



Ministry of
Environment

DIRECTOR'S INTERIM CRITERIA FOR CONTAMINATED SITES

Air Concentration Criteria

Prepared pursuant to Section 63.1 (1) of the *Environmental Management Act*
and Section 11 (1) (d) of the Contaminated Sites Regulation

Approved:

Director of Waste Management

Date

Acknowledgements

This criteria document is based largely on the scientific background information and methodologies provided by the Science Advisory Board for Contaminated Sites in British Columbia (SABCS), in its reports (SABCS, 2005; 2006) commissioned by the B.C. Ministry of Environment.

It should be noted that this document includes some departures from both previous ministry policies and SABCS recommendations. As such, the ministry anticipates that future changes or amendments may be warranted. Such revisions and amendments will be incorporated in later editions of this document.

Limitations of Application of Air Concentration Criteria

The Director's interim air concentration criteria provide a basis for evaluating substances in air at a site which originate from soil, sediment, or water at the site. The criteria may be used to identify the presence or absence of contamination; the need for and extent of remedial actions; and to establish remediation targets for use at contaminated sites.

The following limitations apply to these criteria:

- They are not intended to authorize, supersede or negate any other regulatory requirements related to air quality mandated by other federal, provincial, or local government agencies.
- They do not constitute authorized air emission standards for operating facilities, prescribed industries, trades, or businesses in British Columbia.
- They are not to be used to contravene or contradict regional or local air quality objectives or requirements established by local governments (e.g. the Greater Vancouver Regional District), which are designed to manage or regulate general air quality within an air shed. A responsible person for a contaminated site must comply with all applicable federal, provincial, and local government regulations and requirements related to air quality applicable to the locale in which a site is located.
- They are not to be used to assess or regulate air quality within a workplace. Protection of worker health and safety in the workplace is the responsibility of the Workers' Compensation Board (WCB) of British Columbia under the *Worker's Compensation Act* (British Columbia, 2005) and the Occupational Health and Safety Regulation (British Columbia, 2006). The WCB enforces compliance with various occupational health and safety guidelines, including those related to occupational exposure to chemical contaminants in workplace air.

1.0 Introduction

Soil vapour intrusion is the migration of volatile or semi-volatile chemicals from contaminated groundwater, soil or sediment into nearby buildings. When chemical releases occur near buildings, the subsequent volatilization of chemicals from subsurface contamination can result in the intrusion of vapour phase contaminants into indoor air (Figure 1). If the soil vapour intrusion pathway is complete, building occupants may face unacceptable health risks from the inhalation of vapours.

Because of this risk, the soil vapour intrusion pathway is now commonly evaluated at contaminated sites where buildings are located near subsurface volatile chemicals (Health Canada, 2004c). This evaluation often requires that substance concentrations in soil vapour and sometimes in indoor air be characterized as part of the risk assessment process in order to assess potential risks to human health by inhalation.

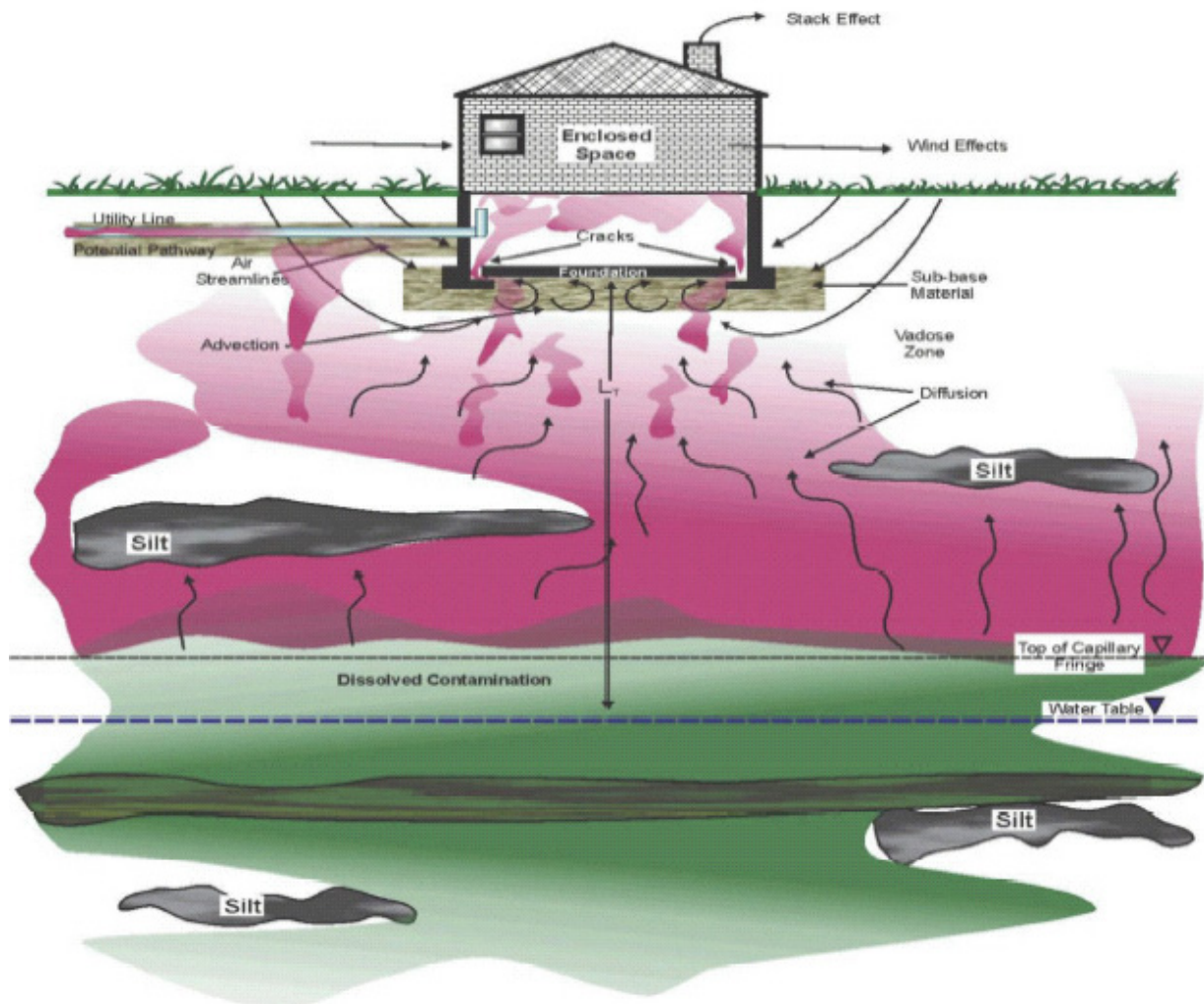


Figure 1. Vapour intrusion into a residential building (adapted from USEPA, 2002).

2.0 Legal authority

The criteria have been established under the Director's authority provided under section 63.1 (1) of the *Environmental Management Act* and section 11 (1) (d) of the Contaminated Sites Regulation (the Regulation) (see Appendix 1). These criteria have legal standing under the provisions of the Regulation and will remain in effect until YYY, 2008, unless otherwise cancelled by the Director.

3.0 Application of the Director's interim air concentration criteria

The Director's interim air concentration criteria (the criteria or ACC) presented in Table 1 are for use in assessing whether:

- air associated with contaminated sites is contaminated;
- there is the need for remedial measures; and
- remediation of air at contaminated sites is satisfactory.

These criteria are to be used in the same manner as the numerical standards for soil, water and sediment under the Contaminated Sites Regulation (British Columbia, 2004). They can also be used for the assessment, remediation, and management of soil, sediment, and water that give rise to air contaminants at contaminated sites (as defined under section 39 (1) of the Act), using the numerical standard approach available under the Regulation.

Limitation of responsibility

Under the Regulation, a responsible person for a contaminated site is not required to consider any substance *not* prescribed in Table 1 as an air contaminant at a contaminated site.

3.1 Use in identifying sites with unacceptable concentrations of substances in air

The criteria shall be used to determine if concentrations of substances in air at a site pose a potential risk to human health. The criteria complement the existing standards of the Regulation and must be used in keeping with the requirements of sections 15 through 18 of the Regulation.

Air samples and soil vapour samples collected for comparison with the criteria must be collected and analyzed in accordance with approved air sampling procedures and chemical analytical methods and protocols or alternative procedures, methods, or protocols acceptable to a Director. Examples of approved procedures for soil vapour

sample collection include those of the B.C. Ministry of Environment (2006b) and SABCS (2005; 2006)

A site is a “contaminated site” if the concentration of any substance listed in Table 1 exceeds the criterion for that substance in the air overlying or entering any structure (under construction or completed) that is on the land, sediment or water at the site.

3.2 Use in defining remediation targets

The criteria provide a basis for establishing remediation targets (target clean up concentrations) under the numerical criteria-based approach for sites in British Columbia with air contaminants. Remediation targets specify tolerable concentrations of substances in environmental media. These targets must be achieved to demonstrate satisfactory remediation of a contaminated site.

Under the numerical concentration approach, sites found to have unacceptable concentrations of air contaminants will be considered satisfactorily remediated for regulatory purposes if, as applicable, the soil, water and/or sediment at the site that give rise to air contaminants is removed or treated using engineered treatment works. Exceptions include works implemented as part of a risk assessment/risk management approach at the site, where the soil, water, or sediment of the site is no longer giving rise to air contaminant concentrations in excess of the criteria.

3.3 Ecological health limitations in defining remediation targets

The criteria are specific to the protection of human health. No approved derivation methodology exists to calculate criteria for the protection of ecological receptors. Consequently, a person responsible for remediating a site based on the criteria must ensure that using the criteria to define remedial targets will not result in an unreasonable environmental health hazard.

Responsible persons are advised to consider carefully the following factors when reviewing the potential of a substance in Table 1 to impact ecological receptors:

- the quantity of the substance-contaminated material to be remediated or relocated;
- the acute and chronic toxicity, bioavailability, and bioaccumulative potential of the substance; and
- the environmental persistence, fate, and transport associated with the substance.

3.4 Requirement for ecological assertion by responsible person for outdoor air

Before the ministry will issue a Determination of Contaminated Site, Approval in Principle, or Certificate of Compliance for any site involving an air contaminant listed

in Table 1, a responsible person for the site must provide the following assertion in any site investigation, remediation plan, or summary of analytical results characterizing the site:

“I [*name of responsible person for the site*] have a reasonable basis to conclude that, with respect to the quality of air overlying the land, sediment or water at my site, ecological receptors will not be significantly impacted by the use of the Director’s interim air concentration criteria as remedial targets for the following substances: [*list substances*].”

The ministry does not require information in support of the above assertion to be submitted to, or reviewed by, ministry staff, because the ministry does not consider use of the criteria to be an alternative risk assessment/risk management process.

Furthermore, the ministry will not review any information on which the above assertion is based, or verify or otherwise warrant the validity of the responsible person’s assertion to any third party.

3.5 Role of contaminated sites Approved Professionals

Within the scope of authority and responsibility provided under Protocol 6, “Eligibility of Applications for Review by Approved Professionals” (B.C. Ministry of Water, Land and Air Protection, 2004), approved professionals may make recommendations to the Director under the *Environmental Management Act*, related to satisfactory remediation of a site based on the criteria.

Because the ministry does not review or warrant the validity of the responsible person’s assertion about the level of ecological protection provided by use of the human health-based criteria, the assertion is not subject to quality review under the quality review framework for approved professionals.

Furthermore, for the purposes of Protocol 6, the ministry does not consider any rationale provided in support of the assertion of ecological health to constitute an ecological risk assessment for a site, as long as:

- the Approved Professional has, or seeks and relies on, the advice of an individual with experience in performing ecological health assessment;
- the extent of the ecological health assessment performed is limited strictly to exposure pathway and critical receptor analyses; and
- the ecological health assessment performed is restricted solely to consideration of impacts attributable to substances listed in the criteria.

In all other respects, recommendations by Approved Professionals related to satisfactory remediation at sites eligible for review under Protocol 6 are subject to quality review.

4.0 Derivation of air concentration criteria

The procedures used to calculate the criteria are described in Appendix 2.

5.0 Background levels of potential contaminants of concern

Sections 11 (3) and 17 (2) of the Regulation make no provision related to a “background release” for any air contaminant that may be present at a site. However, the Regulation does provide for such release related to soil, sediment, and water contamination at a site. A responsible person for a site is not required to consider remedial action at a site to address air contamination arising from land, sediment, or water by a substance in Table 1 if the Director has provided a background release for that substance.

If the risk-based approach has been selected to support planning for remedial action under section 18 (5) of the Regulation for a substance prescribed in Table 1, then the risk levels associated with exposure to background concentrations of that substance in air at the site become the applicable risk-based standards for the air quality of the site.

6.0 References

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US Environmental Protection Agency (USEPA). 2002. Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). Office of Solid Waste and Emergency Response. Washington, D.C.

For more information, contact the Environmental Management Branch at site@gov.bc.ca.

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Table 1. Director's interim air concentration criteria ^{1,2}

| Substance | Chemical Abstract Service (CAS) Number | Agricultural, Urban Park, Residential Use³ | Commercial Use | Industrial Use⁴ |
|---|---|--|-----------------------|-----------------------------------|
| acenaphthene | 83-32-9 | 100 | 350 | 1 000 |
| acetaldehyde | 75-07-0 | 4.5 | 15 | 40 |
| acetone | 67-64-1 | 20 | 60 | 200 |
| acetonitrile | 75-05-8 | 60 | 200 | 550 |
| acrolein | 107-02-8 | 0.02 | 0.06 | 0.2 |
| acrylonitrile | 107-13-1 | 0.15 | 0.45 | 1.5 |
| anthracene | 120-12-7 | 600 | 2 000 | 5 500 |
| benz[a]anthracene | 56-55-3 | 0.1 | 0.35 | 1 |
| benzene | 71-43-2 | 1.5 | 4 | 10 |
| benzo[b]fluoranthene | 205-99-2 | 0.1 | 0.35 | 1 |
| benzo[k]fluoranthene | 207-08-9 | 1 | 3.5 | 10 |
| benzo[a]pyrene | 50-32-8 | 0.01 | 0.035 | 0.1 |
| benzyl chloride | 100-44-7 | 5 | 15 | 45 |
| 1,1-biphenyl | 92-52-4 | 0.9 | 3 | 8.5 |
| bis(2-chloroethyl)ether | 111-44-4 | 0.03 | 0.1 | 0.3 |
| bis(2-chloroisopropyl) ether | 39638-32-9 | 80 | 250 | 700 |
| bis(chloromethyl) ether | 542-88-1 | 0.015 | 0.05 | 0.15 |
| bis(2-chloro-1-methylethyl)ether | 108-60-1 | 1 | 3 | 9 |
| bromobenzene | 108-86-1 | 10 | 30 | 90 |
| bromodichloromethane | 75-27-4 | 0.7 | 2 | 6.5 |
| bromomethane | 74-83-9 | 5 | 15 | 45 |
| 1,3-butadiene | 106-99-0 | 2 | 6 | 20 |
| carbon disulfide | 75-15-0 | 700 | 2 000 | 6 500 |
| carbon tetrachloride (tetrachloromethane) | 56-23-5 | 0.65 | 2 | 6 |
| 2-chloroacetophenone | 532-27-4 | 0.03 | 0.09 | 0.3 |
| chlorobenzene | 108-90-7 | 50 | 150 | 450 |
| 2-chloro-1,3-butadiene | 126-99-8 | 7 | 20 | 65 |
| chloroethane (ethyl chloride) | 75-00-3 | 10 000 | 30 000 | 90 000 |
| chloroform (trichloromethane) | 67-66-3 | 0.45 | 1.5 | 4 |
| chloromethane | 74-87-3 | 5.5 | 15 | 50 |
| beta-chloronaphthalene | 91-58-7 | 150 | 500 | 1 500 |
| o-chloronitrobenzene | 88-73-3 | 15 | 45 | 150 |
| p-chloronitrobenzene | 100-00-5 | 20 | 60 | 200 |
| 2-chlorophenol | 95-57-8 | 10 | 30 | 90 |
| 2-chloropropane | 75-29-6 | 100 | 300 | 1 000 |
| o-chlorotoluene | 95-49-8 | 40 | 100 | 350 |
| Chrysene | 218-01-9 | 10 | 35 | 100 |
| cumene (isopropylbenzene) | 98-82-8 | 400 | 1 000 | 4 000 |
| cyanide (hydrogen) | 74-90-8 | 3 | 9 | 30 |
| cyanogens | 460-19-5 | 80 | 250 | 700 |
| cyanogens bromide | 506-68-3 | 400 | 1 000 | 3 500 |
| cyanogens chloride | 506-77-4 | 200 | 650 | 2 000 |
| n-decane | 124-18-5 | 2 500 | 8 000 | 25 000 |
| dibenz[a,h]anthracene | 53-70-3 | 0.01 | 0.035 | 0.1 |
| dibenzofuran | 132-64-9 | 8 | 25 | 70 |
| dibromochloromethane | 124-48-1 | 40 | 100 | 350 |
| 1,2-dibromo-3-chloropropane | 96-12-8 | 15 | 50 | 150 |
| 1,2-dibromoethane | 106-93-4 | 0.015 | 0.05 | 0.15 |

Table 1. Director's interim air concentration criteria (continued) ^{1,2}

| Substance | Chemical Abstract Service (CAS) Number | Agricultural, Urban Park, Residential Use ³ | Commercial Use | Industrial Use ⁴ |
|---|--|--|----------------|-----------------------------|
| 1,4-dichlorobenzene | 106-46-7 | 800 | 2 500 | 7 000 |
| 1,2-dichlorobenzene | 95-50-1 | 200 | 600 | 2 000 |
| 1,4-dichlorobenzene | 106-46-7 | 800 | 2 500 | 7 000 |
| dichlorodifluoromethane | 75-71-8 | 200 | 600 | 2 000 |
| 1,1-dichloroethane | 75-34-3 | 500 | 1 500 | 4 500 |
| 1,2-dichloroethane | 107-06-2 | 0.4 | 1 | 3.5 |
| 1,1-dichloroethylene | 75-35-4 | 0.2 | 0.6 | 2 |
| 1,2-dichloroethylene (cis) | 156-59-2 | 20 | 60 | 200 |
| 1,2-dichloroethylene (trans) | 156-60-5 | 15 | 50 | 150 |
| 1,2-dichloropropane | 78-87-5 | 0.65 | 2 | 6 |
| 1,3-dichloropropene | 542-75-6 | 2.5 | 7.5 | 20 |
| dicyclopentadiene | 77-73-6 | 7 | 20 | 65 |
| epichlorohydrin | 106-89-8 | 8.5 | 25 | 75 |
| ethyl acetate | 141-78-6 | 2 000 | 5 500 | 15 000 |
| ethyl acrylate | 140-88-5 | 7 | 20 | 65 |
| ethyl benzene | 100-41-4 | 1 000 | 3 000 | 9 000 |
| ethylene oxide | 75-21-8 | 0.1 | 0.3 | 0.9 |
| ethyl ether | 60-29-7 | 400 | 1 000 | 3 500 |
| ethyl methacrylate | 97-63-2 | 200 | 550 | 1 500 |
| fluoranthene | 206-44-0 | 80 | 250 | 700 |
| fluorine | 86-73-7 | 1 | 3.5 | 10 |
| furan | 110-00-9 | 2 | 6 | 20 |
| n-hexane | 110-54-3 | 700 | 2 000 | 6 500 |
| indeno[1,2,3-c,d]pyrene | 193-39-5 | 0.1 | 0.35 | 1 |
| isobutanol | 78-83-1 | 600 | 2 000 | 5 500 |
| maleic hydrazide | 123-33-1 | 1 000 | 3 000 | 9 000 |
| methomyl | 16752-77-5 | 50 | 150 | 450 |
| methyl acetate | 79-20-9 | 2 000 | 6 000 | 20 000 |
| methyl acrylate | 96-33-3 | 60 | 200 | 550 |
| methylcyclohexane | 108-87-2 | 3 000 | 9 000 | 27 000 |
| methylene bromide (dibromomethane) | 74-95-3 | 5 | 15 | 45 |
| methylene chloride (dichloromethane) | 75-09-2 | 20 | 65 | 200 |
| methyl ethyl ketone | 78-93-3 | 5 000 | 15 000 | 45 000 |
| methyl isobutyl ketone | 108-10-1 | 3 000 | 9 000 | 27 000 |
| methyl methacrylate | 80-62-6 | 700 | 2 000 | 6 500 |
| methyl styrene (mixture) | 25013-15-4 | 40 | 100 | 350 |
| methyl tertbutyl ether (MTBE) | 1634-04-4 | 3 000 | 9 000 | 27 000 |
| naphthalene | 91-20-3 | 3 | 9 | 25 |
| nitrobenzene | 98-95-3 | 2 | 6 | 20 |
| n-nitrosodi-n-butylamine | 924-16-3 | 0.0065 | 0.02 | 0.055 |
| m-nitrotoluene | 99-08-1 | 2.5 | 7.5 | 25 |
| o-nitrotoluene | 88-72-2 | 2.5 | 7.5 | 25 |
| p-nitrotoluene | 99-99-0 | 2.5 | 7.5 | 25 |
| polychlorinated biphenyls (PCBs) ⁵ | 1336-36-3 | 0.02 | 0.055 | 0.15 |
| propylene oxide | 75-56-9 | 2.5 | 8 | 25 |
| pyrene | 129-00-0 | 60 | 200 | 550 |

Table 1. Director's interim air concentration criteria (continued) ^{1,2}

| Substance | Chemical Abstract Service (CAS) Number | Agricultural, Urban Park, Residential Use ³ | Commercial Use | Industrial Use ⁴ |
|-------------------------------|--|--|----------------|-----------------------------|
| 1,1,1,2-tetrachloroethane | 630-20-6 | 1.5 | 4 | 10 |
| 1,1,2,2-tetrachloroethane | 79-34-5 | 0.15 | 0.5 | 1.5 |
| tetrachloroethylene (PCE) | 127-18-4 | 600 | 2 000 | 5 500 |
| toluene | 108-88-3 | 5 000 | 15 000 | 45 000 |
| 1,2,4-trichlorobenzene | 120-82-1 | 4 | 10 | 35 |
| 1,1,1-trichloroethane | 71-55-6 | 2 000 | 6 000 | 20 000 |
| 1,1,2-trichloroethane | 79-00-5 | 0.6 | 2 | 5 |
| trichloroethylene | 79-01-6 | 0.1 | 0.3 | 1 |
| trichlorofluoromethane | 75-69-4 | 700 | 2 000 | 6 500 |
| 1,1,2-trichloropropane | 598-77-6 | 10 | 30 | 90 |
| 1,2,3-trichloropropane | 96-18-4 | 10 | 35 | 100 |
| 1,2,3-trichloropropene | 96-19-5 | 1 | 3 | 9 |
| triethylamine | 121-44-8 | 7 | 20 | 65 |
| 1,2,4-trimethylbenzene | 95-63-6 | 6 | 20 | 55 |
| 1,3,5-trimethylbenzene | 108-67-8 | 6 | 20 | 55 |
| vinyl acetate | 108-05-4 | 200 | 600 | 2 000 |
| vinyl bromide (bromoethene) | 593-60-2 | 0.3 | 0.95 | 3 |
| vinyl chloride (chloroethene) | 75-01-4 | 1 | 3.5 | 10 |
| xylenes | 1330-20-7 | 100 | 300 | 900 |

¹ All values in $\mu\text{g}/\text{m}^3$ unless otherwise stated. Substances must be analyzed using methods specified in a Director's protocol or alternative methods acceptable to a Director.

² Air concentration criteria in this table are specific to human health only. It is up to the responsible person for the site to ensure that use of the Director's interim air concentration criteria does not constitute a significant risk or hazard to ecological health.

³ Air concentration criteria for agricultural, urban park, and residential use apply to freshwater or marine sediment that gives rise to air contaminants at sensitive sediment sites, or to any water that gives rise to air contaminants, irrespective of the water or site use.

⁴ Air concentration criteria for industrial use apply to freshwater or marine sediment giving rise to air contaminants at typical sediment sites.

⁵ Polychlorinated biphenyls (PCBs) include Arochlor mixtures 1242, 1248, 1254, and 1260.

Appendix 1. Relevant legislative and regulatory citations

Environmental Management Act (British Columbia, 2003)

1 (1) “air” means the atmosphere but does not include the atmosphere inside

- (a) a human made enclosure that is not open to the weather,
- (b) an underground mine, or
- (c) a place designated by order of the Lieutenant Governor in Council

“air contaminant” means a substance that is introduced into the air and that

- (a) injures or is capable of injuring the health or safety of a person,
- (b) injures or is capable of injuring property or any life form,
- (c) interferes with or is capable of interfering with visibility,
- (d) interferes with or is capable of interfering with the normal conduct of business,
- (e) causes or is capable of causing material physical discomfort to a person, or
- (f) damages or is capable of damaging the environment

“waste” includes

- (a) air contaminants
- (b) litter
- (c) effluent,
- (d) refuse,
- (e) biomedical waster,
- (f) hazardous waste, and
- (g) any other substance prescribed by the Lieutenant Governor in Council, or the minister under section 22 [*minister’s regulations – codes of practice*] or, if either of them prescribes circumstances in which a substance is a waste, a substance that is present in those circumstances,

whether or not the type of waste referred to in paragraphs (a) to (f) or prescribed under paragraph (g) has any commercial value or is capable of being used for a useful purpose

1 (3) For the purposes of the definition of “air contaminant” and “effluent”, it is not necessary to prove

- (a) that the air contaminant or effluent, if diluted at or subsequent to the point of introduction, continues to be capable of harming, injuring or damaging a person, life form, property or the environment, or
- (b) the actual presence of a person who, or a life form that, is capable of being harmed or injured by the introduction of the air contaminant or effluent.

6 (3) Subject to subsection (5), a person must not introduce or cause or allow to be introduced into the environment, waste produced by a prescribed activity or operation.

39 (1) In this Part and Part 5 [*Remediation of Mineral Exploration Sites and Mines*]:

“contaminated site” means an area of the land in which the soil or any groundwater lying beneath it, or the water or the underlying sediment, contains

- (a) a hazardous waste, or
- (b) another prescribed substance

in quantities or concentrations exceeding prescribed risk based or numerical criteria or standards or conditions

63.1 (1) A director may make regulations prescribing substances and risk based or numerical criteria, standards and conditions for the purpose of the definition of “contaminated site” in section 39 [definitions and interpretation] if the director considers it necessary in the public interest.

Contaminated Sites Regulation (British Columbia, 2004a)

11 (1) Subject to section 12 and subsections (2), (3) and (4) of this section, the following substances, standards and conditions are prescribed for the purposes of the definition of “contaminated site” in section 39 of the Act:

- (d) the concentration of any substance at the site, not specified in Schedule 4, 5, 6, 7, 9 or 10, is greater than,
 - (i) if the substance is specified without a particular use, the concentration specified for that substance in a director’s interim standard, and
 - (ii) if the substance is specified with a particular use, the concentration specified for that substance and use in a director’s interim standard.

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Appendix 2. Derivation of air concentration criteria

The Director's interim air concentration criteria (the criteria or ACC) were calculated using modified equations originally recommended by the Science Advisory Board for Contaminated Sites in British Columbia (SABCS, 2005) and Health Canada (2004a, 2004b, 2005) to derive target air concentrations for use in contaminated site risk assessment. The ministry's criteria equations and parameter values are presented below.

The modifications incorporated human health receptor parameters and exposure time assumptions made by Contaminated Sites Soil Taskgroup (B.C. Ministry of Environment, 1996). Relevant toxicity reference values for the inhalation route of exposure used to calculate the criteria appear in Table A. These toxicity reference values were obtained largely from the SABCS (2005) and Health Canada (2005). Toxicity reference values drawn from these sources (which in turn were based on the US Department of Energy, Risk Assessment Information System (RAIS) database as of 2004), were updated to reflect RAIS values current as of October 2006 for use in Table A.

Equations

Part 1. Threshold contaminants (non-carcinogenic substances)

$$ACC = (HQ^T \times RfC) / ET$$

where:

| | | |
|-----------------|---|---|
| ACC | Air Concentration Criteria (mg/m ³) | |
| HQ ^T | Target Hazard Quotient for substance = 1.0 | |
| RfC | Reference Concentration (mg/m ³): substance specific (see Table A) or if RfC unavailable for substance, RfC = RfC _{calc} | |
| ET | Exposure Term: land-use specific | |
| | AL/RL/PL | ET = 1.0 (24hr/24hr x 7d/7d x 52 wk/52wk x 70 yr/70yr) |
| | CL | ET = 0.33 (12hr/24hr x 5d/7d x 48 wk/52wk x 70 yr/70yr) |
| | IL | ET = 0.11 (8hr/24hr x 5d/7d x 48 wk/52wk x 35 yr/70yr) |

RfC_{calc} Reference Concentration calculated (mg/m³): substance specific

$$RfC_{calc} = (RfD \times BW) / IR$$

where:

| | |
|-----|--|
| RfD | Reference Dose (mg/kg/d): substance specific (see Table A) |
| BW | Body weight (kg): age specific, adult = 70 kg, child = 13 kg |
| IR | Inhalation Rate (m ³ /d): age specific, adult = 23 m ³ /d, child = 5 m ³ /d |

Part 2. Non-threshold contaminants (carcinogenic substances)

$$ACC = ILCR^T / (UR \times ET)$$

where:

| | | | |
|-------------------|---|-----------|---|
| ACC | Air Concentration Criteria (mg/m ³) | | |
| ILCR ^T | Target Incremental Lifetime Cancer Risk = 1 x 10 ⁻⁵ | | |
| UR | Cancer Unit Risk (mg/m ³) ⁻¹ : substance specific (see Table A) or if UR unavailable for substance, UR = UR _{calc} | | |
| ET | Exposure Term land-use specific | | |
| | AL/RL/PL | ET = 1.0 | (24hr/24hr x 7d/7d x 52 wk/52wk x 70 yr/70yr) |
| | CL | ET = 0.33 | (12hr/24hr x 5d/7d x 48 wk/52wk x 70 yr/70yr) |
| | IL | ET = 0.11 | (8hr/24hr x 5d/7d x 48 wk/52wk x 35 yr/70yr) |

UR_{calc} Cancer Unit Risk calculated (mg/m³)⁻¹

$$UR_{calc} = (SF \times IR) / BW$$

where:

| | |
|----|--|
| SF | Cancer Slope Factor (mg/kg/d) ⁻¹ : substance specific (see Table A) |
| IR | Inhalation Rate (m ³ /d): age specific, adult = 23 m ³ /d, child – 5 m ³ /d |
| BW | Body weight (kg): age specific, adult = 70 kg, child = 13 kg |

Table A. Toxicity reference values used in derivation of Director's interim air concentration criteria

| Substance | Chemical Abstract Service Number (CAS) | Reference Concentration, RfC (mg/m ³) | Reference Dose, RfD (mg/kg-d) | Unit Risk, UR (mg/m ³) ⁻¹ | Slope Factor, SF (mg/kg-d) ⁻¹ |
|---|--|---|-------------------------------|--|--|
| acenaphthene | 83-32-9 | 1.19E-01 | 6.00E-02 | | |
| acetaldehyde | 75-07-0 | 9.00E-03 | 2.60E-03 | 2.20E-03 | 7.70E-03 |
| acetone | 67-64-1 | 1.99E-02 | 1.00E-02 | | |
| acetonitrile | 75-05-8 | 6.00E-02 | 1.70E-02 | | |
| acrolein | 107-02-8 | 2.00E-05 | 5.70E-06 | | |
| acrylonitrile | 107-13-1 | 2.00E-03 | 5.70E-04 | 6.80E-02 | 2.38E-01 |
| anthracene | 120-12-7 | 5.96E-01 | 3.00E-01 | | |
| benz[a]anthracene | 56-55-3 | | | 8.80E-02 | 3.10E-01 |
| benzene | 71-43-2 | 3.00E-02 | 8.60E-03 | 7.80E-03 | 2.73E-02 |
| benzo[b]fluoranthene | 205-99-2 | | | 8.80E-02 | 3.08E-01 |
| benzo[k]fluoranthene | 207-08-9 | | | 8.80E-03 | 3.08E-02 |
| benzo[a]pyrene | 50-32-8 | | | 8.80E-01 | 3.08E+00 |
| benzyl chloride | 100-44-7 | 9.74E-03 | 4.90E-03 | 2.00E-03 | |
| 1,1-biphenyl | 92-52-4 | | | 1.10E-02 | 5.00E-02 |
| bis(2-chloroethyl)ether | 111-44-4 | | | 3.30E-01 | 1.10E+00 |
| bis(2-chloroisopropyl) ether | 39638-32-9 | 7.95E-02 | 4.00E-02 | | |
| bis(chloromethyl) ether | 542-88-1 | | | 6.20E-01 | 2.17E+02 |
| bis(2-chloro-1-methylethyl)ether | 108-60-1 | | | 1.00E-02 | 3.50E-02 |
| bromobenzene | 108-86-1 | 1.00E-02 | 2.86E-03 | | |
| bromodichloromethane | 75-27-4 | 8.86E-03 | 2.00E-03 | 1.40E-02 | 6.20E-02 |
| bromomethane | 74-83-9 | 5.00E-03 | 1.40E-03 | | |
| 1,3-butadiene | 106-99-0 | 2.00E-03 | 5.70E-04 | 3.00E-02 | 1.05E-01 |
| carbon disulfide | 75-15-0 | 7.00E-01 | 2.00E-01 | | |
| carbon tetrachloride (tetrachloromethane) | 56-23-5 | 3.10E-03 | 7.00E-04 | 1.50E-02 | 5.25E-02 |
| 2-chloroacetophenone | 532-27-4 | 3.00E-05 | 8.60E-06 | | |
| chlorobenzene | 108-90-7 | 5.00E-02 | 1.43E-02 | | |
| 2-chloro-1,3-butadiene | 126-99-8 | 7.00E-03 | 2.00E-03 | | |
| chloroethane (ethyl chloride) | 75-00-3 | 1.00E+01 | 2.90E+00 | | |
| chloroform (trichloromethane) | 67-66-3 | 1.99E-02 | 1.00E-02 | 2.30E-02 | 8.05E-02 |
| chloromethane | 74-87-3 | 9.00E-02 | 2.60E-02 | 1.80E-03 | 6.30E-03 |
| beta-chloronaphthalene | 91-58-7 | 1.59E-01 | 8.00E-02 | | |
| o-chloronitrobenzene | 88-73-3 | 7.00E-05 | 2.00E-05 | 7.10E-04 | |
| p-chloronitrobenzene | 100-00-5 | 6.00E-04 | 1.70E-04 | 5.10E-04 | |
| 2-chlorophenol | 95-57-8 | 9.94E-03 | 5.00E-03 | | |
| 2-chloropropane | 75-29-6 | 1.00E-01 | 2.90E-02 | | |
| o-chlorotoluene | 95-49-8 | 3.98E-02 | 2.00E-02 | | |
| chrysene | 218-01-9 | 8.80E-04 | | 8.80E-04 | 3.10E-03 |
| cumene (isopropylbenzene) | 98-82-8 | 4.00E-01 | 1.10E-01 | | |
| cyanide (hydrogen) | 74-90-8 | 3.00E-03 | 8.57E-04 | | |
| cyanogen | 460-19-5 | 7.95E-02 | 4.00E-02 | | |
| cyanogen bromide | 506-68-3 | 3.99E-01 | 9.00E-02 | | |
| cyanogen chloride | 506-77-4 | 2.22E-01 | 5.00E-02 | | |
| n-decane | 124-18-5 | 2.64E+00 | 1.30E+00 | | |
| dibenz[a,h]anthracene | 53-70-3 | | | 8.80E-01 | 3.10E+00 |
| dibenzofuran | 132-64-9 | 7.95E-03 | 2.00E-03 | | |
| dibromochloromethane | 124-48-1 | 3.98E-02 | 2.00E-02 | | |

| Substance | Chemical Abstract Service Number (CAS) | Reference Concentration, RfC (mg/m ³) | Reference Dose, RfD (mg/kg-d) | Unit Risk, UR (mg/m ³) ⁻¹ | Slope Factor, SF (mg/kg-d) ⁻¹ |
|--------------------------------------|--|---|-------------------------------|--|--|
| 1,2-dibromo-3-chloropropane | 96-12-8 | 2.00E-04 | 5.70E-05 | 6.00E-04 | 2.10E-01 |
| 1,2-dibromoethane | 106-93-4 | 9.00E-03 | 5.70E-03 | 6.00E-01 | 2.10E+00 |
| 1,2-dichlorobenzene | 95-50-1 | 2.00E-01 | 5.71E-02 | | |
| 1,4-dichlorobenzene | 106-46-7 | 8.00E-01 | 2.29E-01 | | |
| dichlorodifluoromethane | 75-71-8 | 2.00E-01 | 5.70E-02 | | |
| 1,1-dichloroethane | 75-34-3 | 5.00E-01 | 1.43E-01 | | |
| 1,2-dichloroethane | 107-06-2 | | | 2.60E-02 | 9.10E-02 |
| 1,1-dichloroethylene | 75-35-4 | 2.00E-01 | 5.70E-02 | 5.00E-02 | |
| 1,2-dichloroethylene (cis) | 156-59-2 | 1.99E-02 | 1.00E-02 | | |
| 1,2-dichloroethylene (trans) | 156-60-5 | 1.71E-02 | 2.00E-02 | | |
| 1,2-dichloropropane | 78-87-5 | 4.00E-04 | 1.40E-04 | 1.50E-02 | 6.80E-02 |
| 1,3-dichloropropene | 542-75-6 | 2.00E-02 | 5.71E-03 | 4.10E-03 | 1.40E-02 |
| dicyclopentadiene | 77-73-6 | 7.00E-03 | 2.00E-03 | | |
| epichlorohydrin | 106-89-8 | 1.00E-03 | 2.90E-04 | 1.20E-03 | 4.20E-03 |
| ethyl acetate | 141-78-6 | 1.79E+00 | 9.00E-01 | | |
| ethyl acrylate | 140-88-5 | | | 1.40E-03 | |
| ethyl benzene | 100-41-4 | 1.00E+00 | 2.86E-01 | 1.10E-03 | 3.85E-03 |
| ethylene oxide | 75-21-8 | | | 1.00E-01 | 3.50E-01 |
| ethyl ether | 60-29-7 | 3.98E-01 | 2.00E-01 | | |
| ethyl methacrylate | 97-63-2 | 1.79E-01 | 9.00E-02 | | |
| fluoranthene | 206-44-0 | 7.95E-02 | 4.00E-02 | | |
| fluorene | 86-73-7 | 7.95E-02 | 4.00E-02 | 9.00E-03 | 4.00E-02 |
| furan | 110-00-9 | 1.99E-03 | 1.00E-03 | | |
| n-hexane | 110-54-3 | 7.00E-01 | 2.00E-01 | | |
| indeno[1,2,3-c,d]pyrene | 193-39-5 | | | 8.80E-02 | 3.10E-01 |
| isobutanol | 78-83-1 | 5.96E-01 | 3.00E-01 | | |
| maleic hydrazide | 123-33-1 | 9.94E-01 | 5.00E-01 | | |
| methomyl | 16752-77-5 | 4.97E-02 | 2.50E-02 | | |
| methyl acetate | 79-20-9 | 1.99E+00 | 1.00E+00 | | |
| methyl acrylate | 96-33-3 | 5.96E-02 | 3.00E-02 | | |
| methylcyclohexane | 108-87-2 | 3.00E+00 | 8.60E-01 | | |
| methylene bromide (dibromomethane) | 74-95-3 | 5.00E-03 | 1.40E-03 | | |
| methylene chloride (dichloromethane) | 75-09-2 | 3.00E+00 | 8.57E-01 | 4.70E-04 | 1.65E-03 |
| methyl ethyl ketone | 78-93-3 | 5.00E+00 | 1.40E+00 | | |
| methyl isobutyl ketone | 108-10-1 | 3.00E+00 | 8.60E-01 | | |
| methyl methacrylate | 80-62-6 | 7.00E-01 | 2.00E-01 | | |
| methyl styrene (mixed isomers) | 25013-15-4 | 4.00E-02 | 1.10E-02 | | |
| methyl tertbutyl ether (MTBE) | 1634-04-4 | 3.00E+00 | 8.57E-01 | | 9.10E-04 |
| naphthalene | 91-20-3 | 3.00E-03 | 8.57E-04 | | |
| nitrobenzene | 98-95-3 | 2.00E-03 | 5.70E-04 | | |
| n-nitrosodi-n-butylamine | 924-16-3 | 1.14E-03 | 5.70E-04 | 1.60E+00 | |
| m-nitrotoluene | 99-08-1 | 2.53E-03 | 5.70E-04 | | |
| o-nitrotoluene | 88-72-2 | 2.53E-03 | 5.70E-04 | | |
| p-nitrotoluene | 99-99-0 | 2.53E-03 | 5.70E-04 | | |
| polychlorinated biphenyls (PCBs) | 1336-36-3 | | | 5.70E-01 | 2.00E+00 |
| propylene oxide | 75-56-9 | 3.00E-02 | 8.60E-03 | 3.70E-03 | 1.30E-02 |
| polychlorinated biphenyls (PCBs) | 1336-36-3 | | | 5.70E-01 | 2.00E+00 |
| propylene oxide | 75-56-9 | 3.00E-02 | 8.60E-03 | 3.70E-03 | 1.30E-02 |
| pyrene | 129-00-0 | 5.96E-02 | 3.00E-02 | | |
| 1,1,1,2-tetrachloroethane | 630-20-6 | 5.96E-02 | 3.00E-02 | 7.40E-03 | 2.59E-02 |

| Substance | Chemical Abstract Service Number (CAS) | Reference Concentration, RfC (mg/m ³) | Reference Dose, RfD (mg/kg-d) | Unit Risk, UR (mg/m ³) ⁻¹ | Slope Factor, SF (mg/kg-d) ⁻¹ |
|-------------------------------|--|---|-------------------------------|--|--|
| 1,1,2,2-tetrachloroethane | 79-34-5 | 1.19E-01 | 6.00E-02 | 5.80E-02 | 2.03E-01 |
| tetrachloroethylene (PCE) | 127-18-4 | 6.00E-01 | 1.71E-01 | 5.90E-03 | 2.07E-02 |
| toluene | 108-88-3 | 5.00E+00 | 1.43E+00 | | |
| 1,2,4-trichlorobenzene | 120-82-1 | 4.00E-03 | 1.14E-03 | | |
| 1,1,1-trichloroethane | 71-55-6 | 2.20E+00 | 6.29E-01 | | |
| 1,1,2-trichloroethane | 79-00-5 | 7.95E-03 | 4.00E-03 | 1.60E-02 | 5.70E-02 |
| trichloroethylene | 79-01-6 | 4.00E-01 | 1.10E-02 | 1.10E-01 | 4.00E-01 |
| trichlorofluoromethane | 75-69-4 | 7.00E-01 | 2.00E-01 | | |
| 1,1,2-trichloropropane | 598-77-6 | 9.94E-03 | 5.00E-03 | | |
| 1,2,3-trichloropropane | 96-18-4 | 1.19E-02 | 6.00E-03 | | |
| 1,2,3-trichloropropene | 96-19-5 | 1.00E-03 | 2.86E-04 | | |
| triethylamine | 121-44-8 | 7.00E-03 | 2.00E-03 | | |
| 1,2,4-trimethylbenzene | 95-63-6 | 6.00E-03 | 1.70E-03 | | |
| 1,3,5-trimethylbenzene | 108-67-8 | 6.00E-03 | 1.70E-03 | | |
| vinyl acetate | 108-05-4 | 2.00E-01 | 5.70E-02 | | |
| vinyl bromide (bromoethene) | 593-60-2 | 3.00E-03 | 8.60E-04 | 3.20E-02 | 1.10E-01 |
| vinyl chloride (chloroethene) | 75-01-4 | 1.00E-01 | 2.90E-02 | 8.80E-03 | 3.10E-02 |
| xylenes | 1330-20-7 | 1.00E-01 | 2.86E-02 | | |