Joint Submission of

Georgia Strait Alliance

and

Sierra Legal Defence Fund

To the CRD Scientific and Technical Review Panel

In the Matter of the Public Review of

Liquid Waste Management Issues in the Core Area

April 7, 2006

The **Georgia Strait Alliance (GSA)** is a charitable, non-profit society formed to protect and restore the marine environment and promote the sustainability of Georgia Strait, its adjoining waters and communities.

The goals of GSA are to:
1. Protect biodiversity and wildlife habitat;
2. Restore the region's water and air quality;
3. Promote the social, cultural, economic and environmental sustainability of the region's communities;
4. Foster understanding and stewardship of the marine environment; and
5. Raise awareness of the links between the health of ecosystems and human communities.

GSA is active on a range of educational and advocacy efforts aimed at safeguarding the marine environment and the health of the human and non-human inhabitants that make this remarkable inland sea their home. Our programs include intertidal stewardship and monitoring; encouragement of reduced use of toxic household products; promotion of green boating and best practices in marine industries; Marine Protected Areas; improved sewage treatment, and reduction of pollution and habitat impacts from salmon farms. We promote science, collaboration and common sense as tools in the pursuit of sustainability. We also recognize that "sustainability" must encompass not only a healthy environment, but also social factors such as human health and a healthy economy.

GSA is made up of over 50 member groups and 1000s of individuals around the region. Our organizational members include environmental, recreational, labour, and community groups, sport and commercial fishing organizations, small businesses, marine industry organizations and many others that together comprise well over 100,000 people

Sierra Legal Defence Fund (SLDF) is a non-profit charitable national organization with offices in Vancouver and Toronto. SLDF is Canada's largest public interest environmental law organization, comprised of lawyers, scientists, communications professionals and support staff. Our lawyers and scientists represent environmental organizations, labour groups, First Nations and citizens' organizations.

SLDF represents the GSA and T Buck Suzuki Environmental Foundation, in aid of their efforts to protect British Columbia's marine environment by enforcing environmental laws that prohibit pollution, particularly pollution caused by untreated municipal sewage.

SLDF lawyers work in close co-operation with our clients to provide strategic legal counsel about environmental law. Our scientists undertake research and investigation, including in the areas of marine pollution. When necessary, SLDF pursues precedent-setting litigation that will advance protection of the environment.

A. Overview and Introduction

GSA and SLDF provide these joint submissions to express our concerns with the discharge of untreated sewage into Juan de Fuca Strait by the Capital Regional District (CRD).

At the outset, it must be stated that, in our opinion, the CRD's discharge of untreated sewage at the Clover and Macauley Point outfall facilities is in violation of section 36(3) of the federal *Fisheries Act* R.S.C. 1985, Chap. F-14, and constitutes an offence pursuant to section 40(2). The *Fisheries Act* is one of Canada's most important environmental laws, and merits consideration by this Panel.

Furthermore, based on a scientific analysis of the CRD's own marine sediment data sampled over the years 2000-2004, we have also demonstrated that the immediate vicinity of the Clover and Macauley Point outfall facilities contain disturbingly high levels of toxic substances which are prescribed by the *Contaminated Sites Regulation*, BC Reg. 375/96 ("CSR"). Accordingly, the immediate vicinity of these two outfall facilities could be designated by provincial government officials as a contaminated site pursuant to the *British Columbia Environmental Management Act*, S.B.C. 2003 c. 53 ("EMA"). Designation of a contaminated site allows the provincial government to order "remediation" (EMA s.48). The statutory definition of remediation is not limited to "clean-up," but includes limiting further contamination (EMA s. 1 definition).

We appreciate that this Panel is undertaking a scientific and technical review. However, in our submission, the Panel cannot possibly advise on what are appropriate sewage treatment practices without considering whether certain practices are, in fact, prohibited by law. To determine what level of pollution is "acceptable" without considering whether that level of pollution is lawful would be troubling, and would bring the credibility of the Panel's findings into question.

Moreover, environmental regulations like the CSR were enacted with the specific purpose of protecting public health and the marine environment from levels of contamination deemed to be unsafe. Sediment criteria prescribed by law in the CSR reflect conclusions both by scientists and regulators about levels of contamination that pose serious threats to the environment, human health, and marine life.

In this regard, we note our concern with the third principle guiding this review, in which CRD commits to changing its sewage disposal practices *only* "if any significant negative environmental effects are detected." In our submission, this Panel should advise CRD to change its sewage disposal practices not merely in consideration of undefined "significant" environmental effects, but in consideration of whether the CRD is in violation of federal and provincial environmental laws.

Unfortunately, efforts by SLDF to gather additional technical and scientific data regarding the CRD's sewage effluent have been frustrated by the CRD, which has frustrated our ability to participate in this Panel Review. On November 25, 2005, Senior

Staff Scientist John Werring, R.P.Bio, wrote to the CRD requesting permission to sample the wastewater effluent at the Macaulay and Clover Point outfalls. On December 19, 2005, Dwayne Kalynchuk, the General Manager of Environmental Services at CRD, wrote to Mr. Werring and refused permission. Mr. Kalynchuk advised that CRD sampled its own effluent and that its samples were independently tested, with data reported in annual reports which are public documents.

In our submission, in order to facilitate full public participation in this Review, the Panel should request the CRD reconsider its decision to refuse Mr. Werring permission to sample and test this effluent.

B. The *Fisheries Act*

Section 36(3)

Section 36(3) of the *Fisheries Act* prohibits the deposit of a deleterious substance of any type in water frequented by fish:

> (3) Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.

This statutory prohibition applies to the CRD. The CRD is required to comply with the *Fisheries Act*, regardless that it may operate under the Liquid Waste Management Plan, which is effectively an operational certificate or permit.

In *R. v. Northwest Falling Contractors Ltd.*, [1980] 2 S.C.R. 292, the Supreme Court of Canada upheld the constitutionality of the predecessor to s.36(3). In that case, the appellant was charged for spilling diesel fuel into tidal waters.

The Ontario Court of Appeal recently considered section 36(3) in *R. v. Kingston (City)*, [2004] O.J. No. 1940, which is now the leading case on this provision. The case involved the prosecution of the City of Kingston for discharging leachate from a municipal dump into the Cataraqui River. The Court of Appeal confirmed that, in order to prove a violation of section 36(3), the prosecutor is not required to prove that the receiving waters are deleterious to fish, only that the substance entering the waters is deleterious to fish.

Rather, the Court of Appeal agreed that what s.36(3) defines as deleterious is the substance *added* to the water, rather than the water after the addition of the substance. Site-specific impairment is not a necessary ingredient of the s.36(3) offence. The prosecutor must only prove that the leachate, when added to any water, was likely to render the water deleterious to fish or fish habitat or to the use by man of fish that frequent the water.

Acute Lethality Test

The Court of Appeal in *R. v. Kingston* also accepted that a failure of the "Acute Lethality Test" is evidence that discharges are deleterious to fish contrary to section 36(3).

The Acute Lethality Test is a laboratory testing procedure development by Environment Canada to determine whether effluent discharges are deleterious to fish. It is described by Environment Canada more particularly as "Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, EPS 1/RM/13." The Acute Lethality Test involves the placing of 10 juvenile rainbow trout into aquaria containing progressively more dilute concentrations of the effluent discharge substance, in order to observe its effect upon them. The fish are held in these solutions for a period of 96 hours. If more than 50 percent of the fish in the test solution die over the 96 hour period, then the solutions they are in are deemed to be acutely toxic to fish.

The minimum concentration of the effluent at which it is determined that 50 percent of the fish die over this time period is known as the 96-hour LC50, where "LC" denotes lethal concentration. Concentrations of the test effluent above the 96-hour LC50 concentration are also deemed acutely toxic. If the sample effluent kills a sufficient number of rainbow trout during an Acute Lethality Test, one can conclude that the effluent discharge is acutely lethal and the particular discharge will have "failed" the test.

In our submission, this Panel should consider that sewage effluent samples obtained from Clover and Macaulay Point sewage disposal facilities in 1993, 1994, and 1998 by SLDF Staff Scientist John Werring were subject to laboratory testing which determined that all of these samples were acutely toxic to fish. These laboratory test results show all ten fish died within 4 hours, and in one test as quickly as 30 minutes. However, the laboratory testing conducted at those times was a modified, less expensive version of Environment Canada standard Acute Lethality Test, as it employed only a simple pass/fail test for toxicity without progressive dilutions.

If the Panel considers it useful to consider the test results in detail, SLDF will provide them on request.

Evidence of s.36(3) violations

Information obtained by SLDF confirms that federal regulators believe that the CRD is committing an ongoing *Fisheries Act* violation, and that, because of elevated levels of ammonia and oxygen-demanding organic materials, such raw sewage discharges are typically acutely lethal to fish.

The concerns regarding the impacts of the discharge of untreated sewage into the environment are also revealed in the decision by the federal government to expand the shellfish harvesting closure around the Victoria area to 60 km^2 from 40 km^2. Much of the closure area is adjacent to the core area of the CRD. The expansion was declared by

Environment Canada, under the *Canadian Shellfish Sanitation Program,* and is in part due to concerns around sewage contamination and the continuing discharge. With the current presence of sources of contamination, the federal government believes it is unsafe for shellfish in this region to be harvest, or consumed.

These examples underscore that several environmental and health protection regulations deem the discharge of raw sewage to be a risk to both human health and the health of the environment. Moreover, it is apparent that this risk is not merely ongoing, but actively increasing, so long as the CRD continues to discharge sewage untreated into the marine environment.

C. Contamination of outfall seabed

The provincial CSR are designed to protect the public from both the environmental and health risks associated with contaminated sites. Contaminated sites are recognized as a significant environmental concern, and their probable effects levels are based on scientifically recognized research.

Attached as an appendix to this submission is a package sent by SLDF, on behalf of GSA and T Buck Suzuki Environmental Foundation, to the British Columbia Ministry of Environment in November 2005. The package comprises of written submissions, a technical analysis of CRD sediment data conducted by Mr. Stephen Salter, P.Eng., and an overview document explaining that analysis.

In November 2005, Mr. Salter analyzed the CRD's own benthic sediment chemical monitoring data of the Macaulay and Clover Point outfall facilities for the years 2000–2004, comparing this data to the sediment limits prescribed by Schedule 9 of the CSR. He determined that, of the 29 compounds tested by the CRD, 19 compounds exceeded provincially regulated limits for a "Typical" contaminated site. The compounds exceeding regulated contaminated sites criteria included toxic heavy metals like cadmium, copper, lead, mercury, zinc, and various polycyclic aromatic hydrocarbons (PAHs).

The seabed in the immediate vicinity of these outfalls therefore satisfies the definition of a contaminated site, leading to our request that the Ministry of Environment immediately designate these areas as contaminated sites. The Ministry of Environment has hired a consultant to study this issue and has indicated it will report by late April 2006.

Our provincial contaminated sites regulations were enacted based on and in consideration of scientific research identifying probable effect levels which, if exceeded, could cause harm to human health and to the marine environment. The seabed around Victoria's outfall, according to Mr. Salter's analysis of CRD's data, comprises a contaminated site. The CRD's disposal of untreated sewage has exceeded standards which scientists and the provincial Cabinet have determined are minimum standards to protect human health and the marine environment.

In our submission, this Panel must endorse advanced sewage treatment, in order to limit the ongoing contamination of this site and the marine animals dependant on it.

D. Water column and surface contamination

When pollutants are discharged into the marine environment, the effects on human health range from exposure by marine and other water users, to contamination of fish, which we then eat.

The *Health Canada Guidelines for Canadian Recreational Water Quality* place restrictions on the levels of fecal coliform that can be present in the marine environment, as well as restrictions on the presence of oil and other petrochemicals, for the purpose of protecting human health. The probable effect levels established in these and other guidelines were established through rigorous scientific research, and reflect a precautionary approach.

However, there is evidence that CRD is polluting the marine environment in contravention of these guidelines.

The CRD Wastewater Monitoring report for 2003 states that 5,000,000 kgs of oil and grease per year flow through these outfalls. The T Buck Suzuki Environmental Foundation has video footage taken on August 5, 2005 showing the oil and grease floating to the surface.

The CRD's Wastewater Monitoring reports show surface fecal coliform counts up to 3,700 in 2003 and 1,900 in 2004. Though these CRD reports reveal that their annual averages are below 200 CFU/ml, Health Canada criteria are based on 30-day averages. CRD Wastewater Monitoring reports also show effluent fecal coliform counts up to 10,800,000 (Macaulay) and 12,800,000 (Clover) in 2003, and 6,045,000 (Macaulay) and 10,800,000 (Clover) in 2004.

In addition, Environment Canada studies have shown that sewage is present on the surface for eight months of the year, where seabirds, including murrelets, feed on it. 63 marine species are known to be at risk in this region. CRD is elevating the risk faced by these species by exposing them to chemicals that scientists and our government have deemed to be dangerous.

The presence of high fecal coloform levels and contaminants such as oil and grease are undoubtedly having a direct impact on human health as windsurfers, whale-watchers, fishers, and other water users cross the Initial Dilution Zones around the Macaulay and Clover Point outfalls regularly, and as divers swim near the Macaulay Point. Initial Dilution Zone. Exposure to these substances can have direct health impact on water users. The presence of these contaminants also reveal that the effluent from the CRD is not diluted as is being claimed, but that many of the harmful components stay in the region, continuing to contaminate our waters and wildlife.

E. Conclusion

The detrimental impacts of toxic chemicals and organic loading is not always easy to prove through evidence. The negative impacts may not reveal themselves in the environment for decades to come, when it's far too late to mediate the impact. Indeed, that is why federal environmental laws like the *Fisheries Act* do not require proof of harm, but rather proof of pollution. In the absence of proof of "significant negative environmental effects," environmental law can ensure that our society takes a precautionary approach to protecting human health and the environment.

Ample research conducted over many decades has established that various toxic substances above certain levels are detrimental to human health and the environment, and that their presence simply must be minimized to the greatest extent possible. Even more important, in our respectful submission, than additional scientific research about the effects of CRD's sewage disposal, is the need to recommend that CRD comply with the law.

By appearing to violate provincial and federal environmental laws and regulations, the CRD sets a poor example. Should this Panel endorse the CRD's continued and ongoing pollution, boat owners will ask why they will have to abide by upcoming shipping regulations that will require them to install holding tanks. Marinas will balk at installing expensive sewage pump-out stations. Smaller coastal municipalities may delay overdue upgrades to their own sewage treatment facilities. Halting marine pollution by the CRD is critical to resolving a host of pollution problems in our region.

The GSA and SLDF strongly believe that the most appropriate action for the Capital Regional District is to implement sewage treatment immediately.

We encourage Panel members to review the attached technical information, and to contact us directly with any requests for clarification or additional information.

Sincerely,

Christianne Wilhelmson
Program Coordinator, GSA

November 10, 2005

Sent Via Courier

Environmental Protection Division
Ministry of Environment
Environmental Management Branch
PO Box 9342 Stn. Prov. Govt.
Victoria, BC V8W 9M1

Attn: Charles Porter, Director Environmental Management

Dear: Mr. Porter

Re: Urgent request for designation of contaminated sites

We write, on behalf of our clients the Georgia Strait Alliance and T Buck Suzuki Environmental Foundation, with an urgent request for designation of sites in the immediate vicinity of the Macaulay and Clover Points sewage outfalls as contaminated sites pursuant to the provisions of the *British Columbia Environmental Management Act*, S.B.C. 2003 c. 53 ("EMA"). We base this request on information regarding the disturbing presence of high levels of prescribed substances listed in Schedule 9 of the *Contaminated Sites Regulation*, BC Reg. 375/96 ("CSR") as found in marine sediments sampled during the years 2000-2004 at and around the two outfalls. As a Director of Waste Management under the EMA you have the jurisdiction to make such a designation pursuant to section 44 the Act. Alternatively, we respectfully request that you exercise your authority to order an investigation of the sites in accordance with section 41 of the Act.

The Contaminated Sites Provisions

The purposes of the contaminated sites provisions in the EMA and its regulations are to protect the public from both the environmental and health risks associated with contaminated sites, and from the financial burden of paying for the clean up of such pollution. Contaminated sites are recognized as a significant environmental and financial concern, and therefore these provisions are an integral part of British Columbia's environmental protection regime.

Contaminated site is defined in section 39(1) of the Act as follows:

> 39(1) "contaminated site" means an area of the land in which the soil or any groundwater lying beneath it, or the water or the underlying sediment, contains
> (a) a hazardous waste, or
> (b) another prescribed substance
> in quantities or concentrations exceeding prescribed risk based or numerical criteria or standards or conditions;

The EMA allows the Minister of Environment to pass regulations prescribing the other substances and numerical criteria used in the definition of 'contaminated site'. Sections 1 and 11(1)(c) of the CSR make it clear that the values laid out in Schedule 9 of the CSR are the numerical criteria for sediments:

> 1 In this regulation:
> "generic numerical sediment criterion" means the concentration of a substance specified in Schedule 9 for a particular sediment use;
>
> 11(1) Subject to section 12 and subsections (2), (3) and (4) of this section, the following substances, standards and conditions are prescribed for the purposes of the definition of "contaminated site" in section 39 of the Act:
> (c) the concentration of any substance in sediment at the site is greater than the applicable generic numerical sediment criterion;

Schedule 9 contains separate sediment criteria for freshwater sediments and for marine and estuarine sediments, as well as for typical and sensitive sites. Schedule 9 lists a total of 33 prescribed substances for marine sediment. According to the definition of contaminated site in s. 39(1) of the EMA, concentrations of any one of the 33 prescribed substances in excess of the numerical criteria set out in Schedule 9 of the CSR qualifies the site for designation as contaminated.

Other provisions in the EMA specify who are the responsible persons for a contaminated site, and who are therefore potentially liable (EMA s.45-47). Note s.47(4) makes it clear that holding a permit does not release a responsible person from potential liability. Thus although the CRD's Liquid Waste Management Plan allows the operation of a facility that we are told does not contaminate or otherwise harm the environment, it cannot act as a shield for responsibility if it turns out (as it has) that the facility is harming the environment by causing contamination of sediment.

Sediment Sampling Data

Our clients are concerned that Capital Regional District's ("CRD") own benthic (sea floor) sampling data indicate concentrations of prescribed substances that exceed the levels established for typical marine sediments in Schedule 9 of the CSR in numerous instances.

Over the course of this summer and into the fall, Stephen Salter (a professional engineer and volunteer working with our clients) undertook an analysis of the CRD benthic sampling data for the years 2000-2004. A copy of Mr. Salter's analysis in spreadsheet form (the "Salter Analysis") is enclosed with this letter along with a description of the prescribed substances detected in unsafe levels.

The Salter Analysis reviews the CRD data that is available for sampling locations in the immediate vicinity of the Macaulay and Clover Point outfalls, which start at a site immediately below the outfall pipe and move out to a distance of 800 meters. The CRD analysed samples taken at the various locations to determine concentrations of a number of chemicals, including 29 of the 33 listed in Schedule 9 of the CSR. Mr. Salter compared the CRD's results with the numerical criteria prescribed in Schedule 9 of the CSR for typical marine sites. The results of this comparison show concentrations of 19 chemicals to have exceeded prescribed concentrations over the period 2000-2004. Five of these chemicals were detected at levels over 20 times higher than the CSR limits for typical marine sites (lead, Acenaphthene, Anthracene, Phenanthrene, and Benzo-a-anthracene).

Significance of the Salter Analysis

As stated above the Salter Analysis shows concentrations of 19 substances in excess of numerical criteria for typical marine sediment sites. These findings are of significant concern because of the nature of the substances that the government has chosen to include in Schedule 9 of the CSR. The prescribed substances were chosen because of the risk they pose either to the marine environment or human health or both. The prescribed substances are either toxic substances (in that they are considered toxic to marine life) and/or bioaccumulative (in that they do not degrade or breakdown in the marine environment and instead increase in concentrations in marine life as they move up the food chain)[1].

The Schedule 9 criteria for typical marine sediments were set based on a level beyond which one would expect to find a moderate probability of significant adverse effects[2]. In particular, the Schedule 9 criteria were generally set by multiplying the national guidelines on 'probable effects levels' (PEL) by 1.2[3] (PEL levels are the level at which changes in benthic invertebrate populations are likely to occur, and are contained in the Council of Canadian Ministers of the Environment (CCME) Sediment Quality Guidelines). Therefore, the substances on the list are by their very nature a threat when

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[1] D. MacDonald et al., *Development and Application of Sediment Quality Criteria for Managing Contaminated Sediment in British Columbia* (Nov 2003, MacDonald Environmental Sciences, Nanaimo, BC), pp. 5 & 6, available at: http://wlapwww.gov.bc.ca/epd/epdpa/contam_sites/whats_new/pdfs/develop_applicat_sqc_rep_nov19%20_wma.pdf. This document was prepared for the Ministry of Environment in November 2003 to provide context for the development of and guidance on the application of the sediment quality criteria that came into effect on March 5, 2004 and later became the basis for Schedule 9 of the CSR (see http://wlapwww.gov.bc.ca/epd/epdpa/contam_sites/whats_new).

[2] D. Macdonald, *supra* at p. 25

[3] D. Macdonald, *supra* at p. 34.

found in marine sediment in concentrations that exceed those set out in Schedule 9 of the CSR.

Additionally, the Salter Analysis shows that the number of substances in excess of national PEL guidelines, as well as the degree to which they are in excess, result in the two outfalls and their immediate vicinity being Medium-High priority contaminated sites according to the federal Contaminated Sites Management Working Group (CSMWG) methodology to prioritize contaminated sites[4]. Indeed, considering just the polycyclic aromatic hydrocarbons (PAHs) in the 2003 data, two of the sampling locations in close proximity to the Macaulay Point outfall would qualify as Highest priority sites.

Finally, the Salter Analysis shows concentrations of substances in excess of the CRD's own non-binding Sediment Quality Guidelines for the marine sediment. The CRD standards are not enshrined in regulation and are therefore only guidelines. They allow for concentrations of contaminants in significantly greater concentrations than the standards legislated by British Columbia. We do not therefore think the CRD criteria are defensible as a safety standard for protection of the marine environment or human health. Because they are so lax, however, exceeding the CRD criteria should be seen as another clear indicator of risk of harm to the marine environment.

Two examples: effects of elevated copper and PAH levels on biodiversity

Copper concentrations in the sediments at the Macaulay Point outfall have exceeded the CSR Schedule 9 criteria every year from 2000-2004. Copper concentrations at the Clover Point outfall exceeded the CSR criteria for the years 2002-2004. At times these concentrations have been over twice the CSR Schedule 9 criteria.

The CCME has determined that adverse biological effects for copper in marine sediments include: decreased benthic invertebrate diversity, reduced abundance, increased mortality, and behavioural changes[5]. It should be noted that in 1972 - 1976 (prior to and shortly after discharge began), the CRD reported that the number of species of marine benthic organisms (a measure of biodiversity) found in the vicinity of both the Clover and Macaulay Point outfalls was unexpectedly large at around 300 species[6]. The CRD's 2003 Marine Monitoring Annual Report places the number of species in the immediate vicinity of the Macaulay Point outfall in that year at only 55, which strongly suggests there has been a decrease in benthic diversity at that location. This is consistent with one of the stated adverse biological effects of elevated levels of copper in marine sediments.

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[4] See http://www.ec.gc.ca/etad/csmwg/pub/marine_aquatic/en/chap3_e.htm.

[5] Canadian Council of Ministers of the Environment. 1999. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Copper. 4 pages.

[6] Ellis, D.V., M.M. Saavedra Alvarez, and P.M. Hoover. 1991. Data Analysis of Marine Benthos at the Macaulay and Clover Point Outfall Sites. A report to the Capital Regional District of British Columbia. August 16, 1991. 42 pages plus Appendices.

As for total PAHs, sampling locations around the Macaulay Point outfall detected levels approximately seven times the CSR criteria in 2000, four times the criteria in 2001, and five times the criteria in 2003. Numerous individual PAHs have exceeded the CSR criteria at both Clover and Macaulay Point outfalls. At the sampling stations around Macaulay Point outfall, some, such as Acenaphthene and Phenanthrene, have been detected at up to thirty times the CSR criteria.

Adverse effects of PAHs in marine sediments are similar to copper and include: decreased benthic invertebrate abundance, decreased biodiversity, decreased growth, increased mortality, and physiological and behavioural changes in the benthic organisms exposed to these chemical[7]. Confounding the issue of biological effects of PAH's in general is the fact that there are several different kinds of PAHs: low molecular weight PAHs (LMW-PAHs) and high molecular weight PAHs (HMW-PAHs). In addition, each individual chemical can express its own toxic effect to marine organisms under varying conditions. LMW-PAHs are considered to be acutely toxic to aquatic organisms, whereas HMW – PAHs are generally considered to be non-acutely toxic but a number of them are carcinogenic (i.e. cancer causing).

The CCME's stated probable effects level (the level at which changes in benthic invertebrate populations are likely to occur) for Phenanthrene, an acutely toxic LMW-PAH, is 0.544 mg/kg. The CRD's 2003 Marine Monitoring Annual Report places the number of species at sample site M1SE (100 metres southeast of the Macaulay outfall terminus) in that year at only 55, which strongly suggests there has been a decrease in benthic diversity at that location as well (compared to 300+ species in 1972-76). This is consistent with the one of the stated adverse biological effects of elevated levels of PAH's in marine sediments. Phenanthrene concentrations in the sediments at the same location in 2003 were measured to be 19.287 mg/kg.

Effect of the Salter Analysis

The information presented in the Salter Analysis provides adequate information to substantiate a determination that areas in the vicinity of the Macaulay and Clover Point outfalls are contaminated sites within the meaning of British Columbia law.

The effect of such a designation would be to engage the broad and flexible provisions of the EMA to allow, finally, for a constructive remediation plan for the site. The EMA allows for pragmatic and functional solutions to contaminated sites in the province based on the principals of risk management, focused first and foremost on the elimination of the source of contamination – in this case the continued discharge of raw sewage into the marine environment. For example, the EMA authorizes the Director to order remediation (EMA s.48), which can include limiting further contamination (EMA s.1 definition of 'remediation'). We feel that the Act is the best available tool to address this problem.

[7] Canadian Council of Ministers of the Environment. 1999. Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Polycyclic Aromatic Hydrocarbons. 16 pages.

At a minimum the information presented justifies and necessitates a call for a detailed site investigation in the vicinity of both outfalls. The Act allows for a site investigation to be ordered by the Director against any owner or operator of the site (EMA s. 41). The Provincial Crown is owner of the site as owner of the seabed (the ownership of the seabed in the Strait of Juan de Fuca was determined by the Supreme Court of Canada in *Ref. Re: Ownership of the Bed of the Strait of Georgia and Related Areas*, [1984] 1 SCR 388). The CRD constructed and operated the sewage outfalls at the sites and therefore can be considered operator of the site (EMA s.39(1) definition of 'operator').

We respectfully submit that, given the serious threat that contaminated sites pose to the environment and human health, and the liability they pose to future generations, it is in the public interest for the Director to at least proceed with an investigation in this case. Of course, given the wealth of information provided in the Salter analysis, it might be more timely and cost-effective to immediately designate the sites as contaminated and order wastewater treatment to prevent additional contamination.

In light of the serious nature of the contamination evidenced in the benthic sampling data we feel this request requires urgent and immediate attention. We are happy to meet with you to discuss this issue further or provide more information.

We look forward to hearing from you soon.

Sincerely,

Margot Venton and John Werring
Barrister and Solicitor R.P. Bio

Sierra Legal Defence Fund

cc. The Honourable Barry Penner, Minister of Environment
Lynn Bailey, Director of Waste Management

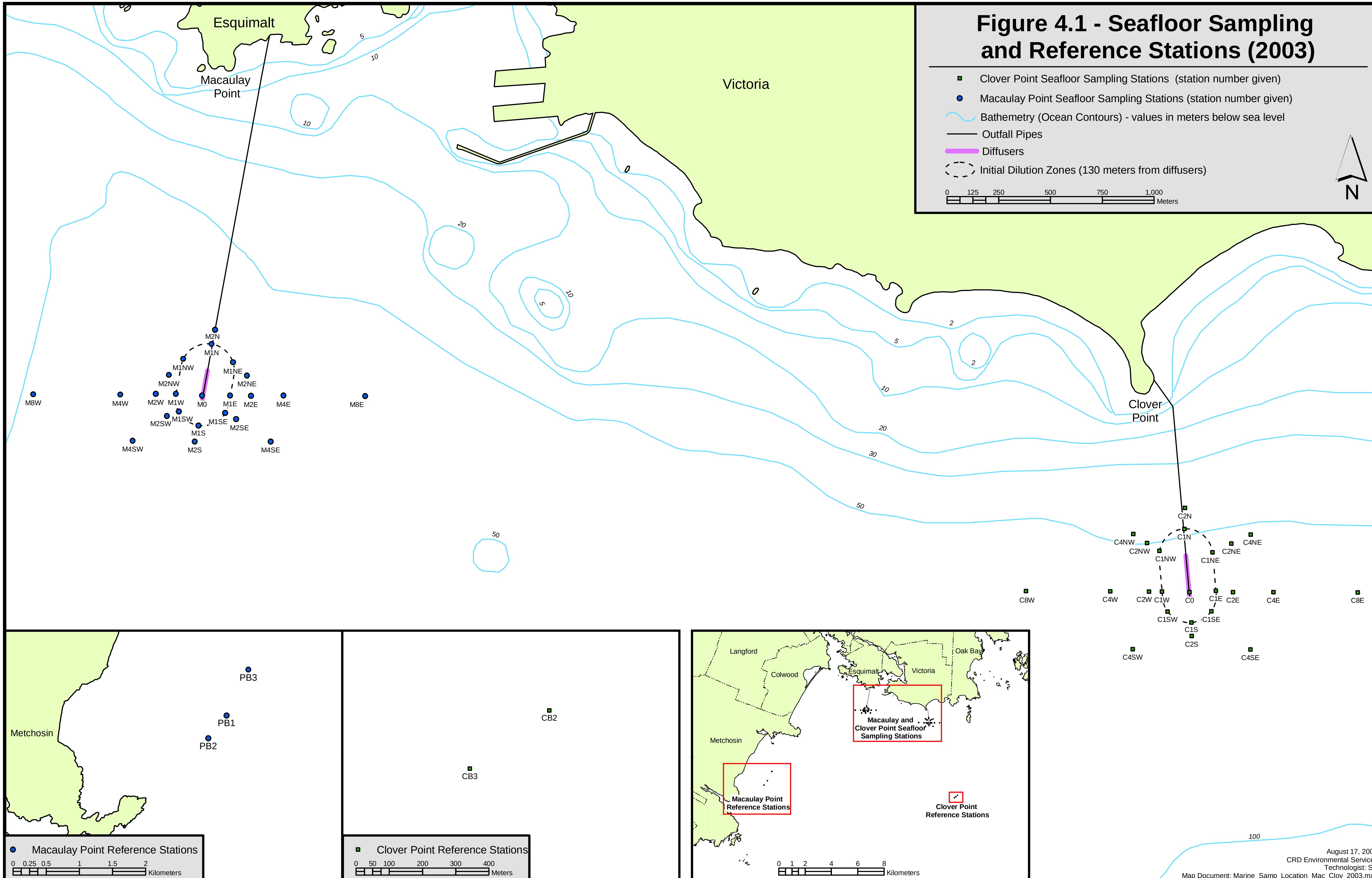
Figure 4.1 - Seafloor Sampling and Reference Stations (2003)
Clover Point Seafloor Sampling Stations (station number given)
Macaulay Point Seafloor Sampling Stations (station number given)
Bathemetry (Ocean Contours) - values in meters below sea level
Outfall Pipes
Diffusers
Initial Dilution Zones (130 meters from diffusers)
0 125 250 500 750 1,000 Meters
N
Esquimalt
Macaulay Point
Victoria
Clover Point
M8W
M4W
M2W
M1W
M0
M1E
M2E
M4E
M8E
M2N
M1N
M1NW
M2NW
M1NE
M2NE
M2SW
M1SW
M1SE
M2SE
M1S
M2S
M4SW
M4SE
C2N
C1N
C4NW
C2NW
C1NW
C1NE
C2NE
C4NE
C8W
C4W
C2W
C1W
C0
C1E
C2E
C4E
C8E
C1SW
C1SE
C1S
C2S
C4SW
C4SE
Metchosin
PB3
PB1
PB2
Macaulay Point Reference Stations
0 0.25 0.5 1 1.5 2 Kilometers
CB2
CB3
Clover Point Reference Stations
0 50 100 200 300 400 Meters
Langford
Colwood
Esquimalt
Victoria
Oak Bay
Metchosin
Macaulay and Clover Point Seafloor Sampling Stations
Macaulay Point Reference Stations
Clover Point Reference Stations
0 1 2 4 6 8 Kilometers
August 17, 2004
CRD Environmental Services
Technologist: SR
Map Document: Marine_Samp_Location_Mac_Clov_2003.mxd

Clover and Macaulay Point outfalls – contaminated sites?

In this Analysis we examined the Capital Regional District's (CRD's) own benthic (sea floor) sediment chemical monitoring data, for the years 2000 – 2004 as reported in the CRD's "Macaulay and Clover Point Wastewater and Marine Environment Program Annual Reports". The raw data presented in these reports include the concentrations of heavy metals and toxic organic chemicals found in marine benthic sediments sampled from 23 locations at and around the Macaulay Point outfall. CRD only reported data from samples collected directly at the Clover Point outfall most years, except for 2003 when data was presented for 14 locations at and around the outfall.

The CRD's analysis of these data brings them to the conclusion that, since very few of these parameters exceed their own Sediment Quality Guidelines, discharge of raw sewage to the marine environment is not adversely impacting the marine environment in the vicinity of the outfalls.

We took a different approach. We compared the CRD's data with the values found in Schedule 9 of the BC *Contaminated Sites Regulation* (CSR). Schedule 9 sets out the concentrations of certain contaminants above which a site would be considered a contaminated site pursuant to the *Contaminated Sites Regulation* and the *Environmental Management Act*. Some interesting facts emerged:

- Of the 33 compounds listed in schedule 9 the BC *Contaminated Sites Regulation*, the CRD reports on 29.
- The "CRD Sediment Quality Guidelines" shown in their 2003 monitoring report are up to **8 times higher** than the *Contaminated Sites Regulation* limits for "Typical Sites" (e.g. acenaphthylene).
- **Of the 29 compounds** tested by the CRD, our analysis (see below) showed that **19** were, at one time or another over the period 2000 – 2004, above the limits specified in the *Contaminated Sites Regulation* for "Typical Sites". These were: cadmium, copper, **lead**, mercury, zinc, **Acenaphthene**, Acenaphthylene, **Anthracene**, Flourene, Naphthalene, **Phenanthrene**, Flouranthene, Pyrene, Benz(a)pyrene, Chrysene, **Benzo-a-anthracene**, Dibenzo[ah]anthracene, 2-methlynaphthalene and Total Polycyclic Aromatic Hydrocarbons. **Five** (5) of these compounds (those bolded) have been detected at **over 20 times** the CSR limits.

<u>Data Analysis</u>

- In 2004, 6 chemicals were found in concentrations higher than the values listed in the CSR at, or in close proximity to, the Macaulay point outfall terminus (M0). Three (3) chemicals exceeding CSR values were found at the Clover Point outfall terminus (C0 - the only Clover Point site sampled in 2004). (Note: CSR exceedances are highlighted in purple on the attached data sheets pages 1-4 for 2000-2003. 2004 data is not detailed because it was only recently made available).
- In 2003, 17 chemicals were found in concentrations higher than the values listed in the CSR at, or in close proximity to, M0. Eleven (11) chemicals exceeding CSR values were found at C0.
- In 2002, 13 chemicals were found in concentrations higher than the values listed in the CSR at, or in close proximity to, M0. One (1) chemical, copper, exceeded CSR values at C0.
- In 2001, 15 chemicals were found in concentrations higher than the values listed in the CSR at, or in close proximity to, M0. Five (5) chemicals exceeded CSR values at C0.
- In 2000, 16 chemicals were found in concentrations higher than the values listed in the CSR at, or in close proximity to, M0.

In summary, in every year examined, there were numerous compounds detected at, or in close proximity to, the Macaulay Point outfall whose concentrations exceeded those specified in the *Contaminated Sites Regulations*. Also, in every year from 2001 through 2004 the data show that the area around the immediate vicinity of the Clover Point outfall is consistently contaminated with one or more prescribed substances. **Therefore the seabed in the vicinity of both outfalls meets the definition of a contaminated site**.

The data show that concentrations of contaminants generally decline with distance from the outfalls, providing clear evidence that the source of the contamination is the outfalls (see pages 5 and 6 of the attached data sheets). In addition, sediment contamination levels measured at the reference stations at Parry Bay and Constance Bank are generally significantly lower than levels measured at and around the outfalls (see page 7). Furthermore, concentrations of several of the contaminants found to be elevated in the sediments at and around the outfalls are also found in high concentrations in the sewage effluent (see page 8), once again demonstrating that the **most likely source of sediment contamination is the outfalls**.

Example: Copper

Copper, a contaminant that is highly toxic to marine life, has been consistently above the *Contaminated Sites Regulation* criteria at and around both outfalls. Clover Point outfall values have consistently increased over the years 2000-2004 (47, 112, 133, 172, 254 mg/kg, respectively), rising above the CSR limit (130 mg/kg) from 2002 onwards (see page 9). Copper contamination at Macaulay Point outfall has shown some annual fluctuations (152, 266, 158, 273, 143 mg/kg, 2000-2004 respectively), but has consistently been over the CSR limit every year.

Copper contamination is highest around the outfalls. In 2003, the only year for which CRD published data at sampling stations around both Clover and Macaulay Point outfalls, a clear 'spike' emerges right over both outfalls (see page 5).

The CRD has set guidelines for copper that are much higher than the CSR limits (three times higher in fact). This demonstrates the out-of-date and unreasonable nature of the CRD guidelines, and the unreasonableness of CRD conclusions that the outfalls are not causing adverse effects on the marine environment. See page 7 for a comparison of the CRD guidelines with various federal and provincial criteria.

Many pipes in the CRD are made of copper. Short of replacing all this piping citywide, the obvious solution to preventing further build up of this contaminant on the seabed is to construct a wastewater treatment plant. Secondary treatment can remove up to 93% of copper from wastewater (see page 10). Because of the copper pipes, source control is not available for this chemical. CRD does undertake source control efforts for some substances, such as mercury, but as shown on page 9, mercury continues to exceed CSR limits.

Priority

Finally, a comparison of the CRD's sediment contamination data with the federal contaminated site methodology for prioritizing contaminated sites reveals that the federal government would consider the Clover and Macaulay outfalls and their immediate vicinity to be Medium-High priority contaminated sites (see page 11). In fact, as shown on page 11, in 2003 two sample locations in close proximity to the Macaulay outfall would qualify as Highest priority contaminated sites for Polycyclic Aromatic Hydrocarbons (PAHs).

Description of the CRD data and the various criteria, standards and guidelines

CRD reports annually on contaminants found in sediments on the seabed at and around the two outfalls. Appendix F of these reports includes the raw data. The 2000-2003 reports are available at http://www.crd.bc.ca/es/environmental%5Fprograms/wastewater_marine/reports.htm. Sample stations are designated as:

- M (for Macaulay) or C (for Clover)
- 0 for stations situated at the outfall terminus. 1 (for stations at or just outside the Initial Dilution Zone (IDZ) – approximately 100 metres from the outfall terminus) or 2, 4 and 8 respectively (for the stations situated approximately 200m, 400m and 800m from the outfall terminus)
- E, etc. (for the compass direction from the outfall terminus)

Thus C0 means right at the Clover Point outfall, and M1SE means the sampling location approximately 100m southeast of Macaulay Point outfall. In addition, reference sampling stations are located at Parry Bay (PB1, PB2, and PB3) and Constance Bank (CB1, CB2, and CB3) to provide comparison values for the concentrations detected at and around the outfalls.

The data sheets refer to a number of standards, criteria and guidelines:

- CCME ISQG levels – these are the 'interim sediment quality guidelines' as set in the Sediment Quality Guidelines for marine sediments by the Council of Canadian Ministers of the Environment (CCME)[1]. They reflect the level of contamination below which adverse biological effects are not expected.

- CCME PEL – these are the 'probable effect levels' as set in the Sediment Quality Guidelines for marine sediments by the CCME. They reflect the levels above which adverse biological effects are expected to occur frequently.

- BC CSR – these are the criteria specified in Schedule 9 of the BC *Contaminated Sites Regulation* (CSR) for typical marine sites. These were set to be a little over the CCME PEL levels.

- CRD sediment quality guidelines – these are the values the CRD itself uses to compare its data to. They are based on the Washington State Department of Ecology (WDOE) Sediment Management Standards[2]. In December 1999, the WDOE stopped updating their guidelines, planning instead to align with national (NOAA) guidelines. The NOAA guidelines are equivalent to the CCME PELs for the marine sediment contaminants considered here[3].

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[1] "Canadian Environmental Quality Guidelines" for Marine Sediment, updated to Dec 2003, available at http://www.ccme.ca. The CCME sediment quality guidelines are scientific tools that synthesize information regarding the relationships between the sediment concentrations of chemicals and any adverse biological effects resulting from exposure to these chemicals. The majority of the data used to derive the CCME's ISQG and PELs for marine sediments are from studies on field collected sediments that measure concentrations of chemicals in sediments and their associated biological effects. These data are compiled in Environment Canada's Biological Effects Database for Sediments (BEDS). There are literally hundreds of reports for each chemical of concern.

[2] WAC 173-204-520 page 7.

[3] http://response.restoration.noaa.gov/book_shelf/122_squirt_cards.pdf.

Page 1: CRD Sediment Data from 2000

Macaulay Pt. and Clover Pt.

	Al	Sb	As	Be	Cd	Cr	Cu	Fe	Pb	Mg	Mn	Hg	Ni	P	K	Se	Ag	Ti	Zn
Revised on November 5, 2005 **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	mg/kg	mg/kg	mg/kg	mg/kg
Ratio of CRD Max to Contaminated Sites Regulation:							**3.0**		**112.3**										**0.7**
CRD "Sediment Quality Guidelines" *	**---**	**150**	**57**	**---**	**5.1**	**260**	**390**	**---**	**450**	**---**	**---**	**0.41**	**---**	**---**	**---**	**---**	**6.1**	**0.5**	**410**
BC Contaminated Sites Regulation Criteria **			**50**		**5.0**	**190**	**130**		**130**			**0.84**					**-**		**330**
Canadian Environmental Quality Guidelines PEL			**41.6**		**4.2**	**160**	**108**		**112**			**0.70**					**-**		**271**
Canadian Environmental Quality Guidelines ISQG	**none**	**none**	**7.24**	**none**	**0.7**	**52.3**	**19**	**none**	**30**	**none**	**none**	**0.13**	**none**	**none**	**none**	**none**	**none**	**none**	**124**
Ratio of CRD Guidelines to BC Contaminated Sites Reg:							**3.00**		**3.46**										**1.24**
Actual Max	31400	17.00	20.00	0.50	0.74	87.00	387	39600	14600	10600	324	8.77	27.00	1880	4430	9.00	2.5	0.00	233
Actual Mean (averages are for Macaulay only)	**27122**	**1.41**	**6.72**	**0.47**	**0.25**	**39.13**	**58.74**	**32074**	**838.2**	**9849**	**257**	**0.61**	**21.65**	**902**	**3591**	**0.69**	**0.46**		**88.07**
Actual Min	17500	0.00	1.90	0.30	0.11	22.00	16	19400	8	7420	205	0.05	15.00	707	2140	0.20	0.07	0.00	0.50
Std Dev.	3139	3.38	3.42	0.06	0.17	12.10	80	3857	2981	906	21	1.78	2.37	259	534	1.82	0.60		46.68
The Clover Pt. rows are hidden - no data from 2000-2002.																			
C0	17500	0.33	6.0	0.3	0.350	22.0	47.0	19400	18.4	7420	233	0.1300	15	1010	2140	0.2	0.400	<0.5	53.0
M0	27500	2.5	6.0	0.5	0.610	57.0	152.0	29400	1573	8460	267	1.3200	27	1880	2830	0.2	1.380	<0.5	233.0
M1E	24100	2.2	10.0	0.4	0.540	87.0	387.0	31100	255	9940	239	1.4200	24	1050	3350	0.4	1.180	<0.5	163.0
M1N	27600	0.37	5.0	0.5	0.190	37.0	21.0	36100	12.4	10600	324	0.0680	21	756	3680	0.3	0.110	<0.5	62.0
M1NE	27100	0.34	5.1	0.4	0.180	37.0	23.0	33400	332	10600	258	0.0600	22	806	3840	0.2	0.130	<0.5	64.0
M1NW	28700	0.27	4.7	0.5	0.150	35.0	19.0	32300	9.3	9930	242	0.0580	20	707	3700	0.3	0.100	<0.5	62.0
M1S	25700	0	20.0	0.4	0.220	36.0	153.0	32600	14600	10100	243	0.1120	22	848	3450	9	0.410	<4	0.5
M1SE	23200	0.9	12.0	0.4	0.740	38.0	74.0	31900	103.0	7860	257	8.7700	22	1330	3010	0.5	2.520	<0.5	146.0
M1SW	25800	0.7	5.5	0.4	0.270	48.0	38.0	32200	22.4	9990	250	0.2730	25	812	3490	0.3	0.300	<0.5	81.0
M1W	26800	1.3	6.8	0.5	0.420	38.0	90.0	33100	50.3	10500	250	0.2450	22	1200	3650	0.4	1.220	<0.5	106.0
M2E	28100	0.7	6.9	0.5	0.250	36.0	30.0	31200	36.7	9450	284	0.1440	21	863	3550	0.3	0.470	<0.5	91.0
M2N	28200	1	6.2	0.5	0.140	35.0	21.0	33500	13.5	10600	265	0.0760	22	791	3760	0.3	0.070	<0.5	69.0
M2NE	31400	0.42	6.3	0.5	0.210	38.0	22.0	36400	10.8	9660	271	0.1440	22	877	4430	0.3	0.120	<0.5	70.0
M2NW	29500	0.26	5.0	0.5	0.150	35.0	21.0	30900	10.2	9850	251	0.0740	20	768	4220	0.2	0.210	<0.5	68.0
M2S	21000	0.47	1.9	0.3	0.130	26.0	21.0	24400	10.3	8120	205	0.1190	17	752	2700	<0.1	0.120	<0.5	52.0
M2SE	22700	0.7	8.0	0.5	0.360	35.0	64.0	28000	75.3	9080	241	0.3880	21	930	2730	0.3	1.070	<0.5	111.0
M2SW	28700	0.55	5.3	0.5	0.120	36.0	23.0	31400	12.6	10300	252	0.0570	21	745	4080	0.3	0.100	<0.5	74.0
M2W	29400	0.31	5.5	0.5	0.150	35.0	27.0	31100	11.1	10400	250	0.0720	21	736	3810	0.3	0.140	<0.5	69.0
M4E	29000	17	6.4	0.5	0.190	35.0	40.0	32800	95.6	10100	259	0.1900	21	941	3720	0.3	0.320	<0.5	97.0
M4SE	25400	1.1	7.2	0.5	0.180	37.0	49.0	39600	2000	10000	276	0.1130	24	832	3290	0.3	0.360	<0.5	145.0
M4SW	28300	0.28	5.1	0.5	0.130	35.0	19.0	31900	10.5	10400	269	0.0790	21	742	4010	0.2	0.090	<0.5	75.0
M4W	27900	0.27	4.7	0.5	0.160	35.0	18.0	30400	8.9	10400	253	0.0500	20	716	3910	0.2	0.080	<0.5	62.0
M8E	28000	0.45	5.4	0.5	0.140	35.0	23.0	32700	18.7	9990	257	0.0500	22	908	3480	0.3	0.100	<0.5	65.0
M8W	29700	0.25	5.5	0.5	0.110	34.0	16.0	31300	7.7	10200	254	0.0500	20	749	3910	0.2	0.070	<0.5	60.0
Parry Bay 1	25000	0.2	4.2	0.4	0.070	31.0	12.0	28800	6.2	8930	285	0.0550	18	575	3150	0.1	0.030	<0.5	50.0
Parry Bay 2	23300	0.24	5.6	0.4	0.070	32.0	14.0	31600	6.3	9850	279	0.0350	20	662	3010	0.2	0.020	<0.5	55.0
Parry Bay 3	28000	0.22	5.5	0.5	0.070	33.0	14.0	30800	6.7	9880	283	0.0320	19	740	3630	0.2	0.030	<0.5	55.0
Constance Bank	17600	0.3	3.9	0.3	0.13	23	12	21200	4.6	7940	258	0.0230	15	556	2430	0.2	0.04	<0.5	37

	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Fluoranthene	Pyrene	Benzo(a)pyrene	Chrycene	Benzo(a)-anthracene	Dibenz[a,h]anthracene	PAH Total
Revised on November 5, 2005 **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
Ratio of CRD Max to Contaminated Sites Regulation:	**24.5**	**3.3**	**26.2**	**12.4**	**4.7**	**31.8**	**19.6**	**16.6**	**18.4**	**16.6**	**23.6**	**12.5**	**7.5**
CRD "Sediment Quality Guidelines" *	**0.5000**	**1.3000**	**0.9600**	**0.5400**	**2.1000**	**1.5000**	**1.7000**	**2.6000**	**1.6000**	**1.4000**	**1.3000**	**0.23**	
BC Contaminated Sites Regulation Criteria **	**0.1100**	**0.1500**	**0.2900**	**0.1700**	**0.4700**	**0.6500**	**1.8000**	**1.7000**	**0.9200**	**1.0000**	**0.8300**	**0.16**	**20**
Canadian Environmental Quality Guidelines PEL	**0.0889**	**0.1280**	**0.2450**	**0.1440**	**0.3910**	**0.5440**	**1.4940**	**1.3980**	**0.7630**	**0.8460**	**0.6930**	**0.135**	
Canadian Environmental Quality Guidelines ISQG	**0.0067**	**0.0059**	**0.0469**	**0.0212**	**0.0346**	**0.0867**	**0.1130**	**0.1530**	**0.0888**	**0.1080**	**0.0748**	**0.00622**	
Ratio of CRD Guidelines to BC Contaminated Sites Reg:	**4.55**	**8.67**	**3.31**	**3.18**	**4.47**	**2.31**	**0.94**	**1.53**	**1.74**	**1.40**	**1.57**	**1.44**	
Actual Max	2.70	0.500	7.600	2.100	2.200	20.700	35.300	28.200	16.900	16.600	19.600	2.000	151
Actual Mean (averages are for Macaulay only)	**0.166**	**0.042**	**0.452**	**0.137**	**0.182**	**1.293**	**2.149**	**1.733**	**1.013**	**0.999**	**1.130**	**0.123**	**9.419**
Actual Min	0.010	0.010	0.010	0.010	0.020	0.040	0.020	0.020	0.010	0.020	0.010	0.010	0.200
Std Dev.	0.546	0.099	1.539	0.424	0.448	4.182	7.163	5.719	3.430	3.367	3.977	0.404	30.522
The Clover Pt. rows are hidden - no data from 2000-2002.													
C0	0.020	0.020	0.050	0.020	0.060	0.160	0.230	0.200	0.120	0.120	0.120	0.020	1.14
M0	0.040	0.090	0.110	0.030	0.160	0.360	0.580	0.460	0.270	0.260	0.270	0.040	2.67
M1E	0.350	0.020	0.930	0.260	0.180	2.520	5.170	4.150	2.430	2.390	2.530	0.240	21.17
M1N	0.010	0.010	0.020	0.010	0.030	0.080	0.090	0.080	0.070	0.060	0.060	0.060	0.58
M1NE	0.020	0.010	0.050	0.020	0.030	0.180	0.250	0.220	0.120	0.120	0.130	0.010	1.16
M1NW	0.010	0.010	0.010	0.010	0.020	0.050	0.020	0.020	0.010	0.020	0.010	0.020	0.21
M1S	2.700	0.500	7.600	2.100	0.500	20.700	35.300	28.200	16.900	16.600	19.600	0.040	150.74
M1SE	0.180	0.030	0.320	0.180	2.200	1.260	1.210	1.000	0.530	0.540	0.560	0.010	8.02
M1SW	0.040	0.020	0.090	0.030	0.040	0.300	0.420	0.330	0.170	0.180	0.190	0.010	1.82
M1W	0.090	0.020	0.160	0.070	0.070	0.530	0.640	0.580	0.300	0.310	0.330	0.010	3.11
M2E	0.110	0.030	0.320	0.100	0.420	0.960	1.380	1.010	0.660	0.550	0.530	2.000	8.07
M2N	0.010	0.010	0.020	0.010	0.040	0.090	0.140	0.130	0.080	0.080	0.080	0.110	0.80
M2NE	0.020	0.010	0.040	0.020	0.050	0.150	0.150	0.110	0.070	0.060	0.060	0.100	0.84
M2NW	0.010	0.010	0.010	0.010	0.020	0.060	0.050	0.050	0.040	0.030	0.020	0.010	0.32
M2S	0.010	0.010	0.010	0.010	0.030	0.060	0.040	0.040	0.020	0.020	0.020	0.010	0.28
M2SE	0.050	0.020	0.270	0.050	0.070	0.560	2.030	1.700	0.880	0.740	0.780	0.010	7.16
M2SW	0.010	0.010	0.010	0.010	0.020	0.050	0.020	0.020	0.010	0.020	0.010	0.010	0.20
M2W	0.010	0.010	0.010	0.010	0.020	0.060	0.050	0.050	0.020	0.040	0.030	0.010	0.32
M4E	0.050	0.030	0.210	0.060	0.060	0.480	0.530	0.550	0.240	0.270	0.250	0.010	2.74
M4SE	0.050	0.040	0.110	0.100	0.110	0.940	0.990	0.760	0.240	0.400	0.280	0.030	4.05
M4SW	0.010	0.010	0.010	0.010	0.020	0.040	0.020	0.020	0.010	0.020	0.010	0.030	0.21
M4W	0.010	0.010	0.010	0.010	0.020	0.050	0.030	0.030	0.020	0.020	0.020	0.010	0.24
M8E	0.020	0.050	0.050	0.030	0.050	0.190	0.260	0.300	0.180	0.220	0.200	0.010	**1.56**
M8W	0.010	0.010	0.020	0.010	0.020	0.070	0.060	0.050	0.030	0.030	0.030	0.030	0.37
Parry Bay 1	<0.01	<0.01	<0.01	<0.01	0.010	0.030	<0.01	<0.01	<0.01	0.010	<0.01	<0.01	0.05
Parry Bay 2	<0.01	0.010	0.030	0.020	0.020	0.100	0.090	0.090	0.030	0.040	0.030	<0.01	0.46
Parry Bay 3	<0.01	<0.01	<0.01	<0.01	0.020	0.040	0.010	0.010	<0.01	0.010	<0.01	<0.01	0.09
Constance Bank	<0.01	<0.01	<0.01	<0.01	0.010	0.060	0.030	0.050	0.020	0.020	0.020	<0.01	0.21

Page 2: CRD Sediment Data from 2001

Macaulay Pt. and Clover Pt.

	Al	Sb	As	Be	Cd	Cr	Cu	Fe	Pb	Mg	Mn	Hg	Ni	P	K	Se	Ag	Ti	Zn
Revised on November 5, 2005 **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	mg/kg	mg/kg	mg/kg	mg/kg
Ratio of CRD Max to Contaminated Sites Regulation:							**2.0**		**0.8**										**0.7**
CRD "Sediment Quality Guidelines" *	**---**	**150**	**57**	**---**	**5.1**	**260**	**390**	**---**	**450**	**---**	**---**	**0.41**	**---**	**---**	**---**	**---**	**6.1**	**0.5**	**410**
BC Contaminated Sites Regulation Criteria **			**50**		**5.0**	**190**	**130**		**130**			**0.84**					**-**		**330**
Canadian Environmental Quality Guidelines PEL			**41.6**		**4.2**	**160**	**108**		**112**			**0.70**					**-**		**271**
Canadian Environmental Quality Guidelines ISQG	**none**	**none**	**7.24**	**none**	**0.7**	**52.3**	**19**	**none**	**30**	**none**	**none**	**0.13**	**none**	**none**	**none**	**none**	**none**	**none**	**124**
Ratio of CRD Guidelines to BC Contaminated Sites Reg:							**3.00**		**3.46**										**1.24**
Actual Max	26100	2.00	14.00	0.50	1.34	107.0	266	38167	100	11000	746	2.77	73.00	3960	4020	1.00	3.7	2.00	237
Actual Mean (averages are for Macaulay only)	**23183**	**0.70**	**6.70**	**0.43**	**0.29**	**35.87**	**45.43**	**33046**	**28.4**	**9095**	**238**	**0.31**	**22.61**	**986**	**3420**	**0.27**	**0.50**		**87.57**
Actual Min	19900	0.10	4.00	0.30	0.08	28.0	16	29400	9	7560	208	0.05	18.00	671	1820	0.20	0.06	0.50	56.00
Std Dev.	1701	0.59	2.51	0.05	0.28	17.1	55	1830	26	821	105	0.65	10.94	714	464	0.16	0.96		59.31
The Clover Pt. rows are hidden - no data from 2000-2002.																			
C0	19900	1.1	7.0	0.3	0.530	107.0	112.0	31300	59.0	11000	746	2.7700	21	2090	1820	0.2	3.680	0.600	224.0
M0	25267	2	11.0	0.4	1.340	72.0	266.0	32000	100.0	9510	282	1.8100	28	3960	3490	1	3.260	0.700	237.0
M1E	21300	0.5	14.0	0.4	0.570	35.0	97.0	33200	52.0	8450	222	0.5380	22	980	3310	0.3	1.240	<0.5	90.0
M1N	24833	0.1	7.0	0.5	0.180	35.0	20.0	38167	13.0	9720	252	0.1000	21	761	3683	0.3	0.140	0.600	64.0
M1NE	23500	<0.3	5.0	0.4	0.130	32.0	17.0	31700	10.0	9490	231	0.1110	18	715	3640	0.2	0.340	<0.5	57.0
M1NW	23300	0.7	4.0	0.4	0.080	33.0	17.0	34000	20.0	9180	236	0.0780	20	722	3460	0.2	0.080	<1	61.0
M1S	23100	0.4	6.0	0.4	0.280	38.0	29.0	33400	27.0	8970	236	0.8020	20	840	3550	0.2	0.670	0.600	71.0
M1SE	22400	2	12.0	0.5	0.660	34.0	86.0	29900	52.0	8610	220	0.5850	23	1440	3020	0.3	1.460	0.600	108.0
M1SW	23500	0.6	6.0	0.4	0.360	35.0	50.0	33300	30.0	9140	237	0.5110	21	870	3320	0.3	0.390	<0.5	91.0
M1W	22300	0.6	7.0	0.4	0.480	54.0	71.0	31400	39.0	8730	226	0.6610	20	848	3330	0.3	0.790	<0.5	216.0
M2E	22300	0.7	7.0	0.4	0.220	33.0	32.0	31900	20.0	8630	233	0.0930	19	757	3230	0.2	0.160	0.600	63.0
M2N	24100	<0.3	5.0	0.4	0.160	34.0	18.0	33800	12.0	9430	249	0.0530	20	721	3630	0.2	0.480	<0.5	59.0
M2NE	22600	0.1	5.0	0.4	0.160	31.0	22.0	31400	12.0	8610	224	0.0490	18	697	3390	0.2	0.120	2.000	58.0
M2NW	26000	0.1	4.0	0.5	0.140	35.0	18.0	34100	10.0	9727	243	0.0670	20	740	4013	0.2	0.130	0.600	61.0
M2S	26100	<0.3	5.0	0.5	0.160	36.0	20.0	35400	19.0	9960	256	0.0510	21	806	4020	0.3	0.080	<0.5	64.0
M2SE	21600	0.8	7.0	0.5	0.470	35.0	68.0	29400	88.0	7910	208	0.7460	21	1710	2840	0.3	1.070	<0.5	98.0
M2SW	23500	0.2	5.0	0.4	0.130	34.0	23.0	33200	13.0	9820	237	0.0680	20	720	3460	0.2	0.100	0.600	63.0
M2W	22600	<0.3	4.0	0.4	0.140	32.0	19.0	31900	10.0	8930	224	0.0900	19	671	3320	0.2	0.130	0.500	59.0
M4E	21700	0.7	8.0	0.4	0.210	30.0	34.0	32800	17.0	8440	228	0.0780	19	830	3240	0.3	0.320	0.600	60.0
M4SE	20400	1.6	7.0	0.4	0.250	28.0	70.0	33600	61.0	7560	250	0.3430	73	828	2720	0.2	0.300	0.500	198.0
M4SW	24700	0.4	6.0	0.5	0.140	34.0	18.0	35100	13.0	10200	257	0.0520	20	792	3750	0.2	0.070	0.500	63.0
M4W	22700	<0.3	5.0	0.4	0.210	32.0	18.0	33100	11.0	9200	234	0.0500	19	707	3360	0.2	0.070	<0.5	59.0
M8E	20500	0.4	8.0	0.4	0.110	29.0	16.0	33500	16.0	8360	252	0.0480	18	831	3000	0.2	0.060	<0.5	56.0
M8W	24900	<0.3	6.0	0.5	0.150	34.0	16.0	33800	9.0	10600	245	0.1020	20	734	3890	0.2	0.080	0.500	58.0
Parry Bay 1	21800	0.2	6.0	0.4	0.160	34.0	14.0	33700	7.0	9780	270	0.0320	19	654	3350	0.2	0.020	0.500	50.0
Parry Bay 2	20700	0.2	6.0	0.4	0.070	32.0	12.0	32200	7.0	8600	259	0.0330	19	633	3150	0.2	0.030	<0.5	48.0
Parry Bay 3	21300	0.2	6.0	0.4	0.060	31.0	13.0	32700	8.0	8410	250	0.0350	18	667	3030	0.2	0.040	0.600	51.0
Constance Bank	15500	<0.3	5	0.3	0.23	24	11	24600	5	7130	257	0.0240	15	625	2770	0.3	0.07	<0.5	36

	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Fluoranthene	Pyrene	Benzo(a)pyrene	Chrycene	Benzo(a)-anthracene	Dibenz[a,h]anthracene	PAH Total
Revised on November 5, 2005 **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
Ratio of CRD Max to Contaminated Sites Regulation:	**28.2**	**1.1**	**21.0**	**10.6**	**1.6**	**25.4**	**8.9**	**7.4**	**7.5**	**6.8**	**10.4**	**6.7**	**4.0**
CRD "Sediment Quality Guidelines" *	**0.5000**	**1.3000**	**0.9600**	**0.5400**	**2.1000**	**1.5000**	**1.7000**	**2.6000**	**1.6000**	**1.4000**	**1.3000**	**0.23**	
BC Contaminated Sites Regulation Criteria **	**0.1100**	**0.1500**	**0.2900**	**0.1700**	**0.4700**	**0.6500**	**1.8000**	**1.7000**	**0.9200**	**1.0000**	**0.8300**	**0.16**	**20**
Canadian Environmental Quality Guidelines PEL	**0.0889**	**0.1280**	**0.2450**	**0.1440**	**0.3910**	**0.5440**	**1.4940**	**1.3980**	**0.7630**	**0.8460**	**0.6930**	**0.135**	
Canadian Environmental Quality Guidelines ISQG	**0.0067**	**0.0059**	**0.0469**	**0.0212**	**0.0346**	**0.0867**	**0.1130**	**0.1530**	**0.0888**	**0.1080**	**0.0748**	**0.00622**	
Ratio of CRD Guidelines to BC Contaminated Sites Reg:	**4.55**	**8.67**	**3.31**	**3.18**	**4.47**	**2.31**	**0.94**	**1.53**	**1.74**	**1.40**	**1.57**	**1.44**	
Actual Max	3.100	0.170	6.100	1.800	0.740	16.500	16.000	12.600	6.900	6.800	8.600	1.070	79.5
Actual Mean (averages are for Macaulay only)	**0.162**	**0.018**	**0.610**	**0.103**	**0.060**	**0.943**	**0.994**	**0.801**	**0.454**	**0.443**	**0.542**	**0.072**	**4.910**
Actual Min	0.010	0.010	0.020	0.010	0.010	0.040	0.020	0.010	0.010	0.010	0.010	0.010	0.0
Std Dev.	0.629	0.033	1.664	0.364	0.148	3.340	3.247	2.556	1.398	1.386	1.746	0.216	12.6
The Clover Pt. rows are hidden - no data from 2000-2002.													
C0	0.010	0.030	0.190	0.030	0.030	0.560	2.100	1.700	0.610	1.220	1.090	0.060	7.63
M0	0.040	0.020	0.140	0.030	0.030	0.430	0.870	0.760	0.410	0.400	0.440	0.050	3.62
M1E	0.060	0.010	0.180	0.050	0.060	0.610	1.070	0.910	0.560	0.510	0.630	0.090	4.74
M1N	0.010	0.010	0.020	0.010	0.020	0.090	0.150	0.140	0.130	0.100	0.130	0.010	0.82
M1NE	0.010	0.010	<0.01	0.010	0.010	0.040	0.040	0.030	0.020	0.020	0.020	0.010	0.22
M1NW	0.010	0.010	<0.01	0.010	0.010	0.050	0.020	0.020	0.010	0.010	0.010	0.010	0.17
M1S	0.030	0.010	0.070	0.020	0.030	0.230	0.430	0.350	0.240	0.210	0.230	0.030	1.88
M1SE	0.240	0.010	0.480	0.190	0.160	1.910	2.260	1.810	1.130	1.100	1.310	0.170	10.77
M1SW	0.020	0.010	0.050	0.020	0.040	0.210	0.190	0.190	0.090	0.100	0.110	0.010	1.04
M1W	0.010	0.020	0.030	0.020	0.030	0.100	0.160	0.150	0.080	0.130	0.100	0.020	0.85
M2E	3.100	0.020	6.100	1.800	0.020	16.500	16.000	12.600	6.900	6.800	8.600	1.070	79.51
M2N	0.010	0.010	<0.01	0.010	0.010	0.070	0.080	0.060	0.050	0.040	0.050	0.010	0.40
M2NE	0.010	0.010	<0.01	0.010	0.010	0.050	0.020	0.010	0.010	0.010	0.010	0.010	0.16
M2NW	0.010	0.010	<0.01	0.010	0.010	0.040	0.020	0.010	0.010	0.010	0.010	0.010	0.15
M2S	0.010	0.010	<0.01	0.010	0.010	0.060	0.030	0.020	0.010	0.010	0.010	0.010	0.19
M2SE	0.020	0.010	0.090	0.020	0.050	0.320	0.660	0.570	0.360	0.290	0.310	0.040	2.74
M2SW	0.010	0.010	<0.01	0.010	0.020	0.060	0.040	0.040	0.020	0.020	0.020	0.010	0.26
M2W	0.010	0.010	<0.01	0.010	0.010	0.070	0.030	0.020	0.010	0.010	0.010	0.010	0.20
M4E	0.010	0.010	0.030	0.020	0.030	0.140	0.090	0.100	0.040	0.050	0.050	0.010	0.58
M4SE	0.060	0.170	0.110	0.080	0.740	0.440	0.500	0.440	0.230	0.240	0.290	0.030	3.33
M4SW	0.010	0.010	<0.01	0.010	0.010	0.050	0.030	0.030	0.020	0.020	0.020	0.010	0.22
M4W	0.010	0.010	<0.01	0.010	0.020	0.050	0.020	0.020	0.010	0.010	0.010	0.010	0.18
M8E	0.010	0.010	0.020	0.010	0.030	0.100	0.140	0.140	0.090	0.090	0.080	0.010	**0.73**
M8W	0.010	0.010	<0.01	0.010	0.020	0.060	0.020	0.010	0.010	0.010	0.010	0.010	0.18
Parry Bay 1	<0.01	<0.01	<0.01	<0.01	0.010	0.030	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
Parry Bay 2	<0.01	<0.01	<0.01	<0.01	0.010	0.030	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04
Parry Bay 3	<0.01	<0.01	<0.01	<0.01	<0.01	0.020	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Constance Bank	<0.01	<0.01	<0.01	<0.01	<0.01	0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01

Page 3: CRD Sediment Data from 2002

Macaulay Pt. and Clover Pt.

	Al	Sb	As	Be	Cd	Cr	Cu	Fe	Pb	Mg	Mn	Hg	Ni	P	K	Se	Ag	Ti	Zn
Revised on November 5, 2005 **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	mg/kg	mg/kg	mg/kg	mg/kg
Ratio of CRD Max to Contaminated Sites Regulation:							**1.2**		**1.0**										**1.3**
CRD "Sediment Quality Guidelines" *	**---**	**150**	**57**	**---**	**5.1**	**260**	**390**	**---**	**450**	**---**	**---**	**0.41**	**---**	**---**	**---**	**---**	**6.1**	**0.5**	**410**
BC Contaminated Sites Regulation Criteria **			**50**		**5.0**	**190**	**130**		**130**			**0.84**					**-**		**330**
Canadian Environmental Quality Guidelines PEL			**41.6**		**4.2**	**160**	**108**		**112**			**0.70**					**-**		**271**
Canadian Environmental Quality Guidelines ISQG	**none**	**none**	**7.24**	**none**	**0.7**	**52.3**	**19**	**none**	**30**	**none**	**none**	**0.13**	**none**	**none**	**none**	**none**	**none**	**none**	**124**
Ratio of CRD Guidelines to BC Contaminated Sites Reg:							**3.00**		**3.46**										**1.24**
Actual Max	28700	3.60	10.70	0.50	83.50	52.00	158	53700	130	11600	352	0.52	34.00	2660	4760	0.50	4.8	0.00	431
Actual Mean (averages are for Macaulay only)	**25170**	**0.74**	**6.48**	**0.46**	**4.05**	**38.30**	**40.96**	**34316**	**32.6**	**10464**	**259**	**0.12**	**21.74**	**927**	**4068**	**0.30**	**0.33**		**101.83**
Actual Min	15000	0.20	4.30	0.20	0.15	25.00	10	20100	7	6900	223	0.03	16.00	568	1830	0.20	0.09	0.00	34.00
Std Dev.	3038	0.85	1.69	0.07	16.62	5.31	38	5749	35	861	26	0.14	3.40	421	644	0.07	0.95		79.34
The Clover Pt. rows are hidden - no data from 2000-2002.																			
C0	18233	3	5.4	0.2	0.620	47.0	133.0	28333	128.3	9683	302	0.5120	20	1367	1830	0.4	4.830	<0.5	147.0
M0	25100	1.3	9.4	0.5	0.760	44.0	158.0	29200	130.0	9810	223	0.1860	34	2660	4330	<0.1	1.290	<0.5	132.0
M1E	28700	3.6	6.4	0.5	0.650	42.0	58.0	37300	53.4	11300	288	0.2550	25	843	4470	0.3	0.250	<0.5	156.0
M1N	28700	0.6	5.0	0.5	0.260	39.0	21.0	36700	40.4	11600	271	0.0260	22	750	4760	0.3	0.340	<0.5	64.0
M1NE	25200	0.3	5.3	0.5	0.540	38.0	22.0	35800	13.5	10900	264	0.0560	22	782	3870	0.3	0.250	<0.5	67.0
M1NW	26300	0.3	4.6	0.5	0.210	36.0	17.0	31700	9.2	10600	249	0.0330	19	697	4320	0.2	0.090	<0.5	58.0
M1S	25100	1.7	5.4	0.5	0.320	35.0	52.0	31700	20.8	10200	247	0.0580	21	855	4190	0.3	0.330	<0.5	79.0
M1SE	21400	0.7	10.7	0.4	0.880	41.0	81.0	33700	98.3	10100	232	0.1420	26	1110	3440	0.5	0.370	<0.5	95.0
M1SW	27900	1.3	8.0	0.5	83.50	42.0	80.0	34900	43.6	10800	263	0.0910	23	989	4730	0.4	0.480	<0.5	431.0
M1W	24667	0.8	7.2	0.4	1.120	52.0	80.0	34900	38.8	10567	248	0.2640	24	962	3987	0.4	1.240	<0.5	116.0
M2E	26100	0.5	7.5	0.4	0.480	44.0	32.0	34700	41.1	10600	284	0.1670	21	846	4050	0.3	0.340	<0.5	211.0
M2N	25800	0.3	5.1	0.5	0.230	37.0	19.0	33000	18.5	10600	267	0.0320	20	749	4220	0.3	0.110	<0.5	64.0
M2NE	24100	0.3	5.2	0.4	0.240	35.0	44.0	31600	11.9	10100	243	0.2240	19	719	4000	0.3	0.360	<0.5	64.0
M2NW	24600	0.3	6.1	0.4	0.230	37.0	17.0	31500	10.1	10400	249	0.0280	20	697	4040	0.3	0.120	<0.5	64.0
M2S	25400	0.7	4.9	0.5	0.190	37.0	25.0	34000	17.9	9870	252	0.0320	20	702	4210	0.2	0.130	<0.5	62.0
M2SE	22000	0.9	7.5	0.4	1.650	33.0	55.0	28600	58.9	10100	241	0.5210	19	1410	3260	0.3	0.580	<0.5	104.0
M2SW	23700	0.4	5.5	0.4	0.290	38.0	17.0	29100	11.0	9630	228	0.0320	18	644	4100	0.2	0.200	<0.5	60.0
M2W	28000	0.2	5.9	0.5	0.230	36.0	18.0	33500	9.3	11000	263	0.0250	21	744	4570	0.3	0.140	<0.5	62.0
M4E	23133	0.6	7.1	0.4	0.240	34.0	29.0	34167	23.3	9900	245	0.0710	21	854	3677	0.3	0.360	<0.5	72.0
M4SE	25800	1.2	9.1	0.5	0.270	32.0	46.0	53700	44.6	10100	352	0.0370	22	1250	3490	0.3	0.140	<0.5	88.0
M4SW	24300	0.3	5.3	0.5	0.190	37.0	17.0	33100	11.2	10500	258	0.0250	20	727	3920	0.3	0.120	<0.5	63.0
M4W	22900	0.3	4.9	0.4	0.210	35.0	17.0	32800	10.7	10700	252	0.2930	20	733	3490	0.2	0.100	<0.5	63.0
M8E	25000	0.3	8.0	0.5	0.200	38.0	22.0	41500	22.4	10800	277	0.2100	23	889	4180	0.3	0.120	<0.5	106.0
M8W	25000	0.2	4.9	0.5	0.180	39.0	15.0	32100	10.6	10500	254	0.0300	20	698	4260	0.3	0.100	<0.5	61.0
Parry Bay 1	27000	0.2	5.8	0.5	0.120	37.0	15.0	34700	8.3	10600	276	0.0220	20	665	3560	0.4	0.210	<0.5	48.0
Parry Bay 2	22200	0.3	5.5	0.4	0.130	36.0	12.0	34800	8.8	9860	256	0.0250	20	701	3530	0.2	0.080	<0.5	53.0
Parry Bay 3	22200	0.3	6.1	0.4	0.130	36.0	12.0	33300	7.2	10200	273	0.0200	20	790	4500	0.2	0.070	<0.5	58.0

	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Fluoranthene	Pyrene	Benzo(a)pyrene	Chrycene	Benzo(a)-anthracene	Dibenz[a,h]anthracene	PAH Total (1)	2-methylnaphthalene
Revised on November 5, 2005 **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
Ratio of CRD Max to Contaminated Sites Regulation:	**1.5**	**0.7**	**1.3**	**1.7**	**0.4**	**2.8**	**1.2**	**1.1**	**1.2**	**1.0**	**1.4**	**0.8**	**0.5**	**0.7**
CRD "Sediment Quality Guidelines" *	**0.5000**	**1.3000**	**0.9600**	**0.5400**	**2.1000**	**1.5000**	**1.7000**	**2.6000**	**1.6000**	**1.4000**	**1.3000**	**0.23**		
BC Contaminated Sites Regulation Criteria **	**0.1100**	**0.1500**	**0.2900**	**0.1700**	**0.4700**	**0.6500**	**1.8000**	**1.7000**	**0.9200**	**1.0000**	**0.8300**	**0.16**	**20**	**0.2400**
Canadian Environmental Quality Guidelines PEL	**0.0889**	**0.1280**	**0.2450**	**0.1440**	**0.3910**	**0.5440**	**1.4940**	**1.3980**	**0.7630**	**0.8460**	**0.6930**	**0.135**		**0.2010**
Canadian Environmental Quality Guidelines ISQG	**0.0067**	**0.0059**	**0.0469**	**0.0212**	**0.0346**	**0.0867**	**0.1130**	**0.1530**	**0.0888**	**0.1080**	**0.0748**	**0.00622**		**0.0202**
Ratio of CRD Guidelines to BC Contaminated Sites Reg:	**4.55**	**8.67**	**3.31**	**3.18**	**4.47**	**2.31**	**0.94**	**1.53**	**1.74**	**1.40**	**1.57**	**1.44**		
Actual Max	0.166	0.110	0.370	0.290	0.190	1.800	2.170	1.910	1.080	1.010	1.170	0.130	9.4	0.160
Actual Mean (averages are for Macaulay only)	**0.036**	**0.015**	**0.070**	**0.046**	**0.043**	**0.306**	**0.410**	**0.347**	**0.175**	**0.191**	**0.184**	**0.025**	**1.851**	**0.06**
Actual Min	0.005	0.005	0.010	0.010	0.010	0.030	0.020	0.020	0.010	0.010	0.010	0.005	0.2	0.020
Std Dev.	0.040	0.024	0.085	0.061	0.038	0.416	0.542	0.460	0.237	0.229	0.249	0.028	2.3	0.040
The Clover Pt. rows are hidden - no data from 2000-2002.														
C0	0.031	0.040	0.09	0.03	0.04	0.26	0.48	0.42	0.27	0.21	0.25	0.035	2.156	0.02
M0	0.166	0.054	0.37	0.10	0.08	1.19	2.17	1.91	1.08	1.01	1.17	0.13	9.430	0.08
M1E	0.025	0.005	0.05	0.03	0.04	0.16	0.25	0.21	0.11	0.11	0.12	0.014	1.124	0.05
M1N	0.054	0.008	0.09	0.04	0.02	0.33	0.63	0.49	0.25	0.34	0.27	0.043	2.565	0.03
M1NE	0.012	0.005	0.02	0.01	0.02	0.08	0.06	0.05	0.02	0.03	0.03	0.005	0.342	0.03
M1NW	0.005	0.008	0.01	0.01	0.02	0.04	0.04	0.04	0.02	0.04	0.03	0.005	0.268	0.02
M1S	0.010	0.006	0.02	0.01	0.02	0.06	0.09	0.09	0.06	0.09	0.07	0.012	0.538	0.02
M1SE	0.096	0.013	0.17	0.09	0.05	0.71	1.10	0.78	0.37	0.39	0.39	0.047	4.206	0.06
M1SW	0.017	0.006	0.04	0.02	0.03	0.16	0.27	0.23	0.12	0.12	0.14	0.016	1.169	0.06
M1W	0.059	0.036	0.12	0.05	0.04	0.48	0.91	0.71	0.35	0.39	0.34	0.045	3.530	0.05
M2E	0.106	0.110	0.20	0.29	0.10	1.80	1.50	1.30	0.45	0.52	0.41	0.057	6.843	0.16
M2N	0.010	0.014	0.03	0.02	0.04	0.17	0.20	0.18	0.11	0.13	0.1	0.018	1.022	0.04
M2NE	0.005	0.005	0.01	0.01	0.01	0.03	0.02	0.02	0.01	0.02	0.01	0.005	0.155	0.02
M2NW	0.005	0.005	0.01	0.01	0.02	0.04	0.02	0.02	0.01	0.01	0.01	0.005	0.165	0.04
M2S	0.007	0.005	0.01	0.01	0.02	0.06	0.04	0.04	0.02	0.03	0.02	0.005	0.267	0.03
M2SE	0.048	0.015	0.12	0.05	0.06	0.38	0.77	0.62	0.36	0.35	0.38	0.046	3.199	0.05
M2SW	0.026	0.005	0.05	0.02	0.02	0.14	0.33	0.28	0.17	0.17	0.19	0.022	1.423	0.04
M2W	0.020	0.005	0.01	0.01	0.02	0.07	0.06	0.05	0.02	0.03	0.03	0.005	0.330	0.03
M4E	0.070	0.006	0.13	0.12	0.19	0.43	0.32	0.33	0.14	0.15	0.17	0.019	2.075	0.15
M4SE	0.030	0.007	0.04	0.07	0.05	0.24	0.15	0.13	0.07	0.12	0.09	0.015	1.012	0.1
M4SW	0.005	0.005	0.01	0.01	0.02	0.04	0.02	0.02	0.01	0.01	0.01	0.005	0.165	0.03
M4W	0.005	0.005	0.01	0.01	0.02	0.04	0.02	0.02	0.01	0.02	0.01	0.005	0.175	0.03
M8E	0.051	0.020	0.09	0.06	0.07	0.34	0.45	0.44	0.26	0.3	0.24	0.043	**2.364**	0.12
M8W	0.005	0.005	0.01	0.01	0.04	0.04	0.02	0.02	0.01	0.02	0.01	0.01	0.195	0.04
Parry Bay 1	<0.005	<0.005	<0.01	<0.01	0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005		0.02
Parry Bay 2	<0.005	<0.005	<0.01	<0.01	<0.01	0.02	0.01	0.01	<0.01	0.01	<0.01	<0.005		0.02
Parry Bay 3	<0.005	<0.005	<0.01	<0.01	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005		0.02

Page 4: CRD Sediment Data from 2003

Macaulay Pt. and Clover Pt.

Revised on November 5, 2005	Al	Sb	As	Be	Cd	Cr	Cu	Fe	Pb	Mg	Mn	Hg	Ni	P	K	Se	Ag	Ti	Zn
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	mg/kg	mg/kg	mg/kg	mg/kg
Ratio of CRD Max to Contaminated Sites Regulation:							**2.1**		**1.5**										**1.1**
CRD "Sediment Quality Guidelines" *	**---**	**150**	**57**	**---**	**5.1**	**260**	**390**	**---**	**450**	**---**	**---**	**0.41**	**---**	**---**	**---**	**---**	**6.1**	**0.5**	**410**
BC Contaminated Sites Regulation Criteria **			**50**		**5.0**	**190**	**130**		**130**			**0.84**					**-**		**330**
Canadian Environmental Quality Guidelines PEL			**41.6**		**4.2**	**160**	**108**		**112**			**0.70**					**-**		**271**
Canadian Environmental Quality Guidelines ISQG	**none**	**none**	**7.24**	**none**	**0.7**	**52.3**	**19**	**none**	**30**	**none**	**none**	**0.13**	**none**	**none**	**none**	**none**	**none**	**none**	**124**
Ratio of CRD Guidelines to BC Contaminated Sites Reg:							**3.00**		**3.46**										**1.24**
Actual Max	27000	2.17	10.90	0.49	0.80	56.70	273	36000	190	10800	345	0.55	28.40	2140	3810	0.52	12.5	0.00	369
Actual Mean (averages are for Macaulay only)	**22848**	**0.72**	**6.14**	**0.40**	**0.34**	**34.11**	**46.10**	**28404**	**41.8**	**8922**	**245**	**0.18**	**20.53**	**867**	**3134**	**0.25**	**0.57**		**85.23**
Actual Min	11400	0.24	3.60	0.22	0.11	16.70	8	15200	3	5650	201	0.02	11.10	428	1500	0.12	0.03	0.00	27.60
Std Dev.	4264	0.49	1.56	0.07	0.19	6.78	50	5020	43	1087	32	0.16	3.34	313	555	0.08	2.00		54.86
C0	20900	0.80	7.1	0.25	0.613	37.6	172.0	28600	58.6	9650	345	0.1580	23.6	1480	1500	0.52	12.500	<0.50	105.0
C1NE	15600	0.30	3.9	0.26	0.184	22.3	12.3	18900	5.3	7230	211	0.0261	14.7	661	2170	0.23	0.150	<0.50	35.5
C1NW	15100	0.26	4.0	0.28	0.197	22.6	14.9	18900	6.2	7220	206	0.0282	15.3	765	2600	0.22	0.102	<0.50	37.8
C1SE	14400	0.33	4.8	0.26	0.221	24.8	13.4	20400	5.7	7220	209	0.0630	16.2	647	2240	0.21	0.508	<0.50	39.5
C1SW	14000	0.30	4.4	0.26	0.171	22.1	11.1	17500	4.7	6990	216	0.2980	14	943	2300	0.2	0.204	<0.50	32.7
C2E	15500	0.38	7.1	0.29	0.436	25.8	17.3	19600	8.9	7240	209	0.4410	16.4	883	2470	0.22	0.399	<0.50	43.6
C2S	18600	0.49	4.9	0.31	0.152	28.3	12.3	22200	6.1	8010	241	0.0261	17.6	736	2770	0.23	0.061	<0.50	39.5
C2W	14800	0.24	4.1	0.25	0.179	22.3	12.1	18300	4.8	6940	263	0.0250	15.1	689	2040	0.18	0.058	<0.50	31.6
C4E	12533	0.26	4.3	0.25	0.151	20.8	10.1	16967	5.1	6523	216	0.0223	12.9	479	1783	0.14	0.052	<0.50	30.0
C4SE	20900	0.30	5.1	0.34	0.145	32.3	13.8	24900	6.9	8460	257	0.0259	19.6	628	3090	0.22	0.054	<0.50	43.9
C4SW	17900	0.28	5.2	0.32	0.135	26.6	15.7	22800	55.0	8220	270	0.0253	17.5	656	2460	0.16	0.050	<0.50	37.4
C4W	16800	0.27	4.4	0.34	0.167	24.6	15.1	21600	4.7	8040	262	0.0231	16.3	800	2430	0.23	0.048	<0.50	43.8
C8E	16400	0.25	4.6	0.27	0.134	25.0	12.3	20500	5.0	7400	237	0.0187	16.1	604	2210	0.16	0.046	<0.50	34.2
C8W	16600	0.33	5.1	0.3	0.165	26.0	13.6	21700	6.4	8010	234	0.0311	16.5	757	2680	0.26	0.125	<0.50	39.5
CB2	13100	0.27	3.6	0.22	0.105	19.8	8.7	16100	3.8	6320	225	0.0151	11.8	521	2170	0.14	0.041	<0.50	28.5
CB3	11400	<0.20	3.6	<0.20	0.117	16.7	7.8	15200	3.3	5650	231	0.0152	11.1	428	1870	0.18	0.033	<0.50	27.6
CB1	16800	0.30	5.1	0.28	0.128	27.0	12.1	21600	5.3	8050	275	0.0262	16.2	587	2530	0.24	0.150	<0.50	39.4
M0	25900	2.10	6.4	0.36	0.803	56.7	273.0	30500	64.6	10800	319	0.1140	28.4	2140	2660	0.37	1.200	<0.50	369.0
M1E	19900	2.17	10.9	0.32	0.785	32.0	85.1	28700	55.0	7990	208	0.2760	21.4	916	2820	0.47	1.120	<0.50	95.9
M1N	24700	0.45	5.0	0.41	0.184	34.3	20.3	29500	11.0	9530	246	0.0396	21	713	3390	0.27	0.119	<0.50	70.7
M1NE	24000	0.35	5.1	0.39	0.237	32.3	19.5	26700	9.8	8990	226	0.0370	19.4	681	3440	0.26	0.147	<0.50	59.7
M1NW	20800	0.32	4.6	0.35	0.179	28.0	14.1	23000	8.4	7850	204	0.0325	16.8	572	3440	0.12	0.080	<0.50	48.9
M1S	20500	0.43	6.2	0.37	0.430	32.3	76.8	28200	69.4	8490	242	0.1270	20.1	865	2720	0.23	0.481	<0.50	65.3
M1SE	17333	1.01	9.6	0.33	0.739	30.6	99.6	22433	186.0	7410	201	0.4637	19.1	1670	2503	0.33	0.647	<0.50	118.9
M1SW	24000	0.57	6.2	0.43	0.382	34.2	62.5	27300	40.8	9060	231	0.4920	20.2	844	3400	0.28	0.965	<0.50	93.1
M1W	22600	0.82	6.3	0.42	0.506	33.4	29.8	25800	45.4	8360	231	0.3950	19.7	819	3080	0.26	3.500	<0.50	76.7
M2E	19100	0.96	7.0	0.35	0.368	34.4	32.5	36000	55.2	8470	268	0.2330	19.9	718	2770	0.18	0.328	<0.50	75.5
M2N	24500	1.07	5.5	0.43	0.274	34.7	29.9	29600	24.2	9480	265	0.0694	22.2	781	3340	0.22	0.205	<0.50	67.3
M2NE	27000	0.73	5.4	0.47	0.227	34.8	23.5	31400	11.7	9680	250	0.5490	20.4	973	3650	0.19	0.561	<0.50	57.9
M2NW	23200	0.28	4.7	0.41	0.208	32.9	17.6	26800	8.4	8920	224	0.0654	19	634	3380	0.2	0.125	<0.50	55.8
M2S	23700	0.32	5.1	0.42	0.174	34.0	24.7	28400	12.0	9070	245	0.3470	21.2	734	3150	0.24	0.395	<0.50	61.3
M2SE	21900	0.77	8.0	0.37	0.496	32.3	51.9	27300	79.5	9710	268	0.2310	21	951	2840	0.27	0.956	<0.50	74.2
M2SW	21800	0.3	4.6	0.38	0.208	32.1	22.2	27400	10.7	8700	225	0.2090	19.8	656	2930	0.23	0.394	<0.50	58.8
M2W	20900	0.32	5.1	0.37	0.261	31.8	27.3	26600	9.2	8650	220	0.0458	19.2	688	2830	0.2	0.463	<0.50	60.3
M4E	22200	0.51	5.6	0.49	0.228	32.1	35.0	30200	27.0	8460	323	0.1020	20.5	792	2930	0.26	0.642	<0.50	127.0
M4SE	21400	1.9	8.4	0.4	0.342	31.2	44.8	29800	190.0	8270	254	0.2330	20.1	878	2700	0.28	0.323	<0.50	88.1
M4SW	26000	0.29	5.0	0.44	0.153	36.1	16.8	29300	10.4	9490	249	0.0342	20.1	723	3810	0.24	0.084	<0.50	59.3
M4W	26500	0.29	5.0	0.42	0.182	35.0	16.2	28200	8.6	9170	241	0.0380	19.9	698	3680	0.2	0.102	<0.50	57.2
M8E	22800	0.37	6.4	0.41	0.191	34.7	21.1	30900	14.7	9400	257	0.0470	22.6	791	3220	0.26	0.262	<0.50	61.1
M8W	24767	0.28	5.1	0.42	0.165	34.6	16.1	29267	9.2	9257	245	0.0369	20.3	694	3410	0.21	0.112	<0.50	58.4
Parry Bay 1	22600	0.24	5.8	0.39	0.125	33.7	13.4	28200	6.9	9000	252	0.0316	20.2	676	3370	0.17	0.056	<0.50	50.5
Parry Bay 3	25700	0.3	5.6	0.43	0.112	36.3	16.7	30200	7.8	9720	265	0.0360	21.3	802	3710	0.24	0.066	<0.50	59.0
Parry Bay 2	21800	0.2	5.9	0.39	0.129	35.1	13.5	28700	6.6	9070	267	0.0319	20.1	652	3010	0.26	0.105	<0.50	53.2

Revised on November 5, 2005	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Fluoranthene	Pyrene	Benzo(a)pyrene	Chrycene	Benzo(a)-anthracene	Dibenz[a,h]anthracene	PAH Total	2-methylnaphthalene
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
Ratio of CRD Max to Contaminated Sites Regulation:	**31.3**	**1.1**	**23.6**	**13.1**	**1.7**	**29.7**	**11.5**	**10.1**	**9.6**	**9.0**	**11.7**	**6.9**	**4.9**	**1.8**
CRD "Sediment Quality Guidelines" *	**0.5000**	**1.3000**	**0.9600**	**0.5400**	**2.1000**	**1.5000**	**1.7000**	**2.6000**	**1.6000**	**1.4000**	**1.3000**	**0.23**		
BC Contaminated Sites Regulation Criteria **	**0.1100**	**0.1500**	**0.2900**	**0.1700**	**0.4700**	**0.6500**	**1.8000**	**1.7000**	**0.9200**	**1.0000**	**0.8300**	**0.16**	**20**	**0.2400**
Canadian Environmental Quality Guidelines PEL	**0.0889**	**0.1280**	**0.2450**	**0.1440**	**0.3910**	**0.5440**	**1.4940**	**1.3980**	**0.7630**	**0.8460**	**0.6930**	**0.135**		**0.2010**
Canadian Environmental Quality Guidelines ISQG	**0.0067**	**0.0059**	**0.0469**	**0.0212**	**0.0346**	**0.0867**	**0.1130**	**0.1530**	**0.0888**	**0.1080**	**0.0748**	**0.00622**		**0.0202**
Ratio of CRD Guidelines to BC Contaminated Sites Reg:	**4.55**	**8.67**	**3.31**	**3.18**	**4.47**	**2.31**	**0.94**	**1.53**	**1.74**	**1.40**	**1.57**	**1.44**		
Actual Max	3.439	0.160	6.836	2.222	0.780	19.287	20.620	17.117	8.815	9.017	9.747	1.104	98.3	0.440
Actual Mean (averages are for Macaulay only)	**0.197**	**0.016**	**0.379**	**0.158**	**0.068**	**1.284**	**1.349**	**1.126**	**0.561**	**0.580**	**0.606**	**0.077**	**6.401**	**0.06**
Actual Min	0.002	0.002	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.002	0.1	0.010
Std Dev.	0.544	0.026	1.077	0.357	0.123	3.087	3.298	2.728	1.400	1.435	1.543	0.177	15.6	0.073
C0	0.294	0.0335	0.522	0.192	0.028	2.070	2.360	1.840	0.945	1.100	1.140	0.173	10.70	0.021
C1NE	0.007	0.0034	0.013	0.010	0.024	0.056	0.040	0.033	0.013	0.013	0.012	0.002	0.23	0.016
C1NW	0.008	0.0020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.002	0.11	0.016
C1SE	0.020	0.0034	0.047	0.011	0.015	0.130	0.220	0.205	0.108	0.121	0.099	0.016	1.00	0.022
C1SW	0.007	0.0020	0.010	0.010	0.010	0.017	0.010	0.010	0.010	0.010	0.010	0.002	0.11	0.012
C2E	0.020	0.0046	0.055	0.013	0.013	0.136	0.320	0.250	0.185	0.129	0.142	0.032	1.30	0.019
C2S	0.003	0.0020	0.010	0.010	0.010	0.017	0.010	0.010	0.010	0.010	0.010	0.002	0.10	0.013
C2W	0.005	0.0020	0.010	0.010	0.023	0.023	0.010	0.013	0.010	0.010	0.010	0.002	0.13	0.040
C4E	0.009	0.0023	0.021	0.010	0.010	0.033	0.160	0.156	0.050	0.061	0.045	0.008	0.56	0.011
C4SE	0.007	0.0020	0.010	0.010	0.010	0.019	0.010	0.010	0.010	0.010	0.010	0.002	0.11	0.014
C4SW	0.002	0.0020	0.010	0.010	0.010	0.016	0.010	0.010	0.010	0.010	0.010	0.002	0.10	0.010
C4W	0.002	0.0050	0.010	0.010	0.010	0.025	0.030	0.038	0.026	0.020	0.014	0.003	0.19	0.012
C8E	0.006	0.0020	0.020	0.010	0.010	0.068	0.120	0.119	0.041	0.074	0.063	0.005	0.54	0.010
C8W	0.005	0.0032	0.010	0.010	0.010	0.035	0.070	0.082	0.052	0.064	0.059	0.011	0.41	0.018
CB2	0.005	0.0020	0.013	0.010	0.010	0.024	0.040	0.010	0.010	0.028	0.021	0.002	0.18	0.010
CB3	0.005	0.0020	0.010	0.010	0.010	0.011	0.010	0.010	0.010	0.010	0.010	0.002	0.10	0.010
CB1	0.002	0.0020	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.002	0.10	0.010
M0	0.382	0.0117	0.409	0.212	0.058	1.890	2.020	1.830	0.682	0.760	0.775	0.108	9.14	0.069
M1E	0.204	0.1600	0.390	0.520	0.780	3.940	4.020	2.970	1.380	1.480	1.100	0.211	17.16	0.440
M1N	0.005	0.0023	0.010	0.010	0.012	0.025	0.020	0.016	0.010	0.012	0.010	0.006	0.14	0.020
M1NE	0.008	0.0028	0.014	0.010	0.031	0.074	0.100	0.079	0.038	0.039	0.037	0.007	0.44	0.028
M1NW	0.010	0.0023	0.016	0.011	0.017	0.074	0.090	0.072	0.038	0.044	0.045	0.048	0.47	0.031
M1S	0.049	0.0105	0.089	0.041	0.022	0.377	0.560	0.402	0.246	0.010	0.300	0.048	2.15	0.041
M1SE	3.439	0.0110	6.836	2.222	0.050	19.287	20.620	17.117	8.815	9.017	9.747	1.104	98.27	0.049
M1SW	0.030	0.0112	0.049	0.022	0.045	0.177	0.200	0.167	0.099	0.083	0.079	0.017	0.98	0.051
M1W	0.070	0.0083	0.207	0.058	0.058	0.623	1.050	0.801	0.397	0.436	0.514	0.051	4.27	0.071
M2E	0.062	0.0087	0.172	0.049	0.026	0.493	1.000	0.994	0.515	0.504	0.501	0.071	4.40	0.029
M2N	0.005	0.0180	0.035	0.020	0.032	0.125	0.150	0.139	0.085	0.094	0.094	0.014	0.81	0.047
M2NE	0.006	0.0096	0.015	0.016	0.023	0.078	0.050	0.050	0.019	0.026	0.024	0.003	0.32	0.022
M2NW	0.004	0.0024	0.010	0.020	0.018	0.051	0.040	0.033	0.015	0.020	0.017	0.003	0.23	0.035
M2S	0.003	0.0020	0.010	0.020	0.026	0.042	0.020	0.019	0.010	0.012	0.010	0.002	0.18	0.041
M2SE	0.030	0.0200	0.035	0.060	0.043	0.598	0.150	0.159	0.085	0.131	0.098	0.015	1.42	0.049
M2SW	0.009	0.0047	0.027	0.016	0.018	0.121	0.130	0.111	0.051	0.066	0.063	0.008	0.62	0.029
M2W	0.008	0.0020	0.017	0.014	0.017	0.081	0.080	0.066	0.027	0.037	0.034	0.004	0.39	0.035
M4E	0.004	0.0041	0.011	0.010	0.021	0.058	0.050	0.050	0.021	0.034	0.022	0.004	0.29	0.031
M4SE	0.020	0.0175	0.025	0.050	0.038	0.298	0.090	0.086	0.039	0.058	0.047	0.007	0.78	0.055
M4SW	0.003	0.0048	0.011	0.010	0.014	0.058	0.070	0.065	0.030	0.028	0.033	0.004	0.33	0.026
M4W	0.004	0.0046	0.012	0.010	0.011	0.062	0.050	0.044	0.023	0.030	0.026	0.004	0.28	0.024
M8E	0.174	0.0405	0.290	0.221	0.185	0.931	0.420	0.589	0.255	0.384	0.330	0.033	**3.85**	0.221
M8W	0.009	0.0057	0.021	0.020	0.012	0.066	0.050	0.045	0.022	0.024	0.026	0.003	0.30	0.025
Parry Bay 1	0.002	0.0020	<0.010	<0.010	0.010	0.034	0.020	0.014	<0.010	0.012	<0.010	<0.002		0.010
Parry Bay 3	0.002	0.0056	<0.010	<0.010	0.011	0.037	0.020	0.024	0.019	0.025	0.023	0.002		0.011
Parry Bay 2	0.003	0.0020	<0.010	<0.010	<0.010	0.031	<0.010	<0.010	<0.010	<0.010	<0.010	<0.002		<0.010

Page 5: Geographical distribution of Copper around outfalls (2003)

Copper (Cu) criteria / standards:

BC *Contaminated Sites Regulation*:	130.0
Canadian PEL:	108.0
Canaadian ISQG:	19.0

Macaulay Point (Copper, 2003)

	West 800	West 400	West 200	West 100	0	East 100	East 200	East 400	East 800
North 200			17.6		29.9		23.5		
North 100				14.1	20.3	19.5			
0	16.1	16.2	27.3	29.8	273.0	85.1	32.5	35.0	21.1
South 100				62.5	76.8	99.6			
South 200			22.2		24.7		51.9		
South 400		16.8						44.8	

Sampling station locations around outfalls:

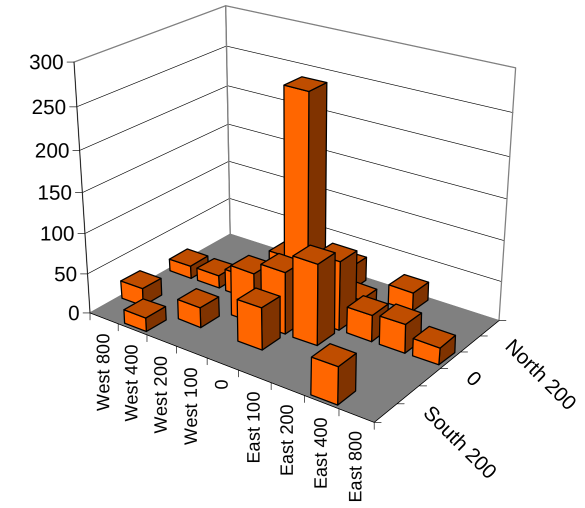
		2NW		2N		2NE		
			1NW	1N	1NE			
8W	4W	2W	1W	0	1E	2E	4E	8E
			1SW	1S	1SE			
		2SW		2S		2SE		
	4SW						4SE	

Clover Point (Copper, 2003)

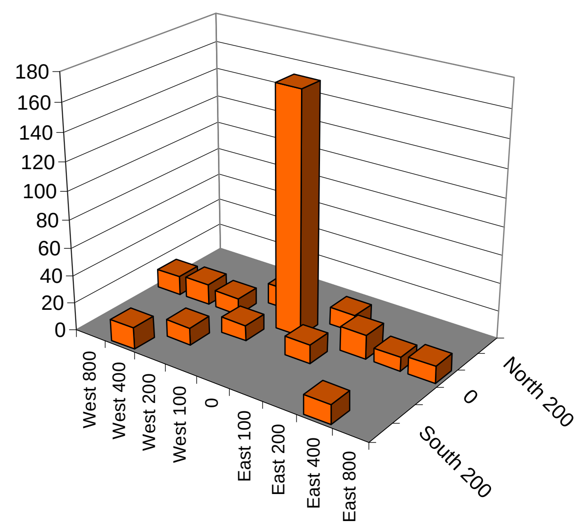
	West 800	West 400	West 200	West 100	0	East 100	East 200	East 400	East 800
North 200									
North 100				14.9		12.3			
0	13.6	15.1	12.1		172.0		17.3	10.1	12.3
South 100				11.1		13.4			
South 200					12.3				
South 400		15.7						13.8	

Graphs are oriented from the point of view of a person on the water, looking north-west

Copper contamination at & around Macaulay Point outfall (2003)



Copper contamination at & around Clover Point outfall (2003)



Page 6: Geographical distribution of Total PAH around outfalls (2003)

Total PAH criteria / standards:

BC *Contaminated Sites Regulation* : 20.0

Macaulay Point (Total PAH, 2003)

	West 800	West 400	West 200	West 100	0	East 100	East 200	East 400	East 800
North 200			0.23		0.81		0.32		
North 100				0.47	0.14	0.44			
0	0.30	0.28	0.39	4.27	9.14	17.16	4.40	0.29	3.85
South 100				0.98	2.15	98.27			
South 200			0.62		0.18		1.42		
South 400		0.33						0.78	

Sampling station locations around outfalls:

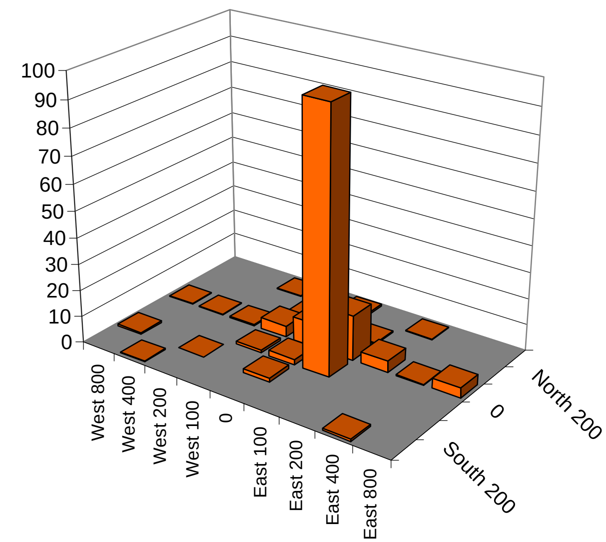
		2NW		2N		2NE		
			1NW	1N	1NE			
8W	4W	2W	1W	0	1E	2E	4E	8E
			1SW	1S	1SE			
		2SW		2S		2SE		
	4SW						4SE	

Clover Point (Total PAH, 2003)

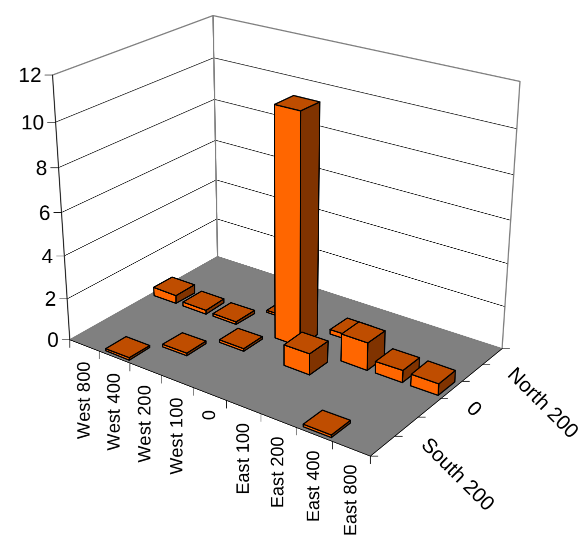
	West 800	West 400	West 200	West 100	0	East 100	East 200	East 400	East 800
North 200									
North 100				0.11		0.23			
0	0.41	0.19	0.13		10.70		1.30	0.56	0.54
South 100				0.11		1.00			
South 200					0.10				
South 400		0.10						0.11	

Graphs are oriented from the point of view of a person on the water, looking north-west

Total PAH contamination at & around Macaulay Point outfall (2003)



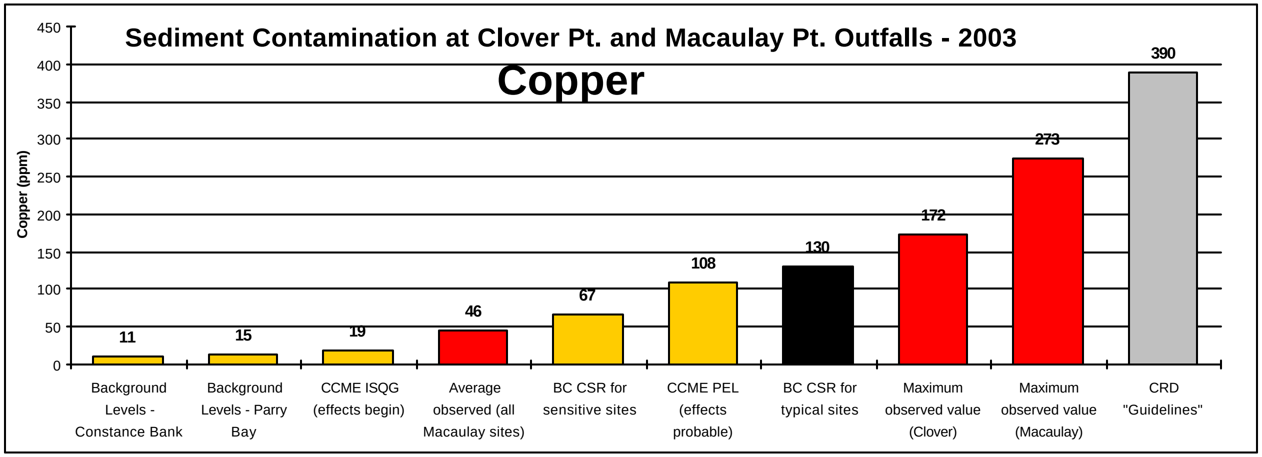
Total PAH contamination at & around Clover Point outfall (2003)



Page 7: Comparing observed background levels, standards/guidelines, and observed levels at & around outfalls (Copper & Phenanthrene, 2003)

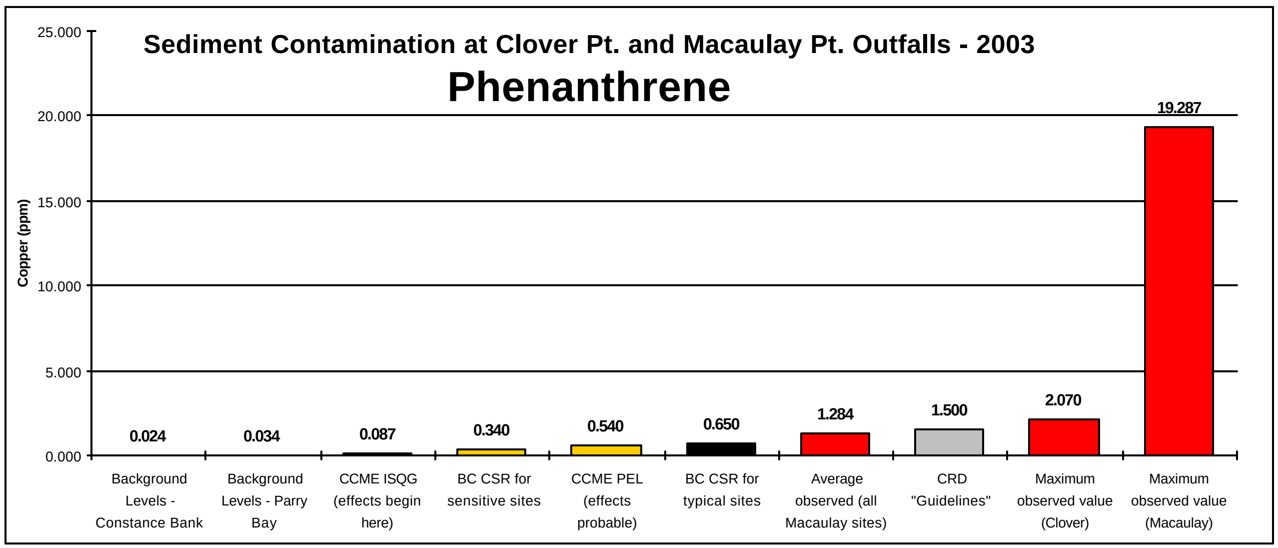
Copper

	mg/kg
Background Levels - Constance Bank	11
Background Levels - Parry Bay	15
CCME ISQG (effects begin)	19
Average observed (all Macaulay sites)	46
BC CSR for sensitive sites	67
CCME PEL (effects probable)	108
BC CSR for typical sites	130
Maximum observed value (Clover)	172
Maximum observed value (Macaulay)	273
CRD "Guidelines"	390



Phenanthrene

	mg/kg
Background Levels - Constance Bank	0.024
Background Levels - Parry Bay	0.034
CCME ISQG (effects begin here)	0.087
BC CSR for sensitive sites	0.340
CCME PEL (effects probable)	0.540
BC CSR for typical sites	0.650
Average observed (all Macaulay sites)	1.284
CRD "Guidelines"	1.500
Maximum observed value (Clover)	2.070
Maximum observed value (Macaulay)	19.287

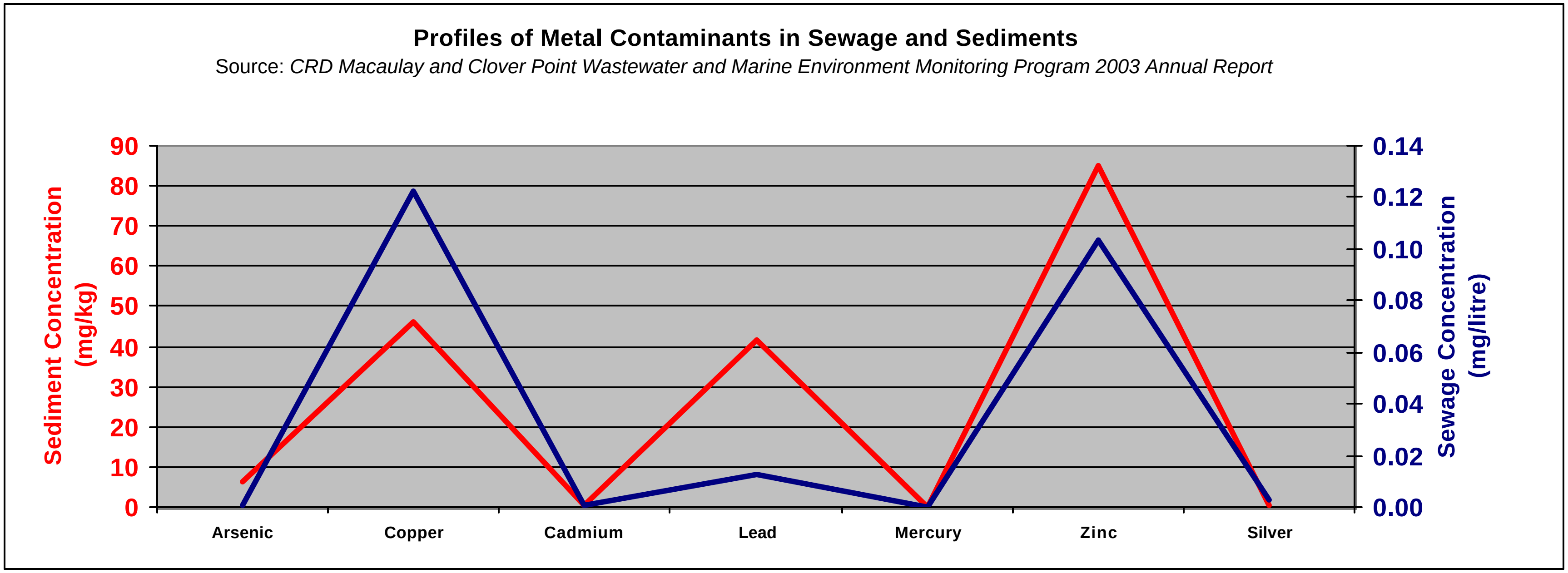


Page 8: Comparing metals in the sewage and sediments at Macaulay Point outfall

This is a "rough science" attempt to show that metals which are high in the sewage effluent are also high in the sediments, suggesting the most likely source of the sediment contamination is the sewage effluent

Correlation: 0.821

		Arsenic	Copper	Cadmium	Lead	Mercury	Zinc	Silver	
Macaulay (2003)	Concentration in Sewage	0.0007	0.1223	0.0010	0.0130	0.0001	0.1037	0.0027	mg/L
	Average concentration in Sediment	6.14	46.10	0.34	41.79	0.18	85.23	0.57	mg/Kg



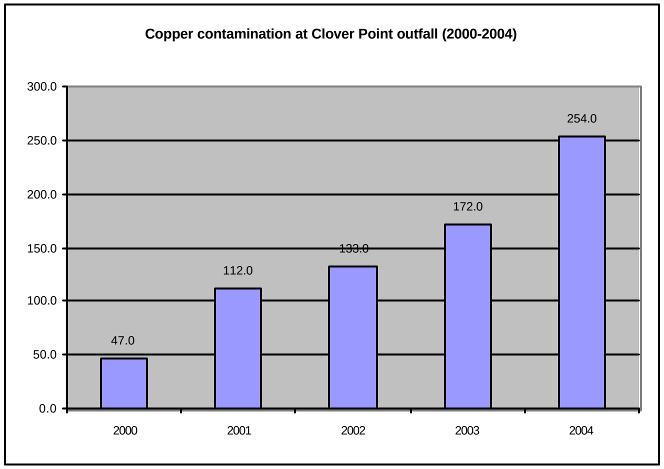
Page 9: Copper and Mercury contamination at outfalls over time (2000 - 2004)

Copper

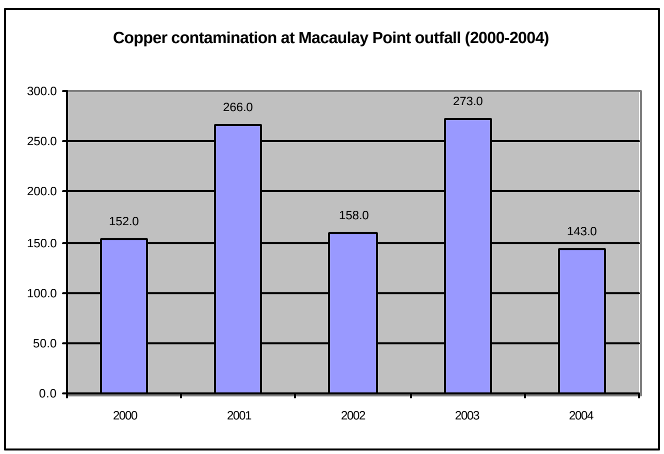
Copper (Cu) criteria / standards:

BC *Contaminated Sites Regulation*:	130.0
Canadian PEL:	108.0
Canadian ISQG:	19.0

Year:	2000	2001	2002	2003	2004
Copper at Clover Point outfall (C0)	47.0	112.0	133.0	172.0	254.0
Copper at Macaulay Point outfall (M0)	152.0	266.0	158.0	273.0	143.0



Copper contamination at Clover Point outfall (2000-2004)



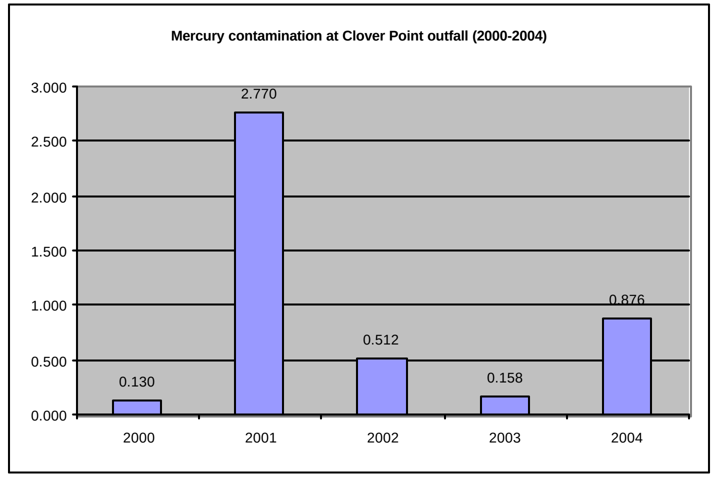
Copper contamination at Macaulay Point outfall (2000-2004)

Mercury

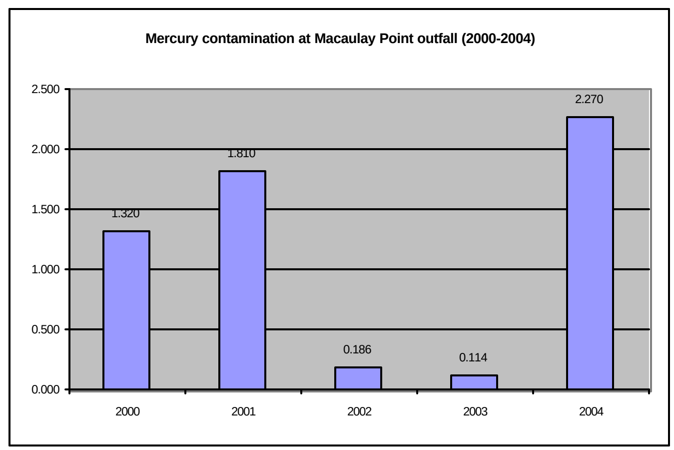
Mercury (Hg) criteria / standards

BC *Contaminated Sites Regulation*:	0.84
Canadian PEL:	0.70
Canadian ISQG:	0.13

Year:	2000	2001	2002	2003	2004
Mercury at Clover Point outfall (C0)	0.130	2.770	0.512	0.158	0.876
Mercury at Macaulay Point ourfall (M0)	1.320	1.810	0.186	0.114	2.270



Mercury contamination at Clover Point outfall (2000-2004)



Mercury contamination at Macaulay Point outfall (2000-2004)

Page 10: Chemical removal by wastewater treatment plants

COMPOUND	Annacis (Secondary)			Iona (Primary)			Lion's Gate (Primary)		
	Influent Loading (g/day)	Effluent Loading (g/day)	%change	Influent Loading (g/day)	Effluent Loading (g/day)	%change	Infuent Loading (g/day)	Effluent Loading (g/day)	%change
Phthalates: Bis-(2ethylexyl)	8,500	1,400	**84**	7,700	6700	**13**	2,400	1,400	**42**
nonylphenols	25,000	3,600	**86**	12,300	13,000	**0**	1,520	2000	**0**
PCBs	7	0.083	**99**	18.9	8.5	**56**	2.2	1.7	**23**
PAHs : (LPAHS)	1,800	9.5	**99.9**	310	120	**62**	86	80	**6**
(HPAHS)	1,980	21	**99**	470	270	**43**	111	108	**3**
Copper	72,000	4,700	**93.5**	82,000	80,000	**3**	26,000	22,000	**16**
Chlorobenzenes	900	110	**87**	320	180	**44**	31	26	**17**
Average percent removal			**92.6**			**31.6**			**15**

Data source: Bertold, S and Stock, P. 1999. GVS&DD Municipal Wastewater Treatment Plant 1997 Monitoring Program: Wastewater Chemistry – Data evaluation. Final Report. Greater Vancouver Regional District, 4330 Kingsway, Burnaby BC.

Page 11: Applying the federal methodology for prioritizing contaminated sites to the Clover and Macaulay Point outfalls (2003)

The federal Contaminated Sites Management Working Group (CSMWG) has developed a methodology to prioritize contaminated sites
(see http://www.ec.gc.ca/etad/csmwg/pub/marine_aquatic/en/chap3_e.htm).
The method is based on BC Ministry of Environment's recommended Sediment Evaluation Methodology.
The approach looks at both the number of substances exceeding CCME PELs (probable effects levels) & the degree to which they exceed those levels (the 'PEL quotient').
If the average PEL quotient is over 2.3 or more than 21 PELs are exceeded, the site is considered Highest Priority.
If the average PEL quotient is over 1.5 or more than 6 PELs are exceeded, the site is considered Medium-high priority.
Lower priority sites are categorized as either Medium-low or Lowest priority.

Based on 2003 data (the only year for which sediment data was collected at sampling stations around both outfalls):

Number of PELs exceeded within 100m of Clover Point outfall:	11	Priority = Medium-high
Number of PELs exceeded within 100m of Macaulay Point outfall:	16	Priority = Medium-high

Applying this methodology to the set of 13 Polycyclic Aromatic Hydrocarbons (PAHs) that have CCME PEL values
(these are the same 13 PAHs in BC's *Contaminated Sites Regulation*) for 2003 data

	Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Fluoranthene	Pyrene	Benzo(a)pyrene	Chrysene	Benzo(a)-anthra	Dibenz[a,h]anthracene	2-methylnaphthalene
	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
Canadian PEL	0.0889	0.1280	0.2450	0.1440	0.3910	0.5440	1.4940	1.3980	0.7630	0.8460	0.6930	0.135	0.2010
Observed values (bolded if above PEL)													
C0	**0.294**	0.034	**0.522**	**0.192**	0.028	**2.070**	**2.360**	**1.840**	**0.945**	**1.100**	**1.140**	**0.173**	0.021
M0	**0.382**	0.012	**0.409**	**0.212**	0.058	**1.890**	**2.020**	**1.830**	0.682	0.762	**0.775**	0.108	0.069
M1E	**0.204**	**0.160**	**0.390**	**0.520**	**0.780**	**3.940**	**4.020**	**2.970**	**1.380**	**1.480**	**1.100**	**0.211**	**0.440**
M1SE	**3.439**	0.011	**6.836**	**2.222**	0.050	**19.287**	**20.620**	**17.117**	**8.815**	**9.017**	**9.747**	**1.104**	0.049
PEL quotients (observed value / PEL)													
C0	3.3071	0.2617	2.1306	1.3333	0.0716	3.8051	1.5797	1.3162	1.2385	1.3002	1.645	1.2815	0.1045
M0	4.297	0.0914	1.6694	1.4722	0.1483	3.4743	1.3521	1.309	0.8938	0.9007	1.1183	0.8	0.3433
M1E	2.2947	1.25	1.5918	3.6111	1.9949	7.2426	2.6908	2.1245	1.8087	1.7494	1.5873	1.563	2.1891
M1SE	38.687	0.0859	27.902	15.431	0.1279	35.454	13.802	12.244	11.553	10.658	14.065	8.1778	0.2438

	Number of PELs exceeded	**Average of PEL quotients**	**Priority (just from PAHs)**
C0	10	1.4904	Medium-High
M0	7	1.3746	Medium-High
M1E	13	2.4383	Highest
M1SE	10	14.495	Highest