BRITISH COLUMBIA | Ministry of Environment and Parks

PROTOCOL 9
FOR CONTAMINATED SITES

Establishing Local Background Concentrations in Groundwater

Version 5

Prepared pursuant to Section 64 of the
Environmental Management Act

Approved: Gwendolyn Lohbrunner, Director of Waste Management — June 10, 2026, Date

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Revision history

Approved Date	Effective Date	Document Version	Notes
January 15, 2004	January 15, 2004	V1	New Document
February 1, 2021	February 1, 2021	V2	Major revisions of the content, added 4 regions/sub-regions and 27 substances
May 13, 2021	May 13, 2021	V3	Revised definition of qualified professional to reflect the *Professional Governance Act*
February 1, 2023	February 1, 2023	V4	Revised definition of qualified professional
June 10, 2026	June 19, 2026	V5	Revised to include circumstances where director's approval is not required

1.0 Definitions

Terms defined in the *Environmental Management Act* (EMA) and Contaminated Sites Regulation (CSR) apply to this protocol in addition to the following:

"local background concentration" means the naturally occurring concentration of a substance in groundwater in a geographic area established in accordance with this protocol.

"potential contaminant of concern" [PCOC] means any contaminant which might be expected to occur at a site based on the historical use of the site, whether that substance has been measured in any environmental medium or determined to exceed the numerical standards of the Contaminated Sites Regulation (CSR).

"qualified professional", in relation to a duty or function under this protocol, means an individual who:

(a) is registered in British Columbia with a professional organization, acts under that organization's code of ethics and is subject to disciplinary action by that organization; and
(b) through suitable education, experience, accreditation and knowledge may reasonably be relied on to provide advice within the individual's area of expertise, which area of expertise is applicable to the duty or function.

2.0 Introduction

This protocol is made under the authority of EMA Sections 64 (1)(c), (d) and 64 (2)(l).

It describes procedures for establishing local background concentrations in groundwater where naturally occurring substance concentrations exceed the generic numerical water standards of the CSR. Concentrations of a substance that occur naturally in groundwater within a geographic region or locally within a defined groundwater flow system are considered representative of background conditions. Local background concentrations are used in the investigation and remediation of a contaminated site.

Local background concentrations established under this protocol are for purposes of investigating and remediating contaminated sites only. They are not intended and should not be considered to represent safe concentrations for specified water uses or to allow unrestricted water uses at sites where they have been established. Background concentrations established via this protocol are not considered toxicologically derived standards for the protection of human health and environment.

3.0 Applying local background concentrations

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

Groundwater that contains a substance at concentrations above the applicable generic numerical water 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 CSR. Similarly, groundwater that has been remediated for a substance to concentrations above the applicable generic numerical water 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 CSR. This protocol is also used to determine the local background concentration for use in the application of risk-based standards for remediation under Sections 18 and 18.1.

4.0 Options for establishing local background concentrations

Where substances occur naturally in groundwater at elevated concentrations, a local background concentration for that substance can be established using one of the options described below.

4.1 Option 1 – Using regional background concentrations

Local background concentrations of select inorganics in groundwater can be established using regional background concentrations provided in Table 1. The values have been calculated from the ministry's background groundwater database for three regions in B.C.: the Lower Mainland Region (includes sub-regions 1 and 2), Southern Vancouver Island Region and the Thompson Okanagan Region. Regional background concentrations in Table 1 are considered representative of local background concentrations in groundwater at any site located within a particular region. Regional boundaries can be viewed on the iMapBC website (iMapBC webpage).

The Background Concentrations webpage provides additional information and access to a database of the individual data points for each monitoring well location, sorted by site-specific locations for each region.

The report "Establishing Regional Background Concentrations in British Columbia" written by Core6 Environmental Ltd. (2018) is available upon request and contains detailed information on the development of the regional background concentrations in groundwater.

4.1.1 Reporting requirements

Establishing a local background concentration in groundwater using Option 1 does not require approval from the director.

Investigation reports prepared in support of applications to the ministry must clearly indicate the use of Option 1 and the local background concentrations in groundwater that were applied. Establishment of a local background concentration must be referenced in the Summary of Site Condition report and Schedule C of any certification documents issued for the site.

For substances or regions not listed in Table 1, local background concentrations in groundwater must be established using Option 2, below.

4.2 Option 2 – Using site- specific concentration data

Under this option, the local background concentration of a substance in groundwater is calculated using one of the following approaches:

Option 2a. Using site-specific concentration data collected from representative background groundwater monitoring wells located on or adjacent to the site of interest; or

Option 2b. Using site-specific concentration data collected from representative background groundwater monitoring wells on or adjacent to the site of interest, supplemented with relevant concentration data from the ministry's background groundwater database

Establishing a local background concentration in groundwater using Option 2 requires approval from the director unless otherwise indicated in Section 4.2.3.

4.2.2 Procedures

Options 2a and 2b require a rigorous approach to site characterization, monitoring well siting and selection, and data collection.

Site Characterization

A minimum level of site characterization is required before pursuing a local background concentration in groundwater at a site. A background investigation must use information gathered from a Stage 2 Preliminary Site Investigation or Detailed Site Investigation as supporting evidence for siting new, or relying on existing monitoring wells, as representative background monitoring wells. All areas of potential environmental concern (APECs) must be assessed for potential contaminants of concern (PCOCs) to demonstrate that the suspected naturally occurring inorganic constituents are not attributed to anthropogenic sources. Furthermore, contaminants of concern (COCs) associated with areas of environmental concern (AECs) must be delineated to the extent that ensures representative background wells are located outside of the influence of site contamination. It is the responsibility of the qualified professional to identify sources of contamination and characterize any secondary impacts arising from the contamination that could result in elevated dissolved inorganic concentrations above natural background levels.

Most local groundwater conditions are the result of water/rock interactions that occur within the unsaturated zone and underlying water table. The solid phases (present minerals and organic matter) within a geologic unit play an important role in defining the natural groundwater chemistry and resultant dissolved substance concentrations. Accordingly, a local background groundwater assessment should target discrete hydrogeologic units at a site.

On certain sites, there may be two or more hydrogeologic units that require separate characterization. When completing the background groundwater assessment, it should be indicated if substances occur at naturally elevated concentrations in more than one hydrogeological unit and separate background groundwater determinations should be completed for each unit of interest.

A conceptual site model should be developed to demonstrate an adequate understanding of hydrogeological and geochemical conditions that result in the naturally elevated substance concentrations in groundwater. The direction of groundwater flow, including the vertical component, should be defined and illustrated from site data.

Monitoring Well Siting Criteria

Monitoring wells must be located near the site of interest, or on the site of interest if it can be demonstrated they are not impacted by anthropogenic sources of contamination. To limit the potential influence of site AECs, background monitoring wells should be located upgradient or cross-gradient of AECs. Preference should be given to the collection of background groundwater from monitoring wells installed on undeveloped or vacant land that has not received imported fill, or in naturally wooded areas, parks or larger residential lots. However, monitoring wells may be placed in urban settings if it's demonstrated they are not contaminated by anthropogenic sources.

To demonstrate an absence of anthropogenic influence, background wells must be sampled for PCOCs that could be sourced from site AECs or that could have migrated onto the site of interest from neighboring site APECs.

Representative background wells must not be:

- located within the footprint of a former excavation or backfill area,
- screened in fill material of questionable quality (i.e., woodwaste, bricks, asbestos, etc.),
- impacted by anthropogenic sources of contamination (e.g., wells with detectable organic constituents such as petroleum hydrocarbons, volatile organic compounds, etc.),
- wells where laboratory detection limits for anthropogenic contaminants of concern are higher than the applicable groundwater standard for the site, and
- influenced by secondary contaminant release processes, such as reducing environments (i.e., low dissolved oxygen and low oxidation-reduction potential) arising from hydrocarbon contamination.

Groundwater Data Collection and Assessment

Groundwater sampling data must be collected from representative background wells to provide a comprehensive estimation of local background conditions. To achieve this, the following data collection requirements must be met:

- Groundwater concentration data must be collected within 500 m of the site of interest and within the same part of the groundwater flow system and the same hydrogeological unit,
- The size of the data set, the number of background wells and sampling events required to determine background concentrations at a site must be based on the complexity of the hydrogeology and site conditions (i.e., complex stratigraphy, large changes in water levels, and multiple contaminant sources, etc. may warrant additional data collection beyond the minimum data requirements detailed in Section 4.2.2 of this protocol),
- Sufficient data must be collected to demonstrate that chemical processes resulting from contamination releases have not increased mobilization or dissolution of naturally occurring substances, and
- Groundwater samples must be analyzed for substances using ministry approved analytical methods as detailed in the latest version of the BC Environmental Laboratory Manual or alternate methods acceptable to the director. Samples must be analyzed only by laboratories registered under the Environmental Data Quality Assurance Regulation.

Groundwater data is expected to be collected in accordance with Technical Guidance Document 8 - Groundwater Investigation and Characterization (TG8). Detection limits that are higher than applicable site standards cannot be used to calculate background groundwater concentrations.

Minimum Data Requirements

Once representative background groundwater monitoring wells have been selected or sited the following requirements must be met:

a) collect samples from a minimum of three representative background monitoring wells,
b) develop each monitoring well to minimize suspended sediments in the collected groundwater samples, and
c) a minimum of two sampling events required, one during the wet and one during the dry seasons (e.g., seasonal high and low water table), to capture any seasonal variability in the natural groundwater chemistry.

The most recent groundwater data set is considered most representative of groundwater conditions. Historical groundwater data may be used provided it meets the requirements of this protocol and is demonstrated to be representative of current conditions.

Calculation of Local Background Concentrations

Where collective background concentration data fall within a single statistical population, the representative local background concentration in groundwater for a substance is the 95th percentile concentration of the data set. The calculation must be conducted in two steps. Step 1 involves calculating the 95th percentile concentration of the data collected from each individual background monitoring well. If there are less than three sampling results, then the maximum value must be used. Step 2 involves calculating the 95th percentile of the values calculated for the combined background monitoring wells. Outliers must be identified using statistical methods and verified as the result of sampling and/or analytical error and removed from the data set. Where data variability is large and the data do not fall within a single population, conservative estimates must be used to determine local background concentrations (i.e., use the minimum concentration of the data set as the background concentration), or additional background wells must be installed and sampled to increase the size of the data set.

4.2.3 Circumstances not requiring director's approval

Director's approval for establishing local background concentrations in groundwater using Option 2 is not required when:

- The substance is not a potential contaminant of concern at the site of interest, and
- The substance is not present above the CSR numerical soil standards in fill material where background wells are located.

Applications to the ministry for certification documents must indicate that local background concentrations were applied and justify why director's approval is not required. The full rationale, including any supporting information and methods used to determine local background concentrations in soil as detailed in Section 4.2.3, must be provided in a separate section of the applicable final report(s). Establishment of a local background concentration must be referenced in the Summary of Site Condition report and Schedule C of any certification documents issued for the site of interest.

4.2.4 Reporting requirements

Where a director's approval is required, an application must include a Contaminated Sites Services Application form, Summary of Site Condition, and a full report detailing the rationale and methods used to determine local background concentrations in groundwater. This report must be a stand-alone document that includes the following detailed information:

a) the location and land use history of the site of interest and surrounding sites,
b) groundwater sampling procedures used,
c) representative background monitoring well selection rationale and locations including a figure showing the well locations,
d) borehole logs including screen depths and lithological descriptions,

e) summary of the regional/local hydrogeology of the site of interest and conceptual site model,

f) contaminants of concern in soil and groundwater considered and demonstrate that they have not impacted representative background monitoring wells,

g) analytical results obtained for background substances and related parameters presented in graphical form on figures and in tabular form,

h) statistical evaluations used in derivation of the recommended background concentration,

i) conclusions and recommended background concentration based on the assessment of the site background groundwater quality, and

j) confirmation that the person carrying out the background groundwater investigations and preparing the report is a qualified professional with experience in the assessment of groundwater flow systems and groundwater quality of the type encountered at the site.

5.0 Alternate approaches

Scientifically defensible modifications to the options outlined in this protocol may be considered by the director. Such requests must be submitted for a director's decision and be accompanied by:

- a completed Contaminated Sites Services Application Form;
- Summary of Site Condition; and
- a supporting technical report prepared by a qualified professional that, at a minimum, meets the intent, technical rigor and documentation requirements of the options set out above.

Applications for a director's approval are subject to ministry service fees as indicated in Schedule 3 of the CSR.

Table 1. Regional estimates for local background concentrations in groundwater for inorganic substances[1]

Substance	Lower Mainland Sub-Region 1	Lower Mainland Sub-Region 2	Thompson Okanagan Region	Southern Vancouver Island Region
Aluminum	330	180	230	110
Antimony	1.6	2.9	2.7	2.0
Arsenic	38	13	13	9.0
Barium	490	170	240	250
Beryllium	0.56	3.3	1.3	2.0
Boron	820	670	880	640
Cadmium	0.97	0.56	0.33	1.0
Chromium	12	3.9	19	3.0
Cobalt[2]	62	18	16	14
Copper	14	13	32	8.0
Iron	290,000	6,900	12,000	270
Lead	2.1	3.0	6.7	3.0
Lithium	28	19	96	33
Manganese	26,000	3,600	7,600	3,000
Mercury	0.49	0.36	0.57	0.29
Molybdenum	9	58	45	17
Nickel	110	100	44	52
Selenium	4.4	4.9	120	6.0
Silver	0.20	0.25	0.98	0.27
Sodium	900,000	2,100,000	1,600,000	1,700,000
Strontium	1,300	670	6,500	760
Thallium	0.33	0.42	0.68	0.50
Titanium	110	94	330	78
Uranium	11	18	87	12
Vanadium	19	26	30	5.0
Zinc	44	43	29	17

Footnotes:

1. Units are in ug/L.
2. The interim cobalt value of 20 ug/L for the remaining regions of the province remains in effect.