



## **Environmental Quality Standards**

### **Introduction to environmental quality standards**

Environmental quality standards are used for determining the acceptability of substances in soil, surface water, groundwater, vapour and sediment at sites. Provisions for these standards are in Parts 5, 6 and 8 of the Contaminated Sites Regulation (the Regulation).

All the environmental quality standards listed in the Regulation are based on, and are designed to be protective of, the toxicological effects of contaminating substances.

Under the Regulation, only the numerical soil, water, vapour and sediment standards are used to determine if a site is a contaminated site. Following that determination, site owners and operators may choose either the numerical or risk-based standards to show that a site has been satisfactorily remediated.

### **Types of standards**

There are five specific types of standards in the Regulation:

- matrix numerical standards;
- generic numerical standards;
- site-specific numerical standards;
- Director's interim numerical standards;
- and
- risk-based standards.

### **Use of the standards**

The first use of the standards is to determine if a

site is contaminated. This involves comparing the results of site investigations with numerical standards, depending on which environmental media are involved. The process involves several steps:

- selection of applicable land uses;
- comparison of generic or matrix numerical standards with site investigation results;
- as necessary, comparison to site-specific numerical and Director's interim numerical standards;
- optional comparison with background levels of substances; and
- exemptions related to the use of biosolids.

### **Selection of applicable land, water, sediment and vapour uses**

The first step is to select the applicable land, water, sediment and vapour uses for the site.

#### **Definitions of land, water, sediment and vapour uses**

Definitions for eight land uses, four water uses, four vapour uses and four sediment types are presented in section 1 of the Regulation.

Ultimately, a Director may specify the applicable land, water, and sediment uses for a site. Subsection 12 (5) of the Regulation lists the factors the Director must consider in making such a ruling for a site.

#### **Multiple land uses**

A land use is established based on the activities occurring at the surface of the site using the land use definitions in the Regulation. There may be

cases where a primary land use is identified for a site or parts of a site where multiple activities occur in the same space. Primary land use can be established as per section 12(5) of the Regulation and using the criteria provided in [Protocol 18, "Criteria for Establishing Multiple Land Uses at Sites"](#).

## Soil standards

### Applicable land uses

Generic and matrix numerical soil standards are provided for eight different land uses in Schedules 3.1 Part 1, 2, and 3:

- natural wildlands (WL<sub>N</sub>)
- reverted wildlands (WL<sub>R</sub>)
- agricultural (AL)
- urban park (PL)
- low density residential (RL<sub>LD</sub>)
- high density residential (RL<sub>HD</sub>)
- commercial (CL)
- industrial (IL)

A substance listed in Schedule 3.1 will only have either generic, or matrix, numerical soil standards.

Subject to the discretion of a Director, subsection 17 (3) specifies that regardless of the use of the land at the surface of a site, soil below 3 m from the surface of a site need only be remediated to numerical soil standards for industrial land. As well, section 17(1)(d) and (e) contains several provisions related to oil and gas drilling sites, where the applicable standards vary with depth from surface land use. Specific provisions for oil and gas drilling sites also appear in sections 11(c.2) and (c.3) in the Regulation.

### Available soil standards

#### Matrix numerical soil standards

Each matrix applies to a substance or group of substances, and contains two main sections – one

for human health protection and one for environmental (i.e. ecological health) protection. Each section contains a listing of the relevant site-specific factors and their corresponding standards. The eight different land uses presented in the matrix are the same eight land uses provided for the generic numerical soil standards.

#### Site-specific factors

The matrix numerical soil standards are found in Schedule 3.1 Part 1 of the Regulation. Each matrix lists eight site-specific factors and eight land uses for a substance. Standards are provided for some or all site-specific factors and land uses, depending on the substance.

As specified in subsection 12 (8) of the Regulation there are two mandatorily applicable matrix factors:

- intake of contaminated soil in the human health protection section; and
- toxicity to soil invertebrates and plants in the environmental protection section.

For human health protection, direct exposure by inadvertent soil ingestion is considered the key site-specific factor and is mandatorily applicable at every site. Indirect exposure through drinking water, while not mandatorily applicable, is also commonly considered to be broadly applicable since contaminants often leach from soil into surface water and groundwater.

For environmental protection, both direct and indirect routes of exposure to soil contaminants are taken into account. The key mandatorily applicable site specific factor is direct toxicity to plants and soil invertebrates.

#### Selecting site-specific factors

For every site where matrix standards are used, the two mandatory standards apply at every site. The standards for the additional matrix site-

specific factors are not mandatory and are applicable only if they are relevant to a particular site.

A Director may specify any of the applicable land uses, water uses to be protected, and any other site-specific factors for a site if the matrix numerical standards approach is being used.

#### *Use of a matrix*

The critical (i.e. most stringent applicable) matrix standard for a substance at a site is chosen by considering all the standards that apply in the matrix for that substance. This is done by first determining the appropriate land use and then identifying the mandatory and other applicable site-specific factors. The most stringent matrix value for the applicable land use among the mandatory and relevant site-specific factors is the numerical standard for that substance.

Example 1: The former site of a coal gasification plant contains soils with coal tars. The land will be redeveloped as an urban park. Chemical analyses have revealed soil samples containing 13 µg/g benzo(a)pyrene.

The matrix for benzo(a)pyrene contains standards for only two site-specific factors – intake of contaminated soil and toxicity to soil invertebrates and plants. These are also the two mandatory site-specific factors. The standard for intake of contaminated soil for urban park land is 10 µg/g; the standard for protection of soil invertebrates and plants is 20 µg/g. Since both standards are mandatory, exceeding the 10 µg/g standard means that the site is a contaminated site.

Example 2: Acme Tubing Co. Ltd. manufactured copper tubing for many years at its site near the Columbia River. The site will be converted to a retail mall (commercial land use), and the groundwater will be used for human consumption. Currently, the groundwater flows into the river, which is used by aquatic life. Soil samples from the tube storage yard had a pH of 6.3 and a 95<sup>th</sup> percentile copper level of 1,200 µg/g.

Four commercial land use standards apply to this site, corresponding to the following four applicable site-specific factors:

- intake of contaminated soil (mandatory) – 25,000 µg/g;
- groundwater used for drinking water – 10,000 µg/g;
- toxicity to soil invertebrates and plants (mandatory) – 300 µg/g and
- groundwater flow to surface water used by aquatic life – 650 µg/g.

Since all of these standards apply, the lowest value, 300 µg/g, is the controlling standard and will be applied to this site. Comparison of the 1,200 µg/g site investigation result with this 300 µg/g standard reveals that the site is a contaminated site.

#### **Generic numerical soil standards**

The concentration of a substance in soil is compared with the applicable generic numerical soil standards in Schedules 3.1 Part 2 (human health) and Part 3 (ecological health) of the Regulation. If the concentration is greater than or equal to the applicable standard, the site is considered to be a contaminated site. If, however, the soil concentration of the substance is less than the applicable standard, the site would not be considered contaminated in relation to that specific investigation result.

Example 3: A former metal plating operation is planned to be used for a day care centre. Day care operations are cited in the definition of residential land use, so the primary land use is low density residential. The 95<sup>th</sup> percentile of the soil lithium concentrations is 253 µg/g, while the low density residential standard for lithium in Schedule 3.1, Part 2 is 30 µg/g. Since the soil concentration is greater than the generic soil standard, the site would be a contaminated site.

#### **Site-specific numerical soil standards**

In accordance with [Protocol 2, "Site-Specific Numerical Soil Standards,"](#) if sufficient site-specific data are available, site-specific numerical soil standards (SSSs) may be calculated for substances for which matrix

standards apply at the site. SSSs cannot be derived for substances for which generic soil standards are provided in Schedule 3.1 Parts 2 and 3.

Provided a SSS developed for a substance in accordance with Protocol 2 is not exceeded at the specific site for which the SSS was developed, the site is not a contaminated site for that substance.

### **Optional comparison with background**

An optional step is to establish local background levels of substances in accordance with [Protocol, "4 Establishing Background Concentrations in Soil"](#) for comparison with site investigation and/or post-remediation soil concentration data. Under subsection 11 (3) of the Regulation, a site is not a contaminated site if it does not contain any substance with a concentration greater than its local background concentration.

The Regulation specifies that a background level must not include any contribution of a substance from local human-made point sources. Further information can be found in [Protocol 4, "Establishing Background Concentrations in Soil"](#).

### **Numerical remediation requirements**

This process is identical to that used to determine if a site is a contaminated site, except that the standards (or SSSs) are compared to post-remediation confirmatory results obtained at the site. If the confirmatory results indicate that the substance still exceeds the applicable standard (Schedule 3.1, Part 1, 2 or 3; or SSS), then the site would still be a contaminated site and would not be considered satisfactorily remediated to the numerical soil standards. Conversely, if the confirmatory results indicate that the most stringent applicable soil standard is no longer exceeded, then the site would be

considered a satisfactorily remediated site and would no longer be contaminated in relation to that specific substance.

Example 4: Remediation of the former metal plating operation described in Example 3 above has been carried out, and the soil lithium levels reduced to 25 µg/g by soil washing. Since the soil lithium concentration is now less than the most stringent applicable low density residential standard of 30 µg/g in Schedule 3.1, Part 2, the site is considered to have been satisfactorily remediated.

Example 5: Four Point Motors is going to replace its corroded underground gasoline storage tanks which contaminated the surrounding soil with benzene. The land use is considered commercial. Groundwater at the site is not used as drinking water. However, groundwater from the site does impact fish residing in the Qualicum River nearby. The benzene concentration in the soil of the site is 5 µg/g, which exceeds the matrix soil standard of 2.5 µg/g to protect groundwater flow to surface water used by aquatic life.

The company elected to calculate site-specific numerical soil clean-up standards. After following Protocol 2, the consultants for Four Point Motors determined that the site-specific numerical soil standard (SSS) to protect groundwater flow to surface water used for aquatic life for benzene would be 4 µg/g. The company instituted a program of bioremediation for benzene in the soil at the site. After 2 years of monitoring, the benzene concentration in the soil had decreased to less than 4 µg/g. Since the post-remediation concentration of benzene was less than the corresponding SSS for benzene at the site, it was concluded that the site had been satisfactorily remediated.

## **Water standards**

### **Applicable water uses**

Generic numerical water standards are provided for four different water uses, in Schedule 3.2:

- aquatic life (AW)
- irrigation (IW)
- livestock (LW), and
- drinking water (DW)

### **Applying water quality standards**

Section 12(5) of the Regulation specifies the water uses that may apply at sites in BC, including aquatic life, drinking, irrigation and livestock watering water uses, as well as the factors a Director must consider in determining current and reasonable potential future water uses at a site. [Protocol 21, “Water Use Determinations”](#), [Technical Guidance 6, “Assessment of Hydraulic Properties for Water Use Determinations”](#), and [Technical Guidance 15, “Concentration Limits for the Protection of Aquatic Receiving Environments”](#) provides criteria for determining current and reasonable potential future water uses at specific sites.

Where drinking water use applies to groundwater at a site under Protocol 21 but site specific circumstances indicate that it is unlikely or unreasonable to anticipate that groundwater would in fact be used as drinking water, a site-specific water use decision may be sought from the Director. Protocol 21, Appendix 1 “*Director’s Decision Framework for Site-Specific Determinations of Water Use*” outlines a multiple-lines-of-evidence approach for seeking a Director’s decision of no drinking water use at a specific site.

Where the water is considered to be transitional between freshwater and marine/estuarine water, or if a proponent elects not to characterize the salinity per se, the more stringent of the freshwater or marine/estuarine standards or guidelines should be used.

#### **Multiple water uses**

The Regulation deals with water uses differently than land use. Since water at a site may be used for several different purposes, more than one water use can apply.

Example 6: Groundwater at a farm is used for both drinking water and livestock watering. In this case,

two water uses and their corresponding water quality standards apply at the site. Of the two applicable water standards, the most stringent must be used to determine if the site is a contaminated site, and when the site has been satisfactorily remediated.

The farm is located next to an estuary and was in the past used to grow corn. The farmer used the pesticide aldrin to control corn root weevil infestations. As a result, the concentration of aldrin in the groundwater at the site is 0.02 µg /L. The Schedule 3.2 drinking water standard for aldrin is 0.009 µg /L and the livestock watering standard for aldrin is 0.04 µg /L. The site exceeds the drinking water standard but not the livestock watering standard. The farm would be determined to be a contaminated site since the groundwater exceeds the drinking water standard, and the groundwater would have to be remediated to an aldrin concentration less than 0.009 µg /L to be considered satisfactorily remediated to the numerical water standards.

**Optional comparison with background** [Protocol 9, “Determining Background Groundwater Quality”](#) provides a procedure for establishing background concentrations in groundwater. As with soil, subsection 11 (3) of the Regulation allows the use of local background concentrations of substances in water for concluding whether a site is, or is not, contaminated for that substance.

### **Vapour standards**

#### **Applicable vapour uses**

Generic vapour standards are provided in Schedule 3.3 for four vapour uses:

- agricultural, urban park, residential use,
- commercial use,
- industrial use, and
- parkade use

#### **Applying vapour standards**

Vapour contamination exists if the concentration of any potential contaminant of concern in vapour that is associated with a soil, sediment, or water source exceeds its Schedule 3.3

standard in the breathing zone. The breathing zone is an area where humans can come into direct contact with contaminated vapour. This can include indoor and outdoor, onsite and offsite environments that exist at the time of site assessment or that have a reasonable potential to exist after site remediation is complete.

There are 3 approaches to estimate the concentrations of vapour substances in the breathing zone:

- Approach A – Estimation based on subsurface and/or sub-slab vapour measurements,
- Approach B – Direct vapour measurement in a breathing zone , or
- Approach C – Estimation of vapour concentrations in a breathing zone based on soil and/or groundwater measurements.

[Technical Guidance 4, “Vapour Investigation and Remediation”](#) provides further details on these approaches. Approaches A and C may include the application of vapour attenuation factors (VAFs), to measure or estimate subsurface or sub-slab vapour concentrations. The application of VAFs, including conditions for use, precluding conditions and the attenuation factors is detailed in [Protocol 22, “Application of Vapour Attenuation Factors to Characterize Vapour Contamination”](#).

## **Sediment standards**

### **Applicable sediment uses**

Generic sediment standards are provided in CSR Schedule 3.4. Sediment standards have been developed for freshwater and estuarine/marine sediments, for both sensitive and typical sediment use:

- freshwater sensitive use,
- freshwater typical use,

- marine sensitive use, and
- marine typical use.

Sensitive sediment use means the use of sediment as habitat for sensitive components of aquatic ecosystems as specified in Part 1 of the Regulation. Typical sediment use applies at a site that is not considered sensitive sediment, based on its biological resources.

In areas that transition from freshwater to estuarine water, the lower (i.e. more stringent) of the freshwater or marine sediment standards applies.

The generic numerical and matrix numerical soil standards (Schedule 3.1) are not intended for use in the assessment of sediments that are (temporarily) underwater. However, soil standards are applicable where sediments are deposited on land.

The Schedule 3.4 sediment standards are limited to the protection of aquatic life. Where sediments may be temporarily exposed (e.g. an intertidal zone) the potential for human contact can also exist. For these temporarily exposed sediments, in addition to the application of the sediment standards, the soil standards for protection of human health (i.e. the Schedule 3.1, Part 2 generic numerical standards or the Schedule 3.1, Part 1 “Intake of contaminated soil” matrix standards) can be used to consider whether human health risks should be assessed.

### **Risk-based standards**

Risk-based standards for remediating contaminated sites are prescribed in sections 18 and 18.1 of the Regulation.

The application of risk-based standards requires the completion of a human and environmental health risk assessment that assesses risks posed

to human and environmental receptors from exposure to contaminating substances at a site. Often this involves complex technical and scientific analysis.

Risks may be assessed by one of two different methods:

- qualitative screening level risk assessment (See [Protocol 13, "Screening Level Risk Assessment"](#)), or
- quantitative detailed deterministic or probabilistic risk assessment (See Health Canada guidance for "[Preliminary Quantitative Risk Assessment \(PQRA\)](#)" and [Protocol 20, "Detailed Ecological Risk Assessment Requirements"](#))

Compliance with risk-based standards is demonstrated when:

- a screening level risk assessment indicates there are no operative exposure pathways for contaminating substances to come into contact with human or environmental receptors;
- a detailed risk assessment indicates risks to human and environmental health from a contaminating substance are less than or equal to the risk-based standards of the Regulation;
- a screening level risk assessment indicates that after partial removal of a contaminating substance or the implementation of risk management controls, there are no operative exposure pathways for human or environmental receptors to come into contact with the remaining contamination; or
- A detailed risk assessment indicates that after partial removal of a contaminating substance or the implementation of risk management controls, risks to human and environmental health from remaining

contamination is less than or equal to the risk-based standards of the Regulation.

Note that where risk management controls are implemented at a site to meet the risk-based standards, the requisite risk controls must be maintained and their ongoing effectiveness monitored and verified.

Where contaminating substances at a site are demonstrated on the basis of a screening level or detailed risk assessment to be in compliance with the risk-based standards, the site is considered to be satisfactorily remediated.

Example 7: The owner of a site whose soil has been contaminated by arsenic emissions from a smelter has decided to manage the site using a risk-based remediation approach. She has decided to use the default risk-based standards specified in subsection 18(3). One metre of the most contaminated surface soil will be replaced by clean fill. The owner's consultant has performed a risk assessment for this scenario, and predicts that a human lifetime cancer risk posed by exposure to arsenic at the site following the replacement of contaminated surface soil with clean fill will be 4 in 1,000,000. The risk reduction achieved by the soil replacement is considered to meet the remediation requirements of the Regulation, because the predicted cancer risk is less than the risk-based standard of 1 in 100,000.

Technical Guidance 7, "[Supplemental Guidance for Risk Assessments](#)" provides further details for conducting human health and environmental risk assessment at sites.

### **Biosolids exemption**

The Regulation contains several provisions that effectively exempt a site as a contaminated site where biosolids such as sewage sludge and compost have been legally applied.

The definition of "soil" excludes sewage sludge, compost, and products derived from these

materials as long as they have been applied to land in compliance with the [Organic Matter Recycling Regulation](#) or under an authorization under the *Environmental Management Act* (the Act). In addition, a site that has been used for the application of these materials under the same circumstances is exempt from the definition as a contaminated site under subsection 11 (4) of the Regulation, provided the site has not been used for any of the industrial or commercial purposes or activities listed in Schedule 2.

### **Application of the Hazardous Waste Regulation on contaminated sites**

[Amendments to the Hazardous Waste Regulation \(HWR\)](#) under the Act came into effect on July 19, 2016. The amendments serve to “decouple” certain provisions of the Regulation and the HWR for onsite managed environmental media, and by so doing, relieve the site and any onsite remediation facilities associated with it, from the application of the HWR. Where contaminated media meets the criteria of hazardous waste and is transported, managed or disposed of off the contaminated site of origin, the media qualifies as hazardous waste and is subject to the requirements of the HWR .

This enables all contaminated onsite media (regardless of the level of contamination) that remains on the site that it originated on to be managed under the Regulation.

### **Standards for substances not contained in schedules**

At some sites, toxic substances will be discovered for which no standards are provided in Schedules 3.1, 3.2, 3.3 or 3.4 of the Regulation. In this circumstance there is no duty to include consideration of such a "non-prescribed substance" in order to obtain a legal instrument (e.g. Approval in Principle, Certificate of Compliance) under the Regulation. However, it is important to note that the issuance of a legal instrument is discretionary on the part of the Director (section 53 (3)(a)(iv) of the Act). If a non-prescribed substance is considered by a Director to be sufficiently toxic that it would pose a significant risk to human or environmental health, the Director may elect to not issue the instrument, may establish a Director's Interim Standard under subsection 11 (1) (d) of the Regulation for the non-prescribed substance, or may impose additional requirements related to the instrument that the Director considers necessary to mitigate or eliminate the risk posed by the non-prescribed substance.

Alternatively, such non-prescribed substances may be addressed within a human and environmental risk assessment performed for the site. If the results of the risk assessment show that the non-prescribed substance does not exceed the risk based standards of the Regulation, the Director may elect to issue an instrument that acknowledges compliance with the risk based standards for the non-prescribed substance.

*For more information, please direct inquiries to [site@gov.bc.ca](mailto:site@gov.bc.ca).*



**Revision History**

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