



Ministry of
Environment and
Climate Change Strategy

PROTOCOL 4 ***FOR CONTAMINATED SITES***

Establishing Background Concentrations in Soil

Prepared pursuant to Section 64 of the
Environmental Management Act

Version 9

Approved: Cameron Lewis
 Director of Waste Management

 November 1, 2017
 Date

1.0 Definitions

The following words, acronyms and expressions used in this protocol are defined in the ministry [Procedure 8, “Definitions and Acronyms for Contaminated Sites”](#):

Act	regional estimate of background concentration in soil
background concentration	regulation
local background concentration in soil	wide area site
numerical standards	

2.0 Introduction

This protocol provides regional background concentration estimates for specified inorganic substances in soil in British Columbia as well as procedures for establishing local background concentrations in soil on a site-specific basis for use under the Contaminated Sites Regulation (the Regulation). This information may be used in the investigation and remediation of contaminated sites and for obtaining soil relocation agreements.

It is not the intent of the Regulation for a Director’s decision on background concentrations to eliminate the need to remediate a contaminated site which has been contaminated through anthropogenic point sources.

3.0 Regulatory basis for a Director’s decision

3.1 Deciding if a site is a contaminated site or has been satisfactorily remediated

Soil that contains a substance at concentrations above the applicable numerical soil standard at a site, but below the local background concentration for that substance as determined under this protocol, would not be considered contaminated under Section 11 (3) of the Regulation. Similarly, soil that has been remediated for a substance to concentrations above the applicable numerical soil standard for the site but below the local background concentration for that substance as determined under this protocol would be considered satisfactorily remediated under Section 17 (2) (b) of the Regulation.

3.2 Deciding if contaminated soil is suitable for relocation

Soil to be relocated from a site that contains a substance at concentrations above an applicable numerical soil standard for the receiving site, but below the local background concentration for that substance at the receiving site as determined under this protocol, can be considered acceptable for deposit at the receiving site in

accordance with section 45 (3) (b) of the Regulation. Some exemptions may apply, see [Fact Sheet 41, "Relocation of Soils from Contaminated Sites"](#) for further details.

Regional estimates of background concentrations in soil for substances listed in Table 1 may also be considered equivalent to local background concentrations of substances in soil for the purposes of sections 11 (3), 17 (2) (b) and 45 (3) (b) of the Regulation.

4.0 Options, procedures and reporting requirements

Substances originating from natural conditions or anthropogenic non-point source contamination may be eligible for a Director's decision under this protocol using one of the options described below and illustrated in Figure 1. Substances that originate from anthropogenic point source contamination are not eligible.

4.1 Option 1 – Director's decision on background concentrations based on ministry data

The first option is to apply the ministry estimate of background concentrations of substances in soil for a region or locale. This data is presented in two ways. First, Table 1 of this protocol presents the data as a regional estimate. Each value has been calculated as the 95th percentile of the data collected for all of the locales within each region. Second, [Technical Guidance 17, "Background Soil Quality Database"](#) provides the individual data points for each sample location, sorted by locales and regions. The data used to calculate the regional background soil quality estimates in Table 1 are based on the Strong Acid Leachable Metals (SALM) digestion method, the official method approved by the ministry ([BC Environmental Laboratory Manual](#)).

The regional estimates of background concentrations in soil listed in Table 1 may be used directly as representative of soil background at any site located in a particular region. The Table 1 estimates are based on near surface soil samples obtained at ministry background sites. However, these regional background estimates may be used as determinants of background concentrations in soil to a depth greater than 1 m from ground surface, provided deep rooting plants and deep burrowing animals are not present at the site. Regional boundaries are shown in Figure 2.

For sites located within the Metro Vancouver area (see Figure 3), the Metro Vancouver area regional estimates of background concentrations in soil applies. Sites located within the Lower Mainland but outside the Metro Vancouver area, should use the Region 2 estimates of background concentrations in soil.

Data provided for a particular locale may also be used as representative of soil background at a site within that locale. However, due to the limited number of data

points (i.e. sampling results) available for each locale, the estimate of background concentrations in soil **must** be calculated using the **median value** of all of the substance-specific data for that locale.

Table 1 provides regional estimates of background concentrations in soil for 26 inorganic substances only. For substances not listed in Table 1, site-specific background concentrations in soil may be established for a substance using the Option 2 procedures described later in this protocol.

The use of regional estimates of background concentrations in soil or median estimates based on the locale approach as described in this section does not require a Director's decision. Rather, investigation reports prepared in support of applications to the ministry must clearly indicate the approach and the background concentrations in soil that were applied.

4.2 Option 2 - A Director's decision on background concentrations based on additional data and sampling

4.2.1 Process overview

The second option allows for the quantification of site-specific local background concentrations in soil for a particular site by either:

- Option 2a.** Augmenting ministry background soil data relevant to the site with additional pertinent data obtained from the literature or from direct background soil sampling and/or
- Option 2b.** Direct background soil sampling conducted at an appropriate local reference site relevant to the site in question.

When Option 2 is used, a full report as described below, detailing the rationale and methods used to determine local background soil quality must be submitted to the ministry for a Director's decision. This report may stand alone or may be a distinct section in another report for the site.

4.2.2 Procedures

Option 2a - Establishing background based on supplemental reference data

Under this option ministry background soil data can be supplemented with relevant background data obtained from reports or databases available from other sources such as the [National Geological Survey of Canada](#) and the [BC Ministry of Energy and Mines Mining Survey data](#) or from direct background soil sampling.

Option 2b - Reference site procedure

Site-specific local background concentrations in soil may be quantified directly through comparison to a representative background reference site or sites. The emphasis in the reference site procedure is on the estimation of representative substance concentrations in soil that can be shown to be attributable solely to natural origin (i.e. not due to anthropogenic sources) or generalized anthropogenic non-point sources (such as lead contamination that may be found in urban areas with long exposure to automobile emissions). This is achieved by careful site selection, analysis and comparison of reference site concentrations in soil to those observed at the site of interest.

The reference site must closely match (i.e., be substantively similar to) the contaminated site in question with respect to:

- a) geographical characteristics (e.g., location, topography, size/area, etc.),
- b) soil physical/chemical characteristics (see soil maps, [Geological Survey of Canada](#) information, etc.),
- c) hydrology¹, and
- d) soil sampling depth.

Reference site(s) may be identified at unimpacted areas of the subject property and will be considered on a case by case basis.

Additionally:

- a) preference should be given to undeveloped or vacant land that has not received imported fill, naturally wooded areas, parks or large residential lots,
- b) reference sites must not be impacted by contaminant sources,
- c) reference sites with any obvious vegetation damage or indications of contamination presence should be avoided, and
- d) the history of the reference site and adjacent land, including current and previous activities must be considered to a level of detail consistent with [Technical Guidance 16, "Soil Sampling Guide for Local Background Reference Sites"](#) and a preliminary site investigation (PSI).

Once a suitable local reference site has been located and if needed, permission to sample has been obtained, the following minimum information should be collected:

- a) name and address of the property owner,
- b) current land use,

¹ Note that if the hydrology at the reference site is not substantively similar to that at the subject property, it must be demonstrated that the hydrology has not impacted the surficial soil in a manner that reduces its acceptability as a reference site.

- c) surrounding land uses,
- d) any previous land uses (site history),
- e) potential contaminant sources (both natural and anthropogenic),
- f) latitude and longitude, and
- g) a diagram of sampling plot locations within the overall property boundary.

Additional detailed information related to soil sampling methodology and the nature of the soil samples obtained at the reference site should also be documented. For example, additional information should be recorded concerning soil sample:

- a) collection,
- b) storage,
- c) preparation,
- d) archiving,
- e) physical characterization, and
- f) chemical analysis.

Sampling procedures and chemical analytical requirements differ for inorganic and organic substances. Soil sampling must be performed in accordance with ministry requirements as per the [BC Field Sampling Manual](#).

Ideally, soil samples taken from the reference site and the site of interest should be subjected to identical analyses, using whenever possible the same analytical laboratory. Samples must be analyzed using ministry approved analytical methods as detailed in the latest version of the [BC Environmental Laboratory Manual](#) or alternate methods acceptable to the Director.

4.2.3 Reporting requirements (for Option 2 only)

The reporting requirements for applications for a Director's decision of local background concentrations in soil developed under Option 2 is the submission of a report containing, at a minimum, details relevant to:

- a) identification of the region in which the site is located, or in the case of proposed soil relocation, the region of the proposed deposit site,
- b) the selection of the reference site(s),
- c) the geographical location of the reference site(s) (i.e., latitude and longitude, PIDs, etc.),
- d) a complete history of land use(s) at the reference site(s),
- e) physical characterization of the reference site(s),
- f) soil sampling procedures used,
- g) soil sampling locations used (i.e. a map showing sampling locations),

- h) soil depths sampled,
- i) documentation of the soil contaminants of concern considered,
- j) analytical results obtained,
- k) the statistical significance of the results obtained,
- l) conclusions forthcoming from the assessment of reference site background soil quality and the comparison of reference site background soil quality to the soil quality of the site of interest, and
- m) a formal written request for a Director's decision for the site under Section 11 (3) or 17 (2) (b) of the Regulation or an agreement to relocate soil under 46.1 (a) (iv) of the Regulation.

5.0 Director's decision on background concentrations – notification on site registry

Applications for a Director's decision on local background concentrations in soil are subject to ministry service fees as indicated in Schedule 3 of the Regulation. After making a decision under Section 11 (3), 17 (2) (b) or 46.1 (a) (iv) of the Regulation, the Director will provide to the Site Registrar the supporting information relating to local background concentrations in soil for the site in compliance with Section 43 of the Act.

6.0 Limitations

6.1 Sample depth

In accordance with Technical Guidance 16, soil samples collected for estimation of background concentrations by the ministry were taken at two depths at each sample location: 0 to 10 cm and 50 to 60 cm. This sampling regime reflects the intent to focus background soil estimates to surficial soil (i.e. 1 m in depth), since at most sites, the biogenic zone in soil is limited to the first metre below ground surface.

6.2 Wide area sites

For Option 2, a Director's decision on background concentrations in soil based on additional data and sampling described above, it is necessary to closely match the site of interest with a local background reference site(s) of suitable geologic type and geographic area and scope. This is problematic in the case of contaminated sites which have been designated wide area sites under the Regulation.

Wide area sites tend to be larger, complex sites which typically encompass considerable geographic area and geologic complexity. While it may be possible to select a reference site(s) of sufficient size, scope and geological complexity to apply the Option 2

approach for a wide area site, the sampling time, effort and analysis required to adequately characterize both the wide area contaminated site and its corresponding local wide area reference site would likely be prohibitively expensive and onerous.

For this reason, the ministry does not recommend the application of local background concentrations in soil for use at wide area sites. Rather, it is recommended that background concentrations in soil at such sites be addressed through the use of the Option 1 approach available under this protocol.

6.3 Point source pollution

It is not the intent of the Regulation to dismiss, through a Director's decision on background concentration(s), the need to remediate contaminated sites that have been contaminated by anthropogenic point source releases. As a result of over 100 years of smelter operations in Trail B.C., concentrations of arsenic, cadmium, lead, zinc and many other heavy metals in the Castlegar, B.C. and Trail, B.C. locales have been enriched. For this reason, an application for a Director's decision on background concentrations for heavy metals in soil at these two locales will not be considered by the ministry.

7.0 Alternate Approaches

Scientifically defensible modifications to the options outlined in this protocol for establishing background concentrations in soil may be considered by the Director. Such requests must be accompanied by a completed [Contaminated Sites Services Application form](#) and a supporting technical report prepared by a qualified professional.

For more information, please direct inquiries to site@gov.bc.ca

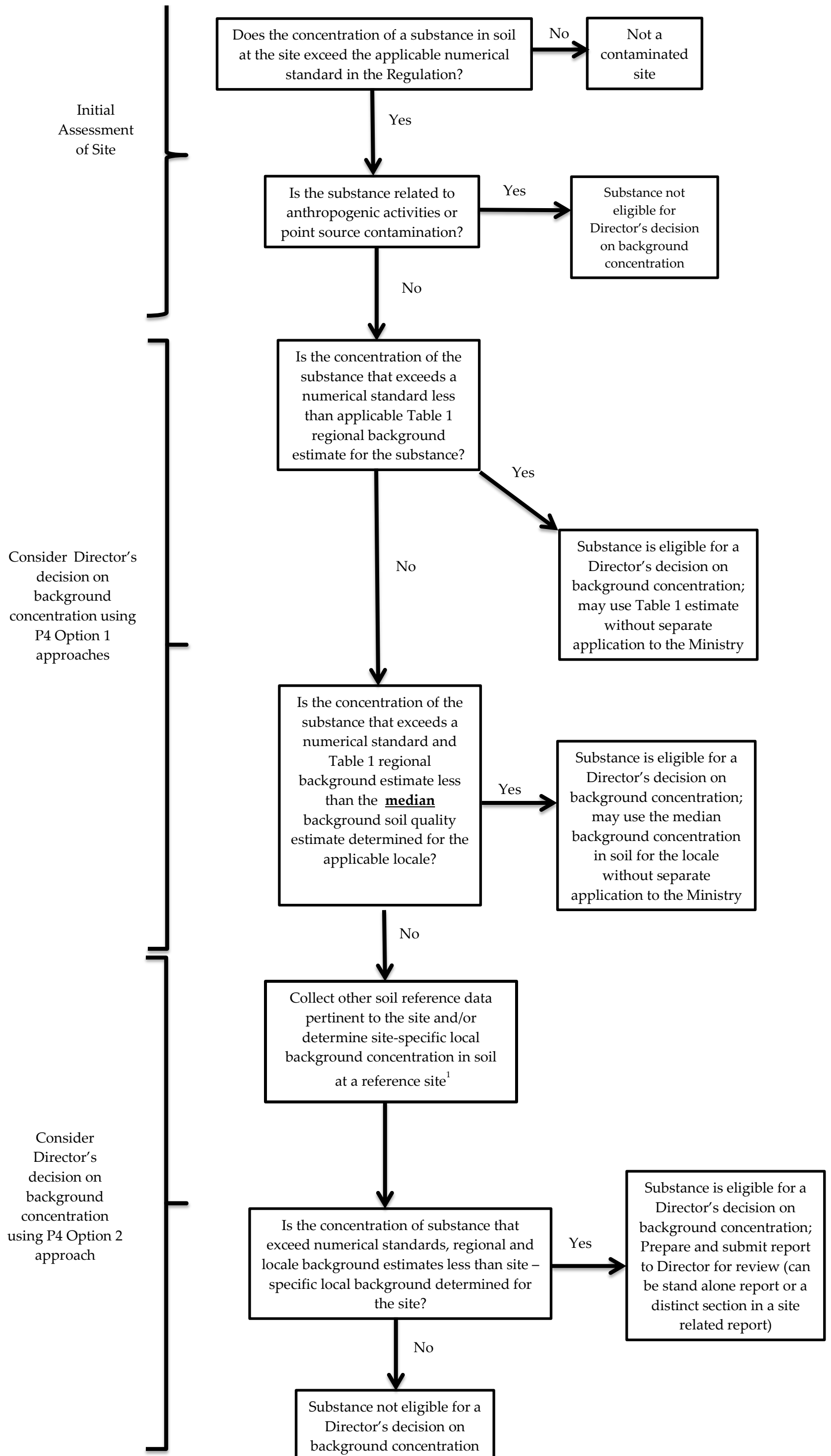
Table 1. Regional estimates for background concentrations in soil for inorganic substances^{1,2,3,4}

Substance	Region 1 Vancouver Island	Region 2 Lower Mainland	Metro Vancouver ⁷	Region 3/8 Thompson/Nicola/ Okanagan	Region 4 Kootenay ⁸	Region 5 Cariboo	Region 6 Skeena	Region 7 Omineca/ Peace
aluminum	55 000	35 000	35 000	30 000	25 000	25 000	40 000	40 000
antimony	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
arsenic	(4)	8.5	8.5	15	(4)	10	10	10
barium	250	150	90	200	350	250	300	500
beryllium	0.7	0.7	0.7	0.5	0.8	0.3	0.6	1
boron	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
cadmium	0.95	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)
chromium ⁵	65	55	50	70	35	100	40	50
cobalt	30	15	15	20	15	20	15	25
copper	100	75	150	75	35	60	50	70
iron	70 000	30 000	30 000	30 000	30 000	30 000	30 000	40 000
lead	40	200	300	15	120	15	20	25
manganese	5 000	900	1 000	1 000	2 000	850	1 500	1 500
mercury ⁶	0.15	0.3	0.35	0.075	0.085	0.09	0.15	0.09
molybdenum	(1)	4	6	2	(1)	(1)	3	3
nickel	50	75	40	85	50	200	40	60
selenium	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
silver	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
strontium	100	60	55	250	150	250	100	70
sulfur	1 000	2 000	3 000	550	950	800	2 500	450
tin	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
vanadium	200	80	75	85	40	75	85	95
zinc	150	100	90	100	200	85	150	150

Footnotes:

1. All values are in µg/g unless otherwise stated. All values have been rounded in accordance with Contaminated Sites Taskgroup rounding rule. Values in brackets indicate that greater than 50% of values were less than the mean detection concentration (MDC) for the substance, consequently tabled regional estimate is one-half the MDC.
2. Each estimate represents the 95th percentile value obtained for a substance in the region or area.
3. All soil samples were subject to the strong acid leachable metals (SALM) method summarized in the *British Columbia Environmental Laboratory Manual*.
4. ND - no data available.
5. Chromium = total chromium
6. Mercury = inorganic mercury
7. Listed estimates for background concentrations in soil may be used within the Metro Vancouver area only. The Metro Vancouver area (see Figure 3) includes the University of British Columbia, Stanley Park, Queen Elizabeth Park, Richmond West, Richmond Central, Burnaby Lake Regional Park, Burnaby North, North Vancouver, New Westminster, and Coquitlam.
8. All results from Castlegar and Trail locales were removed from the data set as they are related to point source contamination. The regional estimate for lead is based on a Director's decision.

Figure 1. Process for background release

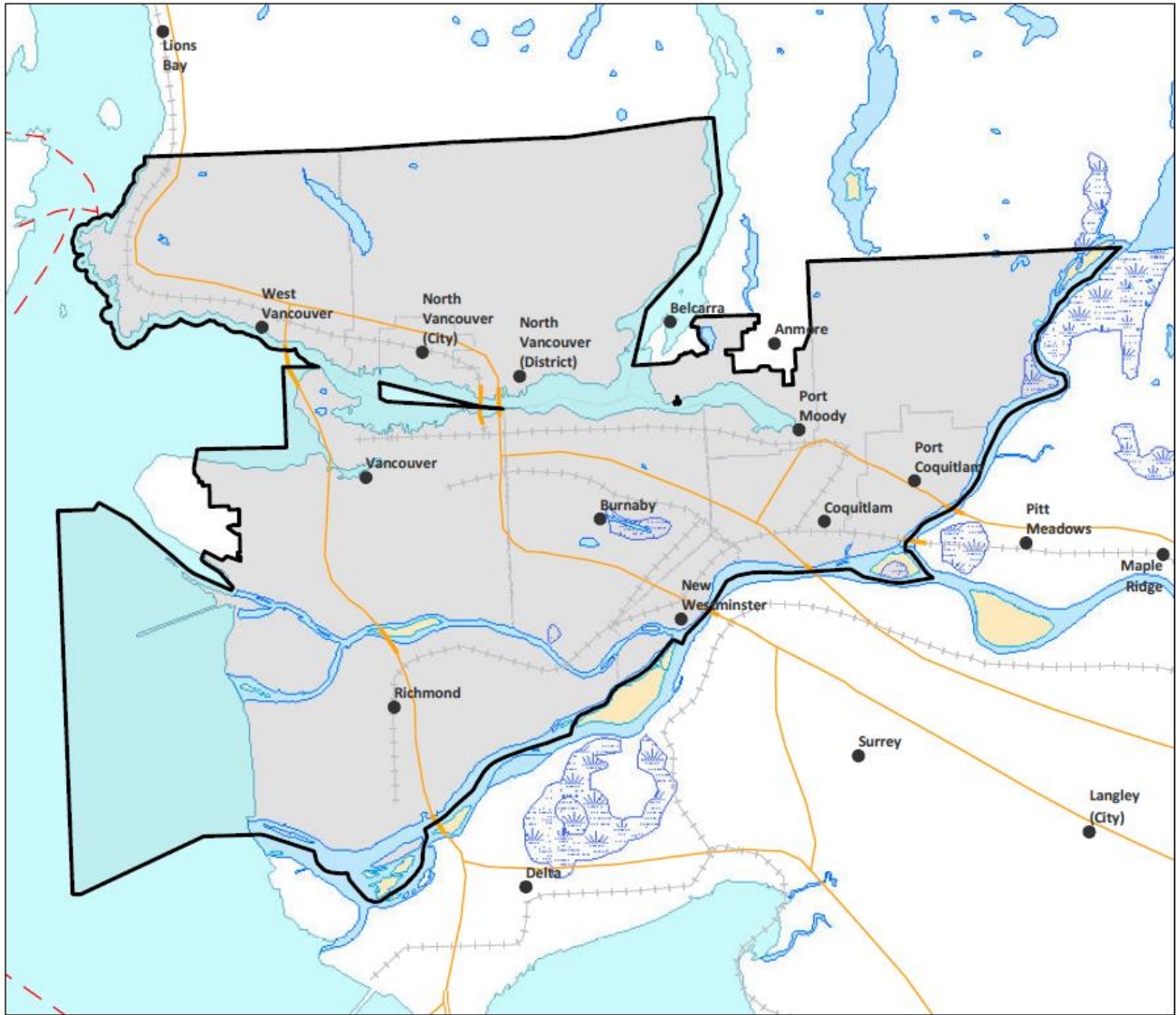


1. Other data pertaining to the site and local background reference sites must be approved by a Director.

Figure 2. Regional boundaries for background soil determinations



Figure 3. Geographic limits for Metro Vancouver area



Revision History

Approval Date	Effective Date	Document Version	Notes
	Nov. 2017		