CSAP
Society of Contaminated Sites Approved Professionals of British Columbia

CSAP TECHNICAL REVIEW COMMENTS

Protocol 4: Determining background soil quality

CSAP Technical Review #55

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In response to the Ministry of Environment's request for comments on Protocol 4: Determining background soil quality (V.9)

CSAP would like to thank Mr. Guy Patrick and Ms. Patty Carmichael for completing this Technical Review of behalf of the CSAP Society.

Comments

The following provides review comments from CSAP Approved Professional reviewers on the above-referenced draft Protocol 4, Version 9, 2017 (Draft P4 v9). A copy of the draft P4 v9 with minor edits and typo corrections is also attached. As an overall comment, the document is expanded to include more substances as background (28 versus 17) and has been restructured, which provides greater clarity. However, we expect that the region-specific background values as provided in the new draft Table 1 will be of very limited use by practitioners because:

- regional background values are proposed to be limited to soils less than 1 m depth, and
- a large majority of the draft background values are less than the new "Omnibus" standards due to become effective November 1, 2017

The following presents specific comments and suggestions.

Section 1.0 Definitions

The definitions section in Draft P4 v9 remains as per the current P4. We suggest that the document would benefit from some clarity by including a definition of "anthropogenic sources" and "non-point anthropogenic sources" and "anthropogenic release." Ambiguity was noted in the following:

- see box at end of Section 2.0;
- Section 4.0 first paragraph;
- Section 4.2.2 "Option 2b - Reference site procedure" first paragraph

Section 3.2 Deciding…

Is reference to section 46.1 (a) (iv) of the Regulation intended to reference 45(3)b or is there a new version of the Regulation planned?

Section 4.0 Options

With reference to Figure 1, we note that footnote 1 on Figure 1 is confusing – there is a first-time reference to Form X and appendix 2 but there is no reference to appendix 1. The footnote also indicates the requirement for approval by Director for Option 1, which contradicts the text.

Section 4.1 Option 1

1st paragraph: It is stated that "Table 1 is based on the Strong Acid Leachable Metals (SALM) digestion method." However, for sodium we understand that the saturated paste method is referenced for the omnibus sodium standards. With such a method, are there regional data available for sodium?

2nd Paragraph:"regional background estimates may only be used as determinants of background soil quality to a maximum depth of 1m from ground surface at a site." This is likely to be an issue for many sites where deeper soils exceed standards but are representative of background. It could also be problematic for disposal of soils from construction sites where excavations are greater than 1 m depth, or where fill materials exceed 1 m depth. Perhaps consider 1) expanding the MOE database by obtaining deeper samples, 2) expanding database by including data available from DSI's submitted to MOE 3) demonstrate that soil less than 1 m depth is similar to soil greater than 1 m depth.

3rd Paragraph: Figure 3 needs to be revised to include scale, north arrow, geographical names or other features such as latitude/longitude ranges, etc. We suggest that P4 could use references in the figures and the text for those not familiar with the Lower Mainland.

4th Paragraph: "Data provided for a particular locale may also be used as representative of soil background at a site located in that locale." Can the data from a few locales closet to a site be used for that site, specifically if the site is on a regional boundary?

"However, due to the limited number of data points (i.e. sampling results) available for each locale, the background soil estimate must be calculated using the median value of the data." Calculating the median will result in lower background values than using the 95th percentile. This may result in an increased level of effort with a possible uncertain outcome – practitioners may therefore be reluctant to use P4 Option 2. Can this be augmented with local results collected by practitioner, and the 95th percentile applied?

5th Paragraph: should reference "28" inorganic substances in Table 1 rather than "17".

Section 4.2.1 Process Overview

In Option 2, two sub-options are provided as per below:

Option 2a. Augmenting ministry background soil data relevant to the site with additional pertinent data obtained from the literature and/or

Option 2b. Direct background soil sampling conducted at an appropriate local reference site relevant to the site in question.

In the wording, it is not clear whether option 2a can include elements of Option 2b or not. "and/or" is used but overall this is confusing.

Given the limited value of Table 1 as discussed below, perhaps a step process should be considered rather than option selection. Step 1 would, for example, refer to Table 1; step 2 would involve collecting data from other sources (i.e., GSC); and Step 3 would involve collecting and sampling reference locations on site, and then off site if necessary.

When using Option 2, a standalone report must be submitted for approval by the Director. Such requirements are likely to increase the time and costs of an investigation. Alternatives processes should be considered as acceptable (e.g., perhaps the CSAP performance review process could accommodate this).

Section 4.2.2 Procedures

Reference Sites

We expect that gaining approval to sample off-site properties that serve as reference sites will be onerous in many cases, leading to time delays and added cost. We suggest that P4 should recognize explicitly that there may be locations on the Site, itself, that can serve as suitable reference sites. Given the limited applicability of Option 1, some explicit language indicating the acceptability of on-site locations should be mentioned.

We note that, after going through the process of selecting an off-site reference location, there may be a real risk that substances at the reference site are in low concentrations but are not necessarily representative of regional background. In such cases, the practitioner may choose to sample additional reference sites at additional cost, or simply give up. Are there alternative processes that can be considered?

"Soil sampling must be performed in accordance with ministry requirements." We note that the new draft P4 no longer makes reference to TG16.

Section 4.2.3 Reporting Requirements

We note that there is a requirement for "a complete history of land use(s) at the reference site." The wording suggests the need for a complete Stage 1 PSI, which is rather onerous, particularly for off-site reference sites. Is that what is intended?

We note that the practitioner is required to describe "the statistical significance of the results obtained". This makes sense intuitively; however, given that statistical power increases with the number of data points (and samples) obtained, further guidance would be appreciated on this issue (e.g., can P4 specify a minimum number of samples to use in calculating a median or 95th percentile?). This would assist the practitioner in making the decision to use or not use Option 2 as a cost-effective approach to address background.

Section 5.0 Background release

We note that ministry fees will be charged to review the standalone report for Option 2. Again, this will add costs to the process, potentially making it unpalatable and possibly unworkable.

Section 6.1 Sample Depth

P4 makes reference to risks to the biogenic zone from shallow soil concentrations. We suggest that the biogenic zone depth is not necessarily relevant to the composition of overburden soils deposited by geologic processes. If the same geologic/stratigraphic unit is sampled, we would expect the metals concentrations to be distributed throughout the deposit, regardless of depth. In such cases, the applicability of the Table 1 background values should not be limited to a depth of one metre. We recommend that the applicable depth remain at 3 m, and suggest that an effort be made to acquire data from greater depths.

Table 1.

As per below, we eliminated Table 1 values that are less than the planned, most stringent Omnibus values effective November 1, 2017 – including the lowest pH value/IW/LW/AL/WL etc. Only those parameters not shaded out could be used for regional background. As is evident, there is very limited to value to Table 1. Either the standard is equal to or higher than the background; there isn't a standard; no data are available; or the method isn't correct for the parameters (i.e., sodium). Selenium would be an issue across the province if the background is based on method detection limits, which are higher than the most stringent standard.

Only two or three parameters do not exceed the most stringent standard within four of the regions. Fourteen parameters have background concentrations below the most stringent standard or have no standard at all. There does not seem to be any benefit in providing background concentrations that are less than the method detection limit (MDC) for seven parameters.

Table 1 - P4 Update

	1	2	GVRD	3/8	4	5	6	7	comments/new standard
	Van Is.	Lower Main		TNRD	Koot	Cariboo	Skeena	Om/Peace	
aluminum									40,000 LD
antimony									< most string std
arsenic				15					10
barium								500	350
beryllium									1
boron									1
cadmium									1
calcium									no std
chromium	65			70		100			60
cobalt	30								25
copper	100	75	150	75					lowest pH
iron	RL							RL	35,000 LD
lead		200	300						
magnesium									no std
manganese	5000				2000				1500
mercury									< most string std
molybdenum		IW	IW						3 for IW
nickel		75		85		200			70
selenium	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	1
silver									< most string std
sodium	300	450	350	650	300	850	200	200	sat. paste?? No comparison
strontium									< most string std
sulfur			AL				AL		2000 only std
thallium									No data
tin									< most string std
vanadium	200								100
zinc					200				150
zirconium									No data

BRITISH COLUMBIA | Ministry of Environment

PROTOCOL 4
FOR CONTAMINATED SITES

Determining Background Soil Quality

Prepared pursuant to Section 64 of the
Environmental Management Act

Version 9 Draft for comment

Approved: _____ _____

Director of Waste Management — 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
background concentration
local background concentration in soil
numerical standards
regional background soil quality estimate
Regulation
wide area site
local human-made point source release

2.0 Introduction

This protocol summarizes available regional background soil quality estimates for specified inorganic substances in British Columbia and provides procedures to establish local background soil quality 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 contaminated soil relocation authorizations.

The ministry does not recommend the direct quantification of local background concentrations at wide area sites (see section 6.2 below).

It is not the intent of the Regulation for a background release to eliminate the need to remediate a contaminated site which has been contaminated through anthropogenic point sources.

3.0 Regulatory basis for background release

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

Any site at which the soil quality for a specified substance exceeds an applicable numerical soil standard in the Regulation, but does not exceed corresponding appropriate background soil quality for the substance as determined under this protocol, can be provided with a release under section 11 (3) or 17 (2) (b) of the Regulation.

3.2 Deciding if contaminated soil is suitable for relocation

Soil to be relocated from a site which exceeds an applicable numerical soil standard for the receiving site, but does not exceed corresponding appropriate background soil quality for the substance at the receiving site as determined under this protocol, can be considered acceptable for deposit at the receiving site in accordance with section 46.1 (a)

(iv) of the Regulation. Otherwise, the soil ~~to be relocated~~ must not be relocated to the receiving site in the absence of a Contaminated Sites Relocation Agreement. Regional background soil quality concentration estimates referenced in Table 1 may also be considered equivalent to local background concentrations in soil for the purposes of sections 11 (3), 17 (2) (b) and 46.1 (a) (iv) 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 background release under this protocol using one of the options described below and illustrated in Figure 1. Substances that originate from anthropogenic activities or point source contamination are not eligible for a background release.

4.1 Option 1. Background release based on ministry data

The first option is the consideration of a background release based on a ministry regional background soil quality estimate or determination of a background soil quality estimate for a locale situated within a ministry region. This data is presented in two ways. First, Table 1 of this Protocol presents the data as a regional estimate. ~~This~~ 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 is based on the Strong Acid Leachable Metals (SALM) digestion method, the official method approved by the Director.

The regional background soil quality estimates 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. Consequently, these regional background estimates may only be used as determinants of background soil quality to a maximum depth of 1m from ground surface at a site. The regional boundaries are displayed in Figure 2.

For sites located within the Greater Vancouver area (see Figure 3), the Greater Vancouver area regional background soil quality estimates presented in Table 1 should be used as applicable regional background soil quality estimates. Sites located within ~~Region 2~~the lower mainland but outside~~, which~~ lie outside the Greater Vancouver area, should use the Region 2 regional background soil quality estimates ~~of~~ in Table 1 as applicable regional background soil quality estimates.

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

points (i.e. sampling results) available for each locale, the background soil estimate **must** be calculated using the **median value** of the data.

Table 1 provides regional background soil quality estimates for 17 inorganic substances only. For substances not listed in Table 1, site-specific local background soil quality may be determined directly for a substance using the Option 2 procedures described later in this protocol.

The use of regional background soil quality estimates or median estimates based on the locale approach as described in this section do not require the approval of the Director. Rather, the approval for the background release can be achieved by submitting to the ministry the site investigation report(s) (i.e., a PSI or DSI) which clearly indicate the background soil quality estimates used.

4.2 Option 2. Background release based on additional data and sampling

4.2.1 Process overview

The second option allows for the quantification of site-specific local background soil quality 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 ~~and/~~ or
Option 2b. Direct background soil sampling conducted at an appropriate local reference site relevant to the site in question.

When ~~option~~ Option 2 is used ~~to determine local background soil quality for a site~~, a full, standalone report, as described below, detailing the rationale and methods used to determine local background soil quality must be submitted to, and approved by, a Director to obtain a background release.

4.2.2 Procedures

Option 2a - Establishing background based on supplemental reference data

An estimate for local background concentration may be established based on additional background soil quality reference data relevant and pertinent to a site. Typically such additional background soil quality reference data is used to supplement or augment ministry background soil quality data available in Technical Guidance 17. Examples of reference data sources include the National Geological Survey of Canada and the BC Ministry of Energy and Mines Mining Survey data.

Option 2b - Reference site procedure

Site-specific local background soil quality 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) and 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 soil substance concentrations to those observed at the site of interest.

The procedure below quantifies local background soil quality directly through site-specific comparison to a local background soil reference site(s). If the concentrations of substances in soil at the suspect or remediated contaminated site of interest or in contaminated soil to be relocated do not exceed substance concentrations established for the local background soil reference site(s) (i.e., the local background soil quality), then the site/ soil is considered:

a) not to be a contaminated site under section 11 (3), or
b) satisfactorily remediated under section 17 (2) (b), or
c) acceptable for deposit under section 46.1 (a) (iv)

The reference site must closely match (i.e., be substantively similar to) the contaminated site in question in 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) hydrology, and
d) soil sampling depth.

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 located next to or within the general vicinity of contaminant point 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 and documented.

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,

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.

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 ministry lab manual or alternate methods acceptable to the Director.

4.2.3 Reporting requirements (for Option 2 only)

The reporting requirements for applications for Director's determination of local background soil quality developed under Option 2 is the submission of a "Direct Determination of Local Background Soil Quality" 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 for 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 ~~contaminated~~ site of interest, and
m) a formal written request for release of the site under section 11 (3) or 17 (2) (b) of the Regulation or approval to relocate soil under 46.1 (a)(iv) of the Regulation.

5.0 Background release – notification on Site Registry

Applications for a Director's determination of local background soil concentration(s) 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 soil quality 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 Sampling Guide for Local Background Reference Sites, soil samples collected for estimation of background concentrations by the ministry were taken at two depths at each sample location: 0 to10 cm and 50 to 60 cm. This sampling regime reflects the intent to focus background soil determination 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

~~Under the local soil background reference site procedure of~~For Option 2 background release based on additional data and sampling described above, it is necessary to closely match the ~~contaminated~~ site of interest ~~in question~~ 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 ~~use in the direct assessment of local background soil quality~~ apply 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 direct determination of local background soil quality for use at wide area sites. Rather, it is recommended that background soil quality at such sites be addressed through the use of the Option 1 approach available under this ~~protocol~~Protocol.

6.3 Point source pollution

It is not the intent of the Regulation to dismiss, through a background release, the need to remediate contaminated sites that have been contaminated by anthropogenic point source releases. For example, ~~As a result of~~ over 100 years of smelter operations in Trail BC resulted in ~~,~~ enriched concentrations of arsenic, cadmium, lead, zinc and many other heavy metals in the Castlegar and Trail locales ~~have been enriched~~. For this reason, a background release for heavy metals in soil at these two locales will not be considered by the ministry.

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

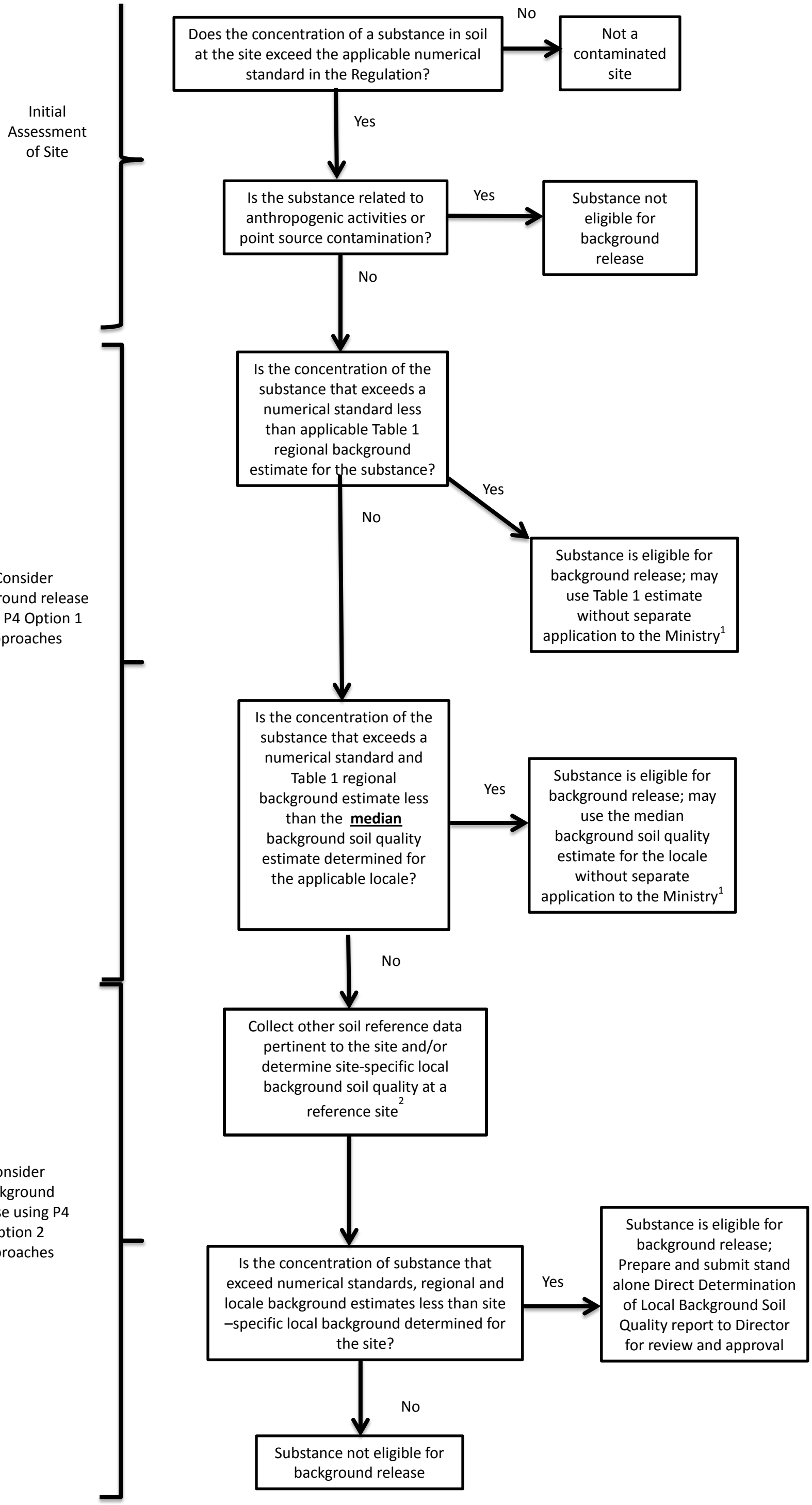
Table 1. Regional background soil quality estimates for inorganic substances[1,2,3,4]

Substance	Region 1 Vancouver Island	Region 2 Lower Mainland	Greater Vancouver Area[7]	Region 3/8 Thompson/Nicola/ Okanagan	Region 4 Kootenay[8]	Region 5 Cariboo	Region 6 Skeena	Region 7 Omineca/ Peace
aluminum	55000	35000	35000	30000	25000	25000	40000	40000
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)
calcium	20000	6000	5500	40000	100000	35000	9500	15000
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	70000	30000	30000	30000	30000	30000	30000	40000
lead	40	200	300	15	120	15	20	25
magnesium	15000	10000	10000	15000	20000	20000	8000	15000
manganese	5000	900	1000	1000	2000	850	1500	1500
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)
sodium	300	450	350	650	300	850	200	200
strontium	100	60	55	250	150	250	100	70
sulfur	1000	2000	3000	550	950	800	2500	450
thallium	ND	ND	ND	ND	ND	ND	ND	ND
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
zirconium	ND	ND	ND	ND	ND	ND	ND	ND

Footnotes:

1. All values are in ug/ 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 background soil quality estimates may be used as regional quality estimates within the Greater Vancouver area only. The Greater 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. The background value selected must still be approved by the Director, but can be requested by completing Form X (Appendix 2).
2. 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 Greater Vancouver area