2.00	5.00	10.00	3.00	0.00	2.00	
		Bluntnosed Minnow	2.60	2.00	0.00	34.00	2.00	77.00	13.00	3.00	6.00	13.00	3.00	0.00	2.00	
		Bluntnosed Minnow	2.20	2.00	0.00	32.00	4.00	76.00	13.00	3.00	5.00	5.00	3.00	0.00	2.00	
		Bluntnosed Minnow	2.80	5.00	0.00	5.00	3.00	49.00	11.00	1.00	5.00	6.00	2.00	0.00	0.00	
		Mean		3.20		25.80	2.80	68.00	11.80		5.00		2.60		1.20	
		BSAF		*1.60*		*5.86*	*5.49*	*3.58*	*6.56*		*2.78*		*2.17*		*6.00*	***4.25***
	Biota	Golden Shiner	3.50	2.00	0.00	10.00	2.00	27.00	5.00	0.00	2.00	6.00	2.00	0.00	0.00	
		Golden Shiner	3.60	3.00	0.00	3.00	2.00	41.00	7.00	0.00	3.00	7.00	2.00	0.00	0.00	
		Mean		2.50		6.50	2.00	34.00	6.00		2.50		2.00			
		BSAF		*1.25*		*1.48*	*3.92*	*1.79*	*3.33*		*1.39*		*1.67*			***2.12***
		Mean YOY BSAF		1.43		3.67	4.71	2.68	4.94		2.08		1.92		6.00	3.19
02LC03	Sediment			0.20 <=W	0.50 <=W	230.00	18.00	320.00	100.00	0.10 <=W	25.00	0.20 <=W	0.20 <=W	0.10 <=W	0.20 <=W	
	Biota	Odonata		0.2	0.5	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.2	
		BSAF				*0.00*	*0.01*	*0.00*	*0.00*		*0.01*					***0.00***
	Biota	Amphipod		0.2	0.5	100	0.1	240	0.2	0.1	0.2	0.2	0.2	0.1	0.2	
		BSAF				*0.43*	*0.01*	*0.75*	*0.00*		*0.01*					***0.24***
	Biota	Ologochaete		0.2	0.5	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.2	
		BSAF				*0.000*	*0.006*	*0.000*	*0.002*		*0.008*					***0.003***
02LC12	Sediment			1.70 <=W	0.50 <=W	74.00	9.70	210.00	24.00	0.10 <=W	8.40	0.20 <=W	2.30	0.10 <=W	0.20 <=W	
	Biota	Chironomid		0.2	0.5	170	12	260	0.2	0.1	8	0.2	0.2	0.1	0.2	
		BSAF				*2.30*	*1.24*	*1.24*	*0.01*		*0.95*		*0.09*			***0.97***
	Biota	Amphipod		0.2	0.5	240	19	390	0.2	0.1	12	0.2	0.2	0.1	0.2	
		BSAF				*3.24*	*1.96*	*1.86*	*0.01*		*1.43*		*0.09*			***1.43***
	Biota	Ologochaete		0.2	0.5	1400	93	2800	0.2	0.1	77	0.2	0.2	0.1	0.2	
		BSAF				*18.92*	*9.59*	*13.33*	*0.01*		*9.17*		*0.09*			***8.52***
	Biota	Odonata		0.2	0.5	34	0.1	90	0.2	0.1	6.4	0.2	0.2	0.1	0.2	
		BSAF				*0.46*	*0.01*	*0.43*	*0.01*		*0.76*		*0.09*			***0.29***
02LC16	Sediment			0.20 <=W	0.50 <=W	5.70	2.50	62.00	5.00	0.10 <=W	2.50	0.20 <=W	0.20 <=W	0.10 <=W	0.20 <=W	
	Biota	Bluntnosed Minnow	3.30	3.60	0.00	47.00	7.00	169.00	21.00	0.00	6.20	0.00	0.00	0.00	0.00	

TABLE 8:
MOE Lyon's Creek East Sediment and Biota Tissue Residues and Calculated BSAFs

Station	Sample Type	Species	%Lipid	3,3',4,4'-tetrachloro-biphenyl ng/g **77**	3,4,4',5-tetrachloro-biphenyl ng/g 81	2,3,3'4,4'-pentachloro-biphenyl ng/g 105	2,3,4,4',5-pentachloro-biphenyl ng/g 114	2,3',4,4',5-pentachloro-biphenyl ng/g 118	2',3,4,4',5-pentachloro-biphenyl ng/g 123	3,3',4,4',5-pentachloro-biphenyl ng/g 126	2,3,3',4,4'5-hexachloro-biphenyl ng/g 156	2,3,3',4,4',5'-hexachloro-biphenyl ng/g 157	2,3',4,4',5,5'-hexachloro-biphenyl ng/g 167	3,3'4,4'5,5'-hexachloro-biphenyl ng/g 169	2,3,3',4,4,'5,5'-heptachloro-biphenyl ng/g 189	Mean
		Bluntnosed Minnow	3.20	11.00	0.00	14.00	10.00	223.00	28.00	0.00	9.00	0.00	3.00	0.00	0.00	
		Bluntnosed Minnow	3.30	4.40	0.00	79.00	15.00	343.00	44.00	0.00	14.00	0.00	6.40	0.00	0.00	
		Bluntnosed Minnow	3.30	6.60	0.00	210.00	20.00	510.00	62.00	0.00	18.00	0.00	9.00	0.00	0.00	
		Mean		6.40		87.50	13.00	311.25	38.75		11.80		4.60			
		BSAF				*15.35*	*5.20*	*5.02*	*7.75*		*4.72*		*23.00*			***10.17***
02LC17	Sediment			0.20 <=W	0.50 <=W	28.00	2.20	53.00	4.30	0.10 <=W	2.40	0.20 <=W	0.20 <=W	0.10 <=W	0.20 <=W	
	Biota	Amphipod+Isopod		0.2	0.5	43	7.7	170	19	0.1	6.2	0.2	0.2	0.1	0.2	
		BSAF				*1.54*	*3.50*	*3.21*	*4.42*		*2.58*					***3.05***
	Biota	Chironomid		0.2	0.5	41	11	270	13	0.1	9.6	0.2	0.2	0.1	0.2	
		BSAF				*1.46*	*5.00*	*5.09*	*3.02*		*4.00*					***3.72***
	Biota	Oligochaete		0.2	0.5	100	7.5	200	2.8	0.1	8.6	0.2	0.2	0.1	0.2	
		BSAF				*3.57*	*3.41*	*3.77*	*0.65*		*3.58*					***3.00***
	Biota	Odonata		0.2	0.5	14	0.1	15	0.2	0.1	2.8	0.2	0.2	0.1	0.2	
		BSAF				*0.50*	*0.05*	*0.28*	*0.05*		*1.17*					***0.41***

TABLE 9:
Summary of BSAFs from MOE Benthos and Young-of-the-Year Data. 2002-2003

Station			3,3',4,4'-tetrachloro biphenyl	3,4,4',5-tetrachloro-biphenyl	2,3,3'4,4'-pentachloro-biphenyl	2,3,4,4',5-pentachloro-biphenyl	2,3'4,4',5-pentachloro-biphenyl	2'3,4,4',5-pentachloro-biphenyl	3,3'4,4',5-pentachloro-biphenyl	2,3,3'4,4'5-hexachloro-biphenyl	2,3,3'44'5'-hexachloro-biphenyl	23',44',55'-hexachloro-biphenyl	3,3'4,4'55'-hexachloro-biphenyl	233'44'55'-heptachloro-biphenyl	Mean
			77	81	105	114	118	123	126	156	157	167	169	189	
03LC16	BSAF	Bluntnose minnow	0.43		5.09	2.29	1.55	1.49		6.25		1.50			**2.66**
02LC16	BSAF	Bluntnose minnow			15.35	5.20	5.02	7.75		4.72		23.00			**10.17**
03LC17	BSAF	Bluntnose minnow	1.60		5.86	5.49	3.58	6.56		2.78		2.17			**4.00**
		Mean	**1.01**		**8.77**	**4.33**	**3.38**	**5.27**		**4.58**		**8.89**			**5.61**
03LC16	BSAF	Golden Shiner	0.59		3.32	2.50	1.76	1.39		5.42					**2.49**
03LC17	BSAF	Golden Shiner	1.25		1.48	3.92	1.79	3.33		1.39		1.67			**2.12**
		Mean	**0.92**		**2.40**	**3.21**	**1.77**	**2.36**		**3.40**		**1.67**			**2.31**
		YOY Mean	***0.97***		***5.58***	***3.77***	***2.58***	***3.81***		***3.99***		***5.28***			***2.21***
02LC03	BSAF	Odonata			0.00	0.01	0.00	0.00		0.01					**0.00**
02LC12	BSAF	Odonata			0.46	0.01	0.43	0.01		0.76		0.09			**0.29**
02LC17	BSAF	Odonata			0.50	0.05	0.28	0.05		1.17					**0.41**
		Mean			***0.32***	***0.02***	***0.24***	***0.02***		***0.65***		***0.09***			***0.23***
02LC03	BSAF	Amphipod			0.43	0.01	0.75	0.00		0.01					**0.24**
02LC12	BSAF	Amphipod			3.24	1.96	1.86	0.01		1.43		0.09			**1.43**
02LC17	BSAF	amph&isop			1.54	3.50	3.21	4.42		2.58					**3.05**
		Mean			***1.74***	***1.82***	***1.94***	***1.48***		***1.34***		***0.09***			***1.57***
02LC12	BSAF	Chironomid			2.30	1.24	1.24	0.01		0.95		0.09			**0.97**
02LC17	BSAF	Chironomid			1.46	5.00	5.09	3.02		4.00					**3.72**
		Mean			***1.88***	***3.12***	***3.17***	***1.52***		***2.48***		***0.09***			***2.34***
02LC03	BSAF	oligochaete			0.00	0.01	0.00	0.00		0.01					**0.00**
02LC12	BSAF	oligochaete			18.92	9.59	13.33	0.01		9.17		0.09			**8.52**
02LC17	BSAF	oligochaete			3.57	3.41	3.77	0.65		3.58					**3.00**
		Mean			***7.50***	***4.33***	***5.70***	***0.22***		***4.25***		***0.09***			***3.84***

TABLE 10:
Summary of Sediment Bioassay Test Outcomes

	Mayfly Survival %	Mayfly growth mg	Chironomid Survival %	Chironomid growth mg
Welland River				
Control	100 a	26.8 a	95.6 a	3.83 ab
WR1-M (=T1-M)	100 a	13.9 c	100 a	3.01 ab
WR4-N (=T4-N)	100 a	28.8 a	93.3 a	3.29 ab
WR7-N (=T7-N)	100 a	13.5 c	100 a	1.88 b
WR-11 (=T11)	100 a	30.2 a	91.1 a	3.75 ab
Lyon's Creek				
T1-M	100 a	51.9 a	100 a	3.9 a
T7-M	96.7 a	14.5 bc	95.6 a	3.94 a
T9-M	100 a	24.5 a	93.3 a	3.72 a
Frenchman's Creek				
FC-1	96.7 a	24.5 a	88.9 a	4.1 a
FC-2	96.7 a	22.1 ab	91.1 a	3.69 a
Negative Controls				
Test Control 1	96.7 a	30.1 a	100 a	3.22 ab
Test Control 2	100 a	25.7 a	100 a	3.61 a

a - tests sharing the same letter are not significantly different

TABLE 11: Characterization of Bioassay Sediments

	Date Sampled	Al	Ba	Be	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Mo
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL		5	4	0.5	2	0.5	10	2	2	2	4	5	2	2	0.01	2
Welland River																
WR-C	**14-Oct-04**	24900	157	1	8	1.1	32200	38	13	59	34000	35	12400	527	0.1	< 2
WR1-M	**14-Oct-04**	15800	103	0.7	6	1.5	41700	436	19	72	60100	23	13600	1070	0.08	47
WR4-N	**14-Oct-04**	14400	88	0.7	7	1.2	40600	194	17	54	39900	25	12400	688	0.17	23
WR7-N	**14-Oct-04**	15100	95	0.7	7	1.1	31500	139	15	228	33000	28	10800	493	0.26	10
WR-11	**14-Oct-04**	17100	109	0.8	8	0.6	30200	36	15	45	31100	22	9920	669	0.16	< 2
Lyon's Creek																
T1-M	**14-Oct-04**	27100	175	1.4	8	1.4	21800	37	9	51	25800	31	9400	480	0.06	< 2
T7-M	**14-Oct-04**	10200	70	0.7	3	< 0.5	22900	84	16	156	130000	67	12300	1210	0.12	14
T9-M	**14-Oct-04**	12800	80	0.6	14	2.2	43200	51	13	85	51200	56	21100	879	0.09	6
Frenchman's Creek																
FC-1	**14-Oct-04**	14300	101	0.6	11	1.2	68800	20	8	22	20600	21	24800	366	0.05	< 2
FC-2	**14-Oct-04**	16600	120	0.8	11	13.7	40900	346	13	57	30100	62	19900	665	0.18	2
Control	**14-Oct-04**	6220	60	< 0.5	7	0.6	73100	12	5	15	14400	20	8840	449	0.06	< 2

		Ni	P	K	Ag	Sr	Tl	Ti	V	Zn	TOC	PCB	As	Sand	Silt	Clay
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	ug/g	%	%	%
EQL		5	5	20	1	2	1	2	2	1	0.01	0.005				
Welland River																
WR-C	**14-Oct-04**	51	1040	3420	< 1	78	< 1	205	41	196	2.99	N.A.	N.A.	15.8	58.9	25.3
WR1-M	**14-Oct-04**	284	988	2510	< 1	86	< 1	296	43	126	1.27	N.A.	N.A.	4.8	57.3	37.9
WR4-N	**14-Oct-04**	156	907	2020	< 1	83	< 1	256	35	186	2.85	N.A.	N.A.	16.2	77.2	6.6
WR7-N	**14-Oct-04**	147	909	1940	< 1	76	< 1	226	34	266	6.57	N.A.	N.A.	21.9	69.3	8.8
WR-11	**14-Oct-04**	55	1050	2350	< 1	68	< 1	269	35	104	1.72	N.A.	N.A.	7.8	80.4	11.8
Lyon's Creek																
T1-M	**14-Oct-04**	36	1330	3040	< 1	246	< 1	116	44	459	5.09	0.022	41.2	9.7	73.8	16.5
T7-M	**14-Oct-04**	76	1390	1310	11	48	< 1	150	32	2490	3.88	25	nd	57.4	34.6	8
T9-M	**14-Oct-04**	50	1360	2090	< 1	107	< 1	208	30	2680	7.2	14	nd	8.8	81.6	9.7
Frenchman's Creek																
FC-1	**14-Oct-04**	22	662	2190	< 1	749	< 1	193	27	130	2.74	N.A.	N.A.	22.9	73.6	3.5
FC-2	**14-Oct-04**	28	696	2420	< 1	165	< 1	225	37	276	3.12	N.A.	N.A.	26.1	58.6	15.4
Control	**14-Oct-04**	11	673	829	< 1	122	< 1	194	16	57	8.89	<0.05	35.6	28.4	57.1	14.5

TABLE 12:
Welland River Sediment PAH Concentrations. 2004

Compound	**EQL ug/g**	WR-C DF=5	WR1-M (T1-M) DF=5	WR1-M (T1-M) Dup. DF=5	WR7-N (T7-N) DF=5	WR4-N (T4-N)	WR-11 (T-11)
Naphthalene	0.05	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	0.05	nd	nd	nd	nd	nd	nd
1-Methylnaphthalene	0.05	nd	nd	nd	nd	nd	nd
Acenaphthylene	0.05	nd	nd	nd	nd	nd	nd
Acenaphthene	0.05	nd	nd	nd	nd	nd	nd
Fluorene	0.05	nd	nd	nd	nd	nd	nd
Phenanthrene	0.05	*0.33	nd	nd	*0.31	0.06	nd
Anthracene	0.05	nd	nd	nd	nd	nd	nd
Fluoranthene	0.05	0.54	*0.26	*0.46	*0.49	0.11	nd
Pyrene	0.05	0.53	*0.26	*0.38	0.68	0.13	nd
Benzo(a)anthracene	0.05	*0.38	nd	*0.28	*0.42	0.07	nd
Chrysene	0.05	*0.37	nd	*0.37	0.53	0.09	nd
Benzo(b)fluoranthene	0.05	*0.49	*0.31	*0.37	*0.46	0.09	nd
Benzo(k)fluoranthene	0.05	nd	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.05	*0.38	*0.25	nd	*0.27	0.06	nd
Indeno(1,2,3-cd)pyrene	0.05	*0.30	nd	nd	nd	0.06	nd
Dibenzo(a,h)anthracene	0.05	nd	nd	nd	nd	nd	nd
Benzo(ghi)perylene	0.05	*0.25	nd	nd	nd	nd	nd
Surrogate Standard Recoveries (Control Limits)							
Acenaphthene-d10 (19-121%)		92%	85%	96%	98%	85%	80%
Anthracene-d10 (27-126%)		94%	86%	93%	97%	83%	80%
Benzo(a)pyrene-d12 (44-136%)		114%	108%	108%	108%	108%	105%

* = detected below EQL but passed compound identification criteria

TABLE 13:
Distribution of Metals and Nutrients in Thompson's Creek, October, 2004.

Sample Id	TOC LECO %	TKN SM 4500B ppm	As ICP/MS ppm	Hg SW 7470 ppm	Ag ICP/MS ppm	Al ICP/MS ppm	Ba ICP/MS ppm	Be ICP/MS ppm	Ca ICP/MS ppm	Cd ICP/MS ppm	Co ICP/MS ppm	Cr ICP/MS ppm	Cu ICP/MS ppm
TC-1	2.18	1340	4.2	0.26	< 0.1	15400	107	0.9	18000	< 0.5	15	35	46
Repeat TC-1	2.17	1400	4.4	0.29	< 0.1	12900	100	0.8	17300	< 0.5	14	29	44
TC-2	8.40	2740	8.5	0.73	< 0.1	15500	120	0.8	42700	< 0.5	11	56	357
TC-3	3.07	1840	3.6	0.06	< 0.1	16700	100	0.8	22200	< 0.5	12	24	17
TC-4	7.05	5600	5.9	0.07	< 0.1	17300	133	0.7	30400	0.9	15	25	26

	Fe ICP/MS ppm	K ICP/MS ppm	Mg ICP/MS ppm	Mn ICP/MS ppm	Mo ICP/MS ppm	Na ICP/MS ppm	Ni ICP/MS ppm	P ICP/MS ppm	Pb ICP/MS ppm	Sr ICP/MS ppm	Ti ICP/MS ppm	V ICP/MS ppm	Zn ICP/MS ppm
TC-1	29400	1890	7440	624	< 3	171	56	1010	26	47.7	164	32	90
Repeat TC-1	27300	1140	7270	604	< 3	124	51	1060	26	46.7	53	29	87
TC-2	27600	1590	6210	357	< 3	164	51	1030	50	78.7	75	32	111
TC-3	25400	1530	11000	591	< 3	255	25	655	20	56.0	14	27	127
TC-4	27800	2810	7320	4350	< 3	595	28	1640	36	92.6	26	28	220

TABLE 14:
Frenchman's Creek: Dioxins and Furans in Sediment. 2004

	T4CDF	P5CDF	H6CDF	H7CD	O8CDF	T4CDD	P5CDD	H6CDD	H7CDD	O8CDD
FC-5A	46	35	33	42	30	8.8	7.3	39	99	290
FC-5B	42	31	23	24	19	9.5	5.8	24	45	130
FC-5C	38	19	44	90	72	7.3	11	69	410	1600
FC-5D	1.8	2.1	2.9	1.9	3.2	0.28	0.66	4.1	16	55
FC-5E	< 0.19	< 0.31	0.67	2	2.1	0.27	0.44	1.7	8.5	37

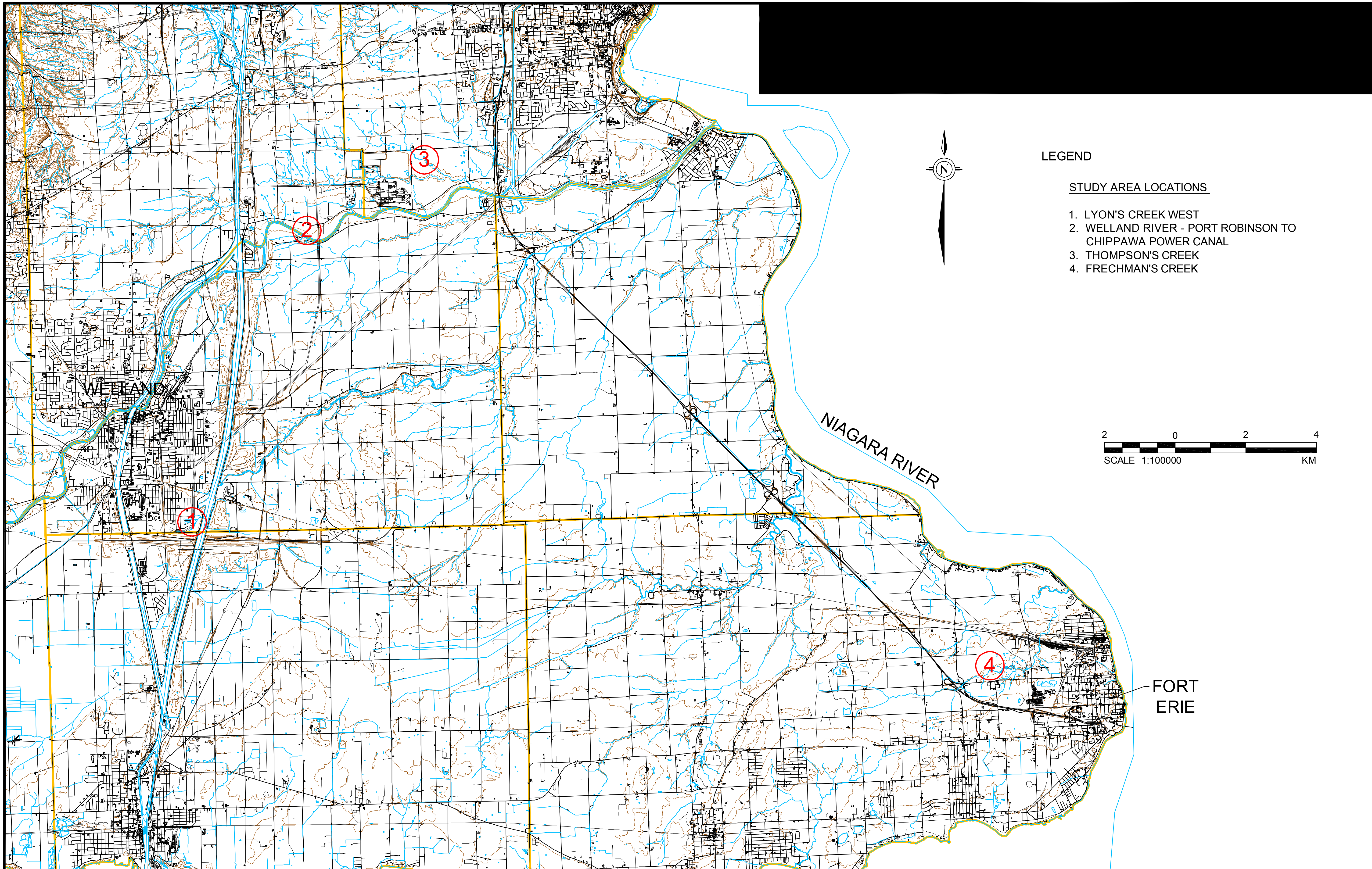
	2378-TCDF	2378-TCDD	12378-PCDF	23478-PCDF	12378-PCDd	123478-HCDF	123678-HCDF	234678-HCDF	123789-HCDF	123478-HCDD
Fish	0.05	1	0.05	0.5	1	0.1	0.1	0.1	0.1	0.5
Birds	1	1	0.1	1	1	0.1	0.1	0.1	0.1	0.05
Mammals	0.1	1	0.05	0.5	1	0.1	0.1	0.1	0.1	0.1
FC-5A	7.5	< 0.56	2.1	3.1	1.2	7.6	< 4.1	3.4	< 0.48	1.9
FC-5B	6.5	< 0.46	2.4	2.9	0.76	6	< 4.8	< 2.1	< 0.42	0.98
FC-5C	9	0.9	< 1.1	1.6	2.3	4.3	< 4.1	1.8	< 0.34	2.7
FC-5D	0.72	< 0.25	< 0.36	< 0.33	< 0.27	< 0.25	< 0.37	0.22	< 0.22	< 0.35
FC-5E	< 0.19	< 0.18	< 0.33	< 0.3	< 0.19	< 0.26	< 0.26	< 0.29	< 0.32	< 0.31

Fish	TEQ	TEQ	TEQ	TEQ	TEQ	TEQ	TEQ	TEQ	TEQ	TEQ
FC-5A	0.375	0	0.105	1.55	1.2	0.76	0	0.34	0	0.95
FC-5B	0.325	0	0.12	1.45	0.76	0.6	0	0	0	0.49
FC-5C	0.45	0.9	0	0.8	2.3	0.43	0	0.18	0	1.35
FC-5D	0.036	0	0	0	0	0	0	0.022	0	0
FC-5E	0	0	0	0	0	0	0	0	0	0

TABLE 14:
Frenchman's Creek: Dioxins and Furans in Sediment. 2004

	123678-HCDD	123789-HCDD	1234678-HCDF	1234789-HCDF	1234678-HCDD	12346789-OCDF	12346789-OCDD	Total TEQ
Fish	0.01	0.01	0.01	0.01	0.001	0.0001	0.0001	
Birds	0.01	0.1	0.01	0.01	0.001	0.0001		
Mammals	0.1	0.1	0.01	0.01	0.01	0.0001	0.0001	
FC-5A	4.1	4.4	23	1.8	53	30	290	
FC-5B	2.1	2.7	15	< 1	24	19	130	
FC-5C	9.4	8.5	38	2.1	210	72	1600	
FC-5D	0.56	0.58	< 1.9	< 0.36	8.2	3.2	55	
FC-5E	0.36	< 0.3	< 1.5	< 0.4	5.2	2.1	37	
Fish	TEQ	TEQ	TEQ	TEQ	TEQ	TEQ	TEQ	
FC-5A	0.041	0.044	0.23	0.018	0.053	0.003	0.029	5.698
FC-5B	0.021	0.027	0.15	0	0.024	0.0019	0.013	3.9819
FC-5C	0.094	0.085	0.38	0.021	0.21	0.0072	0.16	7.3672
FC-5D	0.0056	0.0058	0	0	0.0082	0.00032	0.0055	0.08342
FC-5E	0.0036	0	0	0	0.0052	0.00021	0.0037	0.01271

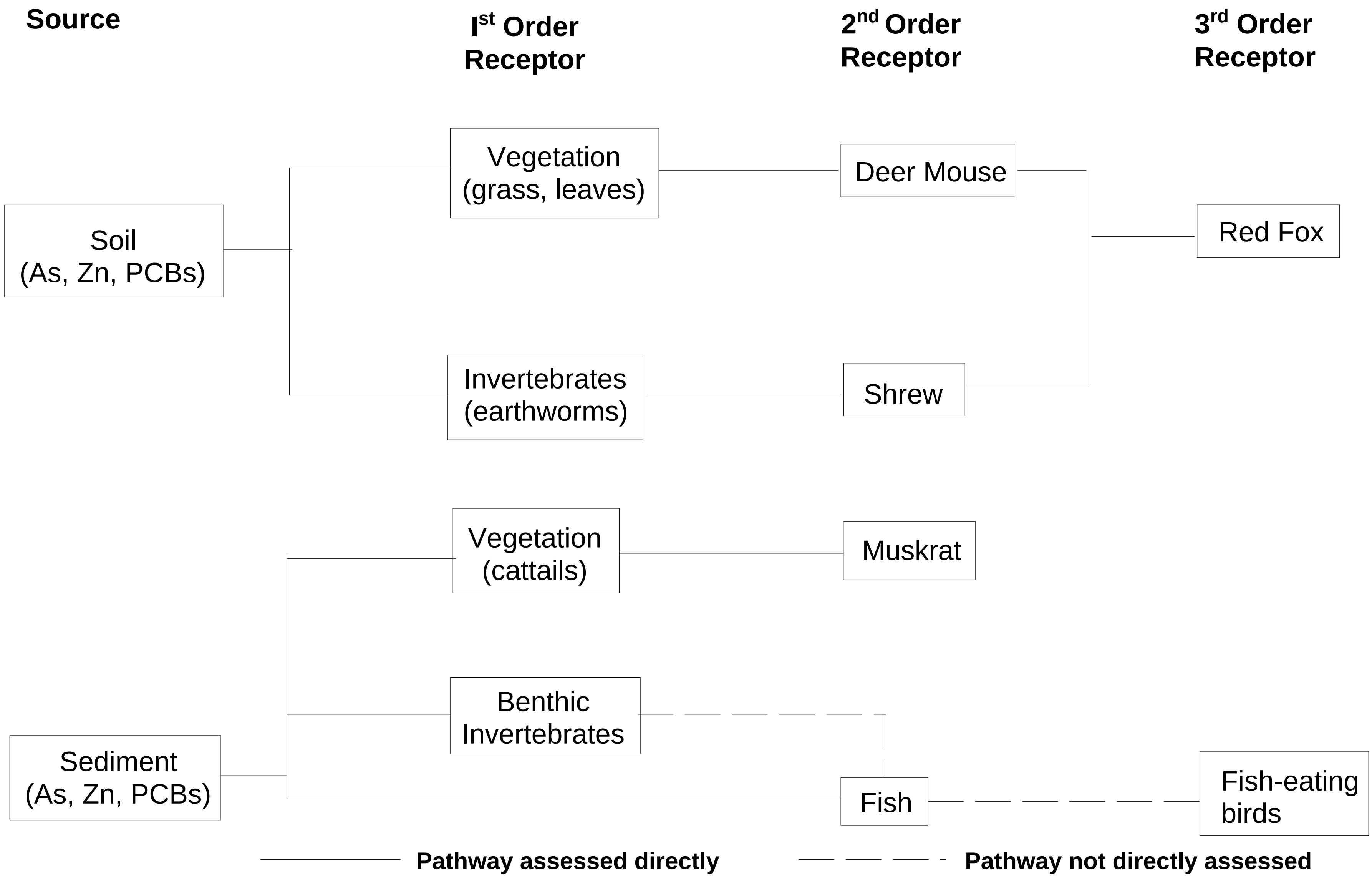
[redacted]



DATE:	MAY 2005	Golder Associates		CAD:	KD
PROJECT:	03-1112-059			CHK:	RJ

PLOT DATE: May 24, 2005
FILENAME: T:\Projects\2003\03-1112-059 (NPCA, Niagara)\-CD- PHASE 3 FINAL\031112059CD01.dwg

Figure 2:
Conceptual Site Model for Lyon's Creek West

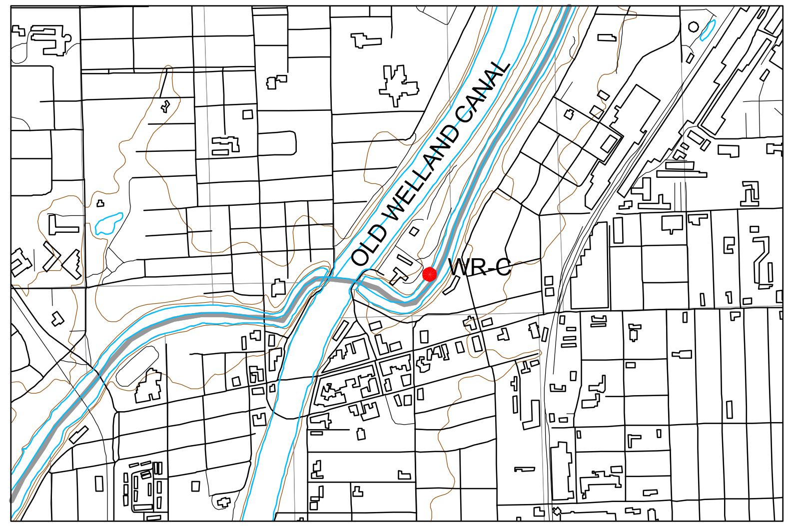


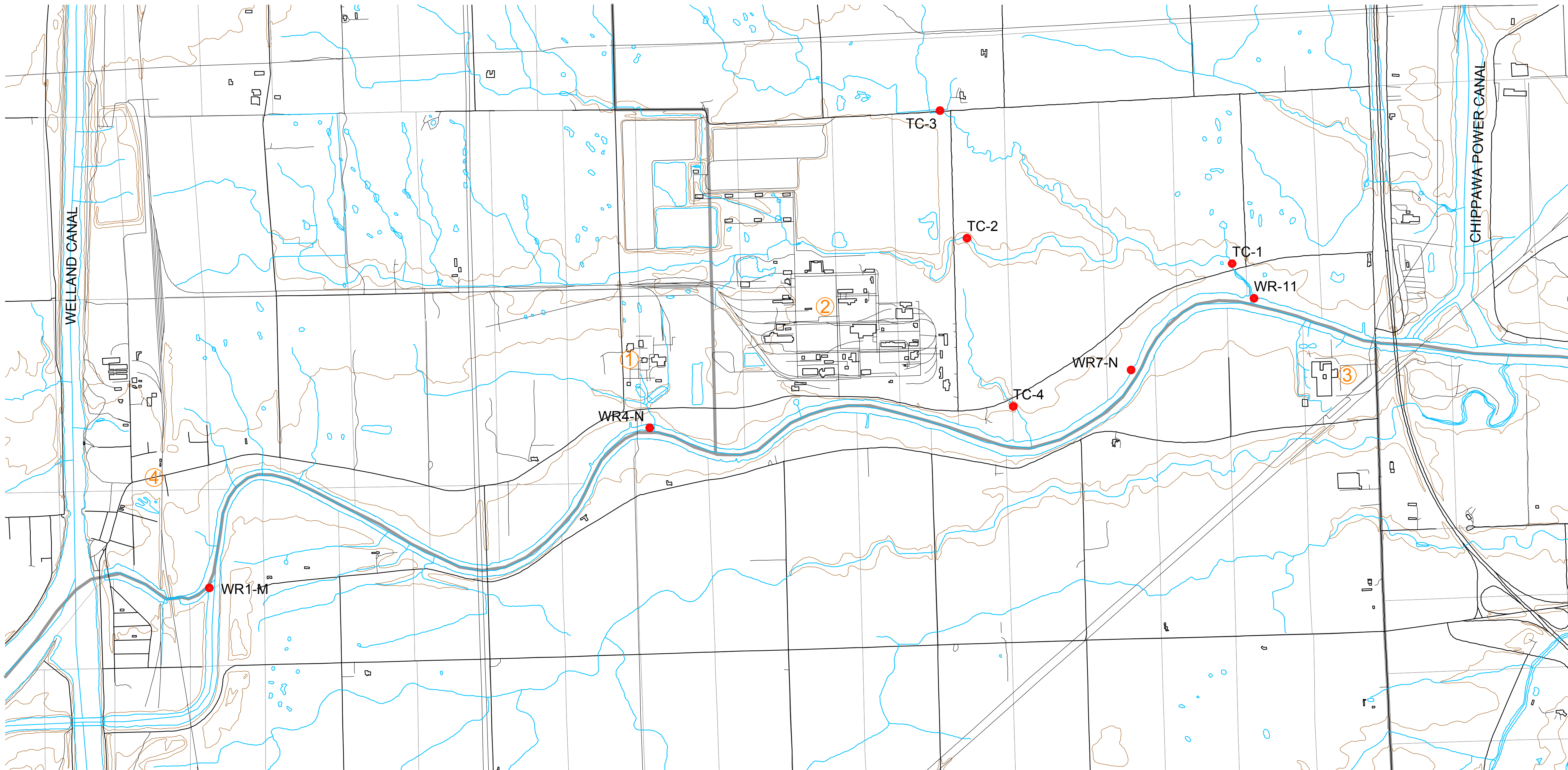
LYON'S CREEK WEST PHASE III
DISTRIBUTION OF PCB
FIGURE 3
LEGEND
67 ST. LAWRENCE SEAWAY AUTHORITY FEB. 1991
LC-6 GOLDER ASSOCIATES 2003
A1 MINISTRY OF ENVIRONMENT 1991
I1 ENVIRONMENTAL STRATEGIES LIMITED SOIL SAMPLE
(<0.05) SOIL / SEDIMENT ([PCB] ug/g)
VEGETATION
BENTHOS - BIOASSAY
INVERTEBRATES
WELLAND CANAL (BY-PASS)
20 0 20 40
SCALE 1:1000 METRES
DATE: MAY 2005
PROJECT: 03-1112-059
CAD: KD
CHK: RJ
Golder Associates

[redacted]

LEGEND

1. GEON (OXY VINYLS) LTD.
2. CYTEC CANADA
3. FORD GLASS (DECOMMISSIONED)
4. PT ROBINSON LAGOONS





500 0 500 1000

SCALE 1:25000 METRES

DATE: MAY 2005

PROJECT: 03-1112-059

Golder Associates

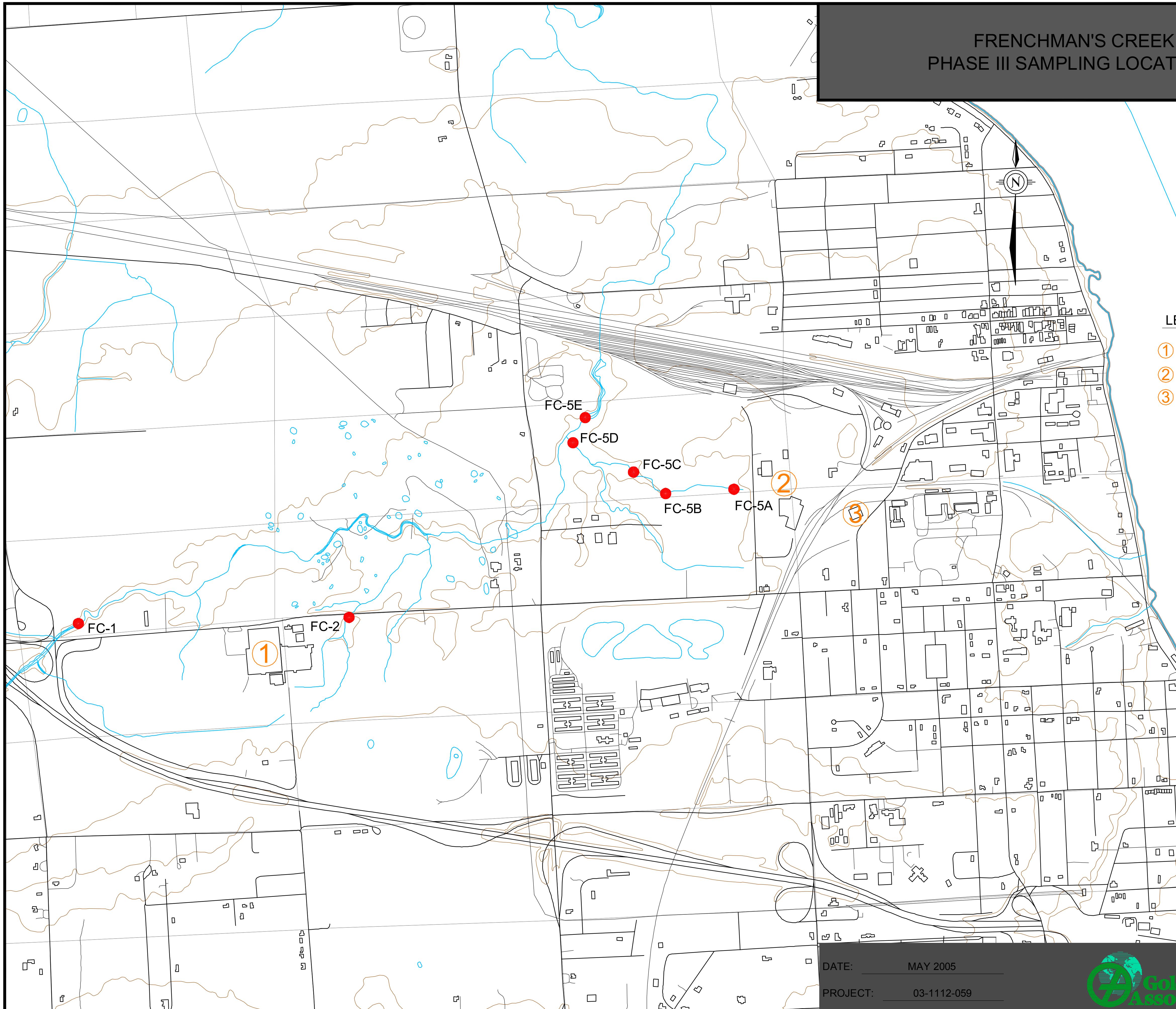
CAD: KD

CHK: RJ

PLOT DATE: May 24, 2005
FILENAME: T:\Projects\2003\03-1112-059 (NPCA, Niagara)\-CD- PHASE 3 FINAL\031112059CD04.dwg

FRENCHMAN'S CREEK
PHASE III SAMPLING LOCATIONS

FIGURE 5



LEGEND

1. FLEET AEROSPACE
2. CANADIAN OXY CHEMICALS - DUREZ DIVISION
3. GOULD NATIONAL BATTERY

300 0 300 600

SCALE 1:15000 METRES

DATE: MAY 2005

PROJECT: 03-1112-059

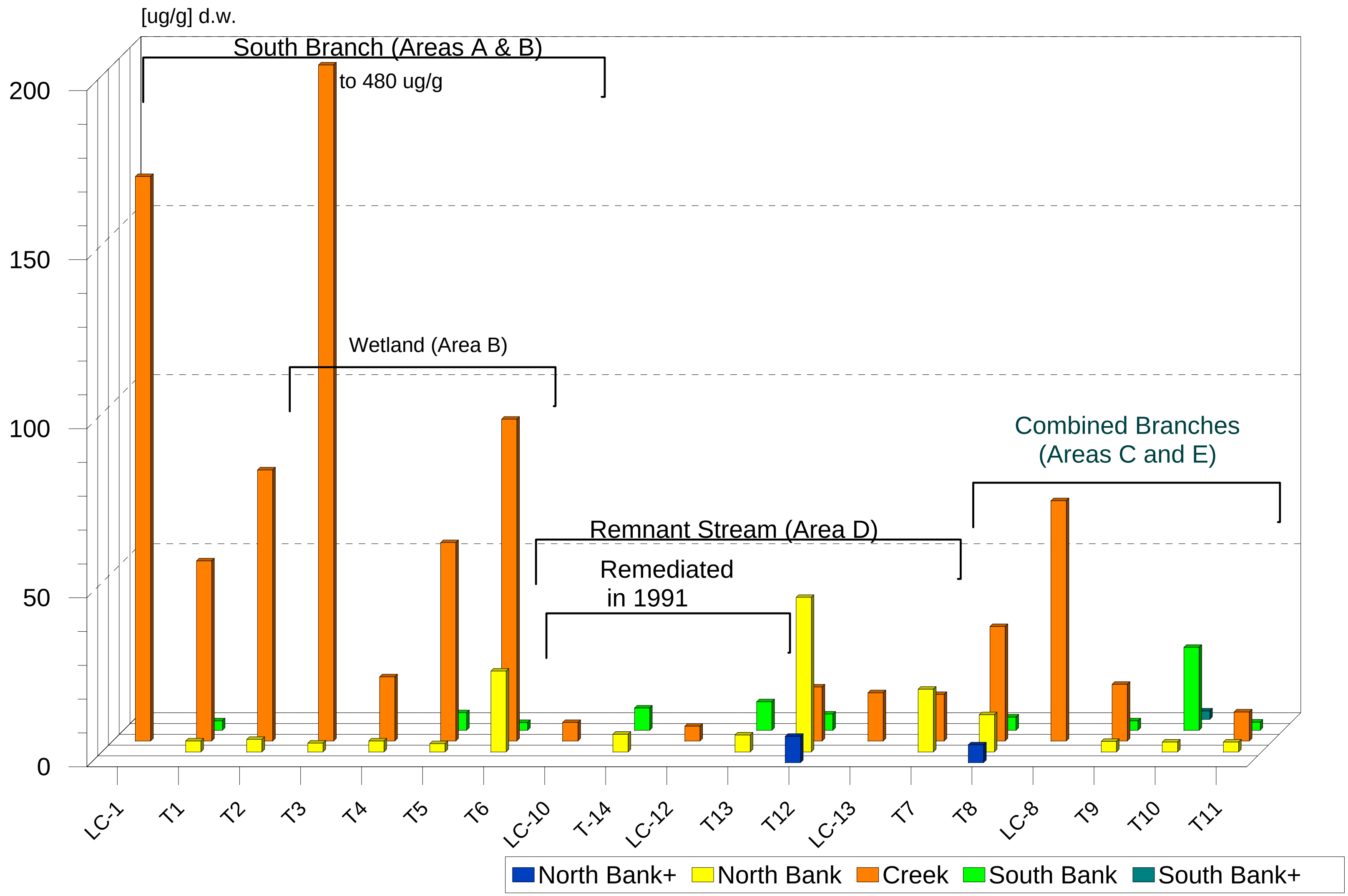
Golder Associates

CAD: KD

CHK: RJ

PLOT DATE: May 24, 2005
FILENAME: T:\Projects\2003\03-1112-059 (NPCA, Niagara)\-CD- PHASE 3 FINAL\031112059CD05.dwg

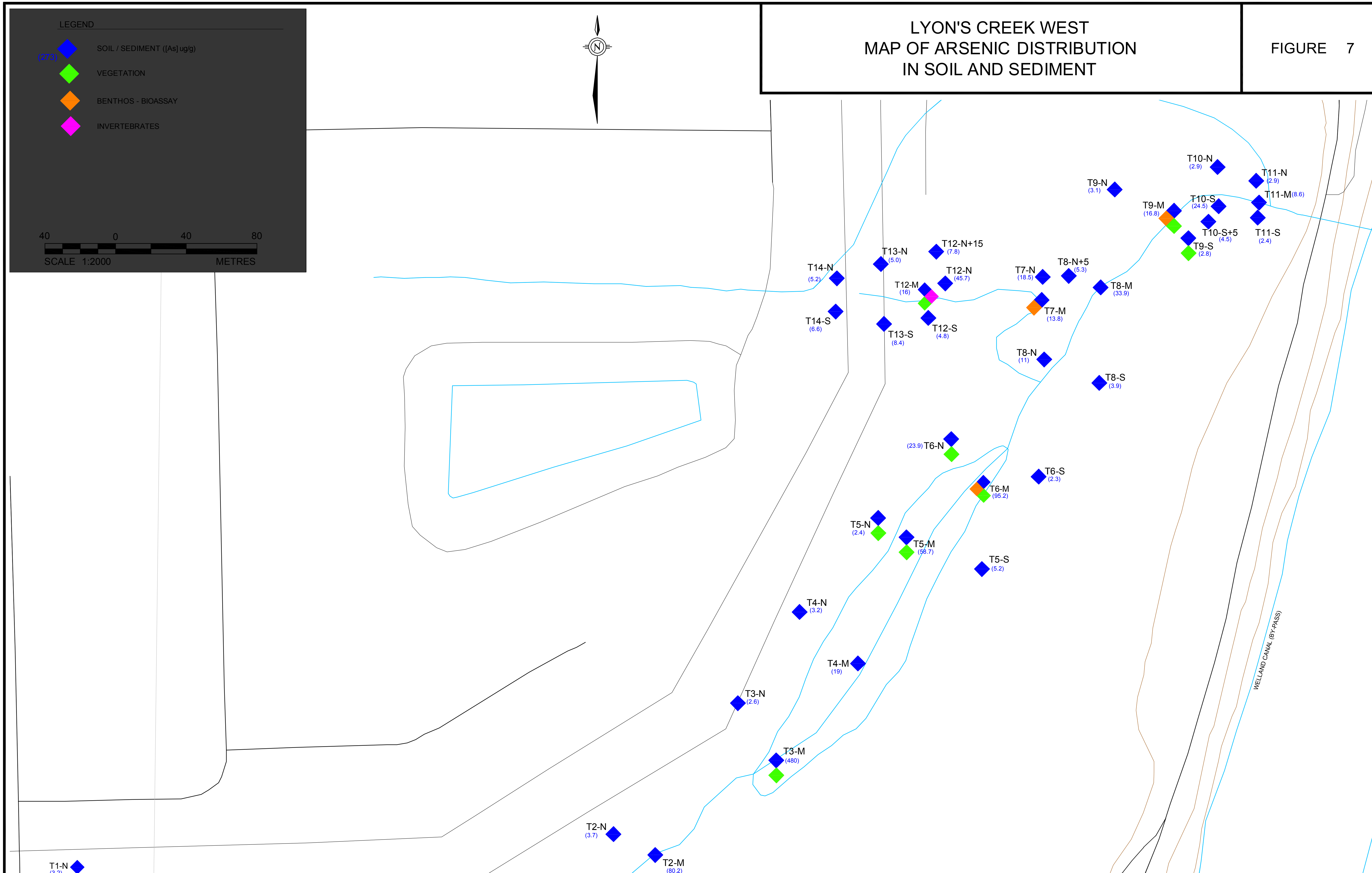
Figure 6:
Distribution of Arsenic in Lyon's Creek West, 2003-4



Golder Associates

LYON'S CREEK WEST
MAP OF ARSENIC DISTRIBUTION
IN SOIL AND SEDIMENT

FIGURE 7



DATE: MAY 2005

PROJECT: 03-1112-059

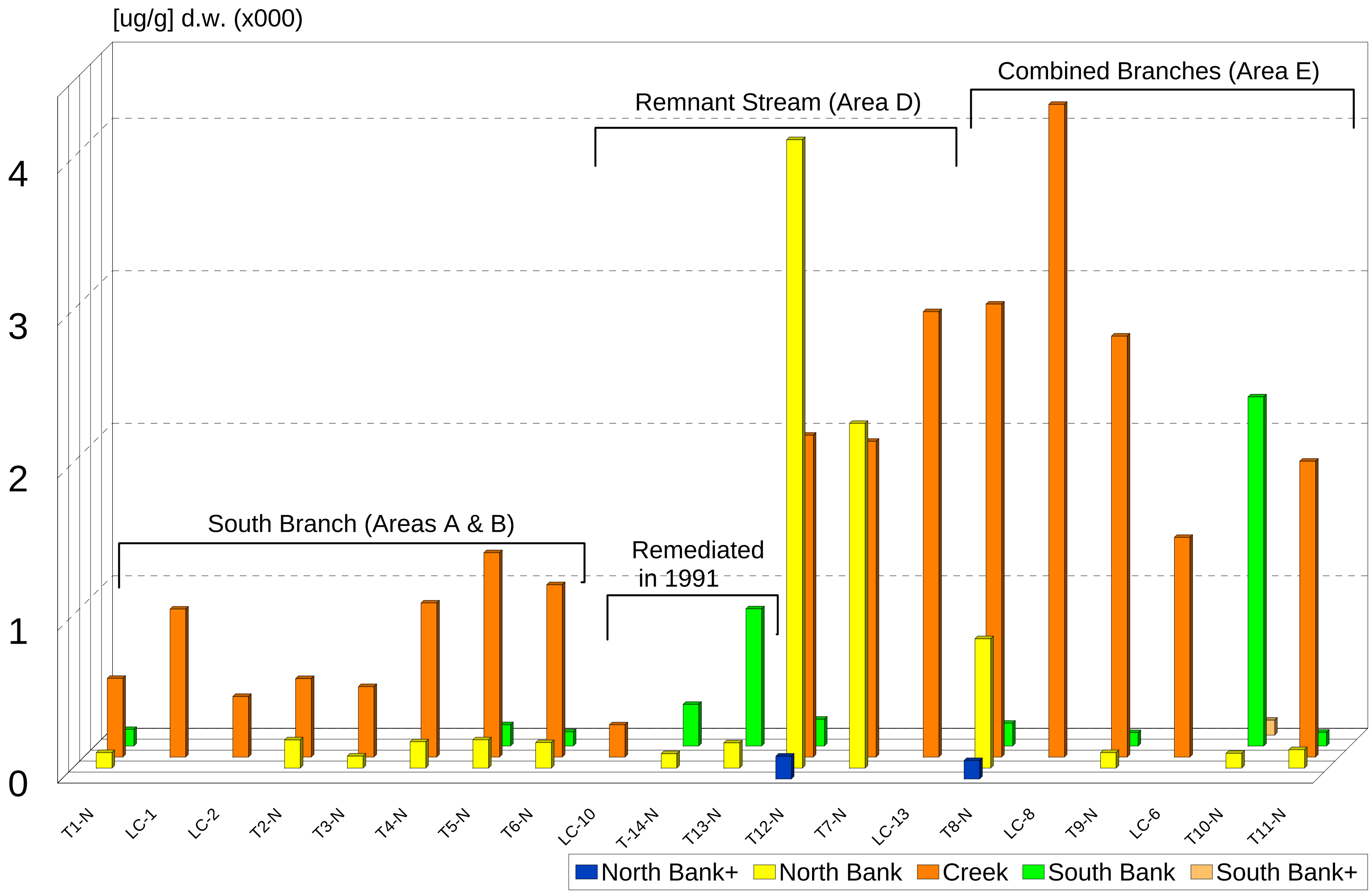
Golder Associates

CAD: KD

CHK: RJ

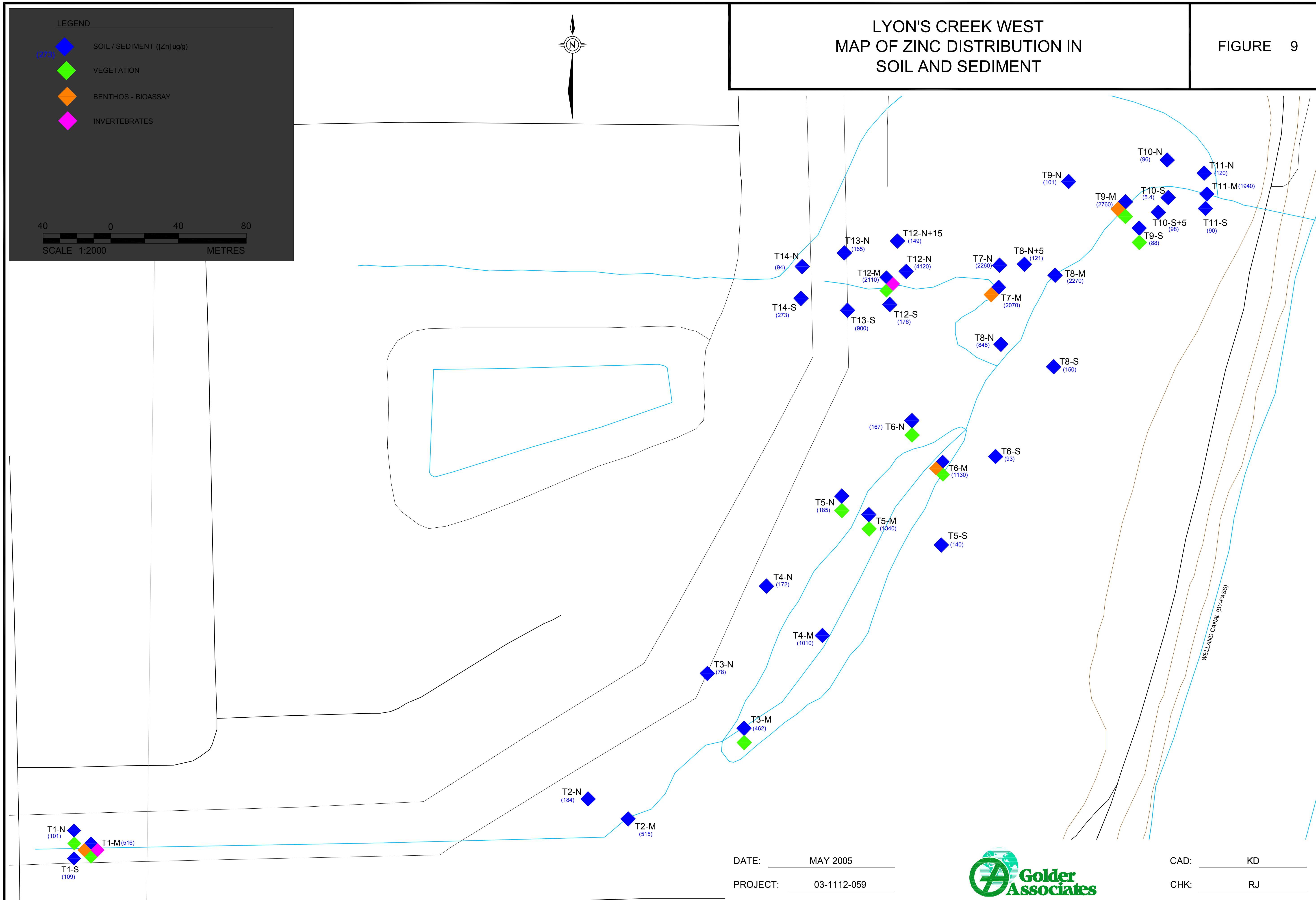
PLOT DATE: May 24, 2005
FILENAME: T:\Projects\2003\03-1112-059 (NPCA, Niagara)\-CD- PHASE 3 FINAL\031112059CD07.dwg

Figure 8:
Distribution of Zinc in Lyon's Creek West, 2003-2004



LYON'S CREEK WEST
MAP OF ZINC DISTRIBUTION IN
SOIL AND SEDIMENT

FIGURE 9



DATE: MAY 2005
PROJECT: 03-1112-059

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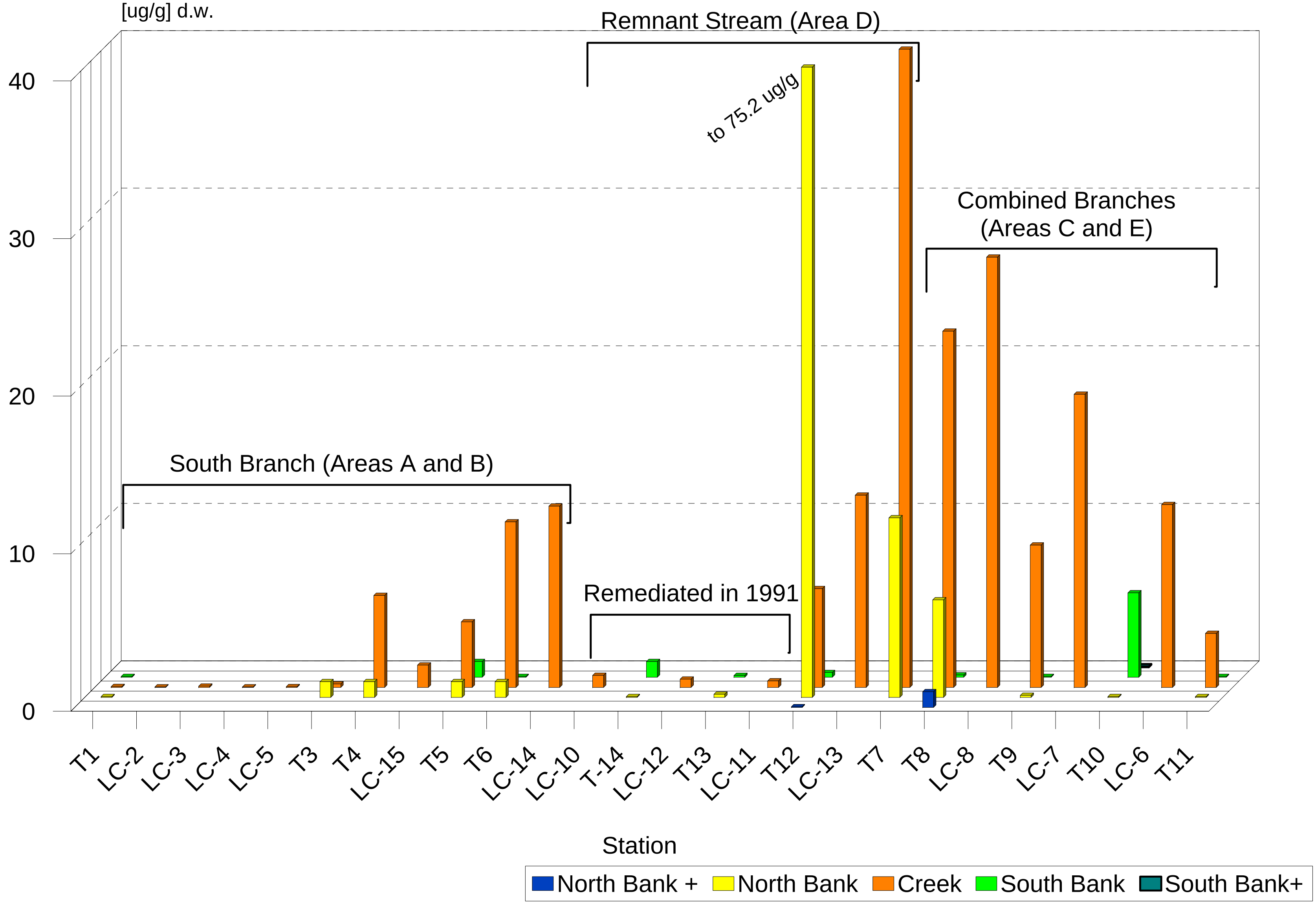
CAD: KD
CHK: RJ

PLOT DATE: May 24, 2005
FILENAME: T:\Projects\2003\03-1112-059 (NPCA, Niagara)\-CD- PHASE 3 FINAL\031112059CD09.dwg

Figure 10:
Distribution of PCBs in Lyon's Creek, 2003-4



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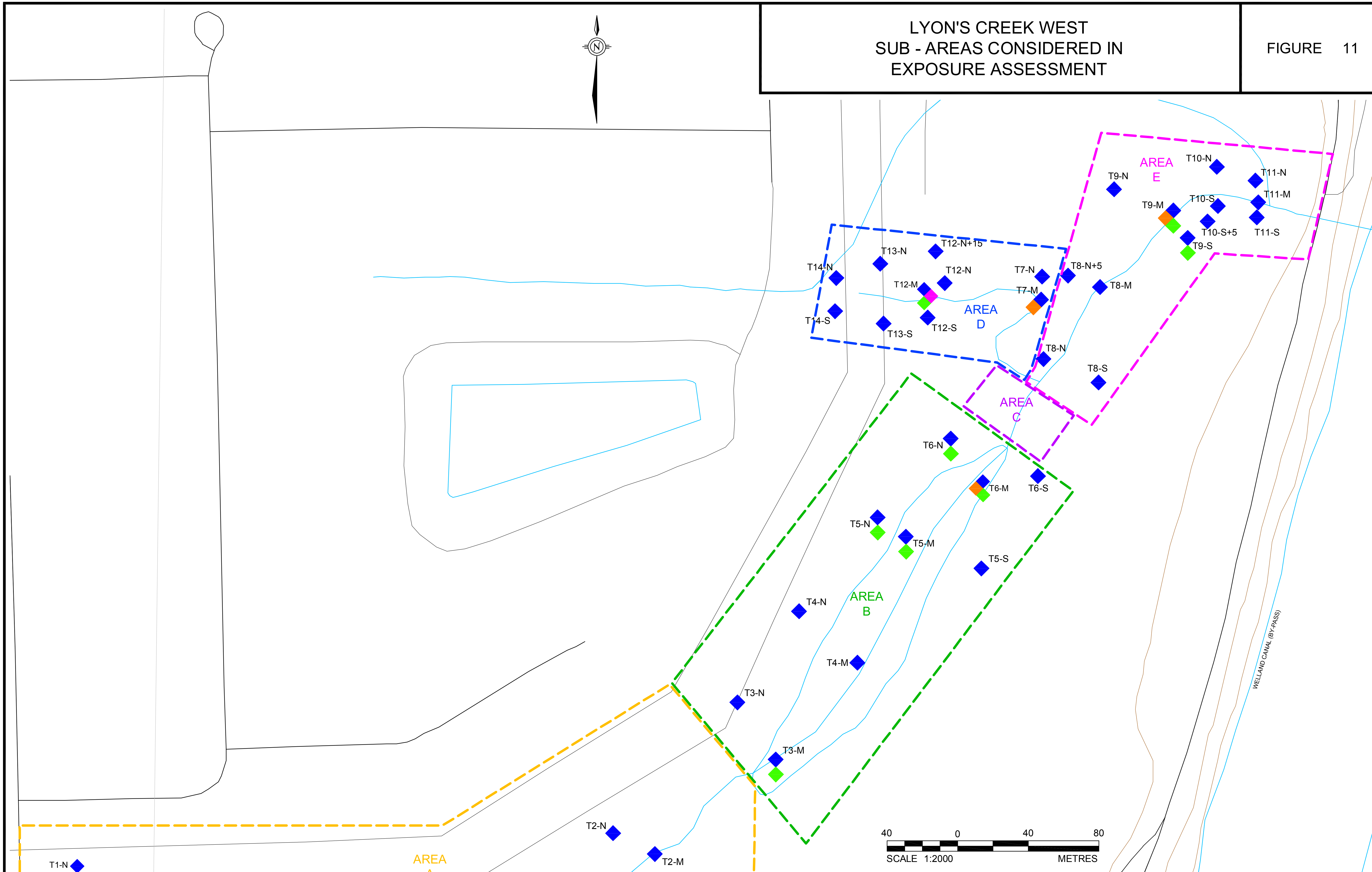
LYON'S CREEK WEST
SUB - AREAS CONSIDERED IN EXPOSURE ASSESSMENT

FIGURE 11



DATE: MAY 2005

PROJECT: 03-1112-059

Golder Associates

CAD: KD

CHK: RJ

PLOT DATE: May 24, 2005
FILENAME: T:\Projects\2003\03-1112-059 (NPCA, Niagara)\-CD- PHASE 3 FINAL\031112059CD11.dwg

APPENDIX A
ANALYTICAL REPORTS - CHEMICAL ANALYSES

PSC
ANALYTICAL SERVICES

3-Aug-2004

GOLDER ASSOCIATES LTD.
2390 Argentia Road
Mississauga, ON
L5N 5Z7

Page: 1
Copy: 1 of 2

Attn: Rein Jaagumagi
Project: 03-1112-05

PO #:

Received: 15-Jul-2004 14:34

Job: 2456810

Status: Final

Soil Samples

Sample Id	As SW 7061 ppm	Zn ICAP ppm	TOC LECO %
T1-N	3.2	101	5.08
T1-S	2.8	109	7.09
T2-N	3.7	184	5.31
T3-N	2.6	78	3.14
T4-N	3.2	172	3.91
T5-N	2.4	185	4.67
T5-S	5.2	140	6.14
T6-N	23.9	167	4.08
T6-S	2.3	93	4.47
T7-N	18.5	2260	11.0
T8-N	11.0	848	4.29
T8-S	3.9	150	4.46
T9-N	3.1	101	3.60
T9-S	2.8	88	3.17
T10-N	2.9	96	2.02
T10-S	24.5	2290	12.1
T11-N	2.9	120	3.97
T11-S	2.4	90	4.11
T12-N	45.7	4120	8.47
T12-S	4.8	176	5.56
Blank	<0.2	<5	<0.05
QC Standard (found)	17.4	133	12.6
QC Standard (expected)	21.1	128	12.3
Repeat T1-N	3.3	106	5.01

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3-Aug-2004

GOLDER ASSOCIATES LTD.
2390 Argentia Road
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Attn: Rein Jaagumagi
Project: 03-1112-05

PO #:

Received: 15-Jul-2004 14:34

Job: 2456810

Status: Final

Vegetation Samples

Sample Id	As ICP/MS ppm	Zn ICP/MS ppm
T1-N (LEAF)	0.4	208.
T1-N (GRASS)	0.2	12.5
T5-N (LEAF)	<0.1	13.7
T5-N (GRASS)	0.3	25.3
T6-N (LEAF)	0.9	26.9
T6-N (GRASS)	3.3	38.0
T9-S (LEAF)	<0.1	50.1
T9-S (GRASS)	<0.1	9.7
Sample+Spike (found)	28.0	228.
Sample+Spike (expected)	25.4	233.
Blank	<0.1	<0.3
QC Standard (found)	5.6	3.0
QC Standard (expected)	5.0	2.5
Repeat T1-N (LEAF)	0.3	198.

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Job: 2456810

Status: Final

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Job approved by:

Signed: ....
Ralph Siebert, B.Sc.
Section Supervisor, Metals

PSC

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23-Jul-2004

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Attn: Rein Jaagumagi
Project: 03-1112-059

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Received: 15-Jul-2004 14:34

Job: 2456810

Status: Final

Soil Samples

Sample Id	PCB's GC/ECD ug/g	DCBP GC/ECD % Recovery
T1-N	<0.05	109. %
T1-S	<0.05	96.0 %
T2-N	<0.05	88.0 %
T3-N	<1.00	---
T4-N	<1.00	---
T5-N	<1.00	---
T5-S	<1.00	---
T6-N	<1.00	---
T6-S	<0.05	101. %
T7-N	11.4	---
T8-N	6.19	---
T8-S	0.15	100. %
T9-N	0.13	102. %
T9-S	<0.05	104. %
T10-N	<0.05	115. %
T10-S	5.36	---
T11-N	<0.05	101. %
T11-S	<0.05	105. %
T12-N	75.2	---
T12-S	0.30	97.0 %
Spiked T1-N	117. %	96.0 %
Blank	<0.05	104. %
QC Standard (found)	101. %	100. %
QC Standard (expected)	100. %	100. %
Repeat T1-N	<0.05	109. %

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Received: 15-Jul-2004 14:34
PO #:

Job: 2456810 Status: Final

- Decachlorobiphenyl (surrogate standard for PCBs).
- No surrogate recoveries were reported for samples requiring dilution.
- The PCBs detected in samples T7-N, T8-N, T8-S, T10-S, T12-N and T12-S is a mix of Aroclors 1254 and 1260.
- The PCBs detected in sample T9-N is Aroclor 1254.
- For the analysis of PCBs, sample T3-N, T4-N, T5-N, T5-S and T6-N were each diluted by a factor of 20, due to interfering material and their E.Q.L.'s were adjusted accordingly.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analyses done unless otherwise agreed upon by contractual arrangement. Your samples will be retained by PASC for a period of 30 days following reporting or as per specific contractual arrangements.

Job approved by:

Signed: ....
Medhat Riskallah, Ph.D., C.Chem.
Manager, Gas Chromatography Section

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25-Oct-2004

GOLDER ASSOCIATES LTD.
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Attn: Rien Jaagumagi
Project: 03-1112-059

Received: 14-Oct-2004 15:30

PO #:

Status: Final

Job: 2460702

Sediment Samples

Sample Id	TOC LECO %	TKN SM 4500B ppm	As ICP/MS ppm	Hg SW 7470 ppm	Ag ICP/MS ppm	Al ICP/MS ppm	Ba ICP/MS ppm	Be ICP/MS ppm
TC-1	2.18	1340	4.2	0.26	<0.1	15400	107	0.9
TC-2	8.40	2740	8.5	0.73	<0.1	15500	120	0.8
TC-3	3.07	1840	3.6	0.06	<0.1	16700	100	0.8
TC-4	7.05	5600	5.9	0.07	<0.1	17300	133	0.7
Blank	<0.05	<2	0.3	<0.01	<0.1	<20	<5	<0.2
QC Standard (found)	12.1	1790	20.2	0.33	1.8	15700	169	0.7
QC Standard (expected)	12.3	1750	21.8	0.32	2.0	17700	166	0.7
Repeat TC-1	2.17	1400	4.4	0.29	<0.1	12900	100	0.8

Sample Id	Ca ICP/MS ppm	Cd ICP/MS ppm	Co ICP/MS ppm	Cr ICP/MS ppm	Cu ICP/MS ppm	Fe ICP/MS ppm	K ICP/MS ppm	Mg ICP/MS ppm
TC-1	18000	<0.5	15	35	46	29400	1890	7440
TC-2	42700	<0.5	11	56	357	27600	1590	6210
TC-3	22200	<0.5	12	24	17	25400	1530	11000
TC-4	30400	0.9	15	25	26	27800	2810	7320
Blank	<50	<0.5	<2	<1	<1	<50	<100	<20
QC Standard (found)	6030	0.5	28	51	31	31600	2390	7820
QC Standard (expected)	6820	0.5	28	51	32	31800	2710	8200
Repeat TC-1	17300	<0.5	14	29	44	27300	1140	7270

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Job: 2460702

Status: Final

Sediment Samples

Sample Id	Mn ICP/MS ppm	Mo ICP/MS ppm	Na ICP/MS ppm	Ni ICP/MS ppm	P ICP/MS ppm	Pb ICP/MS ppm	Sr ICP/MS ppm	Ti ICP/MS ppm
TC-1	624	<3	171	56	1010	26	47.7	164
TC-2	357	<3	164	51	1030	50	78.7	75
TC-3	591	<3	255	25	655	20	56.0	14
TC-4	4350	<3	595	28	1640	36	92.6	26
Blank	<1	<3	<50	<2	<20	<5	<0.3	<5
QC Standard (found)	1230	<3	340	44	765	25	29.7	865
QC Standard (expected)	1230	<3	367	45	846	25	29.5	870
Repeat TC-1	604	<3	124	51	1060	26	46.7	53

Sample Id	V ICP/MS ppm	Zn ICP/MS ppm
TC-1	32	90
TC-2	32	111
TC-3	27	127
TC-4	28	220
Blank	<1	<5
QC Standard (found)	50	134
QC Standard (expected)	49	130
Repeat TC-1	29	87

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Job approved by:

Signed: ....

Ralph Siebert, B.Sc.
Section Supervisor, Metals

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23-Nov-2004

GOLDER ASSOCIATES LTD.
2390 Argentia Road
Mississauga, ON
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Attn: Rein Jaagumagi
Project: 03-1112-059

Received: 8-Oct-2004 13:01

PO #:

Job: 2460485

Status: Final

Soil Samples

Sample Id	As SW 7061 ppm	Zn ICAP ppm	TOC LECO %
T1-M(LC)	53.3	516	5.19
T2-M(LC)	80.2	515	5.08
T3-M(LC)	480.	462	15.7
T4-M(LC)	19.0	1010	6.07
T5-M(LC)	58.7	1340	13.6
T6-M(LC)	95.2	1130	16.1
T7-M(LC)	13.8	2070	3.31
T8-M(LC)	33.9	2970	9.67
T8N+5(LC)	5.3	121	4.77
T9-M(LC)	16.8	2760	7.01
T10S+5(LC)	4.5	98	3.78
T11-M(LC)	8.6	1940	3.60
T12-M(LC)	16.0	2110	9.31
T12-N+15	7.8	149	4.91
T13-S	8.4	900	6.71
T13-N	5.0	165	5.23
T14-S	6.6	273	6.38
T14-N	5.2	94	2.27
Blank	<0.2	<5	<0.05
QC Standard (found)	25.8	133	12.8
QC Standard (expected)	21.1	128	12.3
Repeat T1-M(LC)	51.5	526	4.94

23-Nov-2004

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Project: 03-1112-059

Received: 8-Oct-2004 13:01

PO #:

Job: 2460485

Status: Final

Vegetation Samples

Sample Id	As SW 7061 ppm	Zn ICAP ppm
T1-M	0.7	23.5
T5-M	0.4	20.6
T3-M	4.1	38.8
T6-M	0.2	24.5
T9-M	0.3	108.
T12-M	0.7	130.
Blank	<0.2	<0.3
QC Standard (found)	24.9	79.6
QC Standard (expected)	21.1	82.0
Repeat T1-M	0.8	24.0

23-Nov-2004

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Project: 03-1112-059
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Job: 2460485
Status: Final

Tissue Samples

Sample Id	As SW 7061 ppm
T1	16.3
TI (duplicate)	22.2
T1 (triplicate)	11.2
T7-T12	2.1
Blank	<0.2
QC Standard (found)	24.9
QC Standard (expected)	21.1

23-Nov-2004

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Note: Tissue sample was analysed in triplicate to demonstrate the heterogenity of the sample.

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Job approved by:

Signed: ....
Mike Muneswar
Manager, Environmental Inorganic Services

ANALYTICAL SERVICES

25-Oct-2004

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Attn: Rein Jaagumagi
Project: 03-1112-059

PO #:

Received: 8-Oct-2004 13:01

Job: 2460485

Status: Final

Soil Samples

Sample Id	PCB's GC/ECD ug/g	DCBP GC/ECD % Recovery
T1-M(LC)	<0.05	112. %
T2-M(LC)	0.05	98.0 %
T3-M(LC)	0.22	125. %
T4-M(LC)	5.83	---
T5-M(LC)	4.16	105. %
T6-M(LC)	10.5	---
T7-M(LC)	40.5	---
T8-M(LC)	22.6	---
T8N+5(LC)	<1.00	---
T9-M(LC)	9.03	---
T10S+5(LC)	<0.05	90.0 %
T11-M(LC)	3.42	---
T12-M(LC)	6.26	---
T12-N+15	<0.05	96.0 %
T13-S	0.11	96.0 %
T13-N	0.20	98.0 %
T14-S	<1.00	---
T14-N	<0.05	88.0 %
Blank	<0.05	96.0 %
QC Standard (found)	111. %	85.0 %
QC Standard (expected)	100. %	100. %
Repeat T1-M(LC)	<0.05	114. %

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25-Oct-2004

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Attn: Rein Jaagumagi
Project: 03-1112-059

PO #:

Received: 8-Oct-2004 13:01

Job: 2460485

Status: Final

Vegetation Samples

Sample Id	PCB's GC/ECD ug/g	DCBP GC/ECD % Recovery
T1-M	<0.05	71.0 %
T5-M	<0.05	70.0 %
T3-M	<0.05	65.0 %
T6-M	<0.05	67.0 %
T9-M	0.08	70.0 %
T12-M	0.45	69.0 %
Blank	<0.05	89.0 %
QC Standard (found)	108. %	87.0 %
QC Standard (expected)	100. %	100. %

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25-Oct-2004

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Mississauga, ON
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Attn: Rein Jaagumagi
Project: 03-1112-059

PO #:

Received: 8-Oct-2004 13:01

Job: 2460485

Status: Final

Tissue Samples

Sample Id	PCB's GC/ECD ug/g	DCBP GC/ECD % Recovery
T1	0.06	70.0 %
T7-T12	14.7	---
Blank	<0.05	89.0 %
QC Standard (found)	108. %	87.0 %
QC Standard (expected)	100. %	100. %

25-Oct-2004

GOLDER ASSOCIATES LTD.
2390 Argentia Road
Mississauga, ON
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Attn: Rein Jaagumagi
Project: 03-1112-059

Received: 8-Oct-2004 13:01
PO #:

Job: 2460485 Status: Final

- DCBP: Decachlorobiphenyl (surrogate standard for PCBs)
- No surrogate recoveries were reported for samples requiring dilution.
- The PCBs detected in samples; T5-M(LC), T7-M(LC) and T8-M(LC) is a mix of Aroclors 1248 and 1260.
- The PCBs detected in samples; T13-S and T13-N is a mix of Aroclors 1254 and 1260.
- The PCBs detected in samples; T4-M(LC), T6-M(LC), T9-M(LC), T11-M(LC) and T12-M(LC) is Aroclor 1248.
- The PCBs detected in sample T2-M(LC) is Aroclor 1260.
- The PCBs detected in sample T3-M(LC) is Aroclor 1254.
- For the analysis of PCBs, samples T8N+5(LC) and T14-S were each diluted by a factor of 20 due to interfering material and their E.Q.L.s were corrected accordingly.
- The PCBs detected in tissue sample T1 is Aroclor 1268.
- The PCBs detected in tissue sample T7-T12 is a mix of Aroclors 1254 and 1260.
- The PCBs detected in the tissue samples were quantified on a wet weight basis.
- The PCBs detected in vegetation samples T9-M and T12-M is a mix of Aroclors 1254 and 1260.

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Job approved by:

Signed: M. Riskallah

....
Medhat Riskallah, Ph.D., C.Chem.
Manager, Gas Chromatography Section

Client: Golder Associates Ltd.
Project Reference: 03-1112-059
Work Order Number: 2460485B
Matrix: Sediment

Polynuclear Aromatic Hydrocarbons (PAH's)
Units: Micrograms/gram (µg/g) dry weight

Date: 18-Oct-04

Compound	**EQL µg/g**	T-11(WR)	T4-N(WR)	**EQL µg/g**	T7-N(WR) DF=5	TRI-M(WR) DF=5	TRI-M(WR) Dup. DF=5	WR-C DF=5
Naphthalene	0.05	nd	nd	0.50	nd	nd	nd	nd
2-Methylnaphthalene	0.05	nd	nd	0.50	nd	nd	nd	nd
1-Methylnaphthalene	0.05	nd	nd	0.50	nd	nd	nd	nd
Acenaphthylene	0.05	nd	nd	0.50	nd	nd	nd	nd
Acenaphthene	0.05	nd	nd	0.50	nd	nd	nd	nd
Fluorene	0.05	nd	nd	0.50	nd	nd	nd	nd
Phenanthrene	0.05	nd	0.06	0.50	*0.31	nd	nd	*0.33
Anthracene	0.05	nd	nd	0.50	nd	nd	nd	nd
Fluoranthene	0.05	nd	0.11	0.50	*0.49	*0.26	*0.46	0.54
Pyrene	0.05	nd	0.13	0.50	0.68	*0.26	*0.38	0.53
Benzo(a)anthracene	0.05	nd	0.07	0.50	*0.42	nd	*0.28	*0.38
Chrysene	0.05	nd	0.09	0.50	0.53	nd	*0.37	*0.37
Benzo(b)fluoranthene	0.05	nd	0.09	0.50	*0.46	*0.31	*0.37	*0.49
Benzo(k)fluoranthene	0.05	nd	nd	0.50	nd	nd	nd	nd
Benzo(a)pyrene	0.05	nd	0.06	0.50	*0.27	*0.25	nd	*0.38
Indeno(1,2,3-cd)pyrene	0.05	nd	0.06	0.50	nd	nd	nd	*0.30
Dibenzo(a,h)anthracene	0.05	nd	nd	0.50	nd	nd	nd	nd
Benzo(ghi)perylene	0.05	nd	nd	0.50	nd	nd	nd	*0.25
Surrogate Standard Recoveries (Control Limits)								
Acenaphthene-d10 (19-121%)		80%	85%		98%	85%	96%	92%
Anthracene-d10 (27-126%)		80%	83%		97%	86%	93%	94%
Benzo(a)pyrene-d12 (44-136%)		105%	108%		108%	108%	108%	114%

Client: Golder Associates Ltd.
Project Reference: 03-1112-059
Work Order Number: 2460485B
Matrix: Sediment

Polynuclear Aromatic Hydrocarbons (PAH's)

Units: Micrograms/gram (µg/g) dry weight

Date: 18-Oct-04

		Method Blank			**Spiked Method Blank**			
Compound	**EQL µg/g**	**Result**	**Upper Limit**	**Accept**	**% Recovery**	**Lower Limit**	**Upper Limit**	**Accept**
Naphthalene	0.05	nd	0.05	yes	70	42	107	yes
2-Methylnaphthalene	0.05	nd	0.05	yes	104	44	114	yes
1-Methylnaphthalene	0.05	nd	0.05	yes	101	46	119	yes
Acenaphthylene	0.05	nd	0.05	yes	94	39	114	yes
Acenaphthene	0.05	nd	0.05	yes	89	34	113	yes
Fluorene	0.05	nd	0.05	yes	90	36	120	yes
Phenanthrene	0.05	nd	0.05	yes	95	40	120	yes
Anthracene	0.05	nd	0.05	yes	90	42	124	yes
Fluoranthene	0.05	nd	0.05	yes	93	47	126	yes
Pyrene	0.05	nd	0.05	yes	95	46	125	yes
Benzo(a)anthracene	0.05	nd	0.05	yes	99	45	142	yes
Chrysene	0.05	nd	0.05	yes	100	46	148	yes
Benzo(b)fluoranthene	0.05	nd	0.05	yes	99	40	135	yes
Benzo(k)fluoranthene	0.05	nd	0.05	yes	110	40	129	yes
Benzo(a)pyrene	0.05	nd	0.05	yes	100	41	128	yes
Indeno(1,2,3-cd)pyrene	0.05	nd	0.05	yes	108	35	132	yes
Dibenzo(a,h)anthracene	0.05	nd	0.05	yes	110	34	137	yes
Benzo(ghi)perylene	0.05	nd	0.05	yes	96	38	130	yes
Surrogate Standard Recoveries								
Acenaphthene-d10		87%			92	19	121	yes
Anthracene-d10		87%			89	27	126	yes
Benzo(a)pyrene-d12		105%			107	44	136	yes

Client: Golder Associates Ltd.
Project Reference: 03-1112-059
Work Order Number: 2460485B
Matrix: Sediment

Polynuclear Aromatic Hydrocarbons (PAH's)

Date: 18-Oct-04

Spiked Sample: TRI-M(WR) DF=5

Compound	**EQLµ g/g**	**Amount Spiked**	**% Recovery**	**Lower Limit**	**Upper Limit**	**Accept**
Naphthalene	0.25	2.0	73	35	103	yes
2-Methylnaphthalene	0.25	2.0	88	33	123	yes
1-Methylnaphthalene	0.25	2.0	88	36	130	yes
Acenaphthylene	0.25	2.0	80	31	126	yes
Acenaphthene	0.25	2.0	85	26	120	yes
Fluorene	0.25	2.0	87	31	123	yes
Phenanthrene	0.25	2.0	95	36	118	yes
Anthracene	0.25	2.0	89	45	115	yes
Fluoranthene	0.25	2.0	91	29	130	yes
Pyrene	0.25	2.0	94	23	133	yes
Benzo(a)anthracene	0.25	2.0	97	38	138	yes
Chrysene	0.25	2.0	98	37	148	yes
Benzo(b)fluoranthene	0.25	2.0	95	22	147	yes
Benzo(k)fluoranthene	0.25	2.0	109	31	132	yes
Benzo(a)pyrene	0.25	2.0	91	38	123	yes
Indeno(1,2,3-cd)pyrene	0.25	2.0	93	20	135	yes
Dibenzo(a,h)anthracene	0.25	2.0	102	25	137	yes
Benzo(ghi)perylene	0.25	2.0	90	18	138	yes
Surrogate Standard Recoveries						
Acenaphthene-d10			101	19	121	yes
Anthracene-d10			97	29	126	yes
Benzo(a)pyrene-d12			114	40	130	yes

Client: Golder Associates Ltd.
Project Reference: 03-1112-059
Work Order Number: 2460485B
Matrix: Sediment

Polynuclear Aromatic Hydrocarbons (PAH's)

Date: 18-Oct-04

Legend: EQL = Estimated Quantitation Limit
nd = Not detected above EQL
Dup. = Duplicate
DF = Dilution Factor
* = Detected below EQL but passed compound identification criteria

Date received: October 8, 2004
Date extracted: October 15, 2004
Date analysed: October 15, 2004

ANALYTICAL METHOD:

The solid samples (10 grams wet weight) were mixed with sodium sulfate and extracted with a 1:1 mixture of acetone:dichloromethane. The extracts were cleaned up using alumina column chromatography. Analysis was performed by gas chromatography/mass spectrometry using U.S. EPA Method 8270C (modified).

REPORT DISCUSSION:

Some of the samples were run at a dilution factor of 5 due to elevated levels of nontarget compounds present which would interfere the quantitation of the samples and cause contamination of the equipment if run undiluted. The quantitation limits for these samples were raised to reflect the dilution and high moisture content. The amounts reported have been corrected for the dilution factor used.

Note: Estimated quantitation limit is the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

NOTE: All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies and QA/QC procedures. Philip Analytical is limited in liability to the actual cost of the pertinent analysis done. Your samples will be retained by PASC for a period of 30 days following reporting or as per specific contractual arrangement.

JOB APPROVED BY:

Ming Wang

....
Michael Wang, Ph.D.
Chemist

Maxxam Analytics Inc & PSC ANALYTICAL SERVICES Inc.

Creating a New Kind of Company...

Certificate of Analysis

CLIENT INFORMATION

Attention:	Melissa Mone
Client Name:	PSC Analytical Services Inc.
Project:	2460485
Project Desc:	
Address:	5735 McAdam Road Mississauga, ON L4Z 1N9
Fax Number:	905 890-8575 #01
Phone Number:	905 890-8566

LABORATORY INFORMATION

Contact:	Elaine Cousins, B.Sc.
Project:	AN990310
Date Received:	12-Oct-2004
Date Reported:	17-Nov-2004
Submission No.:	4J0566
Sample No.:	070783-070788

NOTES: *'-' = not analysed '<' = less than Method Detection Limit (MDL) 'NA' = no data available*
Solids data is based on dry weight except for biota analyses. Organic analyses are not corrected for extraction recovery standards except for isotope dilution methods, (i.e. PCDD/F analyses)

PSC Analytical has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in this analysis conform to the performance criteria (detection limits, accuracy and precision) as outlined in the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

The CWS PHC methods employed by PSC conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the 'Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods'. Documentation is available upon request.
PSC has made the following improvements to the CWS-PHC reference benchmark method:
(i) Headspace for F1; and, (ii) Mechanical extraction for F2-F4.

PSC Analytical is accredited by SCC/CAEAL (Lab ID: 197) for all specific parameters as required by GUCSO and O'Reg 153/04. All data is in statistical control and has met all QC & method performance criteria unless otherwise flagged. PSC Analytical is limited in liability to the actual cost of analysis unless otherwise agreed in writing. There is no other warranty expressed or implied. Samples will be retained at PSC for three weeks from receipt of data or as per contract.

COMMENTS: *070783 TEQ = 0.001 Max TEQ < 0.374*
070784 TEQ = 6.276 Max TEQ < 7.296
070785 TEQ = 4.325 Max TEQ < 5.532
070786 TEQ = 10.605 Max TEQ < 11.097
070787 TEQ = 0.349 Max TEQ < 1.052
070788 TEQ = 0.127 Max TEQ < 0.775

Certified by: [signature]

5555 NORTH SERVICE ROAD, BURLINGTON, ONTARIO, CANADA L7L 5H7 TEL: (905) 332-8788 FAX: (905) 332-9169 TOLL FREE: (800) 668-0639

PASC - Certificate of Analysis

Component	MDL	Units	METHOD BLANK	METHOD BLANK	METHOD BLANK	FC-5A	FC-5B
Client ID:			METHOD BLANK	METHOD BLANK	METHOD BLANK	FC-5A	FC-5B
Lab No.:			070783 04	070783 04	070783 04	070784 04	070785 04
Date Sampled:			07-Oct-2004	07-Oct-2004	07-Oct-2004	07-Oct-2004	07-Oct-2004
				M. Spike	% Recovery		
Total Tetrachlorodibenzofurans		pg/g	<0.12	170	-	46	42
Total Pentachlorodibenzofurans		"	<0.15	320	-	35	31
Total Hexachlorodibenzofurans		"	<0.14	760	-	33	23
Total Heptachlorodibenzofurans		"	<0.13	410	-	42	24
Octachlorodibenzofuran		"	0.22	260	-	30	19
Total Tetrachlorodibenzo-p-dioxins		"	<0.12	170	-	8.8	9.5
Total Pentachlorodibenzo-p-dioxins		"	<0.14	130	-	7.3	5.8
Total Hexachlorodibenzo-p-dioxins		"	<0.13	530	-	39	24
Total Heptachlorodibenzo-p-dioxins		"	<0.14	150	-	99	45
Octachlorodibenzo-p-dioxin		"	0.39	320	-	290	130
Surrogate Recoveries		%					
2,3,7,8-T4CDF-13C12			74	73	-	80	77
2,3,7,8-T4CDD-13C12			77	82	-	83	76
1,2,3,7,8-P5CDF-13C12			57	62	-	70	71
1,2,3,7,8-P5CDD-13C12			74	85	-	94	92
1,2,3,6,7,8-H6CDF-13C12			84	62	-	87	88
1,2,3,6,7,8-H6CDD-13C12			83	69	-	87	89
1,2,3,4,6,7,8-H7CDF-13C12			73	51	-	88	87
1,2,3,4,6,7,8-H7CDD-13C12			88	75	-	96	102
OCDD-13C12			81	65	-	98	91
2,3,7,8-Cl4-Dibenzofuran		pg/g	<0.12	170	107	7.5	6.5
2,3,7,8-Cl4-Dibenzo-p-dioxin		"	<0.12	170	110	<0.56	<0.46
1,2,3,7,8-Cl5-Dibenzofuran		"	<0.15	180	115	2.1	2.4
2,3,4,7,8-Cl5-Dibenzofuran		"	<0.14	140	91	3.1	2.9
1,2,3,7,8-Cl5-Dibenzo-p-dioxin		"	<0.14	130	83	1.2	0.76
1,2,3,4,7,8-Cl6-Dibenzofuran		"	<0.13	150	93	7.6	6.0
1,2,3,6,7,8-Cl6-Dibenzofuran		"	<0.13	180	115	<4.1	<4.8
2,3,4,6,7,8-Cl6-Dibenzofuran		"	<0.14	210	136	3.4	<2.1
1,2,3,7,8,9-Cl6-Dibenzofuran		"	<0.16	220	142	<0.48	<0.42
1,2,3,4,7,8-Cl6-Dibenzo-p-dioxin		"	<0.13	150	95	1.9	0.98
1,2,3,6,7,8-Cl6-Dibenzo-p-dioxin		"	<0.13	170	110	4.1	2.1
1,2,3,7,8,9-Cl6-Dibenzo-p-dioxin		"	<0.13	210	137	4.4	2.7
1,2,3,4,6,7,8-Cl7-Dibenzofuran		"	<0.11	170	110	23	15
1,2,3,4,7,8,9-Cl7-Dibenzofuran		"	<0.15	240	151	1.8	<1.0
1,2,3,4,6.7,8-Cl7-Dibenzo-p-dioxin		"	<0.14	150	98	53	24
1,2,3,4,6,7,8,9-Cl8-Dibenzofuran		"	0.22	260	84	30	19
1,2,3,4,6,7,8,9-Cl8-Dibenzo-p-dioxin		"	0.39	320	102	290	130

PASC - Certificate of Analysis

Client ID:			FC-5C	FC-5D	FC-5E
Lab No.:			070786 04	070787 04	070788 04
Date Sampled:			07-Oct-2004	07-Oct-2004	07-Oct-2004
Component	MDL	Units			
Total Tetrachlorodibenzofurans		pg/g	38	1.8	<0.19
Total Pentachlorodibenzofurans		"	19	2.1	<0.31
Total Hexachlorodibenzofurans		"	44	2.9	0.67
Total Heptachlorodibenzofurans		"	90	1.9	2.0
Octachlorodibenzofuran		"	72	3.2	2.1
Total Tetrachlorodibenzo-p-dioxins		"	7.3	0.28	0.27
Total Pentachlorodibenzo-p-dioxins		"	11	0.66	0.44
Total Hexachlorodibenzo-p-dioxins		"	69	4.1	1.7
Total Heptachlorodibenzo-p-dioxins		"	410	16	8.5
Octachlorodibenzo-p-dioxin		"	1600	55	37
Surrogate Recoveries		%			
2,3,7,8-T4CDF-13C12			82	66	80
2,3,7,8-T4CDD-13C12			86	65	86
1,2,3,7,8-P5CDF-13C12			72	61	67
1,2,3,7,8-P5CDD-13C12			101	78	98
1,2,3,6,7,8-H6CDF-13C12			82	77	64
1,2,3,6,7,8-H6CDD-13C12			87	77	71
1,2,3,4,6,7,8-H7CDF-13C12			83	79	53
1,2,3,4,6,7,8-H7CDD-13C12			94	80	80
OCDD-13C12			96	75	77
2,3,7,8-Cl4-Dibenzofuran		pg/g	9.0	0.72	<0.19
2,3,7,8-Cl4-Dibenzo-p-dioxin		"	0.90	<0.25	<0.18
1,2,3,7,8-Cl5-Dibenzofuran		"	<1.1	<0.36	<0.33
2,3,4,7,8-Cl5-Dibenzofuran		"	1.6	<0.33	<0.30
1,2,3,7,8-Cl5-Dibenzo-p-dioxin		"	2.3	<0.27	<0.19
1,2,3,4,7,8-Cl6-Dibenzofuran		"	4.3	<0.25	<0.26
1,2,3,6,7,8-Cl6-Dibenzofuran		"	<4.1	<0.37	<0.26
2,3,4,6,7,8-Cl6-Dibenzofuran		"	1.8	0.22	<0.29
1,2,3,7,8,9-Cl6-Dibenzofuran		"	<0.34	<0.22	<0.32
1,2,3,4,7,8-Cl6-Dibenzo-p-dioxin		"	2.7	<0.35	<0.31
1,2,3,6,7,8-Cl6-Dibenzo-p-dioxin		"	9.4	0.56	0.36
1,2,3,7,8,9-Cl6-Dibenzo-p-dioxin		"	8.5	0.58	<0.30
1,2,3,4,6,7,8-Cl7-Dibenzofuran		"	38	<1.9	<1.5
1,2,3,4,7,8,9-Cl7-Dibenzofuran		"	2.1	<0.36	<0.40
1,2,3,4,6,7,8-Cl7-Dibenzo-p-dioxin		"	210	8.2	5.2
1,2,3,4,6,7,8,9-Cl8-Dibenzofuran		"	72	3.2	2.1
1,2,3,4,6,7,8,9-Cl8-Dibenzo-p-dioxin		"	1600	55	37

PASC - Summary of Analysis Pre. Dates

Batch Code:	**1021CL01**
Total Tetrachlorodibenzofurans	070783 04
	070784 04
	070785 04
	070786 04
	070787 04
	070788 04
Date Analysed:	04/10/27
Date Prepared:	04/10/21

Batch Code:	**1021CL01**
2,3,7,8-Cl4-Dibenzofuran	070783 04
	070784 04
	070785 04
	070786 04
	070787 04
	070788 04
Date Analysed:	04/10/27
Date Prepared:	04/10/21

PSC ANALYTICAL SERVICES Inc.

Certificate of Analysis

CLIENT INFORMATION

Attention: Melissa Mone
Client Name: PSC Analytical Services Inc.
Project: **2456810**
Project Desc:

Address: 5735 McAdam Road
Mississauga, ON
L4Z 1N9
Fax Number: 905 890-8575 #01
Phone Number: 905 890-8566

LABORATORY INFORMATION

Contact: Elaine Cousins, B.Sc.
Project: AN990310
Date Received: 19-Jul-2004
Date Reported: 27-Aug-2004

Submission No.: 4G0790
Sample No.: 044726-044731

REVISED

NOTES: *'-' = not analysed '<' = less than Method Detection Limit (MDL) 'NA' = no data available*
LOQ can be determined for all analytes by multiplying the appropriate MDL X 3.33
Solids data is based on dry weight except for biota analyses.
Organic analyses are not corrected for extraction recovery standards except for isotope dilution methods, (i.e. CARB 429 PAH, all PCDD/F and DBD/DBF analyses)

Methods used by PSC Analytical Services are based upon those found in 'Standard Methods for the Examination of Water and Wastewater', Twentieth Edition. Other methods are based on the principles of MISA or EPA methodologies. New York State: ELAP Identification Number 10756.

All work recorded herein has been done in accordance with normal professional standards using accepted testing methodologies, quality assurance and quality control procedures except where otherwise agreed to by the client and testing company in writing. Any and all use of these test results shall be limited to the actual cost of the pertinent analysis done. There is no other warranty expressed or implied. Your samples will be retained at PSC Analytical Services for a period of three weeks from receipt of data or as per contract.

COMMENTS: *Samples received at 9.7 degrees C.*

Certified by: ____________

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2004-08-30

PASC - Certificate of Analysis

Component	MDL	Units	Method Blank	T1-N	T5-N	T6-N	T7-N	T9-S
Client ID:			Method Blank	T1-N	T5-N	T6-N	T7-N	T9-S
Lab No.:			044726 04	044727 04	044728 04	044729 04	044730 04	044731 04
Date Sampled:			14-Jul-2004	14-Jul-2004	14-Jul-2004	14-Jul-2004	14-Jul-2004	14-Jul-2004
PCB 77	0.0019	ng/g	<	0.031	0.48	16	53	0.38
PCB 81	0.0019	"	<	0.0020	0.023	0.44	<0.51	<0.010
PCB 105	0.0012	"	<0.0010	0.17	1.5	45	110	1.3
PCB 114	0.0028	"	<0.0010	0.0070	0.055	1.6	1.9	0.018
PCB 118	0.0018	"	0.0010	0.29	2.8	85	390	4.2
PCB 123	0.0019	"	<0.0010	0.0080	0.081	2.4	16	0.25
PCB 126	0.0018	"	<0.0010	0.0060	0.018	0.34	1.7	0.016
PCB 156	0.0007	"	0.0010	0.063	0.30	6.2	29	0.43
PCB 157	0.0007	"	0.0010	0.063	0.30	6.2	29	0.43
PCB 167	0.0008	"	<	0.028	0.094	1.8	14	0.19
PCB 169	0.0008	"	<	<0.0040	<0.0070	<0.15	<0.82	<0.0060
PCB 170	0.0014	"	0.0010	0.22	0.86	10	93	1.1
PCB 180	0.0013	"	0.0020	0.47	1.6	18	190	1.8
PCB 189	0.007	"	<	0.0090	0.031	0.43	3.5	0.043
Internal Recoveries		%						
PCB 1-13C12			19	26	51	47	86	28
PCB 3-13C12			20	33	66	56	101	32
PCB 4-13C12			18	22	52	33	61	21
PCB 15-13C12			31	66	93	73	93	51
PCB 19-13C12			23	43	68	66	95	35
PCB 37-13C12			53	88	111	83	92	64
PCB 54-13C12			24	41	51	68	99	23
PCB 77-13C12			78	98	112	81	121	74
PCB 81-13C12			80	97	112	81	121	74
PCB 104-13C12			36	55	61	74	104	32
PCB 105-13C12			101	105	126	71	127	82
PCB 114-13C12			95	99	114	69	113	77
PCB 118-13C12			97	104	125	71	126	84
PCB 123-13C12			99	104	126	68	128	83
PCB 126-13C12			101	106	117	72	123	79
PCB 155-13C12			54	67	91	76	101	50
PCB 156/157-13C12			97	96	110	66	103	72
PCB 167-13C12			103	101	117	65	114	73
PCB 169-13C12			86	93	99	69	102	64
PCB 188-13C12			69	72	92	76	96	53
PCB 180-13C12			98	88	105	74	109	69
PCB 170-13C12			93	87	93	73	109	66
PCB 189-13C12			113	104	125	75	126	77
PCB 202-13C12			109	100	147	93	125	78
PCB 205-13C12			104	87	110	79	99	69
PCB 206-13C12			91	77	85	81	90	55
PCB 208-13C12			111	95	124	90	115	75
PCB 209-13C12			76	60	57	79	73	40
Alternate		%						
PCB 28-13C12			48	92	130	73	131	87
PCB 111-13C12			80	92	109	78	110	78
PCB 178-13C12			75	77	81	78	94	58

Client: PSC Analytical Services Inc. Project:

PSC Submission No: 4G0790

2004-08-30

PASC - Certificate of Analysis

Component	MDL	Units	
Client ID:			T12-S
Lab No.:			044743 04
Date Sampled:			14-Jul-2004
PCB 77	0.0019	ng/g	0.82
PCB 81	0.0019	"	0.025
PCB 105	0.0012	"	3.0
PCB 114	0.0028	"	0.11
PCB 118	0.0018	"	6.1
PCB 123	0.0019	"	0.14
PCB 126	0.0018	"	0.052
PCB 156	0.0007	"	2.2
PCB 157	0.0007	"	2.2
PCB 167	0.0008	"	0.95
PCB 169	0.0008	"	<0.41
PCB 170	0.0014	"	25
PCB 180	0.0013	"	57
PCB 189	0.007	"	0.74
Internal Recoveries		%	
PCB 1-13C12			45
PCB 3-13C12			62
PCB 4-13C12			34
PCB 15-13C12			94
PCB 19-13C12			79
PCB 37-13C12			113
PCB 54-13C12			89
PCB 77-13C12			111
PCB 81-13C12			113
PCB 104-13C12			106
PCB 105-13C12			109
PCB 114-13C12			101
PCB 118-13C12			108
PCB 123-13C12			107
PCB 126-13C12			105
PCB 155-13C12			113
PCB 156/157-13C12			91
PCB 167-13C12			102
PCB 169-13C12			94
PCB 188-13C12			111
PCB 180-13C12			102
PCB 170-13C12			100
PCB 189-13C12			123
PCB 202-13C12			152
PCB 205-13C12			106
PCB 206-13C12			98
PCB 208-13C12			122
PCB 209-13C12			88
Alternate		%	
PCB 28-13C12			94
PCB 111-13C12			104
PCB 178-13C12			96

2004-08-30

PASC - Summary of Analysis Pre. Dates

Batch Code:	**0722CL01**	**0803CL01**
Internal Recoveries	044726 04	044726 04
	044727 04	044729 04
	044728 04	044730 04
	044731 04	
Date Analysed:	04/07/27	04/08/20
Date Prepared:	04/07/22	04/08/03

Batch Code:	**0803CL01**	**0722CL01**
PCB 77	044726 04	044726 04
	044729 04	044727 04
	044730 04	044728 04
		044731 04
Date Analysed:	04/08/20	04/07/27
Date Prepared:	04/08/03	04/07/22

APPENDIX B
SEDIMENT BIOASSAY REPORT

Stantec Consulting Ltd.
11B Nicholas Beaver Road RR3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419
stantec.com

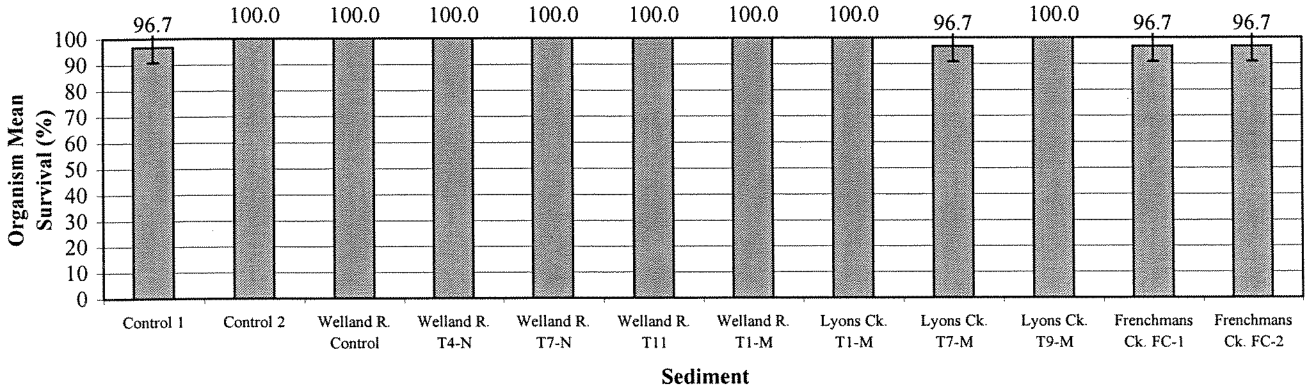
Stantec

SAMPLE IDENTIFICATION

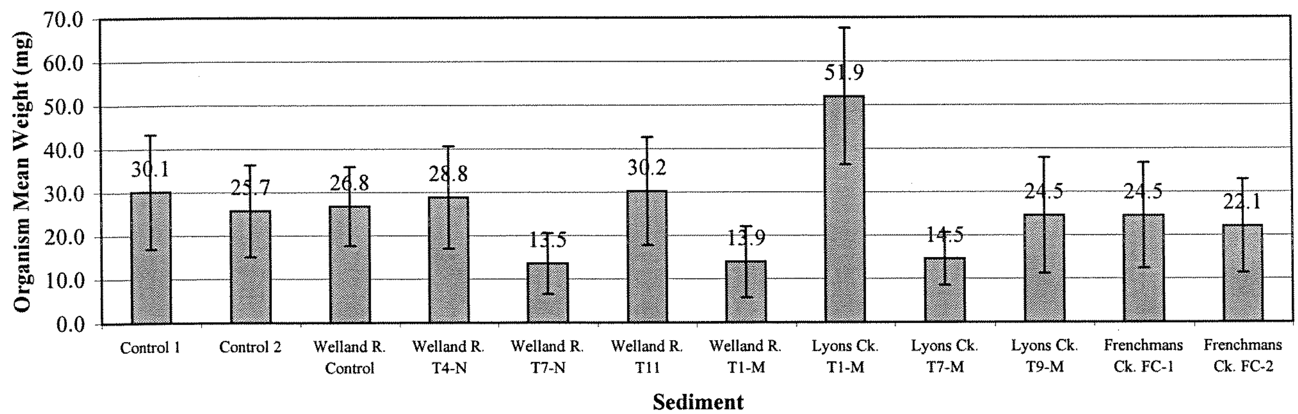
Work Order:	206176	Date Collected :	2004-10-05
Company :	Golder Associates, Mississauga	Time Collected :	Not given
Location :	Mississauga ON	Date Received :	2004-10-08
Sampling Method :	Not given	Time Received :	14:00
Sampled By :	R. Jaagumai	Date Tested :	2004-10-15
Sample Volume:	1 X 23L pail (10 L)	Temp. on arrival :	22.0 °C
Shipped By:	Golder/Rd.	Lab Storage:	4±2 °C

RESULTS*

***Hexagenia limbata* Survival**



***Hexagenia limbata* Growth**



* Results reported relate only to the sample tested.

Date: 2004-12-08

Approved by: K Holtze

Keith Holtze, Director, Laboratory Operations

Work Order : 206176

TUKEY'S MULTIPLE COMPARISON TEST (Toxstat 3.5 [a])

Survival Data (Treatment Average Survival, %)

Control 1	Lyons Ck. T7-M	Frenchmans Ck. FC-1	Frenchmans Ck. FC-2	Control 2	Welland R. Control	Welland R. T4-N	Welland R. T7-N	Welland R T11	Welland R T1-M	Lyons Ck. T1-M	Lyons Ck. T9-M
96.7	96.7	96.7	96.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Growth Data (Treatment Average Weight, mg)

Welland R. T7-N	Welland R. T1-M	Lyons Ck. T7-M	Frenchmans Ck. FC-2	Lyons Ck. T9-M	Frenchmans Ck. FC-1	Control 2	Welland R. Control	Welland R T4-N	Control 1	Welland R. T11	Lyons Ck. T1-M
13.5	13.9	14.5	22.1	24.5	24.5	25.7	26.8	28.8	30.1	30.2	51.9

NOTE: Samples sharing the same line are not significantly different from one another (i.e. they are considered to be homogeneous, that is, from the same population) (α =0.05). All data met the assumptions for normality and homogeneity of variance. Growth data were transformed (log base 10(Y)) prior to statistical analysis.

TEST CONDITIONS

Test Organism[c]:	*Hexagenia limbata*
Source:	University of Windsor[c]
Life Stage:	Nymph (3-4 months old)
Test Type:	Static
# of Replicates:	3
Organisms per Replicate:	10
Organisms per Treatment:	30
Feeding Regime :	None
Test Vessel:	1.8 L square glass jar
Sediment Depth:	Approx. 3 cm
Sediment Volume:	325 mL per replicate
Control Sediment:	Long Point, Lake Erie
Control/Test Water:	Undiluted well water[d]
Overlying Water Volume:	1300 mL per replicate
Test Aeration :	Yes (steady stream of bubbles)
Photoperiod (light/dark) :	16 h / 8 h
Lighting :	Ambient laboratory illumination
Test Temperature :	20 ± 2 °C
Test Duration :	21 days

Test Method: Ontario Ministry of the Environment Laboratory Sediment Biological Testing Protocol. Ontario Ministry of the Environment, August 1992.

[c] Test Organisms: *Hexagenia limbata* eggs were supplied by Department of Biological Sciences, University of Windsor, Windsor ON. Eggs were hatched and reared to testing size in the laboratory. No organisms exhibiting unusual appearance, behavior, or undergoing unusual treatment were used in the test. There appeared to be negligible mortality among the organisms during the 24 hour period prior to test initiation. Organisms appeared healthy, disease free and active during the rearing period and at test initiation.

[d] Control/Dilution Water: Well water with no chemicals added.

Sample Preparation: Sediments were thoroughly homogenized by hand mixing. Prior to test initiation, all sediments were pressed through a 2 mm stainless steel sieve to remove large biota and debris. Approximately 24 hours prior to test initiation, three replicate test vessels each of test and control sediments were individually prepared by drawing sub-samples from the sieved sediment samples. Laboratory water was then added to each test vessel. Replicates were placed in a temperature controlled room and aeration was applied overnight. Test organisms were added the following day.

COMMENTS

There were no unusual conditions or deviations from the test method cited above.

REFERENCE TOXICANT DATA

Substance :	Potassium Chloride
Test Date :	2004-11-11
Test Duration :	96 hours
LC50 (95% confidence limits):	2922 mg/L (2049 - 4182)
Organism Batch :	HI2004-07-31
Historical Mean LC50 :	3119 mg/L
Warning Limits (± 2 SD) :	2430 - 3840
Statistical Method :	Probit [b]
Test Conducted By :	A. Baitz

The reference toxicant test was conducted as a water only test.

REFERENCES

[a] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[b] Stephan, C. E. 1977. Methods for calculating an LC50. P. 65-84 In: P.L. Mayer and J. L. Hamelink (eds.), Aquatic Toxicology and Hazard Evaluation. Amer. Soc. Testing and Materials, Philadelphia PA. ASTM STP 634.

Work Order : 206176

Hexagenia limbata Survival Data

Sediment	Replicate	# Survivors (n=10)	% Surviving Organisms	Treatment Mean Survival (%)	Standard Deviation	CV (%)
Control 1	A	9	90	96.7	5.8	6.0
	B	10	100			
	C	10	100			
Control 2	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10644 Welland R. Control	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10645 Welland R. T4-N	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10646 Welland R. T7-N	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10647 Welland R. T11	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10648 Welland R. T1-M	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10649 Lyons Ck. T1-M	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10650 Lyons Ck. T7-M	A	10	100	96.7	5.8	6.0
	B	9	90			
	C	10	100			
10651 Lyons Ck. T9-M	A	10	100	100.0	0.0	0.0
	B	10	100			
	C	10	100			
10652 Frenchmans Ck. FC-1	A	10	100	96.7	5.8	6.0
	B	10	100			
	C	9	90			
10653 Frenchmans Ck. FC-2	A	10	100	96.7	5.8	6.0
	B	9	90			
	C	10	100			

Data Reviewed By: JL
Date: 2004-12-07

Work Order : 206176

Hexagenia limbata **Weight Data**

Sediment	Organism	Individual Wet Weight (mg) Replicate A	Replicate B	Replicate C	Treatment Mean Wet Weight. (mg)	Standard Deviation	CV (%)
Control 1	1	25.3	42.5	23.1	30.1	12.2	40.5
	2	35.1	37.1	12.5			
	3	16.7	33.2	24.8			
	4	31.0	31.4	27.1			
	5	49.3	25.7	21.0			
	6	39.5	21.3	30.9			
	7	23.6	27.8	59.8			
	8	33.0	30.5	62.5			
	9	25.2	27.3	23.8			
	10	–	27.8	5.1			
Control 2	1	38.6	20.6	21.1	25.7	10.6	41.2
	2	23.5	28.0	29.1			
	3	43.9	35.8	21.5			
	4	26.5	43.2	28.2			
	5	13.7	10.8	39.7			
	6	16.2	28.1	41.5			
	7	23.4	16.8	19.4			
	8	36.6	28.8	44.3			
	9	11.6	8.3	21.4			
	10	18.2	15.7	16.8			
10644 Welland R. Control	1	32.8	33.9	33.7	26.8	9.1	34.1
	2	37.2	37.1	31.1			
	3	29.7	27.3	17.3			
	4	30.9	30.9	18.9			
	5	13.6	10.4	22.3			
	6	39.2	13.0	18.9			
	7	33.7	24.1	40.6			
	8	35.0	11.6	28.5			
	9	21.1	15.6	24.4			
	10	31.1	18.9	40.7			
10645 Welland R. T4-N	1	46.6	26.6	25.8	28.8	11.8	40.9
	2	33.4	45.7	38.4			
	3	38.7	40.7	13.7			
	4	37.0	13.1	41.8			
	5	13.2	21.3	40.4			
	6	20.5	20.9	36.3			
	7	15.3	31.7	24.1			
	8	15.3	10.6	43.0			
	9	29.0	50.5	22.9			
	10	21.8	13.6	31.7			
10646 Welland R. T7-N	1	34.9	15.1	11.2	13.5	7.0	51.8
	2	18.7	8.7	5.9			
	3	11.4	7.8	20.7			
	4	24.0	10.8	6.4			
	5	23.8	11.5	15.0			
	6	5.8	16.8	6.5			
	7	20.4	16.2	4.3			
	8	13.1	6.6	15.6			
	9	7.1	7.4	12.5			
	10	11.8	22.6	12.3			
10647 Welland R. T11	1	25.2	48.0	76.4	30.2	12.4	41.0
	2	28.0	30.5	26.7			
	3	47.4	36.4	36.3			
	4	27.0	21.0	47.3			
	5	25.1	13.8	32.2			
	6	19.3	31.5	22.8			
	7	29.1	25.4	37.1			
	8	26.7	21.3	21.0			
	9	21.0	25.7	41.3			
	10	20.6	19.3	23.3			

Data Reviewed By: JL
Date: 2004-12-07

Work Order : 206176

Hexagenia limbata Weight Data

Sediment	Organism	Individual Wet Weight (mg) Replicate A	Replicate B	Replicate C	Treatment Mean Wet Weight. (mg)	Standard Deviation	CV (%)
10648 Welland R. T1-M	1	39.5	14.4	5.8	13.9	8.2	59.2
	2	24.4	7.8	13.0			
	3	8.3	17.9	11.7			
	4	8.6	12.7	12.2			
	5	6.9	7.4	34.1			
	6	15.2	3.8	13.4			
	7	10.0	13.9	6.9			
	8	27.2	7.5	21.9			
	9	10.3	8.9	12.4			
	10	14.5	14.4	10.9			
10649 Lyons Ck. T1-M	1	76.8	53.9	68.6	51.9	15.6	30.1
	2	78.1	60.5	55.5			
	3	38.7	46.8	63.5			
	4	50.8	41.8	51.1			
	5	42.1	40.8	27.5			
	6	80.3	49.4	55.8			
	7	31.9	35.1	47.2			
	8	45.7	60.7	42.2			
	9	13.3	58.7	65.6			
	10	47.0	50.8	77.9			
10650 Lyons Ck. T7-M	1	11.4	16.6	19.2	14.5	5.6	38.4
	2	22.1	19.8	16.6			
	3	17.1	11.1	9.2			
	4	15.6	8.2	15.9			
	5	7.0	14.1	12.7			
	6	22.8	6.9	21.1			
	7	10.9	10.6	13.7			
	8	10.7	11.6	31.1			
	9	8.5	10.6	18.1			
	10	18.5	–	10.0			
10651 Lyons Ck. T9-M	1	17.2	12.1	48.5	24.5	13.4	54.5
	2	49.7	50.3	40.9			
	3	19.2	17.2	38.8			
	4	18.7	28.4	40.1			
	5	21.5	13.3	23.6			
	6	36.1	37.6	20.2			
	7	13.9	28.3	22.3			
	8	32.0	3.7	7.5			
	9	19.3	6.8	27.1			
	10	25.1	7.9	8.4			
10652 Frenchmans Ck. FC-1	1	31.9	20.9	51.4	24.5	11.5	47.0
	2	33.8	29.8	30.0			
	3	10.0	20.0	30.8			
	4	15.2	16.5	29.2			
	5	34.8	20.3	10.4			
	6	16.4	22.9	25.2			
	7	24.3	15.1	12.2			
	8	28.5	54.1	16.9			
	9	43.9	24.7	15.4			
	10	16.5	9.3	–			
10653 Frenchmans Ck. FC-2	1	38.7	28.3	27.0	22.1	10.2	46.0
	2	28.3	8.6	7.0			
	3	37.9	17.4	29.4			
	4	24.9	22.4	39.9			
	5	12.7	20.1	41.6			
	6	13.7	26.9	7.2			
	7	17.3	34.7	15.4			
	8	14.3	25.4	27.3			
	9	17.0	21.6	11.2			
	10	12.4	–	11.9			

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : **Control 1**
Industry: Stantec Control
Substance: Long Point Sediment
Description: Fine brown organic sediment, no odour.
Date Start: 2004-10-15
Time Start: 16:00

Species: *Hexagenia limbata*
Batch # : HI2004-07-31
Sediment pH: 6.9
Porewater pH: 7.1
Porewater ammonia(mg/L): 1.0

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	8.4	N	EJ/KJ	613	8.3	310	0.75	0.05
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.2	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.6	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.4	N	KJ/EJ	716	8.0			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.8	N	EJ	656	7.8			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.3	N	KJ/EJ	670	8.1	270	0.75	0.04

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : **Control 2**
Industry: Stantec Control
Substance: Long Point Sediment
Description: Fine brown organic sediment, no odour.
Date Start: 2004-10-15
Time Start: 17:00

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 6.9
Porewater pH: 7.1
Porewater ammonia(mg/L): 1.0

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	8.3	N	EJ/KJ	638	8.3	330	1.00	0.07
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.2	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.6	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.5	N	KJ/EJ	707	8.2			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	8.1	N	EJ	771	7.9			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.6	N	KJ/EJ	751	8.3	400	0.50	0.04

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : 10644
Industry: Golder Associates, Mississauga
Substance: Welland R. Control
Description: Fine sediment, dark grey colour, containing shells, strong odour.
Date Start: 2004-10-15
Time Start: 16:00

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 6.9
Porewater pH: 7.5
Porewater ammonia(mg/L): 8.5

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	5.5	N	EJ/KJ	626	8.1	310	2.75	0.13
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.0	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.7	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.4	N	KJ/EJ	642	8.6			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.8	N	EJ	599	8.3			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.2	N	KJ/EJ	539	8.3	370	2.00	0.15

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : 10645
Industry: Golder Associates, Mississauga
Substance: Welland R. T4-N
Description: Fine sediment with clay, containing plant material, strong odour.
Date Start: 2004-10-15
Time Start: 16:15

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 6.9
Porewater pH: 7.3
Porewater ammonia(mg/L): 6.0

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	20.0	Composite	8.3	N	EJ/KJ	559	8.3	280	0.75	0.05
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.4	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	7.9	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.5	N	KJ/EJ	483	8.5			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.8	N	EJ	599	8.2			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.1	N	KJ/EJ	600	8.3	430	0.25	0.02

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : 10646
Industry: Golder Associates, Mississauga
Substance: Welland R. T7-N
Description: Fine sediment with sand, containing plant material, moderate odour.
Date Start: 2004-10-15
Time Start: 16:40

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 7.0
Porewater pH: 7.7
Porewater ammonia(mg/L): 6.5

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	8.0	N	EJ/KJ	558	8.1	270	2.25	0.10
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.1	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.7	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.5	N	KJ/EJ	461	8.5			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.8	N	EJ	526	8.3			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.2	N	KJ/EJ	552	8.4	310	0.50	0.05

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : 10647
Industry: Golder Associates, Mississauga
Substance: Welland R. T11
Description: Fine sediment containing large amount of pore water, strong odour.
Date Start: 2004-10-15
Time Start: 10:05

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 7.1
Porewater pH: 7.2
Porewater ammonia(mg/L): 4.0

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	7.7	N	EJ/KJ	566	7.7	300	1.25	0.02
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.0	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.7	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.4	N	KJ/EJ	495	8.5			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-30	20.0			N	EJ					
15	Sat	2004-10-31	19.0			N	JL					
16	Sun	2004-11-01	20.0			N	EJ					
17	Mon	2004-11-02	20.0	C	8.1	N	EJ	507	8.2			
18	Tues	2004-11-03	20.0			N	EJ					
19	Wed	2004-11-04	20.0			N	EJ					
20	Thurs	2004-11-05	20.0			N	EJ					
21	Fri	2004-11-06	20.0	A	7.7	N	KJ/EJ	492	8.1	290	0.25	0.01

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Stantec

Hexagena limbata Sediment Test Data

Sample # : 10648
Industry: Golder Associates, Mississauga
Substance: Welland R. T1-M
Description: Fine sediment with clay, containing lots of pore water, moderate odour.
Date Start: 2004-10-15
Time Start: 16:25

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 7.3
Porewater pH: 7.5
Porewater ammonia(mg/L): 3.5

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	8.4	N	EJ/KJ	539	8.3	280	0.75	0.05
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.2	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.4	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.4	N	KJ/EJ	501	8.5			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	8.0	N	EJ	523	8.3			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.4	N	KJ/EJ	509	8.4	430	0.25	0.02

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Stantec

Hexagenia limbata Sediment Test Data

Sample # : 10649
Industry: Golder Associates, Mississauga
Substance: Lyons Ck. T1-M
Description: Fine sediment with organic matter and pieces of wood; moderate odour.
Date Start: 2004-10-15
Time Start: 16:50

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 7.1
Porewater pH: 7.3
Porewater ammonia(mg/L): 1.8

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	8.4	N	EJ/KJ	688	8.3	350	0.50	0.03
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.3	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.5	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.3	N	KJ/EJ	734	8.2			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.7	N	EJ	780	8.2			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	7.9	N	KJ/EJ	767	8.2	420	0.25	0.01

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # :	10650	Species:	*Hexagenia limbata*
Industry:	Golder Associates, Mississauga	Batch # :	HI2004-07-31
Substance:	Lyons Ck. T7-M	Sediment pH:	7.2
Description:	Fine sandy sediment with organic matter and plant material, strong odour.	Porewater pH:	7.4
Date Start:	2004-10-15	Porewater ammonia(mg/L):	1.8
Time Start:	16:20		

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	8.1	N	EJ/KJ	620	8.2	340	1.00	0.06
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.2	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.4	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.2	N	KJ/EJ	669	8.4			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.5	N	EJ	664	8.2			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.5	N	KJ/EJ	–	8.5	380	0.50	0.06

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : 10651
Industry: Golder Associates, Mississauga
Substance: Lyons Ck. T9-M
Description: Fine sediment with organic matter and plant material, moderate odour.
Date Start: 2004-10-15
Time Start: 15:10

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 7.2
Porewater pH: 7.1
Porewater ammonia(mg/L): 4.3

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	8.1	N	EJ/KJ	597	8.1	300	2.30	0.11
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.3	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.5	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.2	N	KJ/EJ	882	8.5			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.9	N	EJ	699	8.1			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.4	N	KJ/EJ	683	8.4	490	0.25	0.02

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

***Hexagena limbata* Sediment Test Data**

Sample # :	10652	Species:	*Hexagenia limbata*
Industry:	Golder Associates, Mississauga	Batch # :	HI2004-07-31
Substance:	Frenchmans Ck. FC-1	Sediment pH:	7.1
Description:	Fine sediment with organic matter, plant material and stones, mild odour.	Porewater pH:	7.2
Date Start:	2004-10-15	Porewater ammonia(mg/L):	5.5
Time Start:	17:00		

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	6.4	N	EJ/KJ	692	8.3	310	1.00	0.07
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	7.9	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.5	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.2	N	KJ/EJ	885	8.5			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.9	N	EJ	988	8.4			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.3	N	KJ/EJ	1039	8.5	420	0.25	0.03

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Hexagena limbata Sediment Test Data

Sample # : 10653
Industry: Golder Associates, Mississauga
Substance: Frenchmans Ck. FC-2
Description: Fine sediment with organic matter, plants, rocks and gravel, moderate odour
Date Start: 2004-10-15
Time Start: 16:30

Species: *Hexagenia limbata*
Batch # : Hl2004-07-31
Sediment pH: 7.2
Porewater pH: 7.2
Porewater ammonia(mg/L): 2.0

Test Day	Day	Date	Temp. (oC)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	8.4	N	EJ/KJ	564	8.3	290	1.00	0.07
1	Sat	2004-10-16	20.0			N	RD					
2	Sun	2004-10-17	20.0			N	RD					
3	Mon	2004-10-18	20.0	A	8.2	N	EJ/KJ					
4	Tues	2004-10-19	20.0			N	EJ					
5	Wed	2004-10-20	20.0	B	8.3	N	KJ/EJ					
6	Thurs	2004-10-21	20.0			N	KJ/EJ					
7	Fri	2004-10-22	20.0			N	KJ/EJ					
8	Sat	2004-10-23	20.0			N	RD					
9	Sun	2004-10-24	20.0			N	RD					
10	Mon	2004-10-25	20.0	C	8.4	N	KJ/EJ	561	8.5			
11	Tues	2004-10-26	20.0			N	KJ/EJ					
12	Wed	2004-10-27	20.0			N	EJ					
13	Thurs	2004-10-28	20.0			N	EJ					
14	Fri	2004-10-29	20.0			N	EJ					
15	Sat	2004-10-30	19.0			N	JL					
16	Sun	2004-10-31	19.0			N	JL					
17	Mon	2004-11-01	20.0			N	EJ					
18	Tues	2004-11-02	20.0	C	7.9	N	EJ	568	8.3			
19	Wed	2004-11-03	20.0			N	EJ					
20	Thurs	2004-11-04	20.0			N	EJ					
21	Fri	2004-11-05	20.0	A	8.3	N	KJ/EJ	561	8.3	430	0.25	0.02

"–" = not measured

Data Reviewed By: JL
Date: 2007-12-07

Work Order : 206176

Hexagenia limbata **Initial Weight Data**

Date Weighed : 2004-10-15
Organism Batch : Hl2004-07-31

Organism	Individual Wet Weight (mg)
1	32.790
2	23.540
3	25.900
4	10.880
5	13.820
6	26.800
7	20.820
8	14.230
9	18.100
10	11.180
11	26.440
12	17.100
13	18.740
14	19.250
15	30.630
16	18.650
17	12.600
18	24.710
19	24.810
20	19.390
21	14.960
22	19.500
23	16.210
24	24.500
25	8.900
Mean :	19.778
Standard Deviation :	6.270
Maximum :	32.790
Minimum :	8.900
Number Weighed :	25

Stantec Consulting Ltd.
11B Nicholas Beaver Road RR3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419
stantec.com

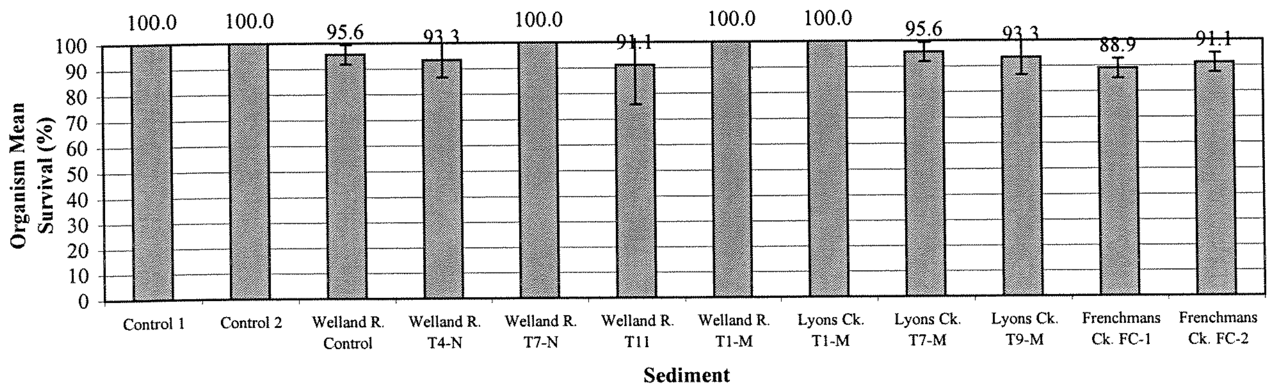
Stantec

SAMPLE IDENTIFICATION

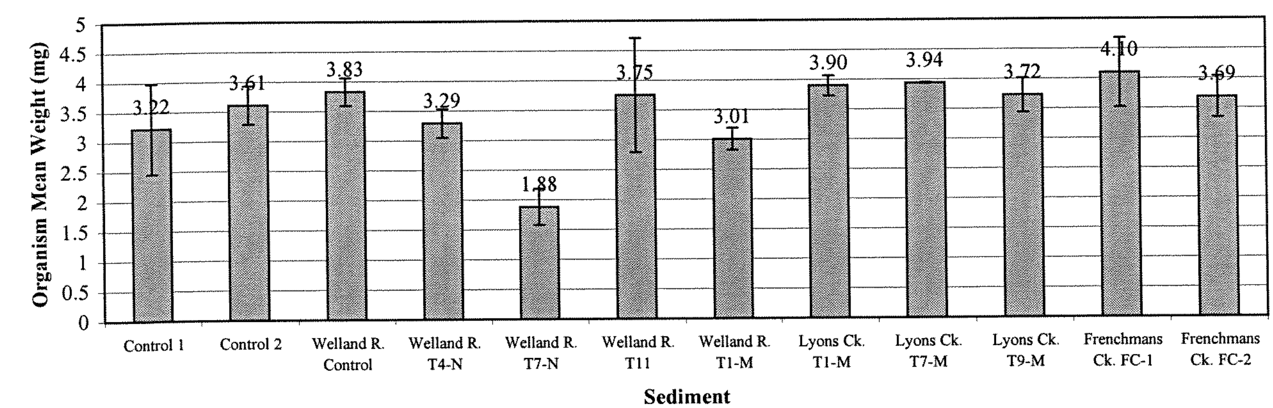
Work Order:	206176	Date Collected :	2004-10-05
Company :	Golder Associates, Mississauga	Time Collected :	Not given
Location :	Mississauga ON	Date Received :	2004-10-08
Sampling Method :	Not given	Time Received :	14:00
Sampled By :	R. Jaagumai	Date Tested :	2004-10-15
Sample Volume:	1 X 23L pail (10 L)	Temp. on arrival :	22.0 °C
Shipped By:	Golder/Rd.	Lab Storage:	4±2 °C

RESULTS*

***Chironomus riparius* Survival**



***Chironomus riparius* Growth**



* Results reported relate only to the sample tested.

Date: 2004-12-08

Approved by: [signature]
Keith Holtze, Director, Laboratory Operations

Work Order : 206176

TUKEY'S MULTIPLE COMPARISON TEST (Toxstat 3.5 [a])

Survival Data (Treatment Average Survival, %)

Frenchmans Ck. FC-1	Frenchmans Ck. FC-2	Welland R. T-11	Welland R. T4-N	Lyons Ck. T9-M	Lyons Ck. T7-M	Welland R. Control	Lyons Ck. T1-M	Welland R. T1-M	Welland R. T7-N	Control 1	Control 2
88.9	91.1	91.1	93.3	93.3	95.6	95.6	100	100	100	100	100

Growth Data (Treatment Average Weight, mg)

Welland R. T7-N	Welland R. T1-M	Control 1	Welland R. T4-N	Control 2	Frenchmans Ck. FC-2	Lyons Ck. T9-M	Welland R. T-11	Welland R. Control	Lyons Ck. T1-M	Lyons Ck. T7-M	Frenchmans Ck. FC-1
1.88	3.01	3.22	3.29	3.61	3.69	3.72	3.75	3.83	3.90	3.94	4.10

NOTE: Samples sharing the same line are not significantly different from one another (i.e. they are considered to be homogeneous, that is, from the same population) (α =0.05). All data met the assumptions for normality and homogeneity of variance.

TEST CONDITIONS

Test Organism:	*Chironomus tentans*	Sediment Depth:	Approx. 3 cm
Source:	Aquatic Bio Systems[c]	Sediment Volume:	325 mL per replicate
Life Stage:	10 - 12 days old	Control Sediment:	Long Point, Lake Erie
Test Type:	Static	Control/Test Water:	Undiluted well water[d]
# of Replicates:	3	Overlying Water Volume:	1300 mL per replicate
Organisms per Replicate:	15	Test Aeration :	Yes (steady stream of bubbles)
Organisms per Treatment:	45	Photoperiod (light/dark) :	16 h / 8 h
Feed Type:	Cerophyll / Tetramin flakes (3:2 w:w)	Lighting :	Ambient laboratory illumination
Feeding Rate (per replicate):	30 mg/day	Test Temperature :	20 ± 2 °C
Test Vessel:	1.8 L square glass jar	Test Duration :	10 days

[d] Control/Dilution Water: Well water with no chemicals added.

Test Method: Ontario Ministry of the Environment Laboratory Sediment Biological Testing Protocol. Ontario Ministry of the Environment, August 1992.

[c] Test Organisms: Organisms were supplied by Aquatic Bio Systems, Fort Collins, Colorado, USA. No organisms exhibiting unusual appearance, behavior, or undergoing unusual treatment were used in the test. Test organisms were shipped via overnight Fedex. On arrival at the laboratory they were moved to pyrex dishes and acclimated to laboratory conditions with periodic partial water changes. There appeared to be negligible mortality among the organisms during the 24 hour period prior to test initiation. Organisms appeared healthy, disease free and active during the laboratory acclimation period and at test initiation. Handling and acclimation procedures followed the general procedures outlined in "Recommended Procedure for the Importation of Test Organisms for Sublethal Toxicity Testing." Environment Canada, September, 1999.

Sample Preparation: Sediments were thoroughly homogenized by hand mixing. Prior to test initiation, all sediments were pressed through a 2 mm stainless steel sieve to remove large biota and debris. Approximately 24 hours prior to test initiation, three replicate test vessels each of test and control sediments were individually prepared by drawing sub-samples from the sieved sediment samples. Laboratory water was then added to each test vessel. Replicates were placed in a temperature controlled room and aeration was applied overnight. Test organisms were added the following day.

COMMENTS

There were no unusual conditions or deviations from the test method cited above. Results reported relate only to the sample tested.

REFERENCE TOXICANT DATA

Substance :	Potassium Chloride	LC50 (95% conf.limits) :	5800 mg/L (2500 - 10000)
Test Date :	2004-10-19	Historical Mean LC50 :	3956 mg/L
Test Duration :	96 hours	Warning Limits (± 2 SD) :	2096 - 6091
Statistical Method :	Non-linear Interpolation [b]	Analyst(s):	E. Jonczyk

The reference toxicant test was conducted as a water only test.

REFERENCES

[a] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[b] Stephan, C. E. 1977. Methods for calculating an LC50. P. 65-84 In: P.L. Mayer and J. L. Hamelink (eds.), Aquatic Toxicology and Hazard Evaluation. Amer. Soc. Testing and Materials, Philadelphia PA. ASTM STP 634.

Work Order : 206176

Chironomus tentans Survival Data

Sediment	Replicate	# Survivors (n=15)	% Surviving Organisms	Treatment Mean Survival (%)	Standard Deviation	CV (%)
Control 1	A	15	100.0	100.0	0.0	0.0
	B	15	100.0			
	C	15	100.0			
Control 2	A	15	100.0	100.0	0.0	0.0
	B	15	100.0			
	C	15	100.0			
10644 Welland R. Control	A	15	100.0	95.6	3.8	4.0
	B	14	93.3			
	C	14	93.3			
10645 Welland R. T4-N	A	13	86.7	93.3	6.7	7.1
	B	14	93.3			
	C	15	100.0			
10646 Welland R. T7-N	A	15	100.0	100.0	0.0	0.0
	B	15	100.0			
	C	15	100.0			
10647 Welland R. T11	A	15	100.0	91.1	15.4	16.9
	B	15	100.0			
	C	11	73.3			
10648 Welland R. T1-M	A	15	100.0	100.0	0.0	0.0
	B	15	100.0			
	C	15	100.0			
10649 Lyons Ck. T1-M	A	15	100.0	100.0	0.0	0.0
	B	15	100.0			
	C	15	100.0			
10650 Lyons Ck. T7-M	A	14	93.3	95.6	3.8	4.0
	B	14	93.3			
	C	15	100.0			
10651 Lyons Ck. T9-M	A	15	100.0	93.3	6.7	7.1
	B	14	93.3			
	C	13	86.7			
10652 Frenchmans Ck. FC-1	A	13	86.7	88.9	3.8	4.3
	B	14	93.3			
	C	13	86.7			
10653 Frenchmans Ck. FC-2	A	13	86.7	91.1	3.8	4.2
	B	14	93.3			
	C	14	93.3			

Data Reviewed By: JC
Date: 2004-12-07

Work Order : 206176

Chironomus tentans Weight Data

Sediment	Replicate	Foil Weight (mg)	Dry Weight Foil + Organisms (mg)	Number of Organisms Weighed	Mean Dry Weight Of Organisms (mg)	Treatment Mean Dry Weight (mg)	Standard Deviation	CV (%)
Control 1	A	798.81	857.88	15	3.94	3.22	0.76	23.59
	B	805.46	854.85	15	3.29			
	C	804.40	840.77	15	2.42			
Control 2	A	798.84	847.42	15	3.24	3.61	0.32	8.95
	B	803.96	861.62	15	3.84			
	C	793.65	849.67	15	3.73			
10644 Welland R. Control	A	799.72	860.24	15	4.03	3.83	0.23	6.11
	B	802.39	852.42	14	3.57			
	C	814.53	868.70	14	3.87			
10645 Welland R. T4-N	A	806.96	852.72	13	3.52	3.29	0.24	7.23
	B	804.62	847.53	13 (1*)	3.30			
	C	808.12	850.75	14 (1*)	3.05			
10646 Welland R. T7-N	A	802.87	826.36	15	1.57	1.88	0.30	16.24
	B	791.82	824.45	15	2.18			
	C	817.46	845.86	15	1.89			
10647 Welland R. T11	A	797.92	865.44	14 (1*)	4.82	3.75	0.96	25.56
	B	798.89	837.51	13 (2*)	2.97			
	C	794.20	832.30	11	3.46			
10648 Welland R. T1-M	A	798.83	847.11	15	3.22	3.01	0.18	6.08
	B	801.69	842.16	14 (1*)	2.89			
	C	804.46	848.18	15	2.91			
10649 Lyons Ck. T1-M	A	809.81	870.98	15	4.08	3.90	0.17	4.34
	B	802.32	860.33	15	3.87			
	C	805.86	862.01	15	3.74			
10650 Lyons Ck. T7-M	A	799.54	850.65	13 (1*)	3.93	3.94	0.01	0.23
	B	797.94	853.01	14	3.93			
	C	795.58	854.80	15	3.95			
10651 Lyons Ck. T9-M	A	802.55	857.14	15	3.64	3.72	0.29	7.69
	B	811.42	868.03	14	4.04			
	C	799.42	841.30	12 (1*)	3.49			
10652 Frenchmans Ck. FC-1	A	801.12	861.32	13	4.63	4.10	0.58	14.14
	B	804.27	862.72	14	4.18			
	C	800.61	845.86	13	3.48			
10653 Frenchmans Ck. FC-2	A	800.72	852.11	13	3.95	3.69	0.35	9.36
	B	797.01	843.15	14	3.30			
	C	798.21	851.50	14	3.81			

* Denotes test organisms which had pupated prior to test completion. These were included in survival counts, but not weighed and therefore excluded from statistical anaylses for the growth endpoint.

Data Reviewed By: JC
Date: 2004-12-07

***Chironomus tentans* Sediment Test Data**

Sample # :	**Control 1**	Species:	*Chironomus tentans*
Industry:	Stantec Control	Batch # :	Ct04-10
Substance:	Long Point Sediment	Sediment pH:	6.9
Description:	Fine brown organic sediment, no odour.	Porewater pH:	7.1
Date Start:	2004-10-15	Porewater ammonia(mg/L):	1.0
Time Start:	10:50		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	21.0	Composite	7.8	Y	EJ/KJ	606	8.0	300	0.75	0.03
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.0	Y	EJ/KJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	5.8	Y	KJ/EJ	697	8.3			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	8.3	N	KJ/EJ	725	8.4	470	0.25	0.02

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

***Chironomus tentans* Sediment Test Data**

Sample # :	**Control 2**	Species:	*Chironomus tentans*
Industry:	Stantec Control	Batch # :	Ct04-10
Substance:	Long Point Sediment	Sediment pH:	6.9
Description:	Fine brown organic sediment, no odour.	Porewater pH:	7.1
Date Start:	2004-10-15	Porewater ammonia(mg/L):	1.0
Time Start:	12:20		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	20.5	Composite	8.1	Y	EJ/KJ	660	8.2	330	1.00	0.06
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.7	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.5	Y	KJ/EJ	639	8.3			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	7.8	N	KJ/EJ	805	8.2	440	0.25	0.01

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Chironomus tentans **Sediment Test Data**

Sample # :	10644	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Welland R. Control	Sediment pH:	6.9
Description:	Fine sediment, dark grey colour, containing shells, strong odour.	Porewater pH:	7.5
Date Start:	2004-10-15	Porewater ammonia(mg/L):	8.5
Time Start:	11:00		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	20.0	Composite	4.8	Y	EJ/KJ	625	8.0	330	7.80	0.30
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.4	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.5	Y	KJ/EJ	670	8.5			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	6.1	N	KJ/EJ	755	8.1	360	18.00	0.85

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

***Chironomus tentans* Sediment Test Data**

Sample # :	10645	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Welland R. T4-N	Sediment pH:	6.9
Description:	Fine sediment with clay, containing plant material, strong odour.	Porewater pH:	7.3
Date Start:	2004-10-15	Porewater ammonia(mg/L):	6.0
Time Start:	11:10		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	8.2	Y	EJ/KJ	562	8.3	280	2.00	0.14
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.4	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.3	Y	KJ/EJ	556	8.5			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	8.2	N	KJ/EJ	565	8.6	340	1.00	0.14

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Chironomus tentans Sediment Test Data

Sample # :	10646	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Welland R. T7-N	Sediment pH:	7.0
Description:	Fine sediment with sand, containing plant material, moderate odour.	Porewater pH:	7.7
Date Start:	2004-10-15	Porewater ammonia(mg/L):	6.5
Time Start:	11:15		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	7.5	Y	EJ/KJ	552	8.2	270	2.30	0.13
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	7.6	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.3	Y	KJ/EJ	538	8.4			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	7.9	N	KJ/EJ	522	8.3	310	3.00	0.22

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Stantec

Chironomus tentans **Sediment Test Data**

Sample # :	10647	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Welland R. T11	Sediment pH:	7.2
Description:	Fine sediment containing large amount of pore water, strong odour.	Porewater pH:	7.2
Date Start:	2004-10-15	Porewater ammonia(mg/L):	4.0
Time Start:	11:30		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	7.5	Y	EJ/KJ	564	8.0	300	1.30	0.05
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.4	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.1	Y	KJ/EJ	547	8.2			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	8.8	N	KJ/EJ	555	8.2	360	0.50	0.03

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

***Chironomus tentans* Sediment Test Data**

Sample # : 10648
Industry: Golder Associates, Mississauga
Substance: Welland R. T1-M
Description: Fine sediment with clay, containing lots of pore water, moderate odour.
Date Start: 2004-10-15
Time Start: 11:50

Species: *Chironomus tentans*
Batch # : Ct04-10
Sediment pH: 7.3
Porewater pH: 7.5
Porewater ammonia(mg/L): 3.5

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (μs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	7.6	Y	EJ/KJ	554	8.1	280	0.50	0.02
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.6	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.6	Y	KJ/EJ	539	8.5			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	5.3	N	KJ/EJ	552	8.0	340	0.75	0.03

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

***Chironomus tentans* Sediment Test Data**

Sample # :	10649	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Lyons Ck. T1-M	Sediment pH:	7.1
Description:	Fine sediment with organic matter and pieces of wood; moderate odour.	Porewater pH:	7.3
Date Start:	2004-10-15	Porewater ammonia(mg/L):	1.8
Time Start:	11:20		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.0	Composite	8.1	Y	EJ/KJ	693	8.1	350	0.50	0.02
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.4	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.6	Y	KJ/EJ	777	8.5			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	7.4	N	KJ/EJ	838	8.3	500	1.25	0.09

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Chironomus tentans Sediment Test Data

Sample # :	10650	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Lyons Ck. T7-M	Sediment pH:	7.2
Description:	Fine sandy sediment with organic matter and plant material, strong odour.	Porewater pH:	7.4
Date Start:	2004-10-15	Porewater ammonia(mg/L):	1.8
Time Start:	12:00		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	20.0	Composite	7.7	Y	EJ/KJ	632	8.0	340	1.00	0.04
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.5	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.6	Y	KJ/EJ	670	8.6			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	6.5	N	KJ/EJ	704	8.1	410	6.50	0.31

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

Chironomus tentans Sediment Test Data

Sample # :	10651	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Lyons Ck. T9-M	Sediment pH:	7.2
Description:	Fine sediment with organic matter and plant material, moderate odour.	Porewater pH:	7.1
Date Start:	2004-10-15	Porewater ammonia(mg/L):	4.3
Time Start:	11:35		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	20.0	Composite	8.2	Y	EJ/KJ	604	8.2	300	2.30	0.14
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.5	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.6	Y	KJ/EJ	592	8.6			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	8.2	N	KJ/EJ	695	8.4	470	6.75	0.61

"–" = not measured

Data Reviewed By: JL
Date: 2004 12-07

Chironomus tentans Sediment Test Data

Sample # :	10652	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Frenchmans Ck. FC-1	Sediment pH:	7.1
Description:	Fine sediment with organic matter, plant material and stones, mild odour.	Porewater pH:	7.2
Date Start:	2004-10-15	Porewater ammonia(mg/L):	5.5
Time Start:	12:10		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	19.5	Composite	8.0	Y	EJ/KJ	693	8.3	310	1.00	0.07
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.5	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.6	Y	KJ/EJ	801	8.7			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	8.4	N	KJ/EJ	929	8.7	440	6.50	1.08

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

***Chironomus tentans* Sediment Test Data**

Sample # :	10653	Species:	*Chironomus tentans*
Industry:	Golder Associates, Mississauga	Batch # :	Ct04-10
Substance:	Frenchmans Ck. FC-2	Sediment pH:	7.2
Description:	Fine sediment with organic matter, plants, rocks and gravel, moderate odour	Porewater pH:	7.2
Date Start:	2004-10-15	Porewater ammonia(mg/L):	2.0
Time Start:	12:10		

Test Day	Day	Date	Temp. (°C)	Replicate	D.O. (mg/L)	Test Fed? (Y/N)	Tech.	Conductivity (µs)	pH	Hardness (mg/l as $CaCO_3$)	Total Ammonia (mg/L)	Unionized Ammonia (mg/L)
0	Fri	2004-10-15	20.5	Composite	8.4	Y	EJ/KJ	562	8.3	290	1.00	0.08
1	Sat	2004-10-16	19.0			Y	RD					
2	Sun	2004-10-17	19.0			Y	RD					
3	Mon	2004-10-18	21.0	A	8.5	Y	KJ/EJ					
4	Tues	2004-10-19	20.0			Y	EJ					
5	Wed	2004-10-20	20.0	B	8.6	Y	KJ/EJ	585	8.6			
6	Thurs	2004-10-21	20.0			Y	KJ/EJ					
7	Fri	2004-10-22	20.0			Y	KJ/EJ					
8	Sat	2004-10-23	20.0			Y	RD					
9	Sun	2004-10-24	20.0			Y	RD					
10	Mon	2004-10-25	20.0	C	8.3	N	KJ/EJ	632	8.6	380	0.75	0.05

"–" = not measured

Data Reviewed By: JL
Date: 2004-12-07

ANALYTICAL SERVICES INC.

CERTIFICATE OF ANALYSIS

Attention: MS. LESLEY NOVAK
Client Name: Stantec Consulting
Address: 11B Nicholas Beaver Rd.
Guelph, ON
N1H 6H9
Telephone: 519-763-4412 FAX: 519-763-4419

GOLDER ASSOCIATES RECEIVED JAN 12 2005

Laboratory Work Order: 126214

This Certificate of Analysis is for the following:

Sample Received on: 15-Oct-2004

Reported on: 23-Nov-2004

Client Reference: Golder Sed.
Purchase Order: 162704011-200
Quotation No.:

The report contains the following sections:
Section: 1. Case Narrative
2. Analytical Results
3. Methodology Summary
4. Certificate of Quality Control
5. Subcontract Attachments

Results for solids samples are corrected for moisture and reported as dry weight.

We are proud to be Accredited by: Standard Council of Canada (SCC) / CAEAL to ISO 17025 (#1799)
Licensed by: Ministry of Environment(MOE)-Drinking Water Testing (#2221) for specific tests

Water samples are discarded 4 weeks after the results have been reported. Solid samples are retained for 3 months. Storage for longer periods requires prior arrangement with the laboratory.

Reviewed and Authorized by

Darlene Hoogenes-Stastny
Project Manager

NOTE: The enclosed results relate only to the sample or item as received by the laboratory.

This report may be reproduced in full. Reproduction of a partial report must have the written authorization of the laboratory.

CERTIFICATE OF ANALYSIS - SECTION 1

CASE NARRATIVE

Attention: MS. LESLEY NOVAK
Client Name: Stantec Consulting
Address: 11B Nicholas Beaver Rd.
Guelph, ON
N1H 6H9
Telephone: 519-763-4412
FAX: 519-763-4419

Laboratory Work Order: 126214

Sample(s) Received on: 15-Oct-2004 Reported on: 23-Nov-2004

Sample Shipment Receipt and Login:

Temperature on receipt was 12.2°C. The maximum allowable temperature is 10°C according to Canadian regulations or guidance documents. Samples submitted to the laboratory soon after sampling are exempt, provided that cooling has been initiated. Cooling is not required for certain situations such as: Waste for classification or specific matrices or tests such as PCB in oil.

There are no other notable comments.

Sample Analysis:

No exceptions were noted during analysis.

General Comments:

None.

PSC Maxxam has performed all analytical testing herein in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act. All methodologies comply with this document and are validated for use in the laboratory. The methods and techniques employed in the analysis conform to the performance criteria(detection limits, accuracy and precision) as outlined in the Protocal for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act.

The CWS PHC methods employed by PSC Maxxam conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following the "Alberta Environment Draft Addenda to the CWS-PHC, Appendix 6, Validation of Alternate Methods". Documentation is available upon request. PSC Maxxam has made the following improvements to the CWS-PHC reference benchmark method:
(i)Headspace for F1; and, (ii) Mechnical extraction for F2-F4.

PSC Maxxam is accredited by SCC/CAEAL for all specific parameters as required by O'Reg 153/04. All data is in statistical control and has met all QC & method performance criteria unless otherwise flagged. PSC Maxxam is limited in liability to the actual cost of analysis unless agreed in writing. There is no other warranty expressed or implied. Samples will be retained at PSC Maxxam for three weeks from receipt of data or as per contract.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph

Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK
Client Reference: Golder Sed.
Work Order: 126214

Purchase Order:162704011-200
Date Received: 15-Oct-2004
Sample Type: Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038973	Sample Description: 10644		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	2.99	%	0.01	
	Aluminum Al	24900	mg/kg	5	
	Barium Ba	157.	mg/kg	4	
	Beryllium Be	1.0	mg/kg	0.5	
	Boron B	8.	mg/kg	2	
	Cadmium Cd	1.1	mg/kg	0.5	
	Calcium Ca	32200	mg/kg	10	
	Chromium Cr	38.	mg/kg	2	
	Cobalt Co	13.	mg/kg	2	
	Copper Cu	59.	mg/kg	2	
	Iron Fe	34000	mg/kg	4	
	Lead Pb	35.	mg/kg	5	
	Magnesium Mg	12400	mg/kg	2	
	Manganese Mn	527.	mg/kg	2	
	Mercury Hg	0.10	mg/kg	0.01	
	Molybdenum Mo	< 2	mg/kg	2	
	Nickel Ni	51.	mg/kg	5	
	Phosphorus P	1040	mg/kg	5	
	Potassium K	3420	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	
	Strontium Sr	78.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	205.	mg/kg	2	
	Vanadium V	41.	mg/kg	2	
	Zinc Zn	196.	mg/kg	1	
04-A038974	Sample Description: 10645		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	2.85	%	0.01	
	Aluminum Al	14400	mg/kg	5	
	Barium Ba	88.	mg/kg	4	
	Beryllium Be	0.7	mg/kg	0.5	
	Boron B	7.	mg/kg	2	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph

Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK
Client Reference: Golder Sed.
Work Order: 126214

Purchase Order:162704011-200
Date Received: 15-Oct-2004
Sample Type: Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038974	Sample Description: 10645		Date & Time Sampled: 14-Oct-2004		
	Cadmium Cd	1.2	mg/kg	0.5	
	Calcium Ca	40600	mg/kg	10	
	Chromium Cr	194.	mg/kg	2	
	Cobalt Co	17.	mg/kg	2	
	Copper Cu	54.	mg/kg	2	
	Iron Fe	39900	mg/kg	4	
	Lead Pb	25.	mg/kg	5	
	Magnesium Mg	12400	mg/kg	2	
	Manganese Mn	688.	mg/kg	2	
	Mercury Hg	0.17	mg/kg	0.01	
	Molybdenum Mo	23.	mg/kg	2	
	Nickel Ni	156.	mg/kg	5	
	Phosphorus P	907.	mg/kg	5	
	Potassium K	2020	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	
	Strontium Sr	83.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	256.	mg/kg	2	
	Vanadium V	35.	mg/kg	2	
	Zinc Zn	186.	mg/kg	1	
04-A038975	Sample Description: 10646		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	6.57	%	0.01	
	Aluminum Al	15100	mg/kg	5	
	Barium Ba	95.	mg/kg	4	
	Beryllium Be	0.7	mg/kg	0.5	
	Boron B	7.	mg/kg	2	
	Cadmium Cd	1.1	mg/kg	0.5	
	Calcium Ca	31500	mg/kg	10	
	Chromium Cr	139.	mg/kg	2	
	Cobalt Co	15.	mg/kg	2	
	Copper Cu	228.	mg/kg	2	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph   Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK	Purchase Order:162704011-200
Client Reference: Golder Sed.	Date Received: 15-Oct-2004
Work Order: 126214	Sample Type: Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038975	Sample Description: 10646		Date & Time Sampled: 14-Oct-2004		
	Iron Fe	33000	mg/kg	4	
	Lead Pb	28.	mg/kg	5	
	Magnesium Mg	10800	mg/kg	2	
	Manganese Mn	493.	mg/kg	2	
	Mercury Hg	0.26	mg/kg	0.01	
	Molybdenum Mo	10.	mg/kg	2	
	Nickel Ni	147.	mg/kg	5	
	Phosphorus P	909.	mg/kg	5	
	Potassium K	1940	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	
	Strontium Sr	76.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	226.	mg/kg	2	
	Vanadium V	34.	mg/kg	2	
	Zinc Zn	266.	mg/kg	1	
04-A038976	Sample Description: 10647		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	1.72	%	0.01	
	Aluminum Al	17100	mg/kg	5	
	Barium Ba	109.	mg/kg	4	
	Beryllium Be	0.8	mg/kg	0.5	
	Boron B	8.	mg/kg	2	
	Cadmium Cd	0.6	mg/kg	0.5	
	Calcium Ca	30200	mg/kg	10	
	Chromium Cr	36.	mg/kg	2	
	Cobalt Co	15.	mg/kg	2	
	Copper Cu	45.	mg/kg	2	
	Iron Fe	31100	mg/kg	4	
	Lead Pb	22.	mg/kg	5	
	Magnesium Mg	9920	mg/kg	2	
	Manganese Mn	669.	mg/kg	2	
	Mercury Hg	0.16	mg/kg	0.01	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph | Reported:23-Nov-2004 |

Attention: MS. LESLEY NOVAK
Client Reference: Golder Sed.
Work Order: 126214

Purchase Order:162704011-200
Date Received: 15-Oct-2004
Sample Type: Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038976	Sample Description: 10647		Date & Time Sampled: 14-Oct-2004		
	Molybdenum Mo	< 2	mg/kg	2	
	Nickel Ni	55.	mg/kg	5	
	Phosphorus P	1050	mg/kg	5	
	Potassium K	2350	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	
	Strontium Sr	68.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	269.	mg/kg	2	
	Vanadium V	35.	mg/kg	2	
	Zinc Zn	104.	mg/kg	1	
04-A038977	Sample Description: 10648		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	1.27	%	0.01	
	Aluminum Al	15800	mg/kg	5	
	Barium Ba	103.	mg/kg	4	
	Beryllium Be	0.7	mg/kg	0.5	
	Boron B	6.	mg/kg	2	
	Cadmium Cd	1.5	mg/kg	0.5	
	Calcium Ca	41700	mg/kg	10	
	Chromium Cr	436.	mg/kg	2	
	Cobalt Co	19.	mg/kg	2	
	Copper Cu	72.	mg/kg	2	
	Iron Fe	60100	mg/kg	4	
	Lead Pb	23.	mg/kg	5	
	Magnesium Mg	13600	mg/kg	2	
	Manganese Mn	1070	mg/kg	2	
	Mercury Hg	0.08	mg/kg	0.01	
	Molybdenum Mo	47.	mg/kg	2	
	Nickel Ni	284.	mg/kg	5	
	Phosphorus P	988.	mg/kg	5	
	Potassium K	2510	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph

Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK
Client Reference: Golder Sed.
Work Order: 126214

Purchase Order:162704011-200
Date Received: 15-Oct-2004
Sample Type: Solids

Sample #	Test	Result		Units	EQL	Comment
04-A038977	Sample Description: 10648			Date & Time Sampled: 14-Oct-2004		
	Strontium Sr	86.		mg/kg	2	
	Thallium Tl	< 1		mg/kg	1	
	Titanium Ti	296.		mg/kg	2	
	Vanadium V	43.		mg/kg	2	
	Zinc Zn	126.		mg/kg	1	
04-A038978	Sample Description: 10649			Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	5.09		%	0.01	
	%Solids, Total	34.3		%	0.1	
	Total PCB (Solid)	0.022		mg/kg	0.005	Interference
	PCB SURROGATE RECOVERY					
			Expected Recovery			
	Decachlorobiphenyl	92.	75.0-125.0	%		
	Aluminum Al	27100		mg/kg	5	
	Barium Ba	175.		mg/kg	4	
	Beryllium Be	1.4		mg/kg	0.5	
	Boron B	8.		mg/kg	2	
	Cadmium Cd	1.4		mg/kg	0.5	
	Calcium Ca	21800		mg/kg	10	
	Chromium Cr	37.		mg/kg	2	
	Cobalt Co	9.		mg/kg	2	
	Copper Cu	51.		mg/kg	2	
	Iron Fe	25800		mg/kg	4	
	Lead Pb	31.		mg/kg	5	
	Magnesium Mg	9400		mg/kg	2	
	Manganese Mn	480.		mg/kg	2	
	Mercury Hg	0.06		mg/kg	0.01	
	Molybdenum Mo	< 2		mg/kg	2	
	Nickel Ni	36.		mg/kg	5	
	Phosphorus P	1330		mg/kg	5	
	Potassium K	3040		mg/kg	20	
	Silver Ag	< 1		mg/kg	1	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph   Reported:23-Nov-2004

Attention:	MS. LESLEY NOVAK	Purchase Order:	162704011-200
Client Reference:	Golder Sed.	Date Received:	15-Oct-2004
Work Order:	126214	Sample Type:	Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038978	Sample Description: 10649		Date & Time Sampled: 14-Oct-2004		
	Strontium Sr	246.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	116.	mg/kg	2	
	Vanadium V	44.	mg/kg	2	
	Zinc Zn	459.	mg/kg	1	
04-A038979	Sample Description: 10650		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	3.88	%	0.01	
	%Solids, Total	44.7	%	0.1	
	Total PCB (Solid)	25.	mg/kg	0.005	Interference
	PCB SURROGATE RECOVERY				
		Expected Recovery			
	Decachlorobiphenyl	n/a due to di75.0-125.0	%		
	Aluminum Al	10200	mg/kg	5	
	Barium Ba	70.	mg/kg	4	
	Beryllium Be	0.7	mg/kg	0.5	
	Boron B	3.	mg/kg	2	
	Cadmium Cd	< 0.5	mg/kg	0.5	
	Calcium Ca	22900	mg/kg	10	
	Chromium Cr	84.	mg/kg	2	
	Cobalt Co	16.	mg/kg	2	
	Copper Cu	156.	mg/kg	2	
	Iron Fe	130000	mg/kg	4	
	Lead Pb	67.	mg/kg	5	
	Magnesium Mg	12300	mg/kg	2	
	Manganese Mn	1210	mg/kg	2	
	Mercury Hg	0.12	mg/kg	0.01	
	Molybdenum Mo	14.	mg/kg	2	
	Nickel Ni	76.	mg/kg	5	
	Phosphorus P	1390	mg/kg	5	
	Potassium K	1310	mg/kg	20	
	Silver Ag	11.	mg/kg	1	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

PSC Analytical Services

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Attention:	MS. LESLEY NOVAK	Purchase Order:	162704011-200
Client Reference:	Golder Sed.	Date Received:	15-Oct-2004
Work Order:	126214	Sample Type:	Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038979	Sample Description: 10650		Date & Time Sampled: 14-Oct-2004		
	Strontium Sr	48.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	150.	mg/kg	2	
	Vanadium V	32.	mg/kg	2	
	Zinc Zn	2490	mg/kg	1	
04-A038980	Sample Description: 10652		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	2.74	%	0.01	
	Aluminum Al	14300	mg/kg	5	
	Barium Ba	101.	mg/kg	4	
	Beryllium Be	0.6	mg/kg	0.5	
	Boron B	11.	mg/kg	2	
	Cadmium Cd	1.2	mg/kg	0.5	
	Calcium Ca	68800	mg/kg	10	
	Chromium Cr	20.	mg/kg	2	
	Cobalt Co	8.	mg/kg	2	
	Copper Cu	22.	mg/kg	2	
	Iron Fe	20600	mg/kg	4	
	Lead Pb	21.	mg/kg	5	
	Magnesium Mg	24800	mg/kg	2	
	Manganese Mn	366.	mg/kg	2	
	Mercury Hg	0.05	mg/kg	0.01	
	Molybdenum Mo	< 2	mg/kg	2	
	Nickel Ni	22.	mg/kg	5	
	Phosphorus P	662.	mg/kg	5	
	Potassium K	2190	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	
	Strontium Sr	749.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	193.	mg/kg	2	
	Vanadium V	27.	mg/kg	2	
	Zinc Zn	130.	mg/kg	1	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph

Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK
Client Reference: Golder Sed.
Work Order: 126214

Purchase Order:162704011-200
Date Received: 15-Oct-2004
Sample Type: Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038981	Sample Description: 10653		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	3.12	%	0.01	
	Aluminum Al	16600	mg/kg	5	
	Barium Ba	120.	mg/kg	4	
	Beryllium Be	0.8	mg/kg	0.5	
	Boron B	11.	mg/kg	2	
	Cadmium Cd	13.7	mg/kg	0.5	
	Calcium Ca	40900	mg/kg	10	
	Chromium Cr	346.	mg/kg	2	
	Cobalt Co	13.	mg/kg	2	
	Copper Cu	57.	mg/kg	2	
	Iron Fe	30100	mg/kg	4	
	Lead Pb	62.	mg/kg	5	
	Magnesium Mg	19900	mg/kg	2	
	Manganese Mn	665.	mg/kg	2	
	Mercury Hg	0.18	mg/kg	0.01	
	Molybdenum Mo	2.	mg/kg	2	
	Nickel Ni	28.	mg/kg	5	
	Phosphorus P	696.	mg/kg	5	
	Potassium K	2420	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	
	Strontium Sr	165.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	225.	mg/kg	2	
	Vanadium V	37.	mg/kg	2	
	Zinc Zn	276.	mg/kg	1	
04-A038982	Sample Description: 10651		Date & Time Sampled: 14-Oct-2004		
	Carbon,Total Organic as C	7.20	%	0.01	
	%Solids, Total	27.3	%	0.1	
	Total PCB (Solid)	14.	mg/kg	0.005	Interference

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph

Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK	Purchase Order:162704011-200
Client Reference: Golder Sed.	Date Received: 15-Oct-2004
Work Order: 126214	Sample Type: Solids

Sample #	Test	Result	Units	EQL	Comment
04-A038982	Sample Description: 10651				Date & Time Sampled: 14-Oct-2004
	PCB SURROGATE RECOVERY				
		Expected Recovery			
	Decachlorobiphenyl	n/a due to di75.0-125.0	%		
	Aluminum Al	12800	mg/kg	5	
	Barium Ba	80.	mg/kg	4	
	Beryllium Be	0.6	mg/kg	0.5	
	Boron B	14.	mg/kg	2	
	Cadmium Cd	2.2	mg/kg	0.5	
	Calcium Ca	43200	mg/kg	10	
	Chromium Cr	51.	mg/kg	2	
	Cobalt Co	13.	mg/kg	2	
	Copper Cu	85.	mg/kg	2	
	Iron Fe	51200	mg/kg	4	
	Lead Pb	56.	mg/kg	5	
	Magnesium Mg	21100	mg/kg	2	
	Manganese Mn	879.	mg/kg	2	
	Mercury Hg	0.09	mg/kg	0.01	
	Molybdenum Mo	6.	mg/kg	2	
	Nickel Ni	50.	mg/kg	5	
	Phosphorus P	1360	mg/kg	5	
	Potassium K	2090	mg/kg	20	
	Silver Ag	< 1	mg/kg	1	
	Strontium Sr	107.	mg/kg	2	
	Thallium Tl	< 1	mg/kg	1	
	Titanium Ti	208.	mg/kg	2	
	Vanadium V	30.	mg/kg	2	
	Zinc Zn	2680	mg/kg	1	
04-A038983	Sample Description: Control				Date & Time Sampled: 14-Oct-2004
	Carbon,Total Organic as C	8.89	%	0.01	
	%Solids, Total	28.7	%	0.1	
	Sample Note	particle size attached			

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

CERTIFICATE OF ANALYSIS - SECTION 2

ANALYTICAL RESULTS

Client:(4017) Stantec Consulting, Guelph | Reported:23-Nov-2004 |

Attention: MS. LESLEY NOVAK	Purchase Order:162704011-200
Client Reference: Golder Sed.	Date Received: 15-Oct-2004
Work Order: 126214	Sample Type: Solids

Sample #	Test	Result		Units	EQL	Comment
04-A038983	Sample Description: Control			Date & Time Sampled: 14-Oct-2004		
	Total PCB (Solid)	< 0.005		mg/kg	0.005	
	PCB SURROGATE RECOVERY					
			Expected Recovery			
	Decachlorobiphenyl	103.	75.0-125.0	%		
	Aluminum Al	6220		mg/kg	5	
	Barium Ba	60.		mg/kg	4	
	Beryllium Be	< 0.5		mg/kg	0.5	
	Boron B	7.		mg/kg	2	
	Cadmium Cd	0.6		mg/kg	0.5	
	Calcium Ca	73100		mg/kg	10	
	Chromium Cr	12.		mg/kg	2	
	Cobalt Co	5.		mg/kg	2	
	Copper Cu	15.		mg/kg	2	
	Iron Fe	14400		mg/kg	4	
	Lead Pb	20.		mg/kg	5	
	Magnesium Mg	8840		mg/kg	2	
	Manganese Mn	449.		mg/kg	2	
	Mercury Hg	0.06		mg/kg	0.01	
	Molybdenum Mo	< 2		mg/kg	2	
	Nickel Ni	11.		mg/kg	5	
	Phosphorus P	673.		mg/kg	5	
	Potassium K	829.		mg/kg	20	
	Silver Ag	< 1		mg/kg	1	
	Strontium Sr	122.		mg/kg	2	
	Thallium Tl	< 1		mg/kg	1	
	Titanium Ti	194.		mg/kg	2	
	Vanadium V	16.		mg/kg	2	
	Zinc Zn	57.		mg/kg	1	

EQL Estimated Quantitation Limit
Refer to the cover page for a list of report contents.

PSC ANALYTICAL SERVICES

Prepared For:
Lesley Novak

Date Generated
3-Nov-2004
Spreadsheet File Name
126214 Stantec Golder sed.XLS

				PSC London ID	04-A038973	04-A038974	04-A038975	04-A038976	04-A038978	04-A038979	04-A038980
				Client ID:	**10644**	**10645**	**10646**	**10647**	**10649**	**10650**	**10652**
				PSC Analytical ID:	04-H073783	04-H073784	04-H073785	04-H073786	04-H073787	04-H073788	04-H073789
				Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
				Duplicate of:							
				Date Sampled:	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04
				Client Description:							
	Parameters	Method	EQL	Units							
C-H-:0	< 12.5 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< 9.5 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< 4.75 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< PHI -1 (2 mm)	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< PHI 0 (1 mm)	Grav	0.1	%	98.7	98.9	98.6	99.6	98.5	96.9	98.4
C-H-:0	< PHI +1 (1/2 mm)	Grav.	0.1	%	95.5	97	95.6	98.5	95.9	83.8	95.5
C-H-:0	< PHI +2 (1/4 mm)	Grav.	0.1	%	93.2	96.5	92.7	97.4	94.1	65.8	94
C-H-:0	< PHI +3 (1/8 mm)	Grav.	0.1	%	84.9	89.2	85.4	94.1	91.3	44.6	83.2
C-H-:0	< PHI +4 (1/16 mm)	Grav.	0.1	%	84.2	83.8	78.1	92.2	90.3	42.6	77.1
C-H-:0	< PHI +5 (1/32 mm)	Grav.	0.1	%	81.8	74.8	70.1	89.2	87.2	39.6	69.9
C-H-:0	< PHI +6 (1/64 mm)	Grav.	0.1	%	79.6	62.2	58.3	78.3	57.6	32.5	51.2
C-H-:0	< PHI +7 (1/128 mm)	Grav.	0.1	%	62.3	14.1	17.6	23.2	27.2	14.6	5
C-H-:0	< PHI +8 (1/256 mm)	Grav.	0.1	%	25.3	6.6	8.8	11.8	16.5	8	3.5
C-H-:0	< PHI +9 (1/512 mm)	Grav.	0.1	%	6.6	2.3	4	3.7	6.2	2.8	2.2
C-H-:0	Gravel	Wentworth	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
C-H-:0	Sand	Wentworth	0.1	%	15.8	16.2	21.9	7.8	9.7	57.4	22.9
C-H-:0	Silt	Wentworth	0.1	%	58.9	77.2	69.3	80.4	73.8	34.6	73.6
C-H-:0	Clay	Wentworth	0.1	%	25.3	6.6	8.8	11.8	16.5	8	3.5

All results expressed on a dry weight basis for soils and a wet weight (as received) basis for tissues.

analyzed at PSC edford

PSC ANALY SERVIC

		04-A038981 **10653**	04-A038982 **10651**	04-A038983 **CONTROL**	04-A038977 **10648**
	Date Generated	04-H073790	04-H073791	04-H073792	04-H074680
	3-Nov-2004	Soil	Soil	Soil	Soil
	Spreadsheet File Name				
	126214 Stantec Golder sed.X	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04
	Parameters				
C-H-:0	< 12.5 mm	100	100	100	100
C-H-:0	< 9.5 mm	100	100	100	100
C-H-:0	< 4.75 mm	100	100	100	100
C-H-:0	< PHI -1 (2 mm)	100	100	100	100
C-H-:0	< PHI 0 (1 mm)	97.5	97.8	95.7	99.7
C-H-:0	< PHI +1 (1/2 mm)	92.3	95.7	88.9	99.5
C-H-:0	< PHI +2 (1/4 mm)	87.3	95.1	87.8	99.4
C-H-:0	< PHI +3 (1/8 mm)	77.9	92.9	74.9	96.6
C-H-:0	< PHI +4 (1/16 mm)	73.9	91.2	71.6	95.2
C-H-:0	< PHI +5 (1/32 mm)	69.8	85.4	51.9	89.4
C-H-:0	< PHI +6 (1/64 mm)	60.2	20.2	29.1	79
C-H-:0	< PHI +7 (1/128 mm)	27.3	11.7	17.7	55.4
C-H-:0	< PHI +8 (1/256 mm)	15.4	9.7	14.5	37.9
C-H-:0	< PHI +9 (1/512 mm)	4.6	6	10	7
C-H-:0	Gravel	< 0.1	< 0.1	< 0.1	< 0.1
C-H-:0	Sand	26.1	8.8	28.4	4.8
C-H-:0	Silt	58.6	81.6	57.1	57.3
C-H-:0	Clay	15.4	9.7	14.5	37.9

All results expressed on a dry weight basis for soils and a wet weight (as received) basis for tissues.

analyzed at PSC edford

PSC ANALYTICAL SERVICES

PSC ID: 04-H073783

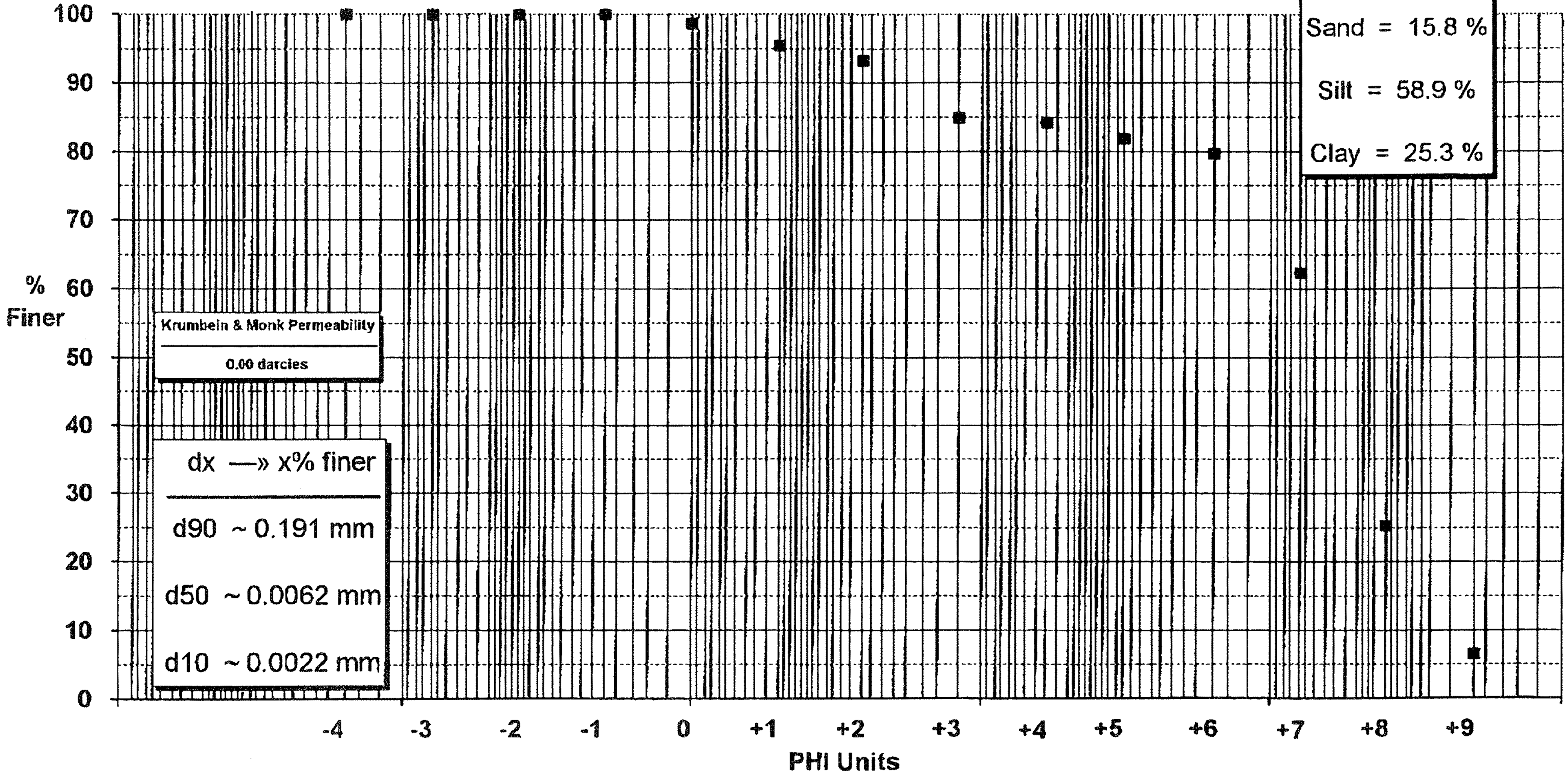
04-A038973

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
15.3 %	16.6 %

Wentworth
Gravel = 0.0 %
Sand = 15.8 %
Silt = 58.9 %
Clay = 25.3 %

Krumbein & Monk Permeability
0.00 darcies

dx —» x% finer
d90 ~ 0.191 mm
d50 ~ 0.0062 mm
d10 ~ 0.0022 mm



Ernest Hone
Approved

PSC ANALYTICAL SERVICES

Prepared For:
Lesley Novak

Date Generated
3-Nov-2004
Spreadsheet File Name
126214 Stantec Golder sed.XLS

				PSC London ID	04-A038973	04-A038974	04-A038975	04-A038976	04-A038978	04-A038979	04-A038980
				Client ID:	**10644**	**10645**	**10646**	**10647**	**10649**	**10650**	**10652**
				PSC Analytical ID:	04-H073783	04-H073784	04-H073785	04-H073786	04-H073787	04-H073788	04-H073789
				Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
				Duplicate of:							
				Date Sampled:	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04
				Client Description:							
	Parameters	Method	EQL	Units							
C-H-:0	< 12.5 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< 9.5 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< 4.75 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< PHI -1 (2 mm)	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< PHI 0 (1 mm)	Grav	0.1	%	98.7	98.9	98.6	99.6	98.5	96.9	98.4
C-H-:0	< PHI +1 (1/2 mm)	Grav.	0.1	%	95.5	97	95.6	98.5	95.9	83.8	95.5
C-H-:0	< PHI +2 (1/4 mm)	Grav.	0.1	%	93.2	96.5	92.7	97.4	94.1	65.8	94
C-H-:0	< PHI +3 (1/8 mm)	Grav.	0.1	%	84.9	89.2	85.4	94.1	91.3	44.6	83.2
C-H-:0	< PHI +4 (1/16 mm)	Grav.	0.1	%	84.2	83.8	78.1	92.2	90.3	42.6	77.1
C-H-:0	< PHI +5 (1/32 mm)	Grav.	0.1	%	81.8	74.8	70.1	89.2	87.2	39.6	69.9
C-H-:0	< PHI +6 (1/64 mm)	Grav.	0.1	%	79.6	62.2	58.3	78.3	57.6	32.5	51.2
C-H-:0	< PHI +7 (1/128 mm)	Grav.	0.1	%	62.3	14.1	17.6	23.2	27.2	14.6	5
C-H-:0	< PHI +8 (1/256 mm)	Grav.	0.1	%	25.3	6.6	8.8	11.8	16.5	8	3.5
C-H-:0	< PHI +9 (1/512 mm)	Grav.	0.1	%	6.6	2.3	4	3.7	6.2	2.8	2.2
C-H-:0	Gravel	Wentworth	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
C-H-:0	Sand	Wentworth	0.1	%	15.8	16.2	21.9	7.8	9.7	57.4	22.9
C-H-:0	Silt	Wentworth	0.1	%	58.9	77.2	69.3	80.4	73.8	34.6	73.6
C-H-:0	Clay	Wentworth	0.1	%	25.3	6.6	8.8	11.8	16.5	8	3.5

All results expressed on a dry weight basis for soils and a wet weight (as received) basis for tissues.

analyzed at PSC edford

PSC ANALYTICAL SERVICES

Prepared For:
Lesley Novak

Date Generated
3-Nov-2004
Spreadsheet File Name
126214 Stantec Golder sed.XLS

	Parameters	Method	EQL	Units							
				PSC London ID	04-A038973	04-A038974	04-A038975	04-A038976	04-A038978	04-A038979	04-A038980
				Client ID:	**10644**	**10645**	**10646**	**10647**	**10649**	**10650**	**10652**
				PSC Analytical ID:	04-H073783	04-H073784	04-H073785	04-H073786	04-H073787	04-H073788	04-H073789
				Matrix:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
				Duplicate of:							
				Date Sampled:	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04
				Client Description:							
C-H-:0	< 12.5 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< 9.5 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< 4.75 mm	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< PHI -1 (2 mm)	Grav.	0.1	%	100	100	100	100	100	100	100
C-H-:0	< PHI 0 (1 mm)	Grav	0.1	%	98.7	98.9	98.6	99.6	98.5	96.9	98.4
C-H-:0	< PHI +1 (1/2 mm)	Grav.	0.1	%	95.5	97	95.6	98.5	95.9	83.8	95.5
C-H-:0	< PHI +2 (1/4 mm)	Grav.	0.1	%	93.2	96.5	92.7	97.4	94.1	65.8	94
C-H-:0	< PHI +3 (1/8 mm)	Grav.	0.1	%	84.9	89.2	85.4	94.1	91.3	44.6	83.2
C-H-:0	< PHI +4 (1/16 mm)	Grav.	0.1	%	84.2	83.8	78.1	92.2	90.3	42.6	77.1
C-H-:0	< PHI +5 (1/32 mm)	Grav.	0.1	%	81.8	74.8	70.1	89.2	87.2	39.6	69.9
C-H-:0	< PHI +6 (1/64 mm)	Grav.	0.1	%	79.6	62.2	58.3	78.3	57.6	32.5	51.2
C-H-:0	< PHI +7 (1/128 mm)	Grav.	0.1	%	62.3	14.1	17.6	23.2	27.2	14.6	5
C-H-:0	< PHI +8 (1/256 mm)	Grav.	0.1	%	25.3	6.6	8.8	11.8	16.5	8	3.5
C-H-:0	< PHI +9 (1/512 mm)	Grav.	0.1	%	6.6	2.3	4	3.7	6.2	2.8	2.2
C-H-:0	Gravel	Wentworth	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
C-H-:0	Sand	Wentworth	0.1	%	15.8	16.2	21.9	7.8	9.7	57.4	22.9
C-H-:0	Silt	Wentworth	0.1	%	58.9	77.2	69.3	80.4	73.8	34.6	73.6
C-H-:0	Clay	Wentworth	0.1	%	25.3	6.6	8.8	11.8	16.5	8	3.5

All results expressed on a dry weight basis for soils and a wet weight (as received) basis for tissues.

analyzed at PSC edford

PSC ANALY SERVIC

		04-A038981 **10653**	04-A038982 **10651**	04-A038983 **CONTROL**	04-A038977 **10648**
	Date Generated	04-H073790	04-H073791	04-H073792	04-H074680
	3-Nov-2004	Soil	Soil	Soil	Soil
	Spreadsheet File Name				
	126214 Stantec Golder sed.X	14-Oct-04	14-Oct-04	14-Oct-04	14-Oct-04
	Parameters				
C-H-:0	< 12.5 mm	100	100	100	100
C-H-:0	< 9.5 mm	100	100	100	100
C-H-:0	< 4.75 mm	100	100	100	100
C-H-:0	< PHI -1 (2 mm)	100	100	100	100
C-H-:0	< PHI 0 (1 mm)	97.5	97.8	95.7	99.7
C-H-:0	< PHI +1 (1/2 mm)	92.3	95.7	88.9	99.5
C-H-:0	< PHI +2 (1/4 mm)	87.3	95.1	87.8	99.4
C-H-:0	< PHI +3 (1/8 mm)	77.9	92.9	74.9	96.6
C-H-:0	< PHI +4 (1/16 mm)	73.9	91.2	71.6	95.2
C-H-:0	< PHI +5 (1/32 mm)	69.8	85.4	51.9	89.4
C-H-:0	< PHI +6 (1/64 mm)	60.2	20.2	29.1	79
C-H-:0	< PHI +7 (1/128 mm)	27.3	11.7	17.7	55.4
C-H-:0	< PHI +8 (1/256 mm)	15.4	9.7	14.5	37.9
C-H-:0	< PHI +9 (1/512 mm)	4.6	6	10	7
C-H-:0	Gravel	< 0.1	< 0.1	< 0.1	< 0.1
C-H-:0	Sand	26.1	8.8	28.4	4.8
C-H-:0	Silt	58.6	81.6	57.1	57.3
C-H-:0	Clay	15.4	9.7	14.5	37.9

All results expressed on a dry weight basis for soils and a wet weight (as received) basis for tissues.

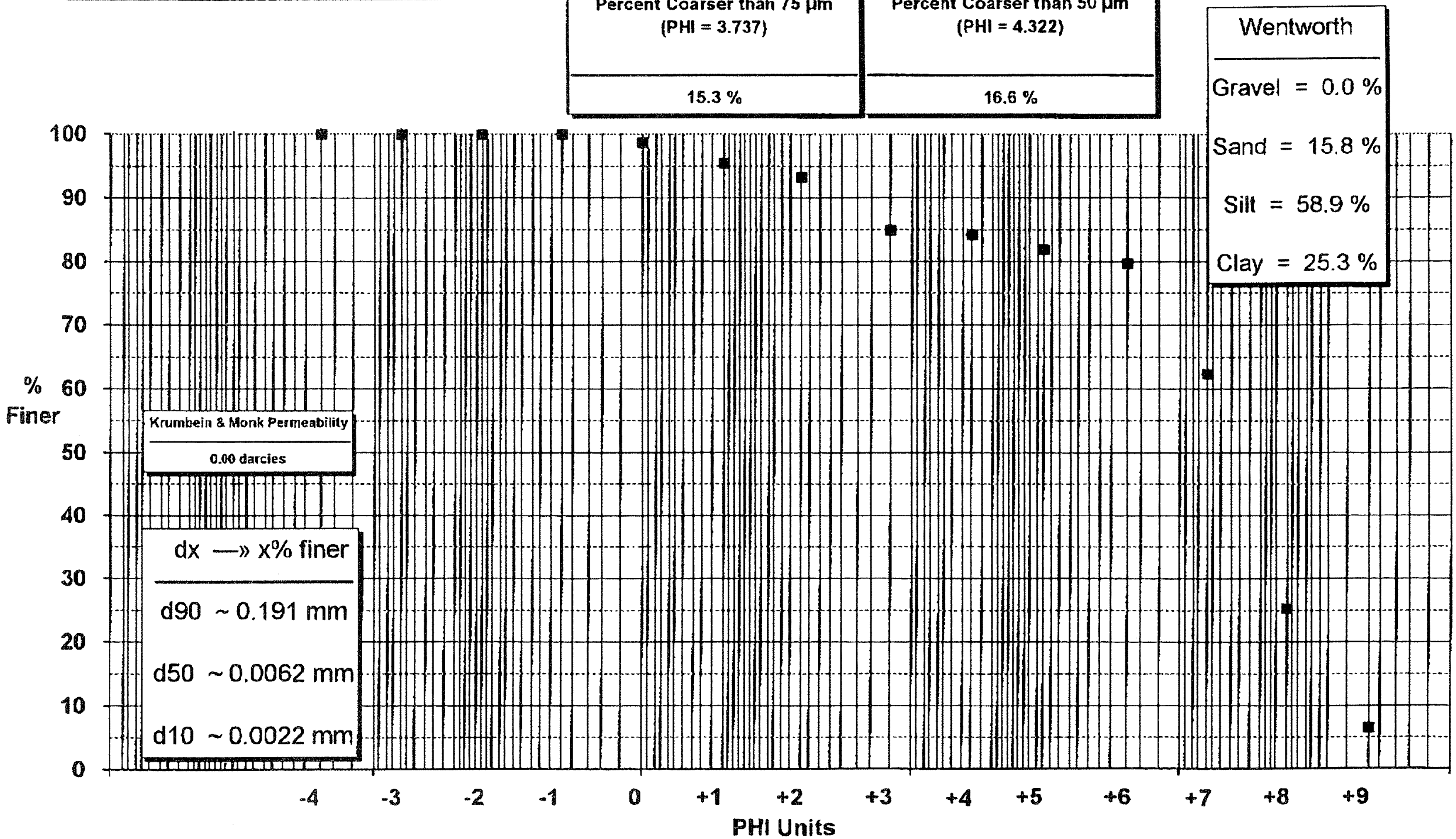
analyzed at PSC edford

PSC ANALYTICAL SERVICES

PSC ID: 04-H073783

04-A038973

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
15.3 %	16.6 %



Ernest Howe
Approved

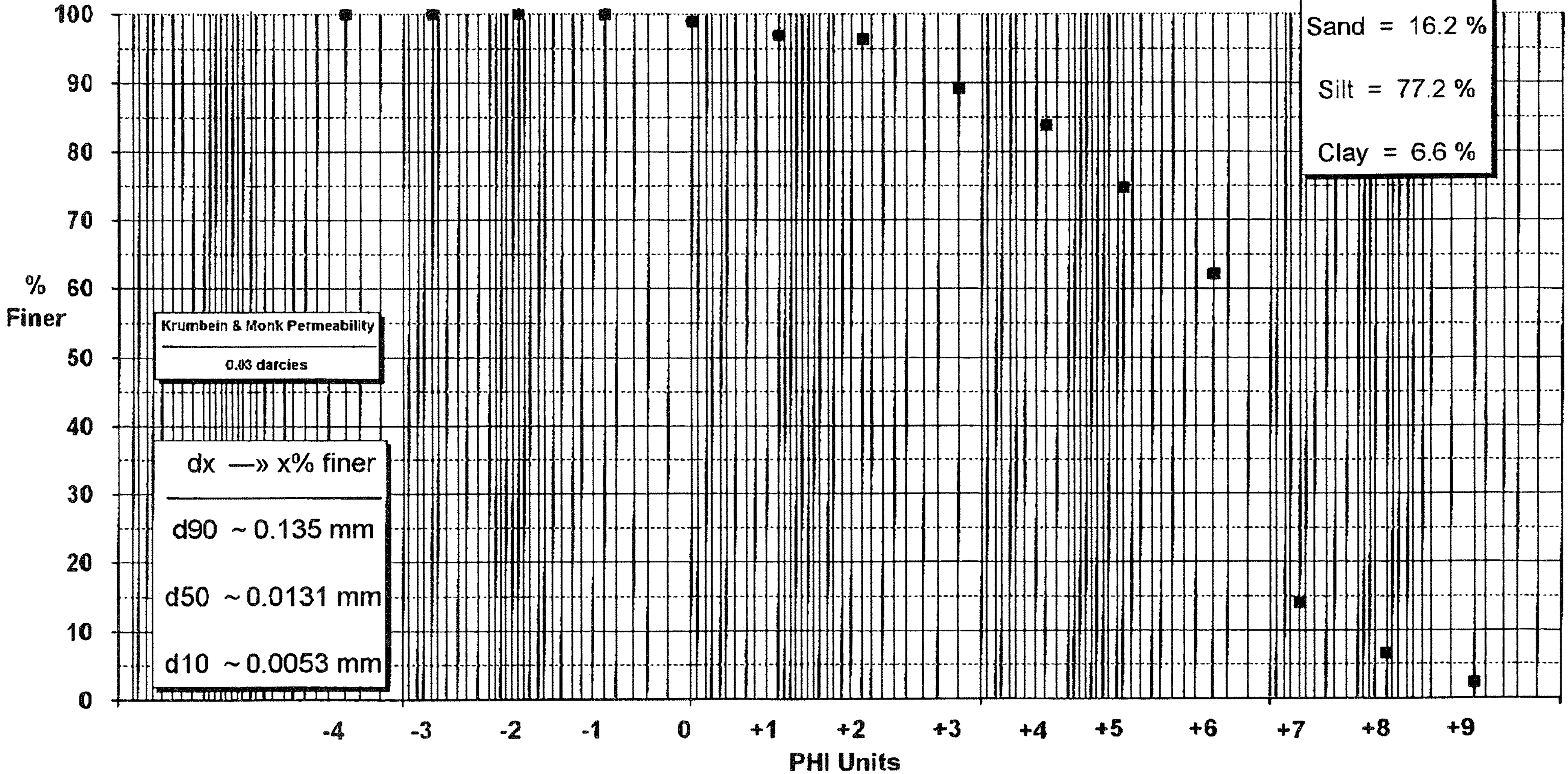
PSC ID: 04-H073784

PSC ANALYTICAL SERVICES

04-A038974

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
12.6 %	19.1 %

Wentworth	
Gravel	= 0.0 %
Sand	= 16.2 %
Silt	= 77.2 %
Clay	= 6.6 %



Krumbein & Monk Permeability
0.03 darcies

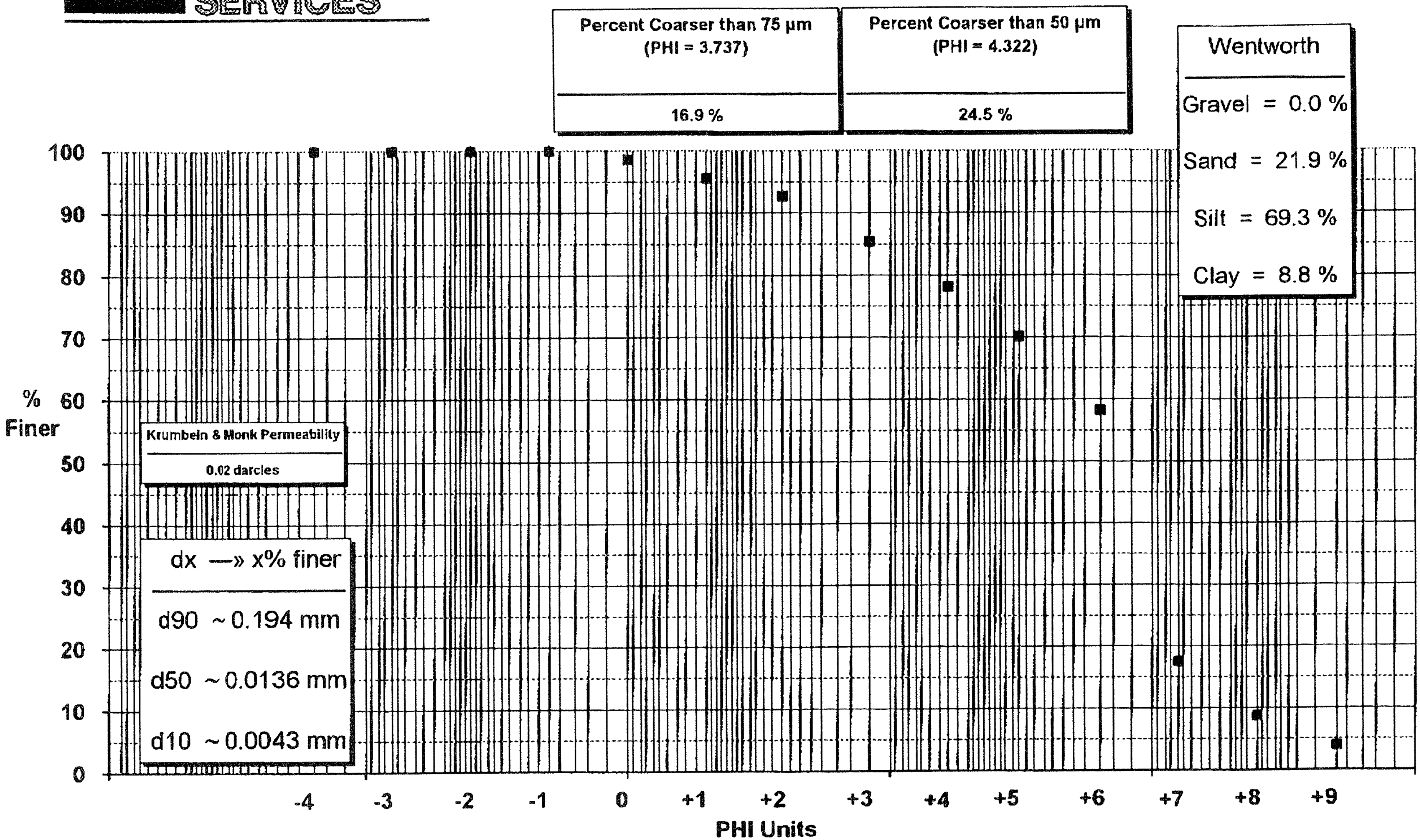
dx —» x% finer
d90 ~ 0.135 mm
d50 ~ 0.0131 mm
d10 ~ 0.0053 mm

Approved

PSC ANALYTICAL SERVICES

PSC ID: 04-H073785

04-A038975

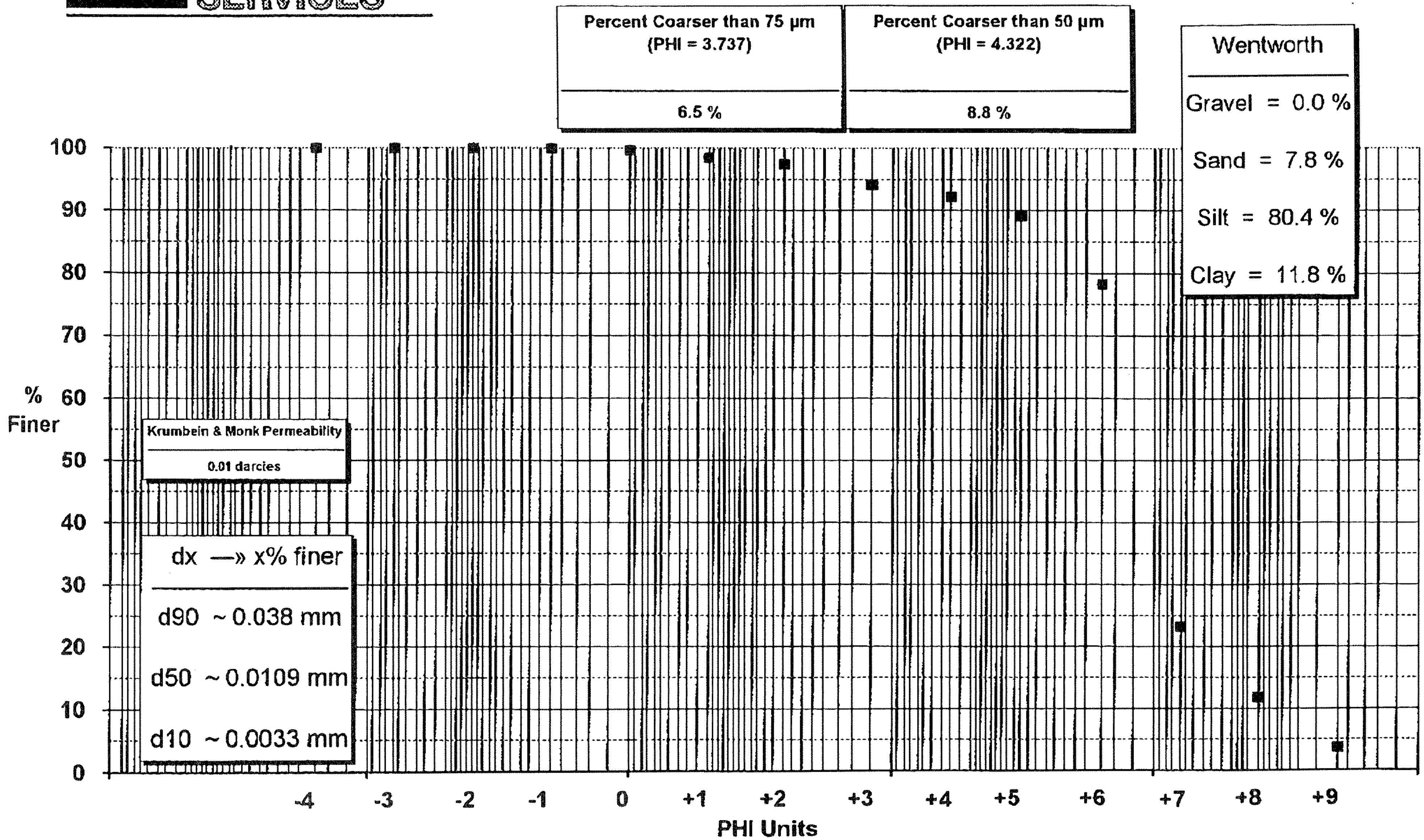


Approved

PSC ANALYTICAL SERVICES

PSC ID: 04-H073786

04-A038976



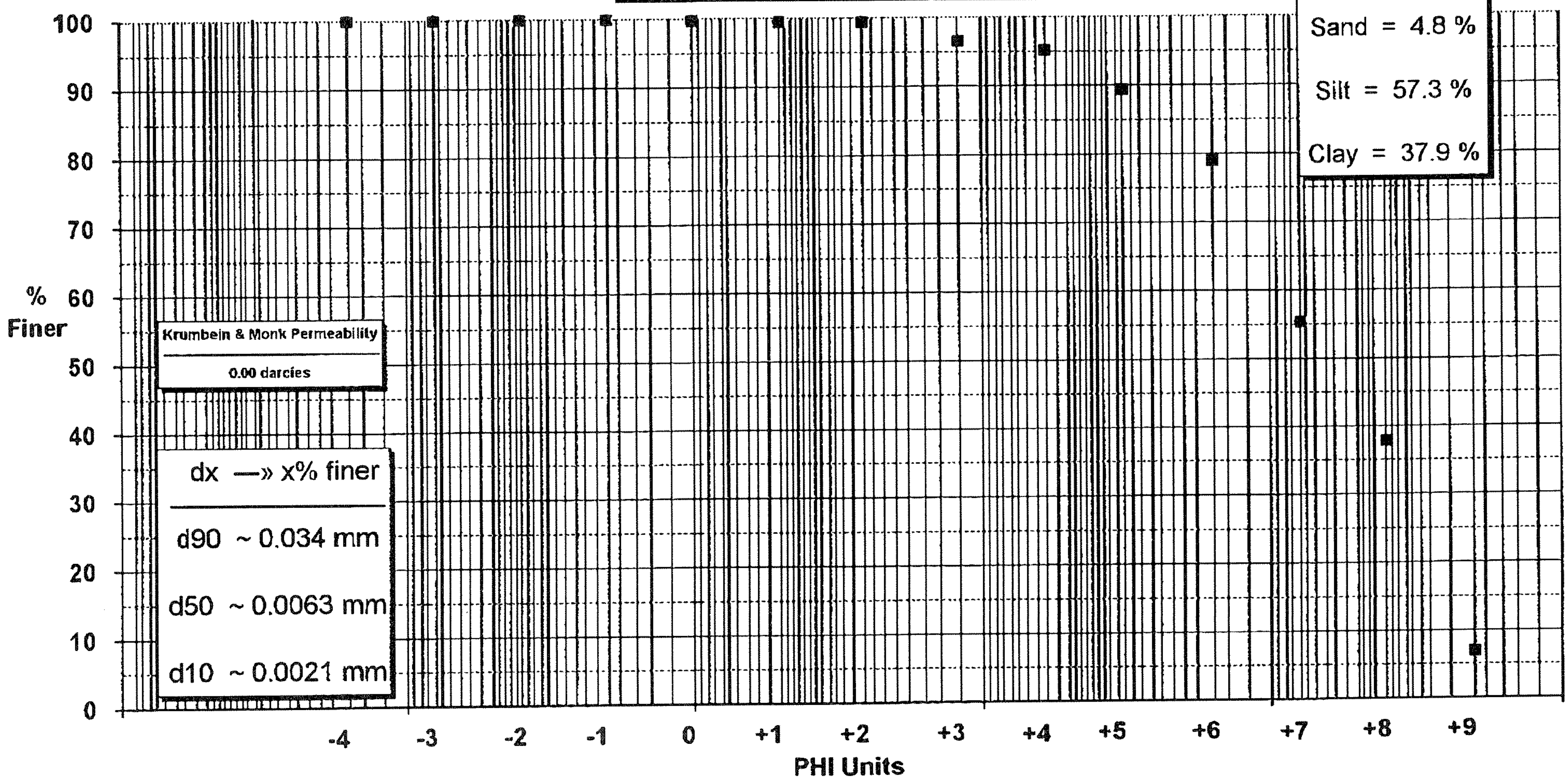
Approved

PSC ID: 04-H074680

PSC ANALYTICAL SERVICES

04-A038977

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
3.9 %	6.7 %



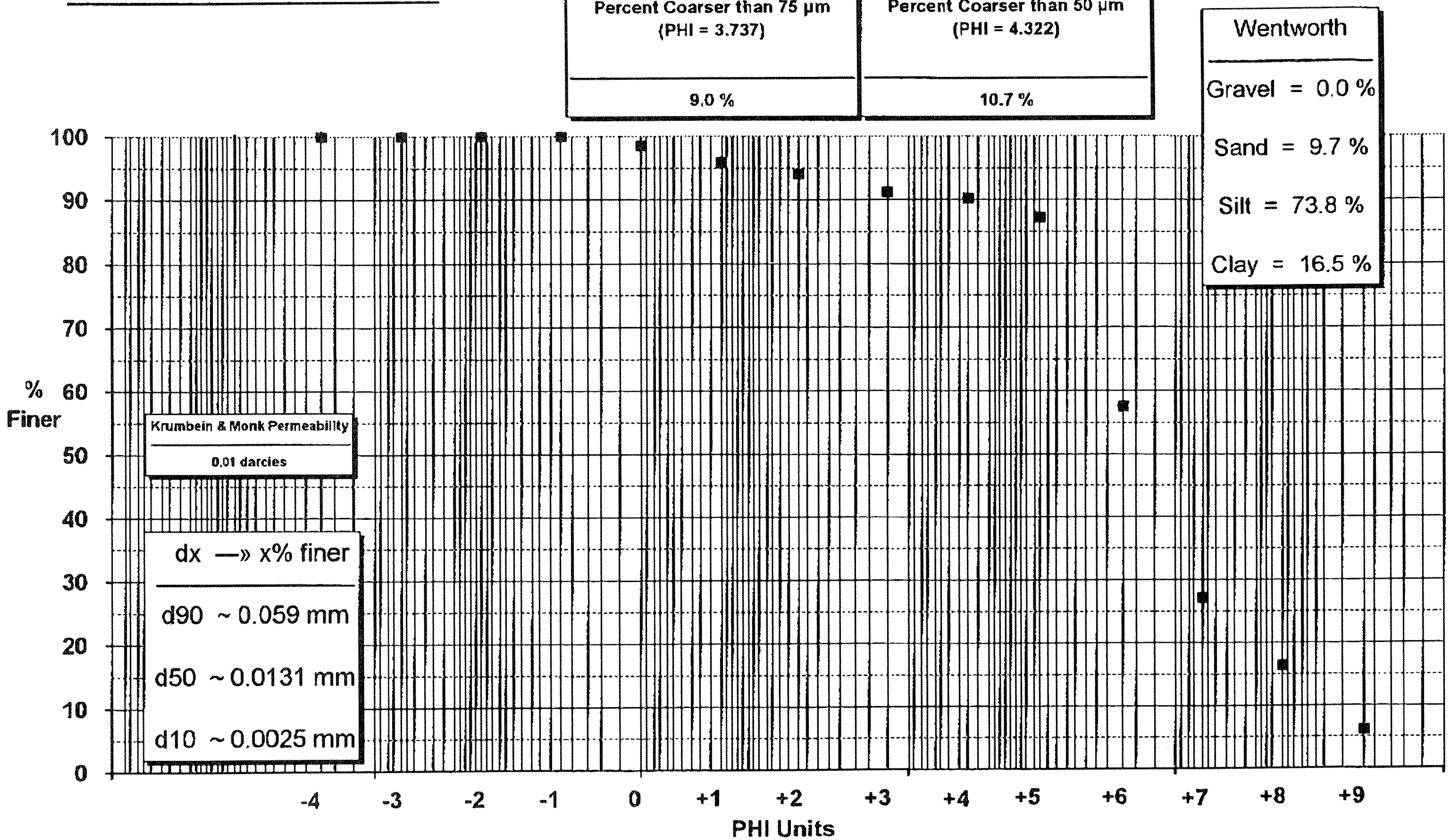
Ernest Hare
Approved

PSC ANALYTICAL SERVICES

PSC ID: 04-H073787

04-A038978

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
9.0 %	10.7 %

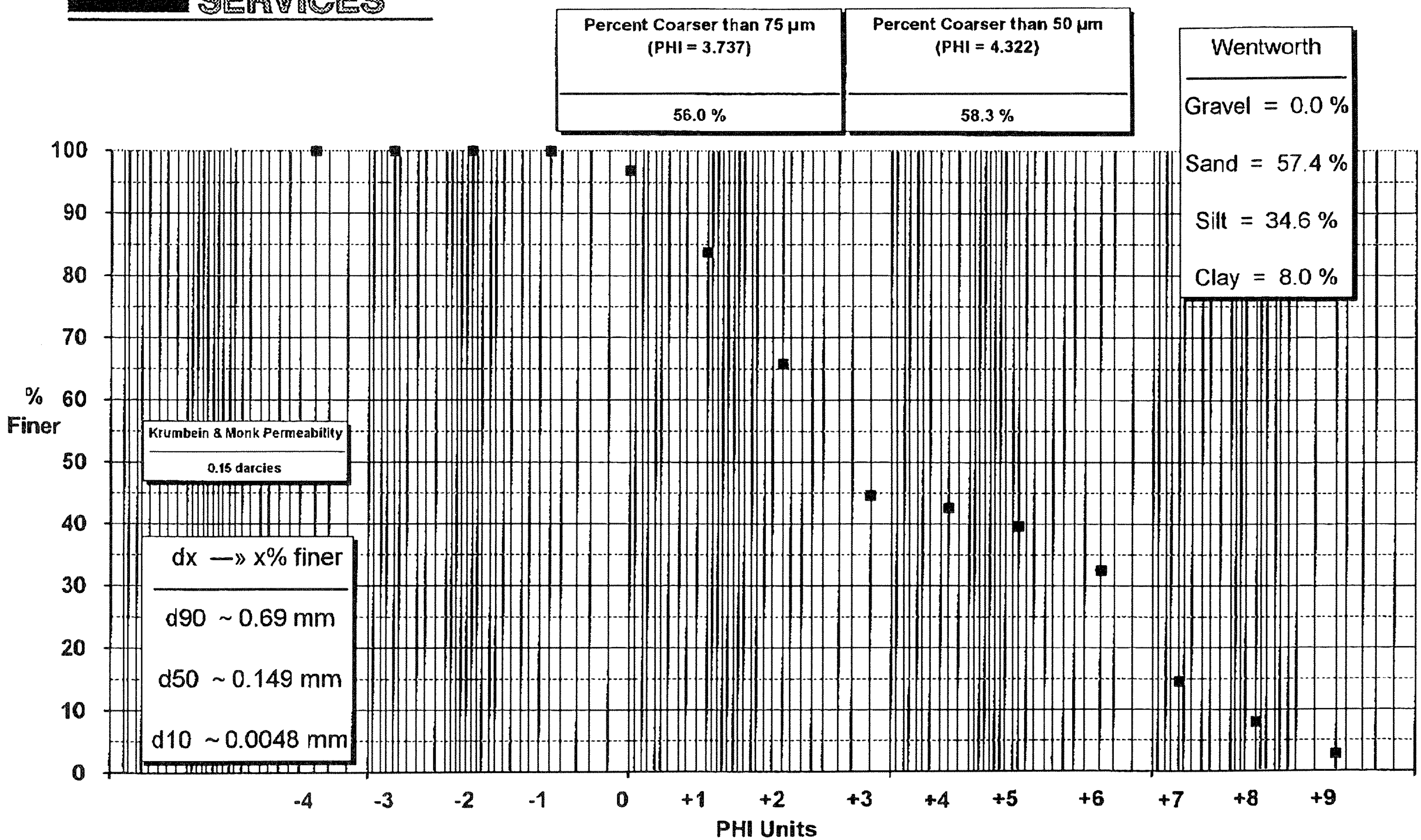


Approved

PSC ANALYTICAL SERVICES

PSC ID: 04-H073788

04-A038979



Approved

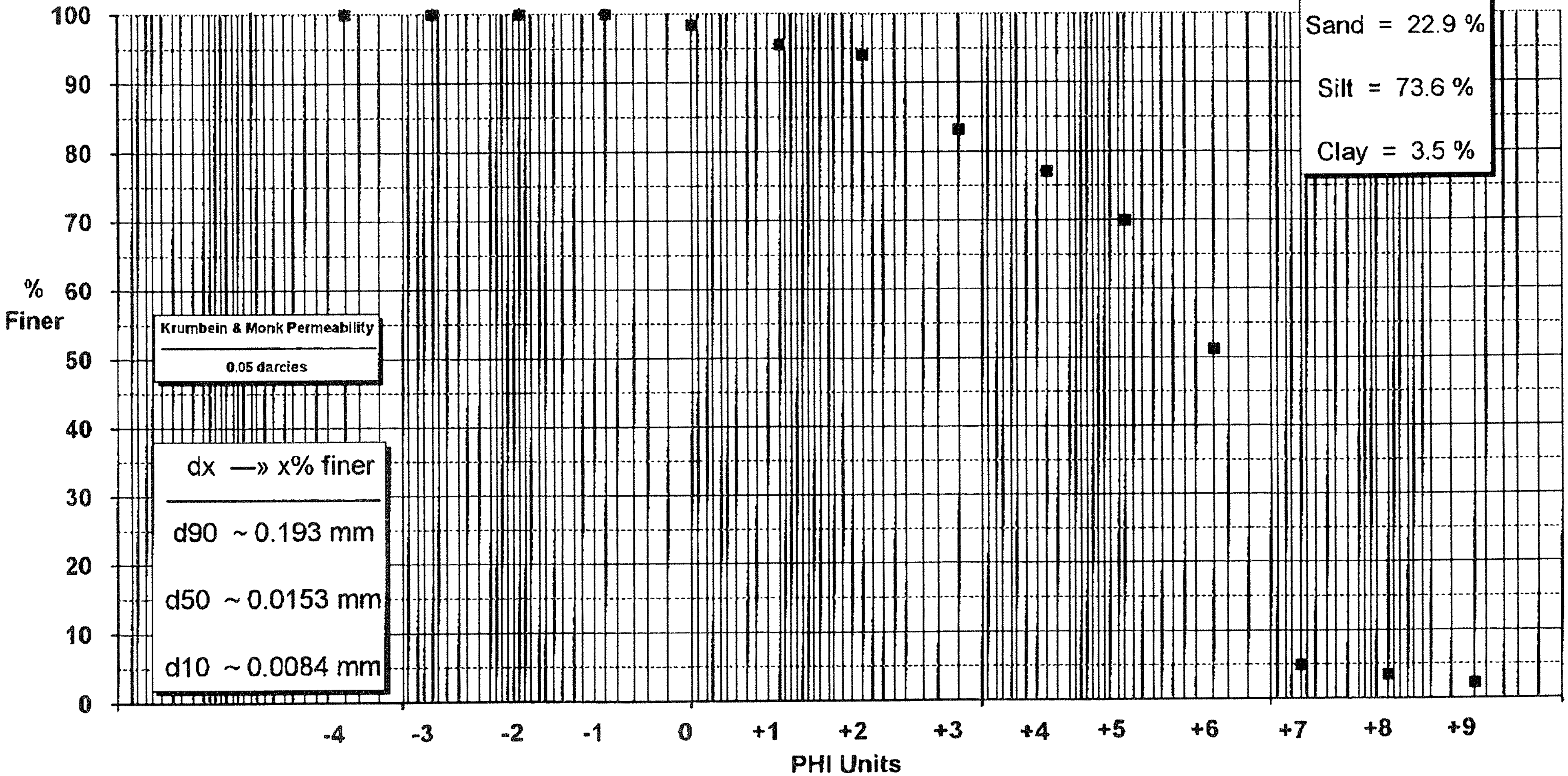
PSC ID: 04-H073789

PSC ANALYTICAL SERVICES

04-A038980

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
18.8 %	25.2 %

Wentworth
Gravel = 0.0 %
Sand = 22.9 %
Silt = 73.6 %
Clay = 3.5 %



Ernest Hare
Approved

PSC ID: 04-H073790

PSC ANALYTICAL SERVICES

04-A038981

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
23.4 %	27.4 %

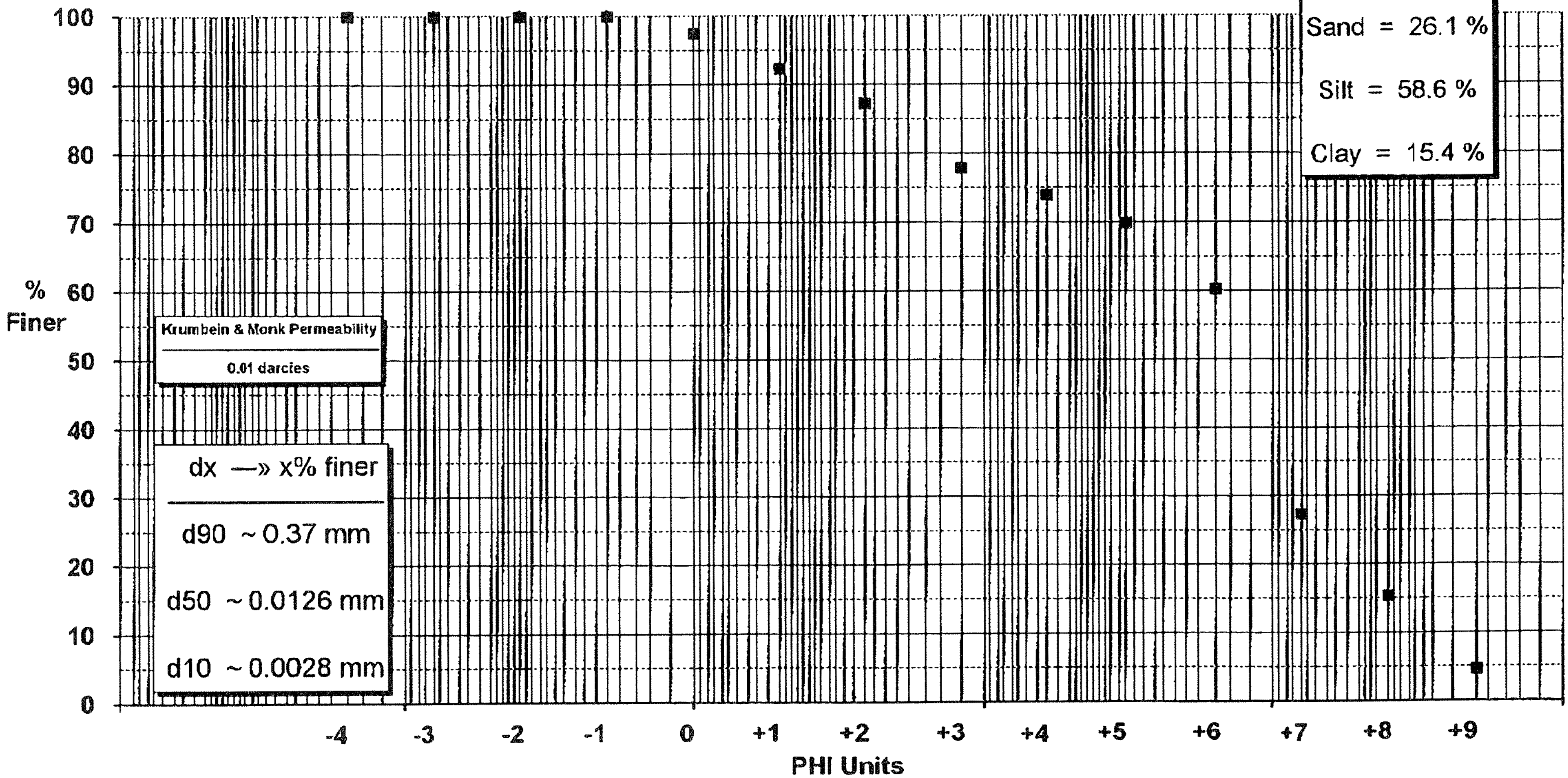
Wentworth

Gravel = 0.0 %

Sand = 26.1 %

Silt = 58.6 %

Clay = 15.4 %



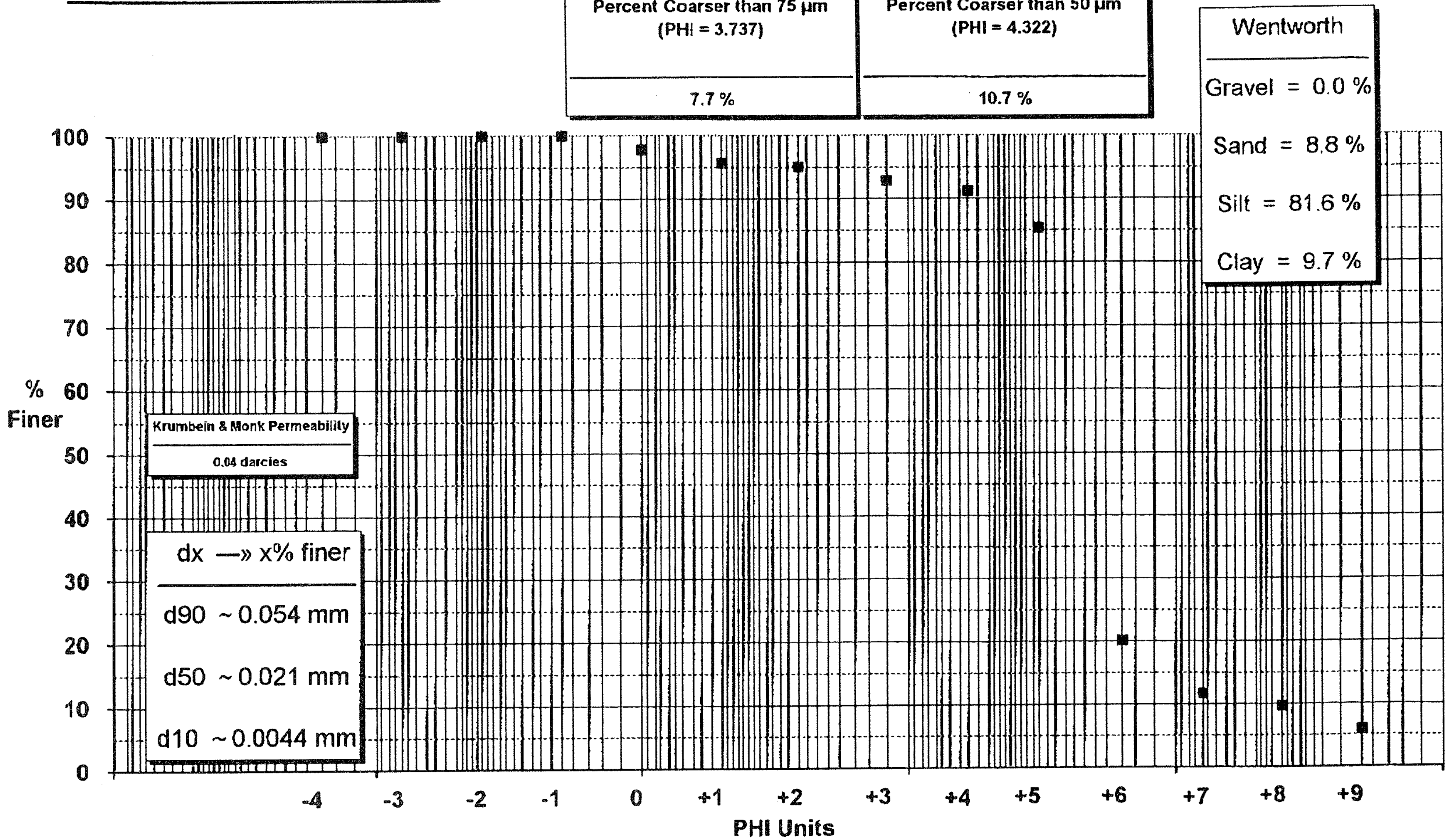
Approved

PSC ANALYTICAL SERVICES

PSC ID: 04-H073791

04-A038982

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
7.7 %	10.7 %



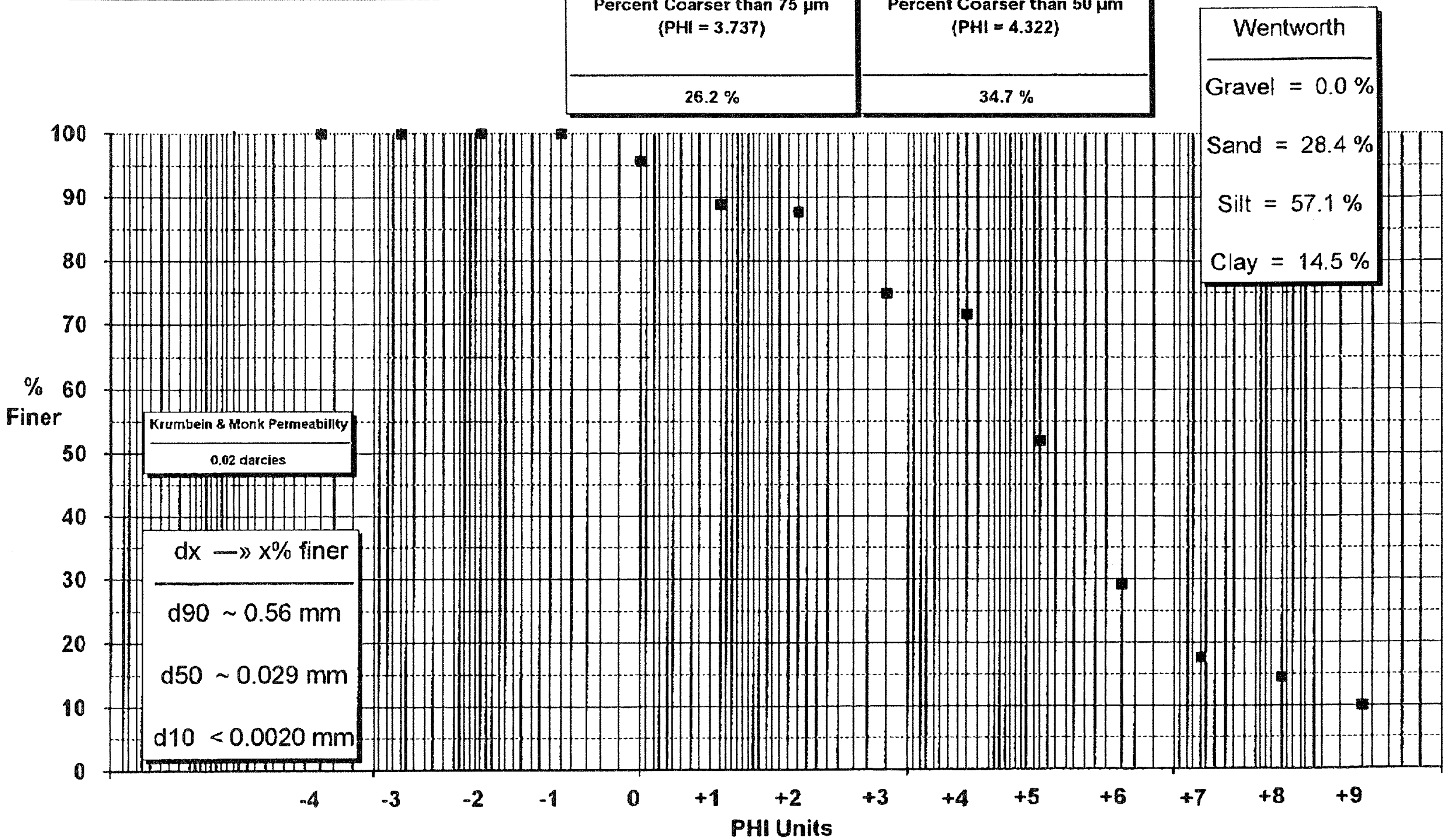
Ernest Hare
Approved

PSC ANALYTICAL SERVICES

PSC ID: 04-H073792

04-A038983

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
26.2 %	34.7 %



Ernest Hare
Approved

CERTIFICATE OF ANALYSIS - SECTION 3

METHODOLOGY SUMMARY

Client:(4017) Stantec Consulting, Guelph

Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK
Client Reference: Golder Sed.
Work Order: 126214

Purchase Order:162704011-200
Date Received: 15-Oct-2004
Sample Type: Solids

Test	Methodology, Reference	Instrument	Analyst
Metals by ICP	Analysis by ICP EPA SW846 6010	TJA Enviro I ICAP 61E	A. Lees
Mercury Hg	Semi-Automated Cold Vapour AAS EPA SW846 7471A	CETAC Mercury Analyzer	P. Clark
Carbon,Total Organic as C			P_MSGA
%Solids, Total	Oven Dried at 104C, Gravimetric Analysis SM 2540G	Balance Sartorius Univs 6	K.Pozarlik
Soil Prep-Dry/Grind/Sieve			K.Pozarlik
Metal Digestion, Solid	Block digestion or equivalent Aqua Regia - London Method	Balance Sartorius Lab 4	L. Luc
Digestion for Hg in Soil	Manual Hot Water Bath digestion EPA SW846 7471A	CETAC Mercury Analyzer	P. Clark
PCB Preparation for Soils	Acetone-Hexane Extraction & Cleanup Philip London Method	Balance Scientech SP404D	A. Hummel
Total PCB (Solid)	GC/ECD Modified Webb McCall Quantitation EPA SW846 8080 Modified	HP 5890GC/ECD #2	S. Mosey

Test procedures are based on the above references.
EXPLANATION OF CODES:
EPA - US Environmental Protection Agency
SM - Standard Methods for the Analysis of Waters and Wastewater
MOE - Ontario Ministry of the Environment
P_ - Philip Analytical Services Location

PSC Analytical Services

CERTIFICATE OF ANALYSIS - SECTION 4

CERTIFICATE OF QUALITY CONTROL

Client: Stantec Consulting
Contact: MS. LESLEY NOVAK

Date Reported: 23-Nov-2004
Work Order: 126214

Client Reference: Golder Sed.

Matrix: Solids

			Process Blank		Process % Recovery			Matrix Spike					Duplicate			
Parameter	EQL	Units	Result	Upper Limit	Result	Lower Limit	Upper Limit	Spike ID	Result	Target	Lower Limit	Upper Limit	Duplicate ID	Original Result	Duplicate Result	QC Flag
Carbon,Total Organic as C	0.01	%	< 0.05	0.02	105.69	85.0	115.0						04-A038973	2.99	3.01	
Aluminum Al	5	mg/kg	2.	5	98.60	60.0	140.0						04-A038973	24900	24400	
Barium Ba	4	mg/kg	0.	4	100.00	60.0	140.0	04-A038973	973.	1010	606.	1410	04-A038973	157.	150.	
Beryllium Be	0.5	mg/kg	0.0	0.5	86.67	65.0	135.0	04-A038973	247.	252.	164.	340.	04-A038973	1.0	< 1	
Boron B	2	mg/kg	0.	2				04-A038973	491.	505.	354.	656.	04-A038973	8.	8.	
Cadmium Cd	0.5	mg/kg	-0.1	0.5	114.41	75.0	125.0	04-A038973	48.5	49.9	32.4	62.4	04-A038973	1.1	1.5	
Calcium Ca	10	mg/kg	6.	10	96.73	65.0	135.0	04-A038973	8900	11300	7340	15300	04-A038973	32200	32000	
Chromium Cr	2	mg/kg	-1.	2	83.95	75.0	125.0	04-A038973	487.	497.	323.	621.	04-A038973	38.	42.	
Cobalt Co	2	mg/kg	0.	2	106.67	75.0	125.0	04-A038973	485.	501.	326.	626.	04-A038973	13.	12.	
Copper Cu	2	mg/kg	0.	2	119.36	75.0	130.0	04-A038973	241.	253.	177.	329.	04-A038973	59.	61.	
Potassium K	20	mg/kg	-5.	20	114.74	70.0	130.0	04-A038973	5830	5050	3540	6560	04-A038973	3420	3270	
Iron Fe	4	mg/kg	1.	4	99.55	60.0	140.0						04-A038973	34000	33700	
Iron Fe	4	mg/kg	-1.	4	93.64	60.0	140.0									
Lead Pb	5	mg/kg	0.	5	104.44	65.0	140.0	04-A038973	733.	749.	449.	1050	04-A038973	35.	29.	
Magnesium Mg	2	mg/kg	1.	2	98.13	75.0	130.0	04-A038973	11000	10500	6820	13600	04-A038973	12400	12200	
Manganese Mn	2	mg/kg	0.	2	97.67	75.0	140.0	04-A038973	464.	503.	302.	704.	04-A038973	527.	521.	
Mercury Hg	0.01	mg/kg	0.00	0.01	92.60	70.0	120.0	04-A038974	0.45	0.50	0.35	0.62	04-A038974	0.17	0.20	
Molybdenum Mo	2	mg/kg	0.	2	112.96	75.0	125.0	04-A038973	463.	500.	350.	625.	04-A038973	< 2	2.	
Nickel Ni	5	mg/kg	-1.	5	100.00	75.0	130.0	04-A038973	1220	1260	819.	1640	04-A038973	51.	53.	

QC Flag(s) pertain to B-Process Blank, R-Process % Recovery, S-Matrix Spike and/or D-Duplicate NA Denotes Not Applicable
When two values exist for the same Spike ID and parameter it indicates the performance of a Matrix Spike (MS) and Matrix Spike Duplicate (MSD).
The acceptance criteria for duplicate results: 25 Percent Relative Difference OR Absolute Difference < 5 times the EQL
except for VOC and PCB: 50 Percent Relative Difference OR Absolute Difference < 5 times the EQL.
Refer to the cover page for a list of report contents.

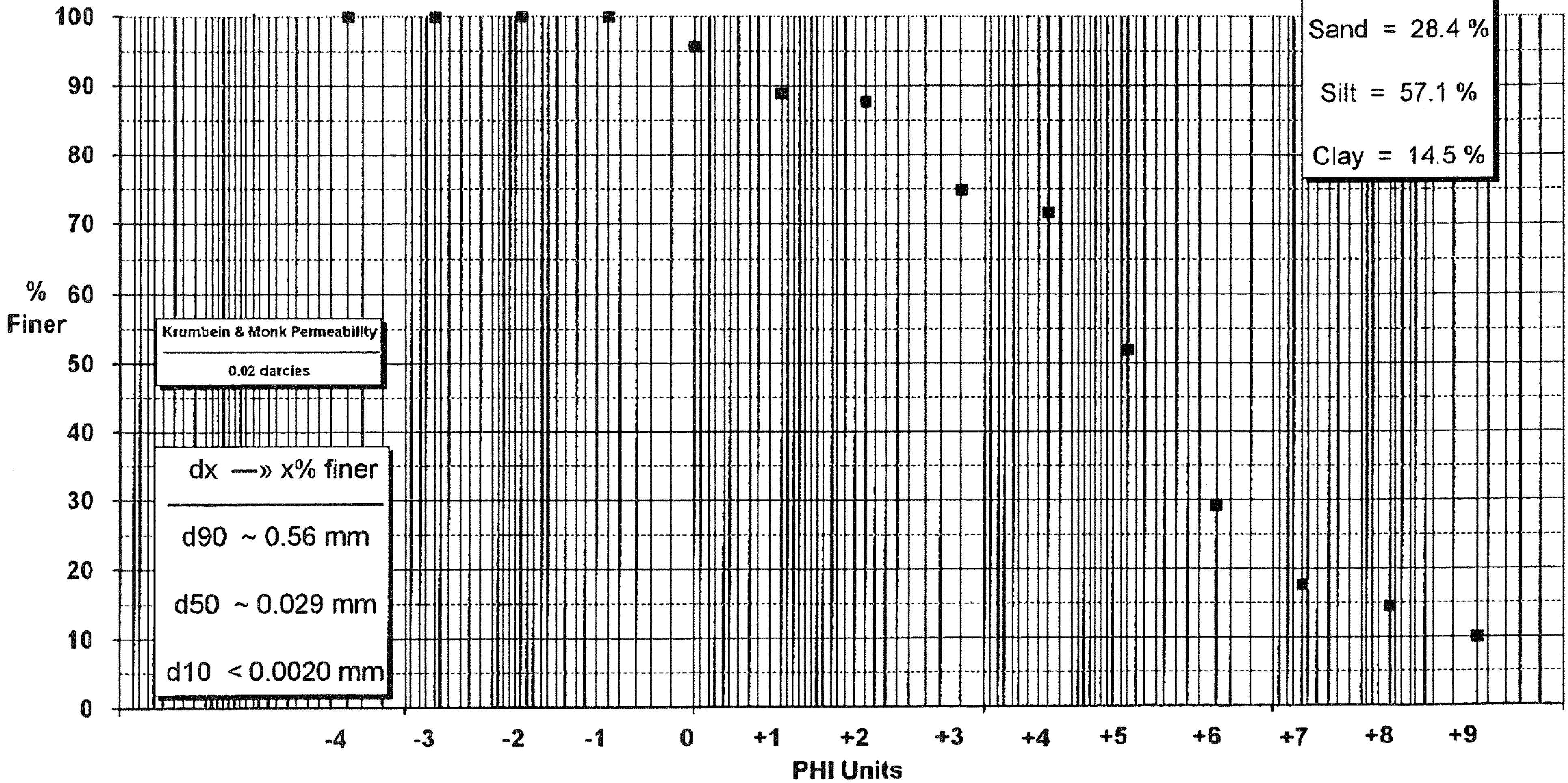
PSC Analytical Services
921 Leathorne Street, London, Ontario, Canada N5Z 3M7 (519) 686-7558 1-800-268-7396 FAX (519) 686-6374

PSC ID: 04-H073792

PSC ANALYTICAL SERVICES

04-A038983

Percent Coarser than 75 µm (PHI = 3.737)	Percent Coarser than 50 µm (PHI = 4.322)
26.2 %	34.7 %



Ernest Hare
Approved

PSC Analytical Services

CERTIFICATE OF ANALYSIS - SECTION 4

CERTIFICATE OF QUALITY CONTROL

Client: Stantec Consulting
Contact: MS. LESLEY NOVAK

Date Reported: 23-Nov-2004
Work Order: 126214

Client Reference: Golder Sed.

Matrix: Solids

			Process Blank		Process % Recovery			Matrix Spike					Duplicate			
Parameter	EQL	Units	Result	Upper Limit	Result	Lower Limit	Upper Limit	Spike ID	Result	Target	Lower Limit	Upper Limit	Duplicate ID	Original Result	Duplicate Result	QC Flag
Carbon, Total Organic as C	0.01	%	< 0.05	0.02	105.69	85.0	115.0						04-A038973	2.99	3.01	
Aluminum Al	5	mg/kg	2.	5	98.60	60.0	140.0						04-A038973	24900	24400	
Barium Ba	4	mg/kg	0.	4	100.00	60.0	140.0	04-A038973	973.	1010	606.	1410	04-A038973	157.	150.	
Beryllium Be	0.5	mg/kg	0.0	0.5	86.67	65.0	135.0	04-A038973	247.	252.	164.	340.	04-A038973	1.0	< 1	
Boron B	2	mg/kg	0.	2				04-A038973	491.	505.	354.	656.	04-A038973	8.	8.	
Cadmium Cd	0.5	mg/kg	-0.1	0.5	114.41	75.0	125.0	04-A038973	48.5	49.9	32.4	62.4	04-A038973	1.1	1.5	
Calcium Ca	10	mg/kg	6.	10	96.73	65.0	135.0	04-A038973	8900	11300	7340	15300	04-A038973	32200	32000	
Chromium Cr	2	mg/kg	-1.	2	83.95	75.0	125.0	04-A038973	487.	497.	323.	621.	04-A038973	38.	42.	
Cobalt Co	2	mg/kg	0.	2	106.67	75.0	125.0	04-A038973	485.	501.	326.	626.	04-A038973	13.	12.	
Copper Cu	2	mg/kg	0.	2	119.36	75.0	130.0	04-A038973	241.	253.	177.	329.	04-A038973	59.	61.	
Potassium K	20	mg/kg	-5.	20	114.74	70.0	130.0	04-A038973	5830	5050	3540	6560	04-A038973	3420	3270	
Iron Fe	4	mg/kg	1.	4	99.55	60.0	140.0						04-A038973	34000	33700	
Iron Fe	4	mg/kg	-1.	4	93.64	60.0	140.0									
Lead Pb	5	mg/kg	0.	5	104.44	65.0	140.0	04-A038973	733.	749.	449.	1050	04-A038973	35.	29.	
Magnesium Mg	2	mg/kg	1.	2	98.13	75.0	130.0	04-A038973	11000	10500	6820	13600	04-A038973	12400	12200	
Manganese Mn	2	mg/kg	0.	2	97.67	75.0	140.0	04-A038973	464.	503.	302.	704.	04-A038973	527.	521.	
Mercury Hg	0.01	mg/kg	0.00	0.01	92.60	70.0	120.0	04-A038974	0.45	0.50	0.35	0.62	04-A038974	0.17	0.20	
Molybdenum Mo	2	mg/kg	0.	2	112.96	75.0	125.0	04-A038973	463.	500.	350.	625.	04-A038973	< 2	2.	
Nickel Ni	5	mg/kg	-1.	5	100.00	75.0	130.0	04-A038973	1220	1260	819.	1640	04-A038973	51.	53.	

QC Flag(s) pertain to B-Process Blank, R-Process % Recovery, S-Matrix Spike and/or D-Duplicate

NA Denotes Not Applicable

When two values exist for the same Spike ID and parameter it indicates the performance of a Matrix Spike (MS) and Matrix Spike Duplicate (MSD).

The acceptance criteria for duplicate results: 25 Percent Relative Difference OR Absolute Difference < 5 times the EQL
except for VOC and PCB: 50 Percent Relative Difference OR Absolute Difference < 5 times the EQL.

Refer to the cover page for a list of report contents.

PSC Analytical Services
921 Leathorne Street, London, Ontario, Canada N5Z 3M7 (519) 686-7558 1-800-268-7396 FAX (519) 686-6374

PSC Analytical Services

CERTIFICATE OF ANALYSIS - SECTION 4

CERTIFICATE OF QUALITY CONTROL

Client: Stantec Consulting
Contact: MS. LESLEY NOVAK

Date Reported: 23-Nov-2004
Work Order: 126214

Matrix: Solids

Client Reference: Golder Sed.

			Process Blank		Process % Recovery			Matrix Spike					Duplicate			
Parameter	EQL	Units	Result	Upper Limit	Result	Lower Limit	Upper Limit	Spike ID	Result	Target	Lower Limit	Upper Limit	Duplicate ID	Original Result	Duplicate Result	QC Flag
Phosphorus P	5	mg/kg	1.	5	99.09	75.0	130.0	04-A038973	470.	502.	301.	653.	04-A038973	1040	1020	
Silver Ag	1	mg/kg	1.	1	112.00	65.0	140.0	04-A038973	244.	249.	124.	349.	04-A038973	< 1	< 1	
Strontium Sr	2	mg/kg	0.	2	116.22	70.0	130.0	04-A038973	498.	507.	355.	659.	04-A038973	78.	75.	
Thallium Tl	1	mg/kg	0.	2	110.71	70.0	130.0	04-A038973	1010	1000	700.	1300	04-A038973	< 1	< 1	
Titanium Ti	2	mg/kg	0.	2	127.42	65.0	140.0	04-A038973	363.	500.	300.	700.	04-A038973	205.	205.	
Vanadium V	2	mg/kg	0.	2	109.52	75.0	140.0	04-A038973	243.	250.	188.	350.	04-A038973	41.	43.	
Zinc Zn	1	mg/kg	0.	1	106.62	75.0	130.0	04-A038973	236.	250.	162.	350.	04-A038973	196.	196.	
Decachlorobiphenyl	NA	%			111.00	75.0	125.0						04-B038852	118.	122.	
Total PCB (Solid)	0.005	mg/kg	< 0.005	0.005	100.00	75.0	125.0	04-B038852	1.5	1.1	0.72	1.5	04-B038852	< 0.05	< 0.05	S

QC Flag(s) pertain to B-Process Blank, R-Process % Recovery, S-Matrix Spike and/or D-Duplicate   NA Denotes Not Applicable
When two values exist for the same Spike ID and parameter it indicates the performance of a Matrix Spike (MS) and Matrix Spike Duplicate (MSD).
The acceptance criteria for duplicate results: 25 Percent Relative Difference OR Absolute Difference < 5 times the EQL
except for VOC and PCB: 50 Percent Relative Difference OR Absolute Difference < 5 times the EQL.
Refer to the cover page for a list of report contents.

PSC Analytical Services
921 Leathorne Street, London, Ontario, Canada N5Z 3M7 (519) 686-7558 1-800-268-7396 FAX (519) 686-6374

PSC Analytical Services

CERTIFICATE OF ANALYSIS - SECTION 4

CERTIFICATE OF QUALITY CONTROL

Client: Stantec Consulting
Contact: MS. LESLEY NOVAK

Date Reported: 23-Nov-2004
Work Order: 126214

Matrix: Solids

Client Reference: Golder Sed.

			Process Blank		Process % Recovery			Matrix Spike					Duplicate			
Parameter	EQL	Units	Result	Upper Limit	Result	Lower Limit	Upper Limit	Spike ID	Result	Target	Lower Limit	Upper Limit	Duplicate ID	Original Result	Duplicate Result	QC Flag
Phosphorus P	5	mg/kg	1.	5	99.09	75.0	130.0	04-A038973	470.	502.	301.	653.	04-A038973	1040	1020	
Silver Ag	1	mg/kg	1.	1	112.00	65.0	140.0	04-A038973	244.	249.	124.	349.	04-A038973	< 1	< 1	
Strontium Sr	2	mg/kg	0.	2	116.22	70.0	130.0	04-A038973	498.	507.	355.	659.	04-A038973	78.	75.	
Thallium Tl	1	mg/kg	0.	2	110.71	70.0	130.0	04-A038973	1010	1000	700.	1300	04-A038973	< 1	< 1	
Titanium Ti	2	mg/kg	0.	2	127.42	65.0	140.0	04-A038973	363.	500.	300.	700.	04-A038973	205.	205.	
Vanadium V	2	mg/kg	0.	2	109.52	75.0	140.0	04-A038973	243.	250.	188.	350.	04-A038973	41.	43.	
Zinc Zn	1	mg/kg	0.	1	106.62	75.0	130.0	04-A038973	236.	250.	162.	350.	04-A038973	196.	196.	
Decachlorobiphenyl	NA	%			111.00	75.0	125.0						04-B038852	118.	122.	
Total PCB (Solid)	0.005	mg/kg	< 0.005	0.005	100.00	75.0	125.0	04-B038852	1.5	1.1	0.72	1.5	04-B038852	< 0.05	< 0.05	S

QC Flag(s) pertain to B-Process Blank, R-Process % Recovery, S-Matrix Spike and/or D-Duplicate NA Denotes Not Applicable
When two values exist for the same Spike ID and parameter it indicates the performance of a Matrix Spike (MS) and Matrix Spike Duplicate (MSD).
The acceptance criteria for duplicate results: 25 Percent Relative Difference OR Absolute Difference < 5 times the EQL
except for VOC and PCB: 50 Percent Relative Difference OR Absolute Difference < 5 times the EQL.
Refer to the cover page for a list of report contents.

PSC Analytical Services
921 Leathorne Street, London, Ontario, Canada N5Z 3M7 (519) 686-7558 1-800-268-7396 FAX (519) 686-6374

CERTIFICATE OF ANALYSIS - SECTION 5

SUBCONTRACT ATTACHMENTS

Client:(4017) Stantec Consulting, Guelph

Reported:23-Nov-2004

Attention: MS. LESLEY NOVAK	Purchase Order:162704011-200
Client Reference: Golder Sed.	Date Received: 15-Oct-2004
Work Order: 126214	Sample Type: Solids

Subcontract Laboratories	Accreditation(s) SCC/CAEAL #	NYS/NELAP #	Other
PSC Analytical Services Mississauga	2360	11680	

Total Number of Attached page(s): 13

PSC ANALYTICAL SERVICES INC.

PSC Analytical Services Inc.
921 Leathorne Street, London, Ontario,
Toll Free: 1-800-268-7396 Tel: (519)6

Work Order #
126214

Chain of Custody

Client: Stantec Client Code #
Contact: Lesley Novck
Address: 11 B Nicholas Beaver Rd Guelph ON N1H 6H9
Tel: 5197634412 Fax #: 5197634419
Project: Golder Sed Quote #: L104159
P.O. # 1627-04011-200
Lab Service Representative: Darlene

ANALYSES REQ: * Particle Size, TOC, ** Metals, PCBs

Page 1 of 1

Invoice to: L. Novck

	SAMPLE DESCRIPTION	MATRIX (Water, Soil, etc.)	Particle Size *	TOC	Metals **	PCBs	Field Filtered	Date & Time Sampled M/D/Y	No. of Bottles	Lab Sample No.
1	10644	Sediment	✓	✓	✓		N	2004-10-14	2	38973
2	10645		✓	✓	✓					74
3	10646		✓	✓	✓					75
4	10647		✓	✓	✓					76
5	10648		✓	✓	✓					77
6	10649		✓	✓	✓	✓				78
7	10650		✓	✓	✓	✓				79
8	10652		✓	✓	✓					80
9	10653		✓	✓	✓					81
10	10651	✓	✓	✓	✓	✓				82
11	Control	✓	✓	✓	✓	✓	✓	✓	✓	83

PLEASE FILL IN ALL THE REQUIRED AREAS BELOW

Total No. of Bottles: 22

TAT (Turnaround Time)

RUSH TAT MUST HAVE PRIOR APPROVAL

X Normal (5-10 working days)

__ RUSH (Specify Below)

DATE Required: ____

TIME Required:

Reporting Format

X Fax Results

X E-mail (Excel Format)

address: lnovak@stantec.com

Special Instructions: * by hydrometer

** please ensure lowest possible MDL, include Hg + Hydrides — see Darlene to confirm analysis

LABORATORY USE ONLY

Received by: [signature]

Date: 10/15/04 Time: 1400

Comment(s): 14,15

Sampled by: ES

Name (print): Emilia Juncyzk

Relinquished to Laboratory: ____

Name (print):

Laboratory prepared Container __ Yes __ No

PLEASE READ THE REVERSE SIDE OF THIS DOCUMENT CAREFULLY. IT CONTAINS CONDITIONS AND LIMITATIONS OF LIABILITY WHICH THE CLIENT ACCEPTS BY RELINQUISHING SAMPLES TO THE LABORATORY

White - Lab Yellow - Client

PSC Analytical Services
921 Leathorne Street, London, Ontario N5Z 3M7
Toll Free: 1-800-268-7396 Tel: (519) 686-7558 Fax: (519) 686-6374

W.O. 126214

Chain of Custody

Client: Stantec Client Code #
Contact: Lesley Novak
Address:
Tel: 5197634412 Fax #:
Project: Quote #:
P.O. #
Lab Service Representative:

ANALYSES REQUESTED: extra samples as requested by Darlene

Page of
Invoice to:

SAMPLE IDENTIFICATION	Matrix (Water, Soil, etc.)	Analyses	Field Filtered	Date & Time Sampled	No. of Bottles	Lab Sample No.
10648	Sediment	IS	N	2004-10-14 12:00	1	38977

Work Order # 126437

PLEASE FILL IN ALL THE REQUIRED AREAS BELOW

Total No. of Bottles:

TAT (Turnaround Time)
RUSH TAT MUST HAVE PRIOR APPROVAL
☐ Normal (5-10 working days)
☐ Rush (Specify Below)
Date:
Time:

Reporting Format
☐ Fax Results
☐ E-mail (Excel format)
address:

Special Instructions: Attention: Darlene

LABORATORY USE ONLY
Received by:
Date: Oct 19, 04 Time: 9:45
Comment(s):
7°C
Laboratory Prepared Container ☐ Yes ☐ No

Sampled by:
Name (print):

Relinquished to Laboratory:
Name (print):

White - Lab Yellow - Client