



Ministry of  
Environment and  
Climate Change Strategy

# ***PROTOCOL 28***

## ***FOR CONTAMINATED SITES***

### 2016 Standards Derivation Methods

Version 3.0

Prepared pursuant to Section 64 of the  
*Environmental Management Act*

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## Chapter 1. General Introduction

### 1.1 Acronyms

The following acronyms are used throughout this protocol and where appropriate their common toxicological meaning is ascribed:

AF<sub>I</sub> – Absorption Factor Ingestion  
 AF<sub>S</sub> – Absorption Factor Skin  
 AL – Agricultural Land Use  
 AW – Aquatic Life Water Use  
 BC – British Columbia  
 BW – Body Weight  
 CAS – Chemical Abstract Service  
 CCME – Canadian Council of Ministers of the Environment  
 CL – Commercial Land Use  
 CSR – Contaminated Sites Regulation  
 DNAPL – Dense Non-Aqueous Phase Liquid  
 DR – Soil Dust Inhalation Rate  
 DW – Drinking Water Use  
 dw – Dry Weight  
 EC – Effective concentration  
 EDI – Estimated Daily Intakes  
 EMA – Environmental Management Act  
 EPHw10-19 – Extractable Petroleum Hydrocarbons in Water, Chain length C10 – C19  
 ET – Exposure Term  
 FCSAP – Federal Contaminated Sites Action Plan  
 FEQG – Federal Environmental Quality Guidelines  
 GM – Geometric Mean  
 H' – Henry's Law Constant  
 IARC – International Agency for Research on Cancer  
 IPCS – International Programme on Chemical Safety  
 IL – Industrial Land Use  
 IR – Soil Ingestion Rate  
 IRIS – Integrated Risk Information System  
 IW – Irrigation Water Use  
 K<sub>d</sub> – Distribution Coefficient  
 kg – kilogram  
 K<sub>oc</sub> – Organic Carbon Partitioning Coefficient  
 LC – Lethal Concentration  
 LEPhw – Light Extractable Petroleum Hydrocarbons in Water  
 LER – Low Effect Range  
 LOEC – Lowest Observed Effect Concentration  
 LW – Livestock Water Use

MER – Moderate Effect Range  
 NOEC – No Observed Effects Concentration  
 OSWER – Office of Solid Waste and Emergency Response  
 PAH – Polycyclic aromatic hydrocarbon  
 PCB – Polychlorinated biphenyl  
 PL – Urban Parkland Use  
 PQRA – Preliminary Quantitative Risk Assessment  
 PSS<sub>HH</sub> – Preliminary Soil Standard – Human Health  
 RfC –Reference Concentration (inhalation)  
 RfD –Reference Dose (oral)  
 RL<sub>HD</sub> – High Density Residential Land Use  
 RL<sub>LD</sub> – Low Density Residential Land Use  
 RsD – Risk-specific Dose  
 RSL – Regional Screening Level  
 SAF – Soil Allocation Factor  
 SALM – Strong Acids Leachable Metals  
 SFO – Oral Slope Factor  
 SR – Soil Dermal Contact Rate  
 TC – Tolerable Concentration  
 TDI – Tolerable Daily Intake  
 TEF – Toxic Equivalency Factors  
 THQ 1.0 – Target Hazard Quotient of 1.0  
 TRV – Toxicity Reference Value  
 US EPA – United States Environmental Protection Agency  
 VPHw – Volatile Petroleum Hydrocarbons in Water  
 WHO – World Health Organization  
 WL – Wildlands Land Use  
 WL<sub>N</sub> – Natural Wildlands Land Use  
 WL<sub>R</sub> – Reverted Wildlands Land Use  
 WQG – Water Quality Guideline

## 1.2 Introduction

The *Environmental Management Act* (EMA) sections 64 (1)(c), 64 (1)(d) and 64 (2)(n) and Contaminated Sites Regulation (CSR) section 67 (e) provide the authority to establish this protocol for developing soil, sediment, water or vapour numerical standards for a substance. Generic numerical standards for soil, water, vapour and sediment are prescribed in the CSR Schedules 3.1 to 3.4. These environmental quality standards are used at contaminated sites in BC to:

- define a contaminated site, as per section 11 of the CSR;
- support specification of applicable land, water, sediment and vapour uses, as per section 12 of the CSR; and
- define remediation completion, as per section 17 of the CSR.

During the remediation of contaminated sites, risk-based standards can be developed by modifying the toxicological derivations used to develop numerical standards using site-specific factors. Thus, this protocol provides qualified professionals with the toxicological equations, assumptions and parameters used in setting generic numerical standards, thereby providing information for deriving risk-based standards via risk assessment processes. The requirements for conducting detailed risk assessment and calculating risk-based standards for use at contaminated sites in BC is found within Protocol 1, “Detailed Risk Assessment.”

Terms defined in EMA and the CSR shall apply to this protocol. Additional terms used in this protocol but not otherwise defined will be given their generally accepted meaning in the field of toxicology and environmental sciences.

### **1.3 Land-use based differential protection**

Generic numerical standards for soil, water, vapour and sediment are derived to provide protection for the different types of receptors likely to be present under different land, water, vapour and sediment uses.

In the case of soil and vapour, human health standards are based on a critical human receptor and its inherent exposure under an assumed land use scenario. In the case of water, the critical receptor determines how the standard is derived, i.e., a human receptor for drinking water standards, aquatic ecological receptors for aquatic life standards, and livestock species and irrigated crops for livestock and irrigation standards, respectively. Soil standards for environmental protection incorporate a different protection goal for ecological receptors based on the land use. Sediments are similar - the standard includes a differential protection level based on the management goal for the particular sediment site.

The critical receptors, assumed land use scenarios, and protection levels for each media can be found in their respective chapters.

### **1.4 Standards development and considerations**

Generic numerical standards are developed by this protocol and prescribed in the CSR by a regulatory amendment. A generic numerical standard remains legally in-force in the CSR Schedules 3.1 to 3.4 until replaced.

All CSR standards are developed assuming that the analytical methods described in the BC Environmental Laboratory Manual are used. As such, substances must be analyzed using the methods specified in the [BC Environmental Laboratory Manual](#), or in an applicable protocol, in order to demonstrate compliance with the contaminated sites legislative framework.

To compare site data against a standard in the CSR, water samples that are analyzed for heavy metals, metalloids and inorganic ions must be analyzed per CSR Schedule 3.2 for total and dissolved substance concentrations.

## **Chapter 2. Derivation of Human Health Protection Soil Standards**

### **2.1 Introduction**

Human health protection soil standards are derived in consideration of the adverse health effects from direct exposure to contaminants by the intake of contaminated soil, but the equation uses apportionment to account for total exposure to additional indirect soil contaminants coming from the ingestion of drinking water contaminated through the soil-to-groundwater pathway and the inhalation of soil vapours from contaminated ambient air.

This chapter describes the derivation methods for human health protection soil standards for the intake of contaminated soil exposure pathway. These soil standards are contained in CSR Schedule 3.1:

- Part 1 Matrix Numerical Soil Standards - “Human Health Protection – Intake of Contaminated Soil”
- Part 2 Generic Numerical Soil Standards to Protect Human Health

### **2.2 Land uses**

The CSR defines the following land uses for soil:

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

Soil standards that protect human health for reverted and natural wildlands land uses are calculated using the same equation and factors; thus, they are only referenced as wildlands in this chapter.

### **2.3 Land use based critical receptors**

For each land use, a sensitive receptor is identified that can reasonably be expected to be associated with the land use. For non-carcinogenic substances, a toddler receptor (early child life stage) is selected as the primary receptor on all land uses where they may be present, as studies indicate that toddlers ingest greater quantities of soil and thereby contaminants, meaning they have greater exposure to the potential adverse effects of many contaminants. For carcinogenic substances, an adult receptor is considered the most appropriate receptor because the length of exposure is the greatest (Table 2-1).

**Table 2-1. Defined land uses and critical receptors for soil**

	<b>WL/AL/PL/RL<sub>LD</sub></b>	<b>RL<sub>HD</sub></b>	<b>CL</b>	<b>IL</b>
<b>Defined Land Use Scenario</b>	<ul style="list-style-type: none"> <li>- Seasonal wildlands camp with a family living on-site, or multi-functional farm with a family living on-site, or urban parkland, or low-density single-family residential housing with backyards</li> <li>- Toddlers are present</li> <li>- Groundwater may be used for drinking water</li> </ul>	<ul style="list-style-type: none"> <li>- High Density multiple families residential housing or institutional housing complex</li> <li>- Toddlers are present</li> <li>- Groundwater may be used for drinking water</li> <li>- Standards assume the prohibition of the use of the land (a) to grow plants for human consumption, and (b) as a children's playground, sports field, picnic area or any other use that promotes frequent contact by children</li> </ul>	<ul style="list-style-type: none"> <li>- Urban commercial property</li> <li>- Toddlers have access to the property</li> <li>- Groundwater may be used for drinking water</li> </ul>	<ul style="list-style-type: none"> <li>- Urban industrial property</li> <li>- Toddlers are not present so adult receptor dominant</li> <li>- Groundwater may be used for drinking water</li> </ul>
<b>Critical Human Receptor</b>	<ul style="list-style-type: none"> <li>- Toddler (non-carcinogenic contaminants)</li> <li>- Adult (carcinogenic contaminants)</li> </ul>	<ul style="list-style-type: none"> <li>- Toddler (non-carcinogenic contaminants)</li> <li>- Adult (carcinogenic contaminants)</li> </ul>	<ul style="list-style-type: none"> <li>- Toddler (non-carcinogenic contaminants)</li> <li>- Adult (carcinogenic contaminants)</li> </ul>	<ul style="list-style-type: none"> <li>- Adult (carcinogenic and non-carcinogenic contaminants)</li> </ul>

## 2.4 Exposure assumptions

The toddler receptor is defined as aged 7 months to 4 years of age, with a body weight of 16.5 kg; and an adult is defined as having a lifespan of 80 years and body weight of 70.7 kg.

A toddler receptor ingests 80 mg/day of soil, whereas an adult ingests 20 mg/day of soil. It is expected that toddler and adult receptors at high-density residential and commercial sites would come into contact with much smaller amounts of soil due to the greater proportion of paved surfaces and areas covered by buildings. The ministry therefore assumes that half the amount of soil is ingested for high density residential and commercial land uses, i.e., 40 mg/day of soil for toddlers and 10 mg/day for adults. See Table 2--2.

**Table 2-2. Land use-specific soil ingestion rates**

CSR Land Use	Soil Ingestion Rate	
	Toddler receptor	Adult receptor
WL	80 mg/day	20 mg/day
AL	80 mg/day	20 mg/day
PL	80 mg/day	20 mg/day
RL <sub>LD</sub>	80 mg/day	20 mg/day
RL <sub>HD</sub>	40 mg/day	10 mg/day
CL	40 mg/day	10 mg/day
IL	-	20 mg/day

## 2.5 Exposure durations

For each defined land use scenario, the exposure duration is the reasonably expected maximum time spent by a receptor at a site. The exposure durations are expressed as an exposure term in Table 2-3.

For the purposes of deriving intake of contaminated soil standards, a chronic human exposure scenario was assumed, i.e., an exposure that equals the expected lifespan of 80 years. Lifetime exposure to a remediated site likely overestimates actual exposure but ensures that no site usage limitations will exist for any of the land uses. For industrial land use, where only adult workers are to be expected, however, the ministry estimates workers are not expected to work more than 8 hours per day in BC and that exposures would be limited to 35 years, considered to be a likely maximal span of a person's career.

Assuming a worst-case scenario, human receptors may reside in an agricultural or residential land use site for the entire day and throughout the year, and a wildlands land use site seasonally (i.e. half of the year). However, in urban parks where visits are often limited to daylight hours and camping is not allowed, a maximum of only 12 hours was considered.

**Table 2-3. Land use-specific exposure durations**

CSR Land Use	Exposure Term
WL	ET = (24hr/24hr x 7d/7d x 26wk/52wk x 80yr/80yr)
AL	ET = (24hr/24hr x 7d/7d x 52wk/52wk x 80yr/80yr)
PL	ET = (12hr/24hr x 7d/7d x 52wk/52wk x 80yr/80yr)
RL <sub>LD</sub>	ET = (24hr/24hr x 7d/7d x 52wk/52wk x 80yr/80yr)
RL <sub>HD</sub>	ET = (24hr/24hr x 7d/7d x 52wk/52wk x 80yr/80yr)
CL	ET = (12hr/24hr x 5d/7d x 48wk/52wk x 80yr/80yr)
IL	For all substances except lead: ET = (8hr/24hr x 5d/7d x 48wk/52wk x 35yr/80yr) For lead: ET = (8hr/24hr x 5d/7d x 48wk/52wk x 80yr/80yr); as no threshold has been established for potential toxic effects associated with lead

## 2.6 Toxicity reference values (TRVs)

The TRVs, including tolerable daily intakes for non-carcinogenic substances, and risk-specific doses for carcinogenic substances, used in the derivation of human health protection soil standards are found in Appendix 8A (see Chapter 8).

## 2.7 Human health soil standards derivation procedure – Method 1

The standards derivation procedure considers that direct contact with soil can expose human receptors to contaminants by inadvertent soil ingestion, dermal contact, and inhalation of soil particles (dust). However, for most non-volatile substances, inadvertent ingestion of contaminated soil is the primary exposure route with respect to human health. In the case of dermal and inhalation exposure to soil, there is insufficient data available to derive scientifically defensible standards. Therefore, only the soil ingestion route was considered when deriving standards.

There is the potential for impact of natural background (i.e., estimated daily intakes (EDIs)) exposures in addition to exposure that may occur at a contaminated site. However, since estimation of generic EDIs is both difficult and of questionable relevance for any specific site, a 20% apportionment (see Note 1 below) of the tolerable daily intake to soil ensures an adequate level of protection. EDIs for background exposures are not included in the derivation of soil standards.

### 2.7.1 Derivation non-carcinogenic (threshold) substances

The preliminary soil standards for non-carcinogenic substances are derived by:

$$PSS_{HH} = \frac{[SAF \times TDI] \times BW}{[(AF_I \times IR) + (AF_D \times DR) + (AF_S \times SR)] \times ET}$$

Where:	PSS <sub>HH</sub>	Preliminary Soil Standard-Human Health
	TDI	Tolerable Daily Intake (mg/kg/day): substance specific (also known as RfDs)
	SAF	Soil Allocation Factor (unitless) = 0.2 <sup>1</sup>
	BW	Body Weight (kg)
	AF <sub>I</sub>	Absorption Factor Ingestion (unitless) = 1 <sup>2</sup>
	IR	Soil Ingestion Rate (kg/day): land use specific
	AF <sub>D</sub>	Absorption Factor Dust (unitless) = 1
	DR	Soil Dust Inhalation Rate (kg/day) = 0
	AF <sub>S</sub>	Absorption Factor Skin (Dermal) (unitless) = 1
	SR	Soil Dermal Contact Rate (kg/day) = 0
	ET	Exposure Term (unitless): land use-specific

**Notes:**

<sup>1</sup> Considering the 5 sources to which people are exposed (i.e., air, water, soil, food and consumer products) only 20% of the total TDI for the substance is allotted to soil. Normal background exposures, i.e., estimated daily intakes, are not included in this consideration.

<sup>2</sup> Unless scientific data indicates otherwise, the absorption of contaminants from soil (represented by AF) is considered 100%. The arsenic standard assumes 60% bioavailability of arsenic following the ingestion of soil,  $AF_I=0.6$ .

**2.7.2 Derivation carcinogenic (non-threshold) substances**

The preliminary soil standard for carcinogenic substances are derived by:

$$PSS_{HH} = \frac{RsD \times BW}{[(AF_I \times IR) + (AF_D \times DR) + (AF_S \times SR)] \times ET}$$

Where:	PSS <sub>HH</sub>	Preliminary Soil Standard-Human Health
	RsD	Risk specific Dose (mg/kg/day): substance specific, equivalent to an Incremental Lifetime Cancer Risk of $1 \times 10^{-5}$ <sup>[1]</sup>
	BW	Body Weight (kg)
	AF <sub>I</sub>	Absorption Factor Ingestion (unitless) = 1
	IR	Soil Ingestion Rate (kg/day): land use specific <sup>2</sup>
	AF <sub>D</sub>	Absorption Factor Dust (unitless) = 1
	DR	Soil Dust Inhalation Rate (kg/day) = 0
	AF <sub>S</sub>	Absorption Factor Skin (Dermal) (unitless) = 1
	SR	Soil Dermal Contact Rate (kg/day) = 0
	ET	Exposure Term (unitless): land use-specific

**Notes:**

<sup>1</sup> RsD calculated as  $1 \times 10^{-5}$  / SFO

<sup>2</sup> Unless scientific data indicates otherwise, the absorption of contaminants from soil (represented by AF) is considered 100%. The arsenic standard assumes 60% bioavailability of arsenic in ingested soil,  $AF_I=0.6$ , based on the 2012 United States Environmental Protection Agency (US EPA) Office of Solid Waste and Emergency Response (OSWER) Directive 9200.1-113 default Relative Bioavailability Factor.

**2.7.3 Final standards setting**

In recognition that some substances may elicit both non-carcinogenic and carcinogenic toxic effects, the final soil standard is determined from the PSS<sub>HH</sub> as follows:

1. Determine if a substance is a “carcinogenic substance” in accordance with [Protocol 30: “Classifying Substances as Carcinogenic”](#).
- 2a. If a substance is not a carcinogenic substance, adopt the PSS<sub>HH</sub> derived for the non-carcinogenic effects endpoint for the substance and respective land use as the CSR Schedule 3.1 standard.

- 2b. If a substance is a carcinogenic substance and appropriate TRVs are available, calculate both non-carcinogenic and carcinogenic effect endpoint-based standards for the substance and respective land use. For each land use, adopt the most stringent of the non-carcinogenic and carcinogenic PSS<sub>HH</sub> as the CSR Schedule 3.1 standard.
3. Where the calculated standard is less than the estimated provincial background soil estimate (see Chapter 9) or analytical detection limit, the final standard is replaced by the greater concentration for a substance.
4. All final standards are rounded according to rules described in Chapter 10.

Final human health protection soil standards appear in CSR Schedule 3.1, Part 1, if sufficient toxicological data is available to develop the mandatory applicable matrix soil standards for human health protection (intake of contaminated soil) and environmental protection (toxicity to soil invertebrates and plants) exposure pathways. Where this condition cannot be met, but a human health protection standard can be derived, the human health protection soil standard appears in CSR Schedule 3.1, Part 2. These substances are listed in Appendix 2A.

## 2.8 Human health soil standards derivation procedure – Method 2

Where a human health protection soil standard cannot be derived by the above described procedures, CSR Schedule 3.1, Part 2 standards are developed by:

1. Selecting the [United States Environmental Protection Agency \(US EPA\) 2015 Regional Screening Levels](#) (RSL):
  - The “resident soil” RSL is selected as the AL and RL<sub>LD</sub> land use standards.
  - The “industrial soil” RSL is selected as both the CL and IL land use standards.
  - WL, PL, and RL<sub>HD</sub> are calculated as two times the “residential soil” RSL.
2. Then the RSLs were modified based on the 1996 “Overview of CSST Procedures for the Derivation of Soil Quality Matrix Standards for Contaminated Sites” by:
  - Adjusting the soil allocation from 100% to 20% of the TDI for non-carcinogenic substances; and
  - Adjusting the allowable lifetime cancer risk level from 1 in 10<sup>-6</sup> to 1 in 10<sup>-5</sup> for carcinogenic substances.
3. In circumstances above where an RSL for a substance was available for both a non-carcinogenic and a carcinogenic endpoint, the more conservative RSL was selected as the CSR Schedule 3.1, Part 2 standard. The classification of substances as non-carcinogenic or carcinogenic substances was adopted from the US EPA rather than determined by the ministry’s [Protocol 30: “Classifying Substances as Carcinogenic”](#).
4. All final standards are rounded according to rules described in Chapter 10.

## 2.9 Additional Information

In the case where there is insufficient acceptable scientific data to calculate a standard, or no appropriate standard, guideline or criterion exists to develop a standard, then “no standard” is indicated in the CSR.

Substance specific considerations for CSR Schedule 3.1, Part 1 substances are listed below:

- Polychlorinated dioxins and furans:** The standard was calculated assuming comparison with soil concentrations of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and dioxin-like polychlorinated biphenyls (PCBs) expressed as a 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) toxicity equivalent (or TEQ) as shown in the equation below:

$$TEQ = \sum_{i=1}^n C_i \times TEF_i$$

*Where: TEQ* = TCDD Toxic equivalence  
*TEF<sub>i</sub>* = Toxicity equivalency factor  
*C<sub>i</sub>* = Concentration of the individual compound  
*n* = number of dioxin-like compounds in mixture

Table 2-4 includes those substances for which 2005 World Health Organization (WHO), International Programme on Chemical Safety (IPCS), 2,3,7,8-TCDD Toxicity Equivalency Factors (TEFs) are provided.

Table 2-4: IPCS-TEFs for Dioxins, Furans and Dioxin-like PCBs (WHO, 2005)

Polychlorinated dibenzo-p-dioxins	IPCS-TEF	Polychlorinated dibenzofurans	IPCS-TEF
2,3,7,8-T <sub>4</sub> CDD	1.0	2,3,7,8-T <sub>4</sub> CDF	0.1
1,2,3,7,8-P <sub>5</sub> CDD	1.0	1,2,3,7,8-P <sub>5</sub> CDF	0.03
1,2,3,4,7,8-H <sub>6</sub> CDD	0.1	2,3,4,7,8-P <sub>5</sub> CDF	0.3
1,2,3,6,7,8-H <sub>6</sub> CDD	0.1	1,2,3,4,7,8-H <sub>6</sub> CDF	0.1
1,2,3,7,8,9-H <sub>6</sub> CDD	0.1	1,2,3,6,7,8-H <sub>6</sub> CDF	0.1
1,2,3,4,6,7,8,-H <sub>7</sub> CDD	0.01	1,2,3,7,8,9-H <sub>6</sub> CDF	0.1
O <sub>8</sub> CDD	0.0003	2,3,4,6,7,8-H <sub>6</sub> CDF	0.1
		1,2,3,4,6,7,8-H <sub>7</sub> CDF	0.01
		1,2,3,4,7,8,9-H <sub>7</sub> CDF	0.01
		O <sub>8</sub> CDF	0.0003
Non-ortho substituted PCBs	IPCS-TEF	Mono-ortho substituted PCBs	IPCS-TEF
3,3',4,4'- T <sub>4</sub> CB (PCB 77)	0.0001	2,3,3',4,4'-P <sub>5</sub> CB (PCB 105)	0.00003
3,4,4',5- T <sub>4</sub> CB (PCB 81)	0.0003	2,3,4,4',5-P <sub>5</sub> CB (PCB 114)	0.00003
3,3',4,4',5-P <sub>5</sub> CB (PCB 126)	0.1	2,3',4,4',5-P <sub>5</sub> CB (PCB 118)	0.00003
3,3',4,4',5,5'-H <sub>6</sub> CB (PCB 169)	0.03	2',3,4,4',5-H <sub>6</sub> CB (PCB 123)	0.00003
		2,3,3',4,4',5-H <sub>6</sub> CB (PCB 156)	0.00003
		2,3,3',4,4',5'-H <sub>6</sub> CB (PCB 157)	0.00003
		2,3',4,4',5,5'-H <sub>6</sub> CB (PCB 167)	0.00003
		2,3,3',4,4',5,5'-H <sub>7</sub> CB (PCB 189)	0.00003

Substance specific considerations for CSR Schedule 3.1, Part 2 substances are listed below:

- **Asbestos:** Standard is not derived based on the toxicology of the substance. Standard is based on the Hazardous Waste Regulation, BC Reg. 63/88, definition for waste asbestos. Note that 1% by weight is equivalent to 10 000 µg/g.
- **Chlorophenols:** Some chlorophenol standards are derived using either the respective 2001 Rijks Instituut voor Volksgezondheid en Milieu (RIVM) TDIs for monochlorophenols (total) or dichlorophenols (total). The sum of the concentrations in soil, of monochlorophenol or dichlorophenol (all isomers) substances prescribed in this schedule, must not exceed the standard. This applies to the following substances:
  - chlorophenol, 3-,
  - chlorophenol, 4-,
  - dichlorophenol, 2,3-,
  - dichlorophenol, 2,5-,
  - dichlorophenol, 2,6-

- dichlorophenol, 3,4-,
  - dichlorophenol, 3,5-,
- **Polycyclic aromatic hydrocarbon (PAHs):** Standards for five PAHs represent a “Benzo(a)Pyrene Toxicity Equivalent Quotient (BaP TEQ)”. Standard is set equal to the corresponding land use, Human Health Protection – Intake of contaminated soil, matrix soil standard for benzo(a)pyrene divided by the 1998 World Health Organization “Benzo(a)Pyrene Toxicity Equivalent Factor (BaP TEF)” for the substance. This applies to standards for:
  - benz(a)anthracene,
  - benzo(b+j)fluoranthenes,
  - benzo(k)fluoranthene,
  - dibenz(a,h)anthracene, and
  - indeno(1,2,3-cd)pyrene.
- **Trichlorophenols:** The trichlorophenol standards were set equal to the standard for trichlorophenol, 2,4,6-. This applies to the following substances:
  - trichlorophenol, 2,3,4-,
  - trichlorophenol, 2,3,5-,
  - trichlorophenol, 2,3,6-,
  - trichlorophenol, 2,4,5-, and
  - trichlorophenol, 3,4,5-.
- Standards for the following substances were set from Schedule 4 of the Stage 9 amendment of the CSR (repealed by B.C. Reg. 253/2016):
  - heavy extractable petroleum hydrocarbons [HEPH],
  - light extractable petroleum hydrocarbons [LEPH],
  - nitrophenol, 2-,
  - nitrophenol, 4-,
  - thallium, and
  - volatile petroleum hydrocarbons [VPH].

## APPENDIX 2A

## Substance-Specific Human Health Soil Standards Considerations

Table 2A-1: Substances with derived standards in Schedule 3.1, Part 2	
antimony	dimethylphenol, 3,4-
benz(a)anthracene	dinitrophenol, 2,4-
benzo(b+j)fluoranthenes	endosulfan (I + II)
bis(2-ethylhexyl) phthalate [DEHP]	fluoride
boron	hexachlorobenzene
carbon tetrachloride	hexachlorocyclohexane, gamma
chlorobenzene	indeno(1,2,3-cd) pyrene
chloroform	methylphenol, 2-
chlorophenol, 2-	methylphenol, 3-
chlorophenol, 3-	methylphenol, -
chlorophenol, 4-	pentachlorobenzene, 1,2,3,4,5-
dibenz(a,h)anthracene	phenanthrene
dibutyl phthalate [DBP]	pyrene
dichlorobenzene, 1,2-	silver
dichlorobenzene, 1,3-	styrene
dichlorobenzene, 1,4-	tetrachlorobenzene, 1,2,3,4-
dichloroethane, 1,1-	tetrachlorobenzene, 1,2,3,5-
dichloroethane, 1,2-	tetrachlorophenol, 2,3,4,5-
dichloroethylene, 1,1-	tetrachlorophenol, 2,3,4,6-
dichloroethylene, 1,2-cis-	tetrachlorophenol, 2,3,5,6
dichloroethylene, 1,2-trans-	tin
dichloromethane	trichlorobenzene, 1,2,3-
dichlorophenol, 2,3-	trichlorobenzene, 1,2,4-
dichlorophenol, 2,4-	trichlorobenzene, 1,3,5-
dichlorophenol, 2,5-	trichloroethane, 1,1,1-
dichlorophenol, 2,6-	trichloroethane, 1,1,2-
dichlorophenol, 3,4-	trichlorophenol, 2,3,4-
dichlorophenol, 3,5-	trichlorophenol, 2,3,5-
dichloropropane, 1,2-	trichlorophenol, 2,3,6-
dichloropropene, 1,3- (cis + trans)	trichlorophenol, 2,4,5-
dimethylphenol, 2,4-	trichlorophenol, 2,4,6-
dimethylphenol, 2,6-	trichlorophenol, 3,4,5-

**Table 2A-2: Substances for which standards were selected from US EPA Regional Ingestion Screening Levels for Soil<sup>1</sup>**

Saturation Limit	Ceiling Limit
acetone (CL,IL)	acetone (CL,IL)
acetophenone	acetophenone (CL, IL)
bromobenzene (CL,IL)	adipic acid
butanol, 2- (RL)	aluminum (CL,IL)
butanol, n-	benfluralin (CL,IL)
butylbenzene, n-	bensulfuron-methyl (CL,IL)
butylbenzene, sec-	benzoic acid
butylbenzene, tert-	butanol, 2- (RL <sub>LD</sub> , RL <sub>HD</sub> )
carbon disulfide	butanol, n- (CL, IL)
chlorobenzotrifluoride, 4- (CL,IL)	butyl phthalyl butyl glycolate (CL, IL)
chlorobutane, 1-	butylbenzene, sec- (CL, IL)
chlorotoluene, 2-	butylbenzene, tert- (CL, IL)
chlorotoluene, 4-	caprolactam (CL,IL)
cyclohexanone (CL, IL)	chlorpropham (CL, IL)
cyclohexene (WL <sub>N</sub> , WL <sub>R</sub> , AL, PL, RL <sub>LD</sub> , RL <sub>HD</sub> )	cyclohexanone (CL, IL)
dibromobenzene, 1,3- (CL, IL)	cyclohexylamine (CL, IL)
dichloropropane, 1,3-	diethyl ether (CL, IL)
diethyl ether	diethyl phthalate (CL, IL)
diisobutylene	dimethylterephthalate (CL, IL)
dimethylaniline, N,N- [DMA] (CL, IL)	ethylenediamine (CL, IL)
isobutanol	fosetyl
isopropylbenzene	imazaquin (IL)
methyl acetate	imazethapyr (IL)
methyl ethyl ketone [MEK] (IL)	iron (IL)
methyl methacrylate	methyl acetate (CL, IL)
methylstyrene, alpha-	methyl ethyl ketone [MEK] (IL)
nonane, n-	metsulfuron-methyl (CL, IL)
propylbenzene, 1-	nitrate (as N)
propylene glycol monomethyl ether	nitrite (as N) (CL, IL)
trichloro-1,2,2-trifluoroethane, 1,1,2-	phenmedipham (IL)
trichlorofluoromethane	phthalic acid, p- (CL, IL)
trimethylbenzene, 1,3,5-	propylene glycol monomethyl ether
vinyl acetate (CL, IL)	strontium (CL, IL)
	trichlorofluoromethane (CL, IL)

<sup>1</sup> Applies to standards for all land uses unless otherwise indicated.

## Chapter 3. Derivation of Environmental Protection (Ecological Health) Soil Standards

### 3.1 Introduction

The environmental protection soil standards are contained in CSR Schedule 3.1:

- Part 1 Matrix Soil Standards - “Environmental Protection – Soil Invertebrates and Plants”, “Livestock Ingesting Soil and Fodder”, and “Major Microbial Function Impairment”
- Part 3 Generic Numerical Soil Standards for Environmental Protection

### 3.2 Land use-based levels of protection

Each of the eight land uses defined in the CSR (see Section 2.2) have specific receptors, exposure pathways and levels of protection. Table 3-1 summarizes the specific factors assigned to each land use.

**Table 3-1. Receptors, exposure pathways and levels of protection**

Land Use	Receptors	Direct Exposure Pathways	Indirect Exposure Pathways	Level of Protection <sup>1</sup> (LER = Low Effect Range; MER = moderate effect range)
IL	Plants Soil invertebrates	Direct soil contact	Contaminant transfer to groundwater affecting aquatic life	Method 1: EC <sub>50</sub> and LC <sub>50</sub> Method 2: MER (EC <sub>50</sub> and LC <sub>50</sub> )
CL	Plants Soil invertebrates	Direct soil contact	Contaminant transfer to groundwater affecting aquatic life	Method 1: EC <sub>50</sub> and LC <sub>50</sub> Method 2: MER (EC <sub>50</sub> and LC <sub>50</sub> )
RL <sub>HD</sub>	Plants Soil invertebrates	Direct soil contact	Contaminant transfer to groundwater affecting aquatic life	Method 1: EC <sub>50</sub> and LC <sub>50</sub> Method 2: MER (EC <sub>50</sub> and LC <sub>50</sub> )
RL <sub>LD</sub>	Plants Soil invertebrates	Direct soil contact	Contaminant transfer to groundwater affecting: 1. aquatic life 2. plants	Method 1: EC <sub>25</sub> and LC <sub>25</sub> Method 2: LER (EC <sub>25</sub> and LC <sub>25</sub> )
PL	Plants Soil invertebrates	Direct soil contact	Contaminant transfer to groundwater affecting: 1. aquatic life 2. plants	Method 1: EC <sub>25</sub> and LC <sub>25</sub> Method 2: LER (EC <sub>25</sub> and LC <sub>25</sub> )
AL	Plants/crops Soil invertebrates Livestock	Direct soil contact	Contaminant transfer to groundwater affecting:	Method 1: EC <sub>25</sub> and LC <sub>25</sub> Method 2: LER (EC <sub>25</sub> and LC <sub>25</sub> )

Land Use	Receptors	Direct Exposure Pathways	Indirect Exposure Pathways	Level of Protection <sup>1</sup> (LER = Low Effect Range; MER = moderate effect range)
	Soil microbes	Soil and fodder ingestion by livestock	1. aquatic life 2. plants 3. livestock	
<b>WL<sub>R</sub></b>	Plants Soil invertebrates	Direct soil contact	Contaminant transfer to groundwater affecting: 1. aquatic life 2. plants	Method 1: EC <sub>25</sub> and LC <sub>25</sub> Method 2: LER (EC <sub>25</sub> and LC <sub>25</sub> )
<b>WL<sub>N</sub></b>	Plants Soil invertebrates	Direct soil contact	Contaminant transfer to groundwater affecting: 1. aquatic life 2. plants	Method 1: EC <sub>15</sub> and LC <sub>15</sub> Method 2: LER/1.6

**Notes:**

<sup>1</sup> EC<sub>x</sub> values are the toxicity test concentrations which result in a non-lethal endpoint in X% of the test organisms. LC<sub>x</sub> values are the toxicity test concentrations which cause lethality in X% of the test organisms; Refer to the Method 2 (Section 3.4.1.2) for definitions of MER and LER.

### 3.3 Toxicity reference values (TRVs)

Toxicity data used to derive the updated soil standards was obtained from agencies who have vetted the data for acceptability in deriving soil guidelines or standards. The sources of soil TRVs were:

- Canadian Council for Ministers of the Environment [\(Scientific Criteria for Deriving Soil Guidelines\)](#);
- United States Environmental Protection Agency, [Interim Ecological Screening Level Documents](#);
- Oak Ridge National Laboratory, [Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision](#); [Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision](#);
- Ontario Ministry of Environment, [Rationale for the Development of Soil and Groundwater Standards for use at Contaminated Sites in Ontario](#); and
- Additional toxicity information was obtained from scientific reports and theses.

Wildlife receptors are not included in the derivation of soil standards. Wildlife receptors must be considered in the development of risk-based standards where appropriate in detailed risk assessment at contaminated sites.

Tables containing ecological health TRVs used to derive soil standards are contained in Appendix 8B of Chapter 8.

### 3.4 Standard derivation procedures

#### 3.4.1 Soil invertebrates and plants

Three methods are used to derive environmental protection soil standards for soil invertebrates and plants. Method 1 is a regression method, whereas Method 2 is a geometric mean method; Method 2 is used in the case that Method 1 does not meet quality criteria.

##### 3.4.1.1 Ecological health method 1 – Regression

Method 1 consists of substance-specific linear regression-based effective concentration estimates, calculated from geometric means of quartile or quintile data bins of combined non-lethal and lethal concentration toxicity data, as follows:

1. All available toxicity data for a substance is compiled and assessed for acceptability against data quality assurance/quality control criteria and data bias checks.
2. No observed effects concentration (NOEC) data lacking an associated percent effect are binned in the first quartile (or quintile) data bin.
3. All data are combined into a single data set comprising effective concentration (EC) and lethal concentration (LC) data.
4. Calculate a linear regression line for the resulting combined EC and LC effects substance specific distribution based on quartile geometric means for the following classes:
  - a. 1<sup>st</sup> quartile – EC and LC effects in the range of 0% to 24% (inclusive);
  - b. 2<sup>nd</sup> quartile – EC and LC effects in the range of 25% to 49% (inclusive);
  - c. 3<sup>rd</sup> quartile – EC and LC effects in the range of 50% to 74% (inclusive); and
  - d. 4<sup>th</sup> quartile – EC and LC effects in the range of 75% to 100% (inclusive).
5. If the quartile regression returns a regression correlation coefficient,  $r^2 \geq 0.75$ , the soil invertebrate and plants soil standards are calculated from the regression line as follows:
  - a.  $WL_N$ : standard is the predicted 15<sup>th</sup> percentile concentration;
  - b.  $WL_R$  /  $AL$  /  $RL_{LD}$  /  $PL$ : standard is the predicted 25<sup>th</sup> percentile concentration; and
  - c.  $RL_{HD}$  /  $CL$  /  $IL$ : standard is the predicted 50<sup>th</sup> percentile concentration.
6. If the quartile regression does not meet data quality criteria, e.g. returns an  $r^2 < 0.75$ , recalculate the regression using quintile data bins:
  - a. 1<sup>st</sup> quintile – EC and LC effects in the range of 0% to 19% (inclusive);
  - b. 2<sup>nd</sup> quintile – EC and LC effects in the range of 20% to 39% (inclusive);
  - c. 3<sup>rd</sup> quintile – EC and LC effects in the range of 40% to 59% (inclusive);
  - d. 4<sup>th</sup> quintile – EC and LC effects in the range of 60% to 79% (inclusive); and
  - e. 5<sup>th</sup> quintile – EC and LC effects in the range of 80% to 100% (inclusive).

7. If the quintile regression returns an  $r^2 \geq 0.75$ , calculate from the regression line, land use soil invertebrate and plants soil standards as follows:
  - a.  $WL_N$ : standard is the predicted 15<sup>th</sup> percentile concentration;
  - b.  $WL_R$  /AL/ $RL_{LD}$ /PL: standard is the predicted 25<sup>th</sup> percentile concentration; and
  - c.  $RL_{HD}$ /CL/IL: standard is the predicted 50<sup>th</sup> percentile concentration.
8. If the quintile regression does not meet data quality criteria, e.g. returns an  $r^2 < 0.75$ , do not use Method 1. Instead use Method 2 to derive the standard.

#### **3.4.1.2 Ecological health method 2 – Geometric mean**

Method 2 calculates substance-specific EC estimates using geometric means of combined EC and LC data available for the substance as follows:

1. All available toxicity data for a substance is compiled and assessed for acceptability against data quality assurance/quality control criteria and data bias checks;
2. NOEC data lacking an associated percent effect are discarded;
3. All data are combined into a single data set comprising EC and LC data;
4. Calculate geometric means for the following data sub-sets:
  - a. Low effect range (LER): set the 25<sup>th</sup> percentile estimate equal to the geometric mean of the 15% – 34% effect range of data (inclusive); and
  - b. Moderate effect range (MER): set the 50<sup>th</sup> percentile estimate equal to the geometric mean of 35% – 65% effect range of data (inclusive).
5. Derive land use soil invertebrate and plants standards as follows:
  - a.  $WL_N$ : standard is the LER/ wildlands divisor;
  - b.  $WL_R$  /AL/ $RL_{LD}$ /PL: standard is the LER; and
  - c.  $RL_{HD}$ /CL/IL: standard is the MER.

The wildlands divisor is a value of 1.6, derived empirically from the relationship of derived PL and WL values from Method 1. The wildlands divisor is intended to provide an estimate of the 15% level of protection for WL standards.

#### **3.4.1.3 Alternative derivation procedures**

In the circumstance that new environmental health protective matrix soil standards could not be derived using either Method 1 or Method 2, standards were either:

- a) Set to the Schedule 5 matrix soil standards and Schedule 4 generic soil standards of the Stage 9 amendment of the CSR (repealed by B.C. Reg. 253/2016), or

- b) Adopted with modification from the Canadian Council of Ministers of the Environment (CCME). AL, PL CL and IL standards are set equal to the corresponding CCME soil quality criteria. WL<sub>N</sub> standard is derived by dividing the parkland soil quality criterion by the wildlands divisor. WL<sub>R</sub> standard is set equal to the parkland soil quality criterion. RL<sub>LD</sub> standard is set equal to the CCME residential soil quality criterion. RL<sub>HD</sub> standard is set equal to the commercial soil quality criterion. Table 3-2 summarizes this:

**Table 3-2. Use of CCME criteria in standards selection for specific substances**

Substance	CCME Resource
anthracene	2010 soil quality criteria
benzo(a)pyrene	2010 soil quality criteria
dichlorodiphenyltrichloroethane, total (DDT)	1999 secondary consumer soil & food ingestion criteria
fluoroanthene	2010 soil quality criteria
methanol	2016 draft soil quality criteria
naphthalene	1997 provisional soil quality criteria
nonylphenol & nonylphenol ethoxylates	2002 soil quality criteria
PCBs	1999 tertiary consumer soil & food ingestion criteria
PCDD/PCDFs	1991 interim soil quality criteria
uranium	2007 soil quality criteria

### 3.4.2 Livestock ingesting soil and fodder

Wherever sufficient livestock toxicity data is available, a "livestock ingesting soil and fodder" standard is derived to ensure that remediated agricultural sites would not pose health risks for domestic livestock directly ingesting soil and foraging on vegetation grown on these sites. Where data indicates a particular or unique species sensitivity to the contaminant in question, the standard is derived using parameters relevant to that species, otherwise cattle are assumed as the default receptor of concern.

The procedure to derive livestock ingesting soil and fodder standards uses dietary toxicity data for livestock species and considers the potential exposure via ingestion of both contaminated soil and contaminated fodder at a site. Estimates of contaminant uptake by plants (fodder) are derived using soil-to-plant transfer coefficients for the vegetative portion of plants.

The livestock ingesting soil and fodder standard is derived by:

$$C_s = \left\{ \frac{TRV \times BW}{[(B_v \times IR_f) + IR_s] \times AB \times ED \times AUF} \right\}$$

Where:	C <sub>s</sub>	Livestock ingesting soil and fodder standard
	TRV	Toxicity reference value: chemical specific
	BW	Receptor body weight (kg) = 600
	B <sub>v</sub>	Soil to plant transfer coefficient for vegetative tissue: chemical specific
	IR <sub>f</sub>	Food ingestion rate (kg/d) or 0.687 x BW <sup>0.651</sup> = 13.5 (cow specific value)
	IR <sub>s</sub>	Soil ingestion rate (kg/d) or 0.083 x DMIR = 1.5 (cow specific value)
	AB	Bioavailability = 1.0 (i.e., 100%)
	ED	Duration of exposure = 1.0 (i.e., 365d/yr)
	AUF	Area use function: ratio of affected area = 1.0 (i.e., 100%) <sup>1</sup>
	DMIR	Dry matter intake rate (kg/d) [part of IR <sub>s</sub> calc.] = 15 (cow specific value)

The estimated TRVs represent dosages where adverse effects to the receptor are not expected to occur. The substance TRV is calculated as detailed below and is generally derived using the lower bound of the estimated high dietary concentration range for the contaminant as reported in Puls R., (1994), Mineral Levels in Animal Health: Diagnostic Data. Sherpa International. Clearbrook, BC. The TRV for use in derivation of livestock ingesting soil and fodder standard is derived by:

$$TRV = \frac{CD \times IR_f}{BW}$$

Where:	TRV	Toxicity reference value: chemical specific
	CD	Lower bound of the high dietary concentration (mg/kg): chemical specific
	IR <sub>f</sub>	Fodder ingestion rate (kg/d) = 13.5
	BW	Body weight (kg) = 600

When applicable, CCME criterion were adopted as soil standards for livestock ingesting soil and fodder in the CSR. This applies to:

- cyanide (1997 agricultural soil & food ingestion criterion), and
- uranium (2007 agricultural soil & food ingestion criterion).

### 3.4.3 Major microbial functional impairment

The CCME guidelines (nutrient and energy cycling check) for protection of soil microbial function are adopted as soil standards for agricultural land use in the CSR. This applies to:

- cadmium,
- chromium,
- copper,
- lead,
- mercury,
- nickel,
- vanadium, and
- zinc.

#### **3.4.4 Final standards selection**

Where the calculated standard is less than the provincial background soil estimate (see Chapter 9), or analytical detection limit, the final standard is replaced by the greater concentration for a substance. All final standards are rounded according to rules described in Chapter 10. In the case where there is insufficient acceptable scientific data to calculate a standard, or no appropriate standard, guideline or criterion exists to develop a standard, then “no standard” is indicated in the CSR.

**APPENDIX 3A**  
**TRV Quality Criteria**

## **Regression method**

Sufficient TRV data is required to use the regression method of deriving soil standards. The weight of evidence approach for guideline derivation requires minimums of: 3 studies; 10 data points; 2 plant species and 2 invertebrate species. However, if the minimums are not met there is provision to use professional judgement in deciding to use the weight of evidence method. Uncertainty factors may be considered for weak or potentially biased data sets. The minimum number of species for deriving the BC soil standards, without an uncertainty factor is three, with at least one plant and one soil invertebrate. Uncertainty factors were considered for weak (e.g. only one plant and one invertebrate species) or potentially biased data sets (e.g. high organic content soils). Lethality data were the minority of all datasets.

The minimum number of data points to perform a quartile regression is three, with a requirement for data in the first quartile bin. The minimum number of data points to perform a quintile regression is four with a requirement for data in the first quintile bin.

The minimum number of toxicity values in a regression bin is one. It was found that for many substances there are relatively few data points in the top quartile and higher minimum numbers of toxicity values per bin would result in few successful regressions. To compensate for the acceptance of single data points in a regression bin, the minimum acceptable R squared ( $r^2$ ) value was raised to a conservative 75%. The conservative R squared requirement effectively screened out regressions with odd dose response curves and these substances were then assessed using the more robust geometric mean method.

## **Geometric mean method**

The minimum data required for use of the geometric mean method are: 10 data points (total) and 3 per category (MER or LER); 3 toxicity studies; 2 plant species and 2 invertebrate species. Acceptability of less than these minimums relies on professional judgement and can include the use of uncertainty factors.

## Chapter 4. Derivation of Soil to Groundwater Protection Matrix Soil Standards

### 4.1 Introduction

The ministry has a model to derive soil to groundwater protective standards for the protection of drinking, aquatic life, irrigation and livestock water uses. The model is based on current day procedures and methods incorporating recent advances related to the science of modelling contaminant transport in soil and water. The groundwater protection model (or model) is also consistent between the various ministry protocols and technical guidance.

### 4.2 Groundwater protection model

The CSR Schedule 3.1, Part 1 standards are based on eight land uses with two mandatory and six site-specific factors. The model is used for the calculation of the site-specific factors, which represent matrix numerical soil standards protective of groundwater and its different uses. The water uses are as follows:

- groundwater used for drinking water;
- groundwater flow to surface water (freshwater or marine) used by aquatic life;
- groundwater used for livestock watering; and
- groundwater used for irrigation.

Application of individual site-specific factors varies by land use; the land uses and site-specific factors are shown in Table 4A-1, Appendix 4A.

The soil standards derived using the model are to ensure that the substance concentrations in groundwater discharging and in contact with a receptor are less than or equal to the substance specific numerical water standard for the water use associated with the respective receptor. For ease of calculation and representation, a point of compliance is used as a surrogate for a receptor. Thus, allowable groundwater concentrations at the point of compliance are based on the respective drinking water use, aquatic water use (freshwater or marine), livestock water use or irrigation water use standards presented in CSR Schedule 3.2. Applicable water uses are determined in accordance with [Protocol 21, "Water Use Determinations"](#).

The model is used in a backward calculation mode to calculate matrix numerical soil standards that are protective of the respective water uses. This process involves specification of the applicable numerical water standards at a point of compliance with subsequent backward calculation of the allowable substance concentrations in the soil at a source area.

The model includes both organic and inorganic substances. Organic substances are generally non-polar including one ionizing substance (pentachlorophenol). The substances selected for inclusion in the model are based on frequency of occurrence at contaminated sites and the

availability of human and environmental health toxicological information. The current list of substances in the model is presented in Table 4A-2, Appendix 4A.

### 4.3 Model details

#### 4.3.1 Framework

The model consists of four components to simulate the fate and transport of a substance from soil to groundwater and the subsequent fate and transport of the substance in groundwater to a point of compliance. The four components are integrated and include both physical and chemical mechanisms. The components are as follows:

- leachate generation in the unsaturated zone via substance partitioning between soil, soil pore air, and soil pore water (leachate generation);
- leachate fate and transport through the unsaturated zone (leachate transport);
- leachate mixing with groundwater at the water table (leachate mixing); and
- substance fate and transport through the saturated zone to a point of compliance (solute transport).

The model is a hybrid of other models provided in literature:

- The leachate generation and leachate mixing components (United States Environmental Protection Agency, [Soil Screening Guidance](#))(1996);
- The leachate transport component, based on a one-dimensional steady-state analytical solution for contaminant fate and transport in the unsaturated zone (Kool, J.B, Huyakorn, P.S., Sudicky, E.A., Saleem, Z.A. (1994). A Composite Modelling Approach for Subsurface Transport of Degrading Contaminants from Land-Disposal Sites. Journal of Contaminant Hydrology, 17)
- The groundwater transport component, based on a two-dimensional steady-state analytical solution for contaminant fate and transport in the saturated zone (Domenico, P.A. (1987). An Analytical Model for Multidimensional Transport of a Decaying Contaminant Species. Journal of Hydrology, 91)

The representativeness of the model for the purposes of calculating soil-groundwater protective standards is achieved by the following elements:

- the major transport processes are represented;
- the major variables affecting each of the transport components are included and can be modified;
- physical and chemical affects are considered;
- model assumptions and criteria derivations are transparent;
- the model can be calibrated;
- the model performs with reasonable accuracy using a small set of input parameters;
- the accuracy and reliability of the model increases as site specific information increases;

- the model can be used with assumed site characteristics or site-specific data; and
- the model is scientifically based and defensible.

## **4.3.2 Conceptual site model**

### **4.3.2.1 Overview**

The model is formulated on a conceptual site model of a contaminated site (see Figure 4B-1, Appendix 4B). The conceptual site model consists of a source of contamination in the unsaturated zone with prescribed dimensions (length, width and depth). Infiltration of precipitation through the contamination source results in leachate generation by partitioning of contaminant mass between soil, soil pore water and soil pore air.

The second component of the model involves leachate migration through the unsaturated zone to the water table. Flow is steady-state and one-dimensional (vertical) in the unsaturated zone. Attenuation mechanisms that are active for unsaturated zone transport include dispersion, sorption and biological degradation (biodegradation) but only for organic substances. Note that, as a conservative measure, the unsaturated zone transport component is not invoked in the calculation of the CSR Schedule 3.1, Part 1 standards. This is done by setting the source depth equal to the water table depth in the model.

The third component of the model involves mixing of leachate and groundwater at the water table. Mixing is based on a simple water balance model between leachate infiltration and groundwater flux. Mixing is calculated to occur to a mixing thickness in the saturated zone. No attenuation processes are active in the mixing component. However, the net effect of mixing is dilution of leachate by groundwater. Dilution as a result of mixing is calculated as a dilution factor.

The final component of the model consists of migration of a solute in groundwater to the point of compliance. Flow is steady-state and two-dimensional (longitudinal and transverse to groundwater flow) in the saturated zone. Attenuation mechanisms that are active for saturated zone transport include dispersion and, for organic substances, sorption and biodegradation.

The point of compliance for drinking, livestock and irrigation water uses is a water well in the saturated zone. The point of compliance for aquatic life water use is 10 m from the high water mark of an aquatic receiving environment consistent with [Technical Guidance 15, "Concentration Limits for the Protection of Aquatic Receiving Environments"](#). For the purpose of calculating matrix numerical soil standards, the points of compliance are assumed to be present 10 m downgradient of the soil source.

### **4.3.2.2 Site conditions/defaults**

The matrix numerical soil standards protective of groundwater are derived using model parameters typical of the climatic conditions of the lower Fraser River/Vancouver area and assumed soil/hydrogeological characteristics typical of those found within the Fraser River

sands of the BC Fraser River delta area. Other assumptions include source dimensions, transport distance (distance from source to point of compliance), and water hardness of the aquatic receiving environment.

The assumed/default model values are summarized as follows and are also provided in Table 4C-1, Appendix 4C.

### **Source dimensions/Transport characteristics**

- The source dimensions are a source length of 10 m (longitudinal to groundwater flow), source width of 30 m (transverse to groundwater flow), and source depth of 3 m. The assumed source dimensions represent a contaminated soil volume of 900 m<sup>3</sup>.
- The transport distance is assumed to be 10 m for all site-specific factors (water uses).

### **Soil/Hydrogeological characteristics**

The soil type is representative of a fine to medium grained sand unit with the following properties:

- total porosity is 36% and 11.9% of the pore volume is water filled in the unsaturated zone (the calculated air-filled porosity is 24.1% in the unsaturated zone);
- effective porosity is 25% in the saturated zone;
- dry bulk density is 1.7 g/cm<sup>3</sup>;
- organic content (fraction of organic carbon) is 0.5%;
- hydraulic conductivity is 3x10<sup>-5</sup> m/s and the hydraulic gradient is 0.8%;
- depth to the water table is 3 m;
- thickness of the unconfined aquifer is 5 m; and
- soil pH and water pH (of the aquifer) are 6.5.

### **Meteorological/Hydrological characteristics**

- The precipitation rate is 1,000 mm/year and the runoff plus surface evapotranspiration rate is 450 mm/year. The calculated infiltration rate is 550 mm/year.
- The number of days of frozen ground is zero.

### **Aquatic Receiving environment**

- The water hardness at the aquatic receiving environment is 200 mg/L as CaCO<sub>3</sub>.

#### **4.3.3 Fate and transport**

Flow in the model is assumed to be essentially one dimensional with incorporation of attenuation processes affecting contaminant movement. Attenuation includes both physical and chemical mechanisms. Physical mechanisms include dilution (mixing) and dispersion.

Chemical mechanisms include partitioning (adsorption/desorption) and biodegradation (organic substances only).

Partitioning within the model is dependent on the substance type. For non-polar organic substances, partitioning is a function of the organic carbon partitioning coefficient of the substance and the amount of organic carbon in the soil. For weakly-ionizing organic substances (e.g., pentachlorophenol), partitioning is additionally influenced by soil pH. Values for organic carbon partitioning coefficients have been compiled from literature. A value for the fraction of organic carbon in soil is based on the assumed soil type.

Partitioning of inorganics is considerably more complex, being additionally dependent on factors such as soil pH, sorption to clays, presence of organic matter and iron oxides, oxidation/reduction conditions, major ion chemistry and the chemical form of the inorganic substance. As a simplification, a distribution coefficient, calculated as a function of pH, is used for partitioning of inorganic substances in the model.

#### **4.3.4 Assumptions**

Model assumptions are based on the fate and transport components and analytical solutions incorporated in the model. Assumptions include:

- the soil is physically and chemically homogeneous;
- the contaminant is not present as a free product phase (i.e., a non-aqueous phase liquid);
- the source concentration in soil is constant;
- partitioning at the source between the air, water and solid phases of the soil is linear and in equilibrium;
- the maximum substance concentration in leachate (leachate concentration) is equivalent to a percentage of the theoretical solubility limit of the substance in water under the defined site conditions;
- the moisture content and infiltration rate are uniform throughout the unsaturated zone;
- flow in the unsaturated zone is assumed to be one-dimensional and downward only, with dispersion, retardation and biodegradation (first-order decay);
- partitioning of solutes in the leachate between the water and solid phases of the unsaturated zone soils is linear and in equilibrium;
- mixing of leachate with groundwater is assumed to occur through mixing of leachate and groundwater mass fluxes;
- the groundwater aquifer is unconfined;
- flow in the saturated zone is uniform and steady;
- co-solubility and oxidation/reduction effects are not considered;
- attenuation in the saturated zone is assumed to be one dimensional with respect to retardation and biodegradation (first-order decay);

- partitioning of solutes in the groundwater between the water and solid phases of the saturated zone soils is linear and in equilibrium;
- dispersion is assumed to occur in the longitudinal and horizontal transverse directions only (vertical dispersion is ignored);
- diffusion is not considered, and
- dilution by groundwater recharge downgradient of the source is not included.

#### 4.3.5 Equations

The mathematical equations for each of the four model components are presented in Appendix 4D as Exhibits 4D-1 through 4D-5. The component equations are presented in the order of calculation in the model, i.e., equations proceed from the point of compliance to calculation of the soil concentration/soil matrix standard in the source area.

The equations are identified as follows:

- solute transport in the saturated zone is presented in Exhibit 4D-1;
- leachate/groundwater mixing equations are presented in Exhibits 4D-2 and 4D-3;
- leachate transport in the unsaturated zone is presented in Exhibit 4D-4; and
- soil/leachate partitioning is presented in Exhibit 4D-5.

A summary of all terms used in the model is presented in Exhibit 4D-6.

Substance properties for all substances in the model are presented in Tables 4E-1 through 4E-4, Appendix 4E and include:

- analytical method detection limits;
- solubility limit;
- dimensionless Henry's Law constant;
- distribution coefficient;
- organic carbon partitioning coefficient; and
- biodegradation half-life (unsaturated and saturated zone values).

Background substance concentrations in soil (background concentration in soil), as applicable, are provided in Table 4E-5, Appendix 4E.

The CSR Schedule 3.2 numerical water standards are used in the model as a point of compliance groundwater concentration.

## 4.4 Standards derivation procedures

### 4.4.1 Methodology

The model spreadsheet used for calculating matrix numerical soil standards is provided as part of [Technical Guidance 13, “Groundwater Protection Model”](#). The model is based on the exhibits referenced in Section 4.3.5. Description of the methodology for calculating individual matrix soil standards is provided below.

#### 4.4.1.1 General sequence

The general calculation methodology for an individual substance is summarized in Flowchart 4F-1 provided in Appendix 4F. Based on the flowchart, calculation begins at the point of compliance with assignment of the applicable water use standard for the selected site-specific factor. Calculation ends with a calculated soil concentration protective of the specific water use standard assigned at the point of compliance.

The calculated soil concentration is compared to background concentrations in soil, as applicable (see Chapter 9), and analytical method detection limits in soil. If less than either, the soil concentration is adjusted upwards to the respective value. The adjusted value is then rounded (see Chapter 10) and becomes the calculated soil standard for the respective site-specific factor.

#### 4.4.1.2 Partitioning considerations

Organic carbon partitioning coefficient and distribution coefficient isotherms ( $K_{oc}$  vs pH and  $K_d$  vs pH, respectively) are provided in the model for weakly ionizing organic substances (pentachlorophenol) and select inorganic substances (arsenic, beryllium, cadmium, chromium (hexavalent), chromium (trivalent), copper, lead, nickel, selenium and zinc), respectively. For these substances, the partitioning value is dependent on the soil pH. To accommodate this dependency, matrix numerical soil standards for these substances (excluding chromium) were calculated for a range of soil pH values for which partitioning values are available. For chromium (hexavalent and trivalent), matrix numerical soil standards were calculated at a soil pH of 6.5 only to minimize the complexity of the matrix in the CSR that includes both substances.

The pH range selected is for soil pH of 5 to 8 in one-half pH increments. For each increment, the mid-point pH value is identified, rounded up, and the corresponding partitioning value is selected. For pH < 5, a pH value of 5.0 is used. For pH > 8, a pH value of 8.0 is used. Where the calculated standards for an increment do not change significantly from the preceding value, the increments are collapsed to minimize repetition of similar standards. Where a range is collapsed, the calculated standard for the lowest pH range of similar standards is used as the

matrix numerical soil standard<sup>1</sup>. Note that as the soil pH value changes, the water pH value used in the model is changed similarly. This influences the numerical water standard selected for pentachlorophenol as described in Section 4.4.1.3.

#### **4.4.1.3 Water use standard selection considerations**

The numerical water standards used at the point of compliance are selected from CSR Schedule 3.2. Considerations related to water use standard selection are described as follows.

For cadmium, copper, lead, nickel and zinc, the freshwater aquatic life water use standards vary by the water hardness of the aquatic receiving environment. The water use standard/water hardness relationship is found in CSR Schedule 3.2. The relationship is presented as a discrete water use standard applicable over a range of water hardness values. To enable calculation of matrix numerical soil standards for these substances in CSR Schedule 3.1, where only a single value may be prescribed for calculation purposes, a default water hardness value of 200 mg/L of CaCO<sub>3</sub> is used. For the respective substances, this default value corresponds to the following ranges/values in water hardness:

- cadmium (water hardness range of 150 to < 210 mg/L);
- copper (water hardness ≥ 200 mg/L);
- lead (water hardness range of 200 to < 300 mg/L);
- nickel (water hardness > 180 mg/L); and
- zinc (water hardness range of 200 to < 300 mg/L).

Where the aquatic receiving water hardness is outside of this specified range (as represented by the default value of 200 mg/L), the matrix numerical soil standard for the aquatic life water use pathway must be recalculated by: 1) determination of the applicable water use standard based on the receiving environment water hardness applicable to the site (water use standard/water hardness relationship found in CSR Schedule 3.2); and 2) calculation of the applicable matrix numerical soil standard based on the newly determined water use standard.

Specific to zinc, the water use standard selected for irrigation water use is dependent on the soil pH. Thus, as the soil pH values change for the increments presented for zinc in CSR Schedule 3.1, Part 1, the irrigation water use standard selected as the groundwater concentration at the point of compliance also changes. The specific irrigation water use standard/soil pH relationship is found in CSR Schedule 3.2.

Specific to pentachlorophenol, the water use standard selected for aquatic life water use is dependent on the water pH and water temperature. Regarding temperature, the matrix numerical soil standards for pentachlorophenol are all based on a temperature ≥ 20 °C.

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<sup>1</sup> For example, if similar soil standards are calculated for pH ranges of 7.0 - 7.5, 7.5 - 8.0 and >8.0, then the calculated value for the pH range of 7.0 – 7.5 is used as the soil standard instead of recalculation of the standard at a pH = 7.0. The net effect is that the soil standard is calculated at a pH = 7.3 (midpoint of 7.0 – 7.5 range) instead of pH=7.0.

Regarding water pH, as noted in Section 4.4.1.2, the water pH value varies similarly to the soil pH. Thus, the aquatic life water use standard selected as the groundwater concentration at the point of compliance changes as the soil/water pH changes. The aquatic life water use standard/water pH/temperature relationship is referenced in CSR Schedule 3.2.

Specific to molybdenum, the water use standard for irrigation water use is dependent on the crop, soil drainage and molybdenum:copper ratio. An IW standard of 10 µg/L was used in deriving the groundwater use for irrigation soil standards.

Specific to selenium, the water use standard selected for irrigation water use is based on continuous or intermittent irrigation of crops.

#### **4.4.1.4 Example soil standards calculations**

Example matrix numerical soil standards calculations for zinc (groundwater used for irrigation water) and pentachlorophenol (groundwater flow to surface water used by aquatic life) are provided in Tables 4G-1 and 4G-2 (Appendix G) respectively.

## **4.4.2 Constraints/other factors**

Certain constraints and other factors are incorporated in the model or as part of standards calculations. They are summarized as follows.

### **Solubility limit**

A solubility limit value for organic substances is used in the model. The limit value used is 50% of the theoretical solubility of the substance. This is to minimize the potential for calculation of soil standards at soil concentrations approaching the presence of nonaqueous phase liquids.

### **Solubility constraint**

For some substances, the calculated leachate concentration exceeds the substance theoretical solubility limit. In these cases, the calculated soil standard is adjusted based on a modelled leachate concentration that is equivalent to the substance solubility limit. This applies to the soil standards for:

- ethylbenzene for the AW pathway
- naphthalene for the DW pathway
- pentachlorophenol [PCP] for some of the DW, AW and LW pathways
- perfluorooctane sulfonate [PFOS] for the AW pathway).

### **Dilution factor**

The dilution factor is calculated as part of mixing of leachate and groundwater (Exhibit 4D-2, Appendix 4D). The calculated dilution factor is 3.3 based on model defaults. Although not

invoked as part of calculation of the matrix numerical soil standards, a constraint is incorporated into the model to limit the dilution factor to a value of 1 where the contamination source extends into the water table.

### **Mixing zone thickness**

The mixing zone thickness is calculated as part of mixing of leachate and groundwater (Exhibit 4D-2, Appendix 4D). For calculating matrix numerical soil standards, a mixing zone thickness of 1.7 m is calculated based on model defaults. Although not invoked in calculating matrix numerical soil standards, a constraint is incorporated into the model to limit the mixing zone thickness to a thickness no greater than the aquifer thickness.

### **Background concentration and detection limit adjustment**

Soil standards for the following substances were adjusted to the respective 2016 reference background concentrations for one or more of the water use pathways: arsenic, beryllium, cadmium, chromium hexavalent, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, vanadium, and zinc. See Chapter 9 for more details.

Soil standards for the DW pathway for ethylene glycol and sulfolane were adjusted to the analytical method detection limit in soil.

### **Inorganic substances**

For inorganic substances, where calculated soil concentrations exceed 1,000,000 µg/g (i.e., 100% substance), the corresponding soil standard is reported as > 1,000 mg/g.

#### **4.4.3 Standards not calculated/provided**

Soil standards are not calculated or provided for all pathways for the following substances in CSR Schedule 3.1, Part 1 (shown as 'NS' indicating no standard or a blank cell):

- anthracene;
- benzo(a)pyrene;
- dichlorodiphenyltrichloroethane, total [DDT];
- fluoranthene;
- mercury;
- polychlorinated biphenyls, total [PCBs];
- polychlorinated dioxins and furans, total [PCDDs and PCDFs];
- tetrachloroethylene (blank cell); and
- trichloroethylene (blank cell).

Soil standards are not provided for the DW and AW pathways for anthracene, benzo(a)pyrene, and fluoranthene as it is predicted, using the model, that the applicable water use standards for the substances will not be exceeded at the point of compliance. For mercury, polychlorinated

biphenyls, total [PCBs], and polychlorinated dioxins and furans, total [PCDDs and PCDFs], soil standards are not calculated due to insufficient acceptable scientific data (soil water distribution coefficient for mercury and data in general for PCBs and PCDDs/PCDFs) to permit calculation. Similarly, an appropriate soil to groundwater fate/transport model is not considered available for DDT to predict the subsurface fate and transport of complex mixtures and therefore soil standards are not calculated.

Regarding tetrachloroethylene and trichloroethylene, soil standards are not provided for the groundwater used for drinking water pathway and the groundwater used for livestock watering pathway (trichloroethylene only). Although it is possible to calculate soil standards for these substances/pathways, the calculated soil standards are below analytical method detection limits and are otherwise problematic. Other factors considered in the decision not to set soil standards for the groundwater to drinking water and livestock watering pathways are:

- tetrachloroethylene and trichloroethylene can be difficult to identify and characterize in site soil investigations due to complex subsurface transport processes (e.g., DNAPL; transport through fissures/fractures/rootlets and along low permeability layers); and
- due to the volatile and soluble nature of tetrachloroethylene and trichloroethylene, the primary and preponderant exposure pathways of concern for these substances are the vapour and water pathways. Therefore, regulatory reliance on the application of the respective vapour and water quality standards for tetrachloroethylene and trichloroethylene is considered adequate to provide effective protection from soil to groundwater mediated exposures to humans and livestock.

Soil standards are also not calculated for certain water use pathways for a number of other substances. For these cases, this is a result of there being no water use standard to use at the point of compliance and therefore a soil standard cannot be calculated. This applies for the following substances: anthracene, barium, benzene, benzo(a)pyrene, cyanide, ethylbenzene, ethylene glycol, fluoranthene, manganese, methanol, naphthalene, nonylphenol and nonylphenol ethoxylates, pentachlorophenol [PCP], perfluorooctane sulfonate [PFOS], phenol, sodium ion, tetrachloroethylene, toluene, trichloroethylene, vanadium and xylenes.

A tabular summary of the substances/pathways for which matrix numerical soil standards are not calculated/provided is included as Table 4H-1, Appendix 4H.

## **APPENDIX 4A**

### **Site-specific factors by land use and substances**

Table 4A-1. Schedule 3.1, Part 1 - Mandatory/non-mandatory site-specific factors by land use

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6	COLUMN 7	COLUMN 8	COLUMN 9
Site-specific Factor	Wildlands (Natural) (WLN)	Wildlands (Reverted) (WLR)	Agricultural (AL)	Urban Park (PL)	Residential (Low Density) (RLD)	Residential (High Density) (RLHD)	Commercial (CL)	Industrial (IL)
<b>HUMAN HEALTH PROTECTION</b>								
Intake of contaminated soil								
Groundwater used for drinking water								
<b>ENVIRONMENTAL PROTECTION</b>								
Toxicity to soil invertebrates and plants								
Livestock ingesting soil and fodder								
Major microbial functional impairment								
Groundwater flow to surface water (freshwater or marine) used by aquatic life								
Groundwater used for livestock watering								
Groundwater used for irrigation								

**Notes:**

A shaded grey cell indicates a mandatory matrix standard (intake of contaminated soil and toxicity to soil invertebrates and plants site-specific factors).

A yellow shaded cell indicates that the site-specific factor applies for the particular land use where the respective water use applies.

**Table 4A-2. Schedule 3.1, Part 1 - Substances**

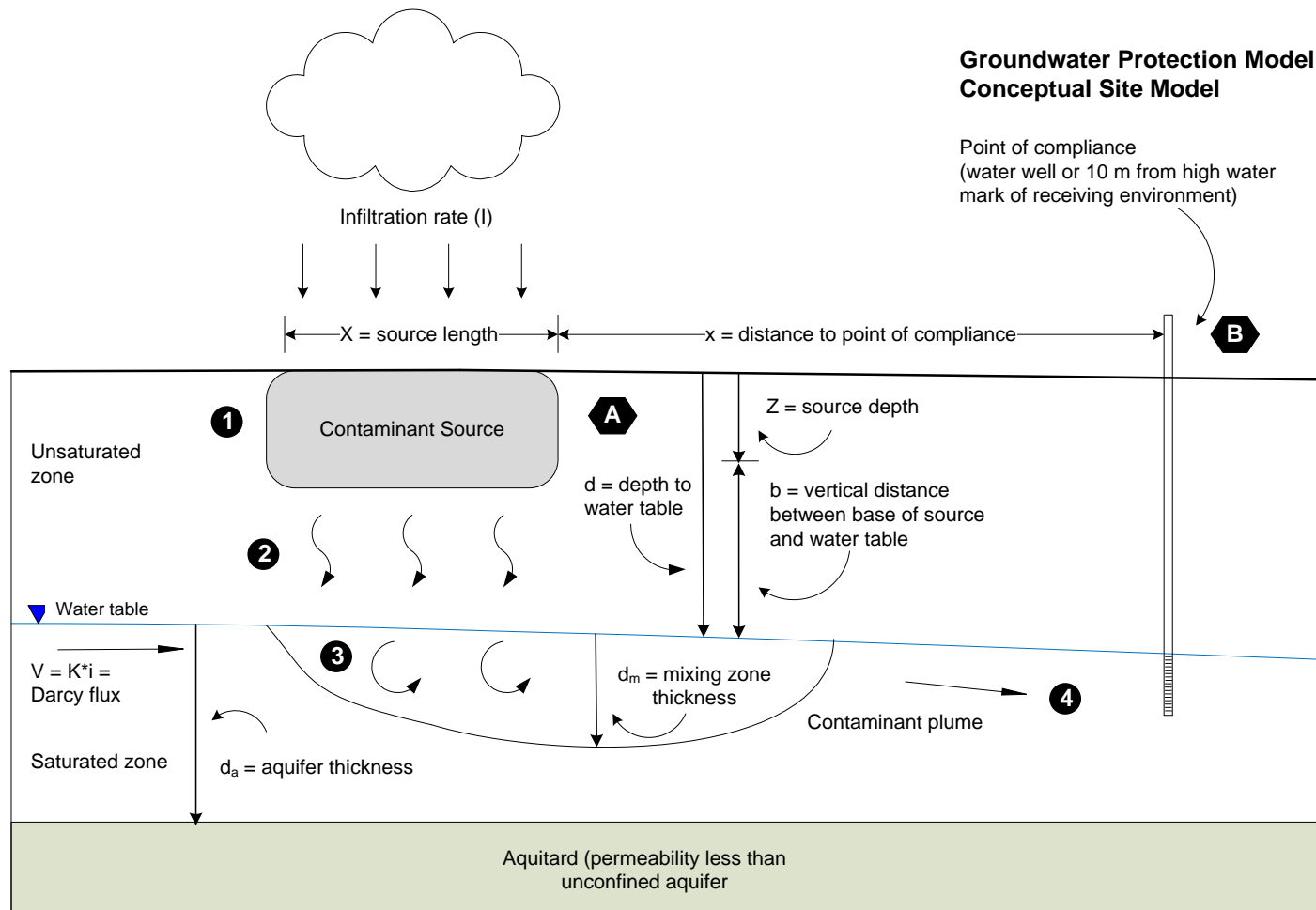
Organic Substances		Inorganic Substances	
Substance	CAS #	Substance	CAS #
anthracene	120-12-7	arsenic	7440-38-2
benzene	71-43-2	barium	7440-39-3
benzo(a)pyrene	50-32-8	beryllium	7440-41-7
dichlorodiphenyltrichloroethane, total [DDT]	N/A	cadmium	7440-43-9
diisopropanolamine [DIPA]	110-97-4	chloride ion	16887-00-6
ethylbenzene	100-41-4	chromium	7440-47-3
ethylene glycol	107-21-1	cobalt	7440-48-4
fluoranthene	206-44-0	copper	7440-50-8
methanol	67-56-1	cyanide	57-12-5
naphthalene	91-20-3	lead	7439-92-1
nonylphenol and nonylphenol ethoxylates	84852-15-3	manganese	7439-96-5
pentachlorophenol [PCP]	87-86-5	mercury	7439-97-6
perfluorooctane sulfonate [PFOS]	1763-23-1	molybdenum	7439-98-7
phenol	108-95-2	nickel	7440-02-0
sulfolane	126-33-0	selenium	7782-49-2
tetrachloroethylene	127-18-4	sodium ion	17341-25-2
toluene	108-88-3	uranium	7440-61-1
trichloroethylene	79-01-6	vanadium	7440-62-2
xylene	1330-20-7	zinc	7440-66-6

**Notes:**

Not included in Table 4A-2: Polychlorinated biphenyls, total [PCBs] and polychlorinated dioxins and furans, total [PCDDs and PCDFs] as no standards are calculated for these substances.

## **APPENDIX 4B**

### **Conceptual Site Model**

**LEGEND**

- |  |   |
|--|---|
| 1 Leachate concentration due to partitioning             | A Soil concentration at source ( $C_s$ )              |
| 2 Unsaturated zone contaminant fate and transport        | B Water use standard at point of compliance ( $C_x$ ) |
| 3 Mixing of leachate and groundwater flux at water table |   |
| 4 Saturated zone contaminant fate and transport          |   |

Schematic only.  
Not to scale.

## **APPENDIX 4C**

### **Model Default Site Conditions/Characteristics**

**Table 4C-1. Model default site conditions/characteristics**

Category	Parameter	Symbol	Unit	Default value
Source Dimensions/ Transport	Source length	X	m	10
	Source width	Y	m	30
	Source depth	Z	m	3
	Distance to point of compliance	x	m	10
Meteorology/ Hydrology	Precipitation rate	P	mm/yr	1,000
	Runoff + Evapotranspiration rate	RO+EV	mm/yr	450
	Infiltration rate	I	mm/yr	550
	Number of days of frozen ground	D <sub>fr</sub>	-	0
Soil/ Hydrogeology	Total porosity	n	-	0.36
	Water-filled porosity	n <sub>w</sub>	-	0.119
	Air-filled porosity	n <sub>a</sub>	-	0.241
	Effective porosity	n <sub>e</sub>	-	0.25
	Dry bulk density of soil	ρ <sub>b</sub>	g/cm <sup>3</sup>	1.7
	Fraction of organic carbon	f <sub>oc</sub>	-	0.005
	Hydraulic conductivity	K	m/s	3E-05
	Hydraulic gradient	i	m/m	0.008
	Depth to water table	d	m	3
	Aquifer thickness	d <sub>a</sub>	m	5
	pH of soil	pH <sub>soil</sub>	-	6.5
	pH of groundwater	pH <sub>water</sub>	-	6.5
Aquatic Receiving Environment	Water hardness	H	mg/L as CaCO <sub>3</sub>	200

## **APPENDIX 4D**

### **Model Component Equations**

**Exhibit 4D-1**  
**Solute transport in the saturated zone**

$$C(x, y, t) = \frac{C_{gw}}{4} \exp \left\{ \frac{x}{2\partial_x} \left[ 1 - \left( 1 + \frac{4\lambda_s \partial_x}{v'} \right)^{1/2} \right] \right\} \operatorname{erfc} \left[ \frac{x - v't \left( 1 + \frac{4\lambda_s \partial_x}{v'} \right)^{1/2}}{2(\partial_x v't)^{1/2}} \right] \\ * \left\{ \operatorname{erf} \left[ \frac{\left( y + \frac{Y}{2} \right)}{2(\partial_y x)^{1/2}} \right] - \operatorname{erf} \left[ \frac{\left( y - \frac{Y}{2} \right)}{2(\partial_y x)^{1/2}} \right] \right\}$$

$$\partial_x = 0.1x \text{ and } \partial_y = 0.1\partial_x$$

$$\lambda_s = \frac{\ln 2}{t_{1/2s}} \text{ where } \ln 2 = 0.6931$$

$$R_f = 1 + \frac{\rho_b}{n} K_d \text{ where } K_d = K_{oc} f_{oc}$$

$$V = K i$$

$$v = \frac{V}{n_e} = \frac{K i}{n_e}$$

$$v' = \frac{v}{R_f}$$

At steady-state conditions ( $t=\infty$ ), consolidating terms, and for maximum groundwater concentrations along the plume centreline ( $y=0$ ),  $C(x, y, t)$  reduces to:

$$C_x = C_{gw} \exp \left\{ \frac{x}{2\partial_x} \left[ 1 - \left( 1 + \frac{4\lambda_s \partial_x}{v'} \right)^{1/2} \right] \right\} \operatorname{erf} \left[ \frac{Y}{4(\partial_y x)^{1/2}} \right]$$

Solving for  $C_{gw}$ :

$$C_{gw} = \frac{C_x}{\exp \left\{ \frac{x}{2\partial_x} \left[ 1 - \left( 1 + \frac{4\lambda_s \partial_x}{v'} \right)^{1/2} \right] \right\} \operatorname{erf} \left[ \frac{Y}{4(\partial_y x)^{1/2}} \right]}$$

or

$$C_{gw} = \frac{C_x}{\exp \left\{ \frac{x}{2\partial_x} \left[ 1 - \left( 1 + \frac{4\lambda_s \partial_x R_f}{v} \right)^{1/2} \right] \right\} \operatorname{erf} \left[ \frac{Y}{4(\partial_y x)^{1/2}} \right]}$$

Where:

- $C_{gw}$  = groundwater concentration below source ( $\mu\text{g/L}$ )
- $C_x$  = water use standard at point of compliance ( $\mu\text{g/L}$ )
- $x$  = distance to point of compliance (m)
- $\partial_x$  = longitudinal dispersivity (m)
- $\partial_y$  = transverse dispersivity (m)
- $\lambda_s$  = biodegradation rate in saturated zone ( $\text{days}^{-1} \cdot 365 \text{ days/yr}$ )
- $t_{1/2s}$  = half-life in saturated zone (days)
- $R_f$  = retardation factor in saturated zone (dimensionless)
- $\rho_b$  = dry bulk density of soil ( $\text{g/cm}^3$ )
- $n$  = total porosity (dimensionless)
- $K_d$  = distribution coefficient (L/kg)
- $K_{oc}$  = organic carbon partitioning coefficient (L/kg)
- $f_{oc}$  = fraction of organic carbon (dimensionless 0.5%)
- $v'$  = retarded average linear groundwater velocity in saturated zone (m/yr)
- $v$  = average linear groundwater velocity in saturated zone (m/yr)
- $V$  = Darcy flux or specific discharge (m/yr)
- $n_e$  = effective porosity (dimensionless)
- $K$  = hydraulic conductivity ( $\text{m/s} \cdot 3.154 \times 10^7 \text{ s/yr}$ )
- $i$  = hydraulic gradient
- $Y$  = source width (m)

**Exhibit 4D-2**  
**Leachate/groundwater mixing**

$$C_z = C_{gw} * DF$$

$$DF = 1 + \left( \frac{d_m V}{X I} \right)$$

Note: DF = 1 if source extends into water table

$$I = P - (RO + EV)$$

Where:

- $C_z$  = leachate concentration at water table ( $\mu\text{g/L}$ )
- $C_{gw}$  = groundwater concentration below source ( $\mu\text{g/L}$ )
- DF = dilution factor (dimensionless)
- $d_m$  = mixing zone thickness (m) (Exhibit D-3)
- X = source length (m)
- I = infiltration rate (m/yr)
- P = precipitation rate (m/yr)
- RO+EV = runoff plus evapotranspiration rate (m/yr)
- V defined in Exhibit 4D-1

**Exhibit 4D-3**  
**Leachate/groundwater mixing – mixing zone thickness**

$$d_m = r + s = 0.1X + d_a \left[ 1 - \exp \left( - \frac{XI}{Vd_a} \right) \right]$$

$$r = 0.1X$$

$$s = d_a \left[ 1 - \exp \left( - \frac{XI}{Vd_a} \right) \right]$$

Note:  $d_m$  constrained to  $\leq d_a$

Where:

$r$  = depth of mixing due to vertical dispersivity (m)

$s$  = depth of mixing due to downward velocity of infiltrating water (m)

$d_a$  = aquifer thickness (m)

$d_m$  defined in Exhibit 4D-2

$X$  defined in Exhibit 4D-2

$I$  defined in Exhibit 4D-2

$V$  defined in Exhibit 4D-1

**Exhibit 4D-4**  
**Leachate transport in the unsaturated zone**

$$C_L = \frac{C_z}{\exp \left[ \frac{b}{2\partial_u} \left( 1 - \left( 1 + \frac{4\lambda_u \partial_u R_u}{v_u} \right)^{1/2} \right) \right]}$$

$$b = d - Z$$

$$\partial_u = 0.1b$$

$$\lambda_u = \frac{\ln 2}{t_{1/2u}} \left( 1 - \frac{D_{fr}}{365} \right) \text{ where } \ln 2 = 0.6931$$

$$R_u = 1 + \frac{\rho_b}{n_w} K_d$$

$$v_u = \frac{I}{n_w}$$

Where:

- $C_L$  = leachate concentration at source ( $\mu\text{g/L}$ )
- $b$  = vertical distance between base of source and water table (m)
- $d$  = depth to water table (m)
- $Z$  = source depth (m)
- $\partial_u$  = dispersivity in unsaturated zone (m)
- $\lambda_u$  = biodegradation rate in unsaturated zone ( $\text{days}^{-1} \times 365 \text{ days/yr}$ )
- $t_{1/2u}$  = half-life in unsaturated zone (days)
- $D_{fr}$  = number of days of frozen ground (days)
- $R_u$  = retardation factor in unsaturated zone (dimensionless)
- $n_w$  = water filled porosity (dimensionless)
- $v_u$  = leachate velocity in unsaturated zone (m/yr)
- $C_z$  defined in Exhibit 4D-2
- $I$  defined in Exhibit 4D-2
- $\rho_b$  defined in Exhibit 4D-1

**Exhibit 4D-5**  
**Soil/leachate partitioning**

$$C_s = \frac{C_L \left[ K_d + \left( \frac{n_w + H' n_a}{\rho_b} \right) \right]}{1000}$$

$$n_a = n - n_w$$

Where:

- $C_s$  = soil concentration at source ( $\mu\text{g/g}$ )
- $n_a$  = air filled porosity (dimensionless)
- $H'$  = dimensionless Henry's law constant
- 1000 = units conversion factor (1000  $\mu\text{g/mg}$ )
- $C_L$  defined in Exhibit 4D-4
- $K_d$  defined in Exhibit 4D-1
- $n_w$  defined in Exhibit 4D-4
- $n$  defined in Exhibit 4D-1
- $\rho_b$  defined in Exhibit 4D-1

### Exhibit 4D-6 Summary of model terms

Category	Parameter	Symbol	Unit	Default value
Source Dimensions/ Transport	Source length	X	m	10
	Source width	Y	m	30
	Source depth	Z	m	3
	Distance to point of compliance	x	m	10
Meteorology/ Hydrology	Precipitation rate	P	mm/yr	1,000
	Runoff + Evapotranspiration rate	RO+EV	mm/yr	450
	Infiltration rate	I	mm/yr	550
	Number of days of frozen ground	D <sub>fr</sub>	-	0
Soil/ Hydrogeology	Total porosity	n	-	0.36
	Water-filled porosity	n <sub>w</sub>	-	0.119
	Air-filled porosity	n <sub>a</sub>	-	0.241
	Effective porosity	n <sub>e</sub>	-	0.25
	Dry bulk density of soil	ρ <sub>b</sub>	g/cm <sup>3</sup>	1.7
	Fraction of organic carbon	f <sub>oc</sub>	-	0.005
	Hydraulic conductivity	K	m/s	3E-05
	Hydraulic gradient	i	m/m	0.008
	Depth to water table	d	m	3
	Aquifer thickness	d <sub>a</sub>	m	5
	pH of soil	pH <sub>soil</sub>	-	6.5
	pH of groundwater	pH <sub>water</sub>	-	6.5
Substance	Half-life in unsaturated zone	t <sub>1/2u</sub>	days	
	Half-life in saturated zone	t <sub>1/2s</sub>	days	
	Organic carbon partitioning coefficient	K <sub>oc</sub>	L/kg	
	Distribution coefficient	K <sub>d</sub>	L/kg	
	Dimensionless Henry's law constant	H'	-	
	Solubility limit (based on substance theoretical solubility)	S	μg/L	
Calculated	Vertical distance between base of source and water table	b	m	
	Mixing zone thickness	d <sub>m</sub>	m	
	Dilution factor	DF	-	
	Leachate velocity in unsaturated zone	v <sub>u</sub>	m/yr	
	Darcy flux or specific discharge	V	m/yr	
	Average linear groundwater velocity in saturated zone	v	m/yr	
	Retardation factor in unsaturated zone	R <sub>u</sub>	-	
	Retardation factor in saturated zone	R <sub>f</sub>	-	
	Dispersivity in unsaturated zone	δ <sub>u</sub>	m	
	Longitudinal dispersivity	δ <sub>x</sub>	m	
	Transverse dispersivity	δ <sub>y</sub>	m	
	Biodegradation rate in unsaturated zone	λ <sub>u</sub>	yr <sup>-1</sup>	
	Biodegradation rate in saturated zone	λ <sub>s</sub>	yr <sup>-1</sup>	

**Exhibit 4D-6**  
**Summary of model terms (cont'd)**

Category	Parameter	Symbol	Unit	Default value
Aquatic Receiving Environment	Water hardness	H	mg/L as CaCO <sub>3</sub>	200
Soil/Groundwater Concentrations	Water use standard at point of compliance	C <sub>x</sub>	µg/L	
	Groundwater concentration below source	C <sub>gw</sub>	µg/L	
	Leachate concentration at water table	C <sub>z</sub>	µg/L	
	Leachate concentration at source	C <sub>L</sub>	µg/L	
	Soil concentration at source	C <sub>s</sub>	µg/g	
	Background concentration in soil	C <sub>b</sub>	µg/g	
	Analytical method detection limit	C <sub>dl</sub>	µg/g	
	Soil standard (adjusted for detection limit, background concentration, and rounding)	C <sub>c</sub>	µg/g	

## **APPENDIX 4E**

### **Substance Properties**

Table 4E-1. Organics/inorganics

Substance	CAS #	Analytical Method Detection Limit <sup>1</sup> (µg/g)	Solubility Limit <sup>2</sup> S (mg/L)	H' (-)	K <sub>oc</sub> (L/kg)	Biodegradation Half-life Unsaturated Zone t <sub>1/2u</sub> (days)	Biodegradation Half-life Saturated Zone t <sub>1/2s</sub> (days)
anthracene	120-12-7		0.0217	0.00227	16,400	195	390
benzene	71-43-2		895	0.227	146	195	390
benzo(a)pyrene	50-32-8		8.1E-04	1.87E-05	587,000		
cyanide	57-12-5		47,700	0.989			
dichlorodiphenyltrichloroethane, total [DDT]	n/a		0.00275	3.40E-04	169,000		
diisopropanolamine [DIPA]	110-97-4		430,000	2.92E-09	10		
ethylbenzene	100-41-4		84.5	0.322	446	145	290
ethylene glycol	107-21-1	10	500,000	2.45E-06	1.00	105	210
fluoranthene	206-44-0		0.13	3.62E-04	55,500	115	230
mercury	7439-97-6		0.03	0.467			
methanol	67-56-1		500,000	1.86E-04	1.00	18	36
naphthalene	91-20-3		15.5	0.0180	1,540	175	350
nonylphenol and nonylphenol ethoxylates	84852-15-3		3.175	4.65E-05	25,000		
pentachlorophenol [PCP]	87-86-5		7	1.00E-06	Table 4E-2	383	767
perfluorooctane sulfonate [PFOS]	1763-23-1		0.025	0.449	71,700		
phenol	108-95-2		41,400	1.36E-05	187	265	530
sulfolane	126-33-0	0.1	500,000	1.98E-04	9.08		
tetrachloroethylene	127-18-4		103	0.724	94.9		
toluene	108-88-3		263	0.271	234	65	130
trichloroethylene	79-01-6		640	0.403	60.7		
xylene	1330-20-7		53	0.271	383	145	290

**Notes:**

<sup>1</sup> Analytical method detection limits only listed for those substances with calculated soil standards less than the detection limit.

<sup>2</sup> Solubility limit values represent 50% of substance theoretical solubility.

Table 4E-2. Organic carbon partitioning coefficient - Pentachlorophenol CAS# 87-86-5

Soil pH (-)	K <sub>oc</sub> (L/kg)	Soil pH (-)	K <sub>oc</sub> (L/kg)
4.9	9,050	7.0	521
5.0	7,960	7.1	496
5.1	6,930	7.2	476
5.2	5,970	7.3	461
5.3	5,100	7.4	447
5.4	4,320	7.5	437
5.5	3,650	7.6	429
5.6	3,070	7.7	423
5.7	2,580	7.8	418
5.8	2,180	7.9	414
5.9	1,840	8.0	410
6.0	1,560	8.1	408
6.1	1,330	8.2	406
6.2	1,150	8.3	404
6.3	998	8.4	403
6.4	877	8.5	402
6.5	781	8.6	401
6.6	703	8.7	400
6.7	640	8.8	400
6.8	592	8.9	400
6.9	552	9.0	399

**Table 4E-3. Distribution coefficients - Inorganics**

<b>Substance</b>	<b>CAS #</b>	<b>K<sub>d</sub> (L/kg)</b>
barium	7440-39-3	100
chloride ion	16887-00-6	0.05
cobalt	7440-48-4	45
cyanide	57-12-5	9.9
manganese	7439-96-5	65
mercury	7439-97-6	52
molybdenum	7439-98-7	20
sodium ion	17341-25-2	20
uranium	7440-61-1	450
vanadium	7440-62-2	1,000

Table 4E-4. Distribution coefficients – Inorganics, soil pH – K<sub>d</sub> isotherms

Soil pH (-)	K <sub>d</sub> (L/kg)					
	Arsenic CAS # 7440-38-2	Beryllium CAS # 7440-41-7	Cadmium CAS # 7440-43-9	Chromium hexavalent CAS # 18540-29-9	Chromium trivalent CAS # 16065-83-1	Copper CAS # 7440-50-8
4.9	25	23	15	31	1,200	39.8
5.0	25	26	17	31	1,900	50.1
5.1	25	28	19	30	3,000	63.1
5.2	26	31	21	29	4,900	79.4
5.3	26	35	23	28	8,100	100
5.4	26	38	25	27	13,000	126
5.5	26	42	27	27	21,000	158
5.6	26	47	29	26	35,000	219
5.7	27	53	31	25	55,000	302
5.8	27	60	33	25	87,000	417
5.9	27	69	35	24	130,000	575
6.0	27	82	37	23	200,000	794
6.1	27	99	40	23	300,000	1,150
6.2	28	120	42	22	420,000	1,660
6.3	28	160	44	22	580,000	2,400
6.4	28	210	48	21	770,000	3,470
6.5	28	280	52	20	990,000	5,010
6.6	28	390	57	20	1,200,000	6,310
6.7	29	550	64	19	1,500,000	7,940
6.8	29	790	75	19	1,800,000	10,000
6.9	29	1,100	91	18	2,100,000	12,600
7.0	29	1,700	110	18	2,500,000	15,800
7.1	29	2,500	150	17	2,800,000	17,800
7.2	30	3,800	200	17	3,100,000	20,000
7.3	30	5,700	280	16	3,400,000	22,400
7.4	30	8,600	400	16	3,700,000	25,100
7.5	30	13,000	590	16	3,900,000	25,100
7.6	31	20,000	870	15	4,100,000	25,100
7.7	31	30,000	1,300	15	4,200,000	25,100
7.8	31	46,000	1,900	14	4,300,000	25,100
7.9	31	69,000	2,900	14	4,300,000	25,100
8.0 to 9.0	31	100,000	4,300	14	4,300,000	25,100

Table 4E-4. Distribution coefficients – Inorganics, soil pH – K<sub>d</sub> isotherms (cont'd)

Soil pH (-)	K <sub>d</sub> (L/kg)			
	Lead CAS # 7439-92-1	Nickel CAS # 7440-02-0	Selenium CAS # 7782-49-2	Zinc CAS # 7440-66-6
4.9	398	16	18	16
5.0	501	18	17	18
5.1	631	20	16	19
5.2	794	22	15	21
5.3	1,000	24	14	23
5.4	1,260	26	13	25
5.5	1,580	28	12	26
5.6	2,190	30	11	28
5.7	3,020	32	11	30
5.8	4,170	34	9.8	32
5.9	5,750	36	9.2	34
6.0	7,940	38	8.6	36
6.1	11,500	40	8.0	39
6.2	16,600	42	7.5	42
6.3	24,000	45	7.0	44
6.4	34,700	47	6.5	47
6.5	50,100	50	6.1	51
6.6	63,100	54	5.7	54
6.7	79,400	58	5.3	58
6.8	100,000	65	5.0	62
6.9	126,000	74	4.7	68
7.0	158,000	88	4.3	75
7.1	178,000	110	4.1	83
7.2	200,000	140	3.8	95
7.3	224,000	180	3.5	110
7.4	251,000	250	3.3	130
7.5	251,000	350	3.1	160
7.6	251,000	490	2.9	190
7.7	251,000	700	2.7	240
7.8	251,000	990	2.5	310
7.9	251,000	1,400	2.4	400
8.0 to 9.0	251,000	1,900	2.2	530

**Table 4E-5. Background concentrations in soil (inorganics)**

Substance	CAS #	Background Concentration in Soil (µg/g)
arsenic	7440-38-2	10
barium	7440-39-3	300
beryllium	7440-41-7	1
cadmium	7440-43-9	1
chromium	7440-47-3	60
cobalt	7440-48-4	25
copper	7440-50-8	75
lead	7439-92-1	120
manganese	7439-96-5	2,000
mercury	7439-97-6	0.2
molybdenum	7439-98-7	3
nickel	7440-02-0	70
selenium	7782-49-2	1
vanadium	7440-62-2	100
zinc	7440-66-6	150

**Reference source:**

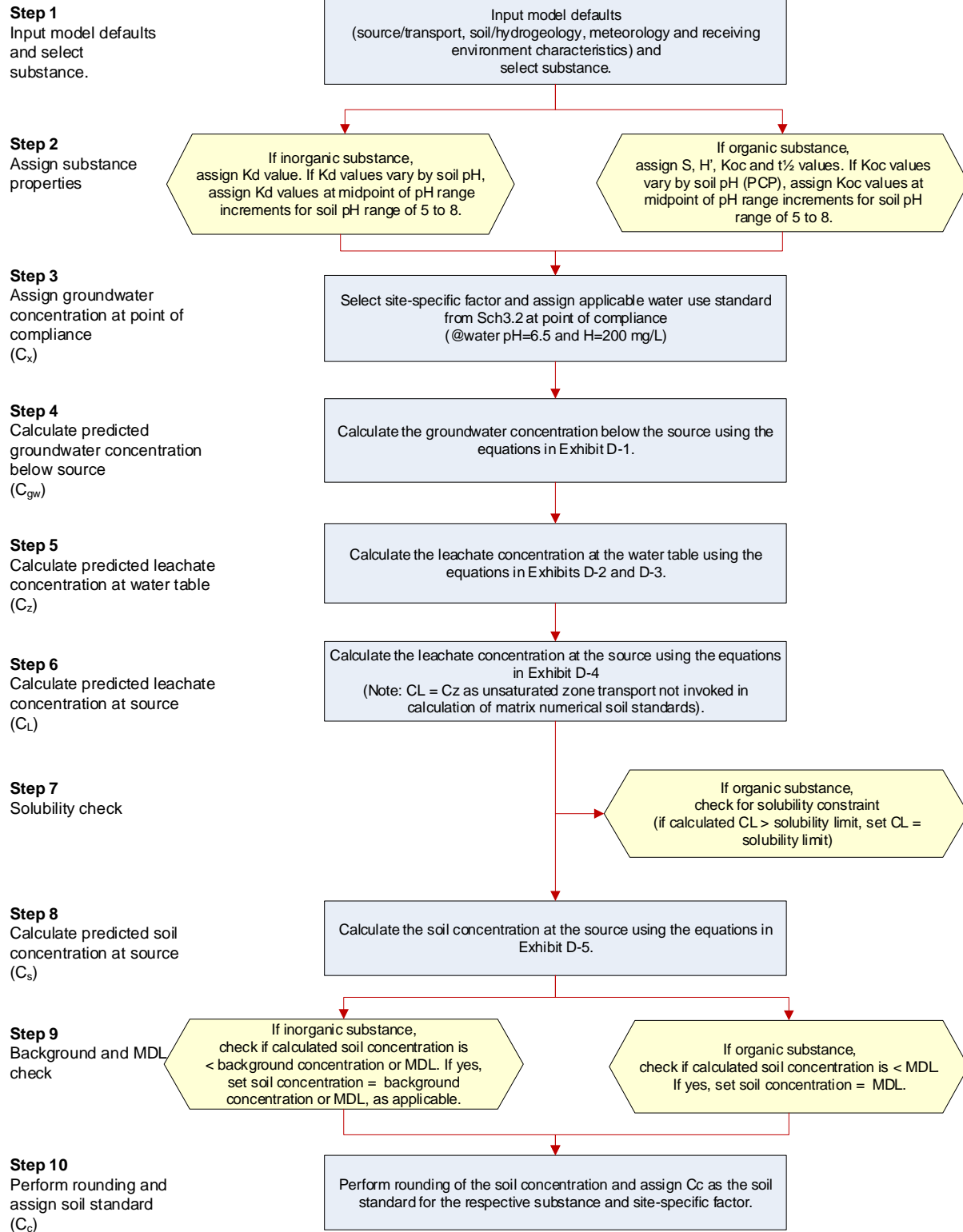
Chapter 9 of [Protocol 28, "2016 Standards Derivation Methods"](#).

## **APPENDIX 4F**

### **Soil Standards Calculation Methodology Flowchart**

**FIGURE F-1. Matrix Numerical Soil Standards Calculation Flowchart.**

(Note: This flowchart is provided for illustrative purposes only. The process description in section 4.4 takes precedence over this flowchart).



## **APPENDIX 4G**

### **Example Matrix Numerical Soil Standards Calculations**

**Table 4G-1. Example matrix numerical soil standards calculations, zinc – groundwater used for irrigation water use**

Soil pH range	Soil pH value used for K <sub>d</sub> selection (rounded midpoint value)	Water pH value used for water use standard selection (same as soil pH value)	K <sub>d</sub> based on soil pH value (L/kg) (from Table 4E-4, Appendix 4E)	Irrigation water use standard based on water pH value (µg/L) (from CSR Schedule 3.2 @ H=200 mg/L)	Calculated soil standard (before adjustments*)	Calculated soil standard (after adjustments*)	Final matrix numerical soil standard soil pH range (after consolidation of pH ranges)	Final matrix numerical soil standard (after consolidation of pH ranges)
< 5.0	5.0	5.0	18	1,000	59.75	150**		
5.0 - < 5.5	5.3	5.3	23	1,000	76.29	150**		
5.5 - < 6.0	5.8	5.8	32	1,000	106.05	150**	< 6.0	150
6.0 - < 6.5	6.3	6.3	44	2,000	291.47	300	6.0 - < 6.5	300
6.5 - < 7.0	6.8	6.8	62	2,000	410.51	400	6.5 - < 7.0	400
7.0 - < 7.5	7.3	7.3	110	5,000	1,819.92	2,000	7.0 - < 7.5	2,000
7.5 - < 8.0	7.8	7.8	310	5,000	5,126.77	5,000	7.5 - < 8.0	5,000
≥ 8.0	8.0	8.0	530	5,000	8,764.29	9,000	≥ 8.0	9,000

**Notes:**

\* adjustments include, as applicable:

background concentration in soil (from Table 4E-5, Appendix 4E);  
analytical method detection limit (from Table 4E-1, Appendix 4E); and,  
rounding (always completed).

\*\* adjusted to background concentration in soil.

Table 4G-2. Example matrix numerical soil standards calculations, pentachlorophenol – groundwater flow to surface water used by aquatic life

Soil pH range	Soil pH value used for $K_d$ selection (rounded midpoint value)	Water pH value used for water use standard selection (same as soil pH value)	$K_{oc}$ based on soil pH value (L/kg) (from Table 4E-2, Appendix 4E)	Irrigation water use standard based on water pH value ( $\mu\text{g/L}$ ) (from Technical Guidance 9 @ $H=200 \text{ mg/L}$ , $T \geq 20^\circ\text{C}$ )	Calculated soil standard (before adjustments*)	Calculated soil standard (after adjustments*)	Final matrix numerical soil standard soil pH range (after consolidation of pH ranges)	Final matrix numerical soil standard (after consolidation of pH ranges)
< 5.0	5.0	5.0	7,960	1	279.09**	300**	< 5.0	300
5.0 - < 5.5	5.3	5.3	5,100	1	159.36	150	5.0 - < 5.5	150
5.5 - < 6.0	5.8	5.8	2,180	1	2.11	2	5.5 - < 6.0	2
6.0 - < 6.5	6.3	6.3	998	1.5	0.23	0.25	6.0 - < 6.5	0.25
6.5 - < 7.0	6.8	6.8	592	2.5	0.1	0.1	$\geq 6.5$	0.1
7.0 - < 7.5	7.3	7.3	461	3.5	0.088	0.09		
7.5 - < 8.0	7.8	7.8	418	6	0.12	0.1		
$\geq 8.0$	8.0	8.0	410	6	0.12	0.1		

**Notes:**

\* adjustments include, as applicable:

background concentration in soil (none for pentachlorophenol);  
analytical method detection limit (from Table 4E-1, Appendix 4E); and,  
rounding (always completed).

\*\* calculated soil standard is constrained to the solubility limit.

## **APPENDIX 4H**

**Substances/Pathways for which Matrix Numerical Soil Standards  
are not Calculated/Provided**

Table 4H-1. Substances/pathways for which matrix numerical soil standards are not calculated/provided

Substance	Chemical Abstract Service # (CAS)	Substance Type	Pathway/Site-specific Factor			
			DW	AW	LW	IW
anthracene	120-12-7	organic	NS	NS	NS	NS
arsenic	7440-38-2	inorganic				
barium	7440-39-3	inorganic			NS	NS
benzene	71-43-2	organic			NS	NS
benzo(a)pyrene	50-32-8	organic	NS	NS	NS	NS
beryllium	7440-41-7	inorganic				
cadmium	7440-43-9	inorganic				
chloride ion	16887-00-6	inorganic				
chromium, hexavalent	18540-29-9	inorganic				
chromium, trivalent	16065-83-1	inorganic				
cobalt	7440-48-4	inorganic				
copper	7440-50-8	inorganic				
cyanide	57-12-5	inorganic			NS	NS
dichlorodiphenyltrichloro-ethane, total [DDT]	n/a	organic	NS	NS	NS	NS
diisopropanolamine [DIPA]	110-97-4	organic				
ethylbenzene	100-41-4	organic			NS	NS
ethylene glycol	107-21-1	organic			NS	NS
fluoranthene	206-44-0	organic	NS	NS	NS	NS
lead	7439-92-1	inorganic				
manganese	7439-96-5	inorganic		NS	NS	
mercury	7439-97-6	inorganic	NS	NS	NS	NS
methanol	67-56-1	organic		NS	NS	NS
molybdenum	7439-98-7	inorganic				
naphthalene	91-20-3	organic			NS	NS
nickel	7440-02-0	inorganic				
nonylphenol and nonylphenol ethoxylates	84852-15-3	organic			NS	NS
pentachlorophenol [PCP]	87-86-5	organic				NS
perfluorooctane sulfonate [PFOS]	1763-23-1	organic			NS	NS
phenol	108-95-2	organic			NS	NS
selenium	7782-49-2	inorganic				

sodium ion	17341-25-2	inorganic		NS	NS	NS
sulfolane	126-33-0	organic				
tetrachloroethylene	127-18-4	organic			NS	NS
toluene	108-88-3	organic			NS	NS
trichloroethylene	79-01-6	organic				NS
uranium	7440-61-1	inorganic				
vanadium	7440-62-2	inorganic		NS		
xylene	1330-20-7	organic			NS	NS
zinc	7440-66-6	inorganic				

**Notes:**

NS – indicates no soil standard calculated.

Yellow shaded cell - indicates soil standard calculated.

Blank white cell – indicates no soil standard provided.

Not included in Table 4H-1: Polychlorinated biphenyls, total [PCBs] and polychlorinated dioxins and furans, total [PCDDs and PCDFs] as no standards are calculated for these substances.

## Chapter 5. Derivation of Generic Water Use Standards

### 5.1 Introduction

The CSR contains water standards for the protection of four water uses: aquatic life, irrigation water, livestock water and drinking water. This chapter describes the derivation methods for generic numerical water standards prescribed in CSR Schedule 3.2.

### 5.2 Standards derivation procedures

#### 5.2.1 Aquatic life water use

Aquatic life standards in the CSR are derived by adoption of guidelines from other jurisdictions and provide a protection level lesser than, or equal to, a 20% effect level (i.e., EC<sub>20</sub>).

Most aquatic life standards are established by applying a 10-fold multiplier to a water quality guideline (WQG) for a given substance adopted from one of the following sources:

1. British Columbia Ministry of Environment and Climate Change Strategy, [Approved and Working Water Quality Guidelines](#);
2. Canadian Council for Ministers of the Environment (CCME), [Canadian Environmental Quality Guidelines](#) (CEQGs); and
3. Environment and Climate Change Canada, [Federal Environmental Quality Guidelines \(FEQGs\)](#).

The 10-fold multiplier assumes that there is a minimum 10 m distance and a greater than 10:1 dilution available before contamination enters a body of water where aquatic life resides or prior to contamination crossing the property boundary of the contaminated site.

The following aquatic life water use standards are derived by the ministry using alternate methods, such as but not limited to the adoption of specific or modified concentrations from equations or tables in the BC Approved and Working Water Quality Guidelines:

- ammonia (Appendix 5, Table 5A-1, 5A-2)
- cadmium;
- chlorophenols (Appendix 5, Table 5A-3)
- non-chlorinated phenols;
- VPH<sub>w</sub>, LEPH<sub>w</sub>, and EPH<sub>w10-19</sub>;
- [Protocol 10, “Hardness Dependent Site-Specific Freshwater Water Standard for Zinc” – zinc](#).

Notes on aquatic life water use standards:

- Ministry WQGs are preferentially selected for calculating the aquatic life water standard unless a CEQG or FEQG WQG is considered to be more robust or applicable to contaminated sites in BC.
- Where a maximum concentration and 30-day average WQG was available, the 30-day average WQG was used in the calculation of the aquatic life water use standard in order to be protective of chronic exposures.
- If a WQG is intended for use in only one type of water (freshwater or marine water), then the WQG is adopted and a footnote is applied to the aquatic life water use standard to indicate this information. Unless otherwise indicated, aquatic life water use standards are to protect freshwater and marine life.
- Measurement of either total or dissolved sulfide (as H<sub>2</sub>S) may be used to demonstrate compliance with the sulfide standard. Where the standards cannot be met by measuring total or dissolved sulfide (as H<sub>2</sub>S), determination of un-ionized sulfide (as H<sub>2</sub>S) may be necessary.
- To demonstrate compliance with the aquatic life standard, samples for cyanide in water must be analyzed using the appropriate “Cyanide Weak Acid Dissociable (WAD)” analytical method for water specified in the British Columbia Environmental Laboratory Manual.
- Aquatic life water use standards are rounded as per the rounding rule (see Chapter 10).

### 5.2.2 Irrigation water use and livestock water use

Irrigation water use and livestock water use standards are set by adoption of a WQG from one of the following sources:

1. BC Ministry of Environment and Climate Change Strategy, [Approved and Working Water Quality Guidelines](#); and
2. CCME, [CEQGs](#).

Notes on irrigation water use and livestock water use standards:

- Ministry WQGs are preferentially selected unless a CCME WQG is considered more robust or applicable to contaminated sites in BC.
- Irrigation water use and livestock water use standards are not rounded.

### 5.2.3 Drinking water

Drinking water standards are set by either adoption of a drinking water guideline from another jurisdiction or *de novo* derivation of a drinking water standard by the ministry. The source of each drinking water use standard is identified by a footnote in CSR Schedule 3.2.

### 5.2.3.1 *Adoption of drinking water guidelines as standards*

Drinking water standards are set by adoption of a drinking water guideline from one of the following sources (in hierarchical order):

1. Health Canada, [Guidelines for Canadian Drinking Water Quality](#);
2. BC Ministry of Environment and Climate Change Strategy, [Approved Water Quality Guidelines: Drinking Water Sources](#);
3. US EPA, 2015 [Regional Screening Levels](#) for resident tapwater (total risk 1E-06, total hazard quotient 1.0);
4. BC Ministry of Health, Drinking Water Guidelines;
5. US EPA, *Safe Drinking Water Act*, [National Primary Drinking Water Regulations](#); and
6. World Health Organization, [Guidelines for Drinking Water Quality](#).

Notes on drinking water use standards based on adopted guidelines:

- Maximum allowable concentrations are preferentially selected over aesthetic (taste and odour) objectives, if both types of guidelines are available.
- All standards adopted from the US EPA RSL are adjusted for 20% apportionment to the drinking water route of exposure. Carcinogenic substances are additionally adjusted to reflect the CSR 18 (3)(a) human lifetime exposure cancer risk of less than or equal to one in 100,000. US EPA Regional Screening Levels that are adopted and subsequently adjusted are rounded as per the rounding rule (see Chapter 10). Substances for which the standard has been adopted from the US EPA RSL are listed in Appendix 5B.
- The standards for some substances are specifically adopted from the 2014 Health Canada “Guidelines for Canadian Drinking Water Quality.” These substances are listed in Appendix 5B.
- Drinking water guidelines adopted from Health Canada, the Province of BC, the US EPA, and the World Health Organization as standards are not rounded or adjusted.
- To demonstrate compliance with the drinking water standard, samples for cyanide in water must be analyzed using the appropriate “Cyanide Strong Acid Dissociable (SAD)” analytical method for water specified in the British Columbia Environmental Laboratory Manual.
- Measurement of either total or dissolved sulfide (as H<sub>2</sub>S) may be used to demonstrate compliance with the sulfide standard. Where the standards cannot be met by measuring total or dissolved sulfide (as H<sub>2</sub>S), determination of un-ionized sulfide (as H<sub>2</sub>S) may be necessary.
- The standard for molybdenum is set equal to the 1986 British Columbia Ministry of Environment drinking water quality guideline for the substance.

- The standard for selenium is set equal to the 2014 British Columbia Ministry of Environment drinking water quality guideline for the substance.
- For the following substances, the standard is set equal to the 2016 British Columbia Environmental Laboratory Technical Advisory Committee reference analytical detection limit:
  - acrolein
  - acrylonitrile
  - benzidine
  - benzotrichloride
  - bromo-2-chloroethane, 1-
  - butadiene, 1,3-
  - chlorobenzotrichloride, 4-
  - crotonaldehyde, trans-
  - dibenz(a,h)anthracene
  - dibromo-3-chloropropane, 1,2-
  - dibromoethane, 1,2-
  - dimethylbenz(a)anthracene, 7,12-
  - ethyleneimine
  - methacrylonitrile
  - methylcholanthrene, 3-
  - nitrosodiethylamine, N-[NDEA]
  - phenol, 2-methyl-4,6-dinitro [DNOC]
  - tetraethyl lead
  - thiocyanate
  - trichloropropane, 1,2,3-

#### 5.2.3.2 *De novo derivation of drinking water use standards*

Drinking water standards are derived by the ministry for priority substances and those substance having only aesthetic-based drinking water guidelines available. TRVs are listed in Chapter 8 and the derivation uses the following equation, receptor characteristics and exposure assumptions.

Drinking water use standards for non-carcinogenic substances are derived by:

$$GWS = \frac{(TRV \times CF \times BW \times AF)}{IR}$$

Where:	GWS	Generic Water Standard (µg/L)
	TRV	Toxicity Reference Value (chronic oral Reference Dose) (mg/kg bw/day)
	CF	Conversion Factor (µg/mg) = 1000
	BW	Body Weight, adult (kg) = 70.7
	AF	Allocation Factor = 20%
	IR	Ingestion Rate of water, adult (L/day) = 1.5

Drinking water use standards for carcinogenic substances are derived by:

$$GWS = \frac{AR \times BW \times IR \times CF}{SF}$$

Where:	GWS	Generic Water Standard (µg/L)
	AR	Acceptable Risk level = $1 \times 10^{-5}$
	BW	Body Weight, adult (kg) = 70.7
	IR	Ingestion Rate of water, adult (L/day) = 1.5
	CF	Conversion Factor (µg/mg) = 1000
	SF	Slope Factor (1/(mg/kg bw/day))

Similar to the final standards setting procedure followed for soil standards (Chapter 2), *de novo* derived drinking water standards include the consideration that carcinogenic substances may elicit both non-carcinogenic and carcinogenic toxic effects, and are therefore set as follows:

- a. A substance is evaluated for its relevant carcinogenic and non-carcinogenic endpoints. The carcinogenicity classification of the US EPA [Regional Screening Levels](#) is used for substances with drinking water standards adopted from the US EPA Regional Screening Levels. Otherwise, [Protocol 30 "Classifying Substances as Carcinogenic"](#) is used.
- b. Where appropriate TRVs are available, both the non-carcinogenic and carcinogenic toxic endpoint-based standards are calculated for the substance.
- c. The most stringent of the calculated carcinogenic or non-carcinogenic standard is developed as the drinking water standard for the substance.

Drinking water use standards derived by the ministry are rounded as per the rounding rule (see Chapter 10).

## **APPENDIX 5A**

### **Aquatic Life Water Standards Dependent on Water Chemistry**

**Table 5A-1. Freshwater Aquatic Life Standards for Ammonia (µg/L)**

	Temperature (°C)										
<b>pH</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>	<b>19</b>	<b>20</b>
<b>≥ 8.5</b>	1310	1320	1320	1330	1340	1350	1280	1210	1140	1080	1020
<b>8.0 - &lt; 8.5</b>	3700	3690	3670	3660	3660	3650	3410	3180	2980	2780	2610
<b>7.5 - &lt; 8.0</b>	11 300	11 200	11 100	11 000	11 000	10 900	10 200	9440	8780	8180	7620
<b>7.0 - &lt; 7.5</b>	18 500	18 300	18 200	18 100	18 000	17 800	16 600	15 400	14 300	13 300	12 300
<b>&lt; 7.0</b>	18 400	18 300	18 100	18 000	17 900	17 700	16 400	15 300	14 200	13 200	12 200

Table 5A-2. Marine Aquatic Life Standards for Ammonia (µg/L)

Salinity (PSU)	pH	Temperature (°C)					
		0	5	10	15	20	25
10	≥ 8.5	4400	3100	2300	1700	1300	1000
	8.0 - < 8.5	14 000	9750	6850	4650	3400	2450
	7.5 - < 8.0	41 000	29 000	20 000	14 000	9700	6900
	7.0 - < 7.5	135 000	96 000	64 000	43 500	30 500	21 500
	< 7.0	410 000	290 000	200 000	140 000	94 000	66 000
20	≥ 8.5	4700	3400	2400	1800	1300	1000
	8.0 - < 8.5	14 500	9900	7000	5000	3600	2500
	7.5 - < 8.0	44 000	30 000	21 000	15 000	10 000	7200
	7.0 - < 7.5	145 000	97 500	67 000	45 000	33 000	22 000
	< 7.0	440 000	300 000	210 000	140 000	97 000	66 000
30	≥ 8.5	5000	3400	2600	1900	1400	1100
	8.0 - < 8.5	15 500	10 700	7450	5150	3700	2650
	7.5 - < 8.0	47 000	31 000	22 000	16 000	11 000	7500
	7.0 - < 7.5	155 000	105 500	71 500	48 000	36 000	23 500
	< 7.0	470 000	310 000	220 000	150 000	110 000	72 000

Table 5A-3. Aquatic Life Standards for Chlorophenol Isomers ( $\mu\text{g/L}$ )<sup>1</sup>

Temperature (°C)	Chlorophenol isomer	Chemical Abstract Service # (CAS)	pH							
			<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2–8.6	8.7–9.1	>9.1
0 – 4.5	chlorophenol, 2-	95-57-8	78	128	220	340	580	960	1580	2600
	chlorophenol, 3-	108-43-0	68	112	186	300	500	840	1400	2300
	chlorophenol, 4-	106-48-9	34	58	96	156	260	440	720	1180
	dichlorophenol, 2,3-	576-24-9	22	36	62	102	166	280	460	760
	dichlorophenol, 2,4-	120-83-2	12	20	32	52	86	144	240	400
	dichlorophenol, 2,5-	583-78-8	10	16	28	46	74	124	200	340
	dichlorophenol, 2,6-	87-65-0	40	66	110	182	300	500	820	1360
	dichlorophenol, 3,4-	95-77-2	12	20	32	54	88	148	240	400
	dichlorophenol, 3,5-	591-35-5	10	14	24	40	68	112	184	300
	trichlorophenol, 2,3,4-	15950-66-0	10	16	26	44	72	120	198	320
	trichlorophenol, 2,3,5-	933-78-8	10	16	26	44	74	122	200	340
	trichlorophenol, 2,3,6-	933-75-5	32	52	88	144	240	400	660	1080
	trichlorophenol, 2,4,5-	95-95-4	10	14	24	40	66	112	184	300
	trichlorophenol, 2,4,6-	88-06-02	24	38	64	106	176	300	480	800
	trichlorophenol, 3,4,5-	609-19-8	4	6	10	18	28	48	78	128
	tetrachlorophenol, 2,3,4,5-	4901-51-3	8	12	20	34	56	94	156	260
	tetrachlorophenol, 2,3,4,6-	58-90-2	22	36	58	98	160	260	440	720
	tetrachlorophenol, 2,3,5,6-	935-95-5	10	16	26	44	72	122	200	340
	pentachlorophenol [PCP]	87-86-5	4	6	10	14	24	40	68	110
5.0 – 9.5	chlorophenol, 2-	95-57-8	58.5	96.0	165.0	255.0	435.0	720.0	1185.0	1950.0
	chlorophenol, 3-	108-43-0	51.0	84.0	139.5	225.0	375.0	630.0	1050.0	1725.0
	chlorophenol, 4-	106-48-9	25.5	43.5	72.0	117.0	195.0	330.0	540.0	885.0
	dichlorophenol, 2,3-	576-24-9	16.5	27.0	46.5	76.5	124.5	210.0	345.0	570.0
	dichlorophenol, 2,4-	120-83-2	9.0	15.0	24.0	39.0	64.5	108.0	180.0	300.0
	dichlorophenol, 2,5-	583-78-8	7.5	12.0	21.0	34.5	55.5	93.0	150.0	255.0
	dichlorophenol, 2,6-	87-65-0	30.0	49.5	82.5	136.5	225.0	375.0	615.0	1020.0

Temperature (°C)	Chlorophenol isomer	Chemical Abstract Service # (CAS)	pH							
			<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2–8.6	8.7–9.1	>9.1
5.0 – 9.5	dichlorophenol, 3,4-	95-77-2	9.0	15.0	24.0	40.5	66.0	111.0	180.0	300.0
	dichlorophenol, 3,5-	591-35-5	7.5	10.5	18.0	30.0	51.0	84.0	138.0	225.0
	trichlorophenol, 2,3,4-	15950-66-0	7.5	12.0	19.5	33.0	54.0	90.0	148.5	240.0
	trichlorophenol, 2,3,5-	933-78-8	7.5	12.0	19.5	33.0	55.5	91.5	150.0	255.0
	trichlorophenol, 2,3,6-	933-75-5	24.0	39.0	66.0	108.0	180.0	300.0	495.0	810.0
	trichlorophenol, 2,4,5-	95-95-4	7.5	10.5	18.0	30.0	49.5	84.0	138.0	225.0
	trichlorophenol, 2,4,6-	88-06-02	18.0	28.5	48.0	79.5	132.0	225.0	360.0	600.0
	trichlorophenol, 3,4,5-	609-19-8	3.0	4.5	7.5	13.5	21.0	36.0	58.5	96.0
	tetrachlorophenol, 2,3,4,5-	4901-51-3	6.0	9.0	15.0	25.5	42.0	70.5	117.0	195.0
	tetrachlorophenol, 2,3,4,6-	58-90-2	16.5	27.0	43.5	73.5	120.0	195.0	330.0	540.0
	tetrachlorophenol, 2,3,5,6-	935-95-5	7.5	12.0	19.5	33.0	54.0	91.5	150.0	255.0
	pentachlorophenol [PCP]	87-86-5	3.0	4.5	7.5	10.5	18.0	30.0	51.0	82.5
10.0 – 14.5	chlorophenol, 2-	95-57-8	39	64	110	170	290	480	790	1300
	chlorophenol, 3-	108-43-0	34	56	93	150	250	420	700	1150
	chlorophenol, 4-	106-48-9	17	29	48	78	130	220	360	590
	dichlorophenol, 2,3-	576-24-9	11	18	31	51	83	140	230	380
	dichlorophenol, 2,4-	120-83-2	6	10	16	26	43	72	120	200
	dichlorophenol, 2,5-	583-78-8	5	8	14	23	37	62	100	170
	dichlorophenol, 2,6-	87-65-0	20	33	55	91	150	250	410	680
	dichlorophenol, 3,4-	95-77-2	6	10	16	27	44	74	120	200
	dichlorophenol, 3,5-	591-35-5	5	7	12	20	34	56	92	150
	trichlorophenol, 2,3,4-	15950-66-0	5	8	13	22	36	60	99	160
	trichlorophenol, 2,3,5-	933-78-8	5	8	13	22	37	61	100	170
	trichlorophenol, 2,3,6-	933-75-5	16	26	44	72	120	200	330	540
	trichlorophenol, 2,4,5-	95-95-4	5	7	12	20	33	56	92	150
	trichlorophenol, 2,4,6-	88-06-02	12	19	32	53	88	150	240	400
	trichlorophenol, 3,4,5-	609-19-8	2	3	5	9	14	24	39	64
	tetrachlorophenol, 2,3,4,5-	4901-51-3	4	6	10	17	28	47	78	130

Temperature (°C)	Chlorophenol isomer	Chemical Abstract Service # (CAS)	pH							
			<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2–8.6	8.7–9.1	>9.1
10.0 – 14.5	tetrachlorophenol, 2,3,4,6-	58-90-2	11	18	29	49	80	130	220	360
	tetrachlorophenol, 2,3,5,6-	935-95-5	5	8	13	22	36	61	100	170
	pentachlorophenol [PCP]	87-86-5	2	3	5	7	12	20	34	55
15.0 – 19.5	chlorophenol, 2-	95-57-8	29.25	48	82.5	127.5	217.5	360	592.5	975
	chlorophenol, 3-	108-43-0	25.5	42	69.75	112.5	187.5	315	525	862.5
	chlorophenol, 4-	106-48-9	12.75	21.75	36	58.5	97.5	165	270	442.5
	dichlorophenol, 2,3-	576-24-9	8.25	13.5	23.25	38.25	62.25	105	172.5	285
	dichlorophenol, 2,4-	120-83-2	4.5	7.5	12	19.5	32.25	54	90	150
	dichlorophenol, 2,5-	583-78-8	3.75	6	10.5	17.25	27.75	46.5	75	127.5
	dichlorophenol, 2,6-	87-65-0	15	24.75	41.25	68.25	112.5	187.5	307.5	510
	dichlorophenol, 3,4-	95-77-2	4.5	7.5	12	20.25	33	55.5	90	150
	dichlorophenol, 3,5-	591-35-5	3.75	5.25	9	15	25.5	42	69	112.5
	trichlorophenol, 2,3,4-	15950-66-0	3.75	6	9.75	16.5	27	45	74.25	120
	trichlorophenol, 2,3,5-	933-78-8	3.75	6	9.75	16.5	27.75	45.75	75	127.5
	trichlorophenol, 2,3,6-	933-75-5	12	19.5	33	54	90	150	247.5	405
	trichlorophenol, 2,4,5-	95-95-4	3.75	5.25	9	15	24.75	42	69	112.5
	trichlorophenol, 2,4,6-	88-06-02	9	14.25	24	39.75	66	112.5	180	300
	trichlorophenol, 3,4,5-	609-19-8	1.5	2.25	3.75	6.75	10.5	18	29.25	48
	tetrachlorophenol, 2,3,4,5-	4901-51-3	3	4.5	7.5	12.75	21	35.25	58.5	97.5
	tetrachlorophenol, 2,3,4,6-	58-90-2	8.25	13.5	21.75	36.75	60	97.5	165	270
	tetrachlorophenol, 2,3,5,6-	935-95-5	3.75	6	9.75	16.5	27	45.75	75	127.5
	pentachlorophenol [PCP]	87-86-5	1.5	2.25	3.75	5.25	9	15	25.5	41.25
20.0 - > 20.0	chlorophenol, 2-	95-57-8	19.5	32	55	85	145	240	395	650
	chlorophenol, 3-	108-43-0	17	28	46.5	75	125	210	350	575
	chlorophenol, 4-	106-48-9	8.5	14.5	24	39	65	110	180	295
	dichlorophenol, 2,3-	576-24-9	5.5	9	15.5	25.5	41.5	70	115	190
	dichlorophenol, 2,4-	120-83-2	3	5	8	13	21.5	36	60	100
	dichlorophenol, 2,5-	583-78-8	2.5	4	7	11.5	18.5	31	50	85

Temperature (°C)	Chlorophenol isomer	Chemical Abstract Service # (CAS)	pH							
			<6.2	6.2–6.6	6.7–7.1	7.2–7.6	7.7–8.1	8.2–8.6	8.7–9.1	>9.1
	dichlorophenol, 2,6-	87-65-0	10	16.5	27.5	45.5	75	125	205	340
	dichlorophenol, 3,4-	95-77-2	3	5	8	13.5	22	37	60	100
	dichlorophenol, 3,5-	591-35-5	2.5	3.5	6	10	17	28	46	75
	trichlorophenol, 2,3,4-	15950-66-0	2.5	4	6.5	11	18	30	49.5	80
	trichlorophenol, 2,3,5-	933-78-8	2.5	4	6.5	11	18.5	30.5	50	85
	trichlorophenol, 2,3,6-	933-75-5	8	13	22	36	60	100	165	270
	trichlorophenol, 2,4,5-	95-95-4	2.5	3.5	6	10	16.5	28	46	75
	trichlorophenol, 2,4,6-	88-06-02	6	9.5	16	26.5	44	75	120	200
	trichlorophenol, 3,4,5-	609-19-8	1	1.5	2.5	4.5	7	12	19.5	32
	tetrachlorophenol, 2,3,4,5-	4901-51-3	2	3	5	8.5	14	23.5	39	65
	tetrachlorophenol, 2,3,4,6-	58-90-2	5.5	9	14.5	24.5	40	65	110	180
	tetrachlorophenol, 2,3,5,6-	935-95-5	2.5	4	6.5	11	18	30.5	50	85
	pentachlorophenol [PCP]	87-86-5	1	1.5	2.5	3.5	6	10	17	27.5

1. The above tables may only be used if measured values of isomer concentrations, water pH, and temperature are known for the site.

## **Appendix 5B**

**Substances with Drinking Water Standards sourced from US EPA RSL (2015) and  
Health Canada (2014)**

**Table 5B-1: Substances for which the 2015 US EPA RSL for tapwater was adopted as a standard**

acenaphthene	diflubenzuron	naphthalene
acephate	diisobutylene	naphthylamine, 2-
acetochlor	dimethipin	napropamide
acetone	dimethoxybenzidine, 3,3'-	nickel
acetophenone	dimethyl methylphosphonate	nitroaniline, 2-
acrylamide	dimethylaminoazobenzene, 4- [DAB]	nitroaniline, 4-
acrylic acid	dimethylaniline, 2,4-	nitrobenzene
acrylonitrile	dimethylaniline, N,N- [DMA]	nitrofurazone
adipic acid	dimethylbenz(a)anthracene, 7,12-	nitroglycerin
alachlor	dimethylbenzidine, 3,3'-	nitroguanidine
aldicarb	dimethylformamide	nitropyrene, 4-
aldicarb sulfone	dimethylhydrazine, 1,1-	nitrosodiethanolamine, N-
aldrin	dimethylphenol, 2,4-	nitrosodiethylamine, N- [NDEA]
allyl alcohol	dimethylphenol, 2,6-	nitroso-di-N-butylamine, N-
allyl chloride	dimethylphenol, 3,4-	nitroso-di-N-propylamine, N-
ametryn	dimethylterephthalate	nitrosodiphenylamine, N-
aminobiphenyl, 4-	dinitrobenzene, 1,2-	nitrosomethylethylamine, N-
aminophenol, 3-	dinitrobenzene, 1,3-	nitrosomorpholine, N-
aminophenol, 4-	dinitrobenzene, 1,4-	nitrosopiperidine, N-
amitraz	dinitro-o-cyclohexyl phenol, 4,6-	nitrosopyrrolidine, N-
aniline	dinitrophenol, 2,4-	nitrotoluene, 2-
anthracene	dinitrotoluene, 2,4-	nitrotoluene, 3-
anthraquinone, 9,10-	dinitrotoluene, 2,6-	nitrotoluene, 4-
aramite	dinitrotoluene, 2-amino-4,6-	nonane, n-
asulam	dinitrotoluene, 4-amino-2,6-	norflurazon
auramine	dinoseb	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine [HMX]
azobenzene	dioxane, 1,4-	octamethylpyrophosphoramide [OMPA]
azodicarbonamide	diphenamid	octyl phthalate, di-N- [DNOP]
benfluralin	diphenyl sulfone	oryzalin
benomyl	diphenyl-1,4-benzenediamine, N,N'-	oxadiazon
bensulfuron-methyl	diphenylamine	oxamyl
bentazon	Direct Black 38	oxyfluorfen
benz(a)anthracene	Direct Brown 95	paclobutrazol

benzidine	disulfoton	parathion
benzo(b+j)fluoranthenes	dodine	parathion, methyl
benzoic acid	endosulfan I + II	pebulate
benzotrichloride	endothall	pendimethalin
benzyl alcohol	endrin	pentachlorobenzene, 1,2,3,4,5-
benzyl chloride	EPTC	pentachloroethane
beryllium	ethanol, 2-(2-methoxyethoxy)-	pentachloronitrobenzene [PCNB]
bifenox	ethephon	pentaerythritol tetranitrate [PETN]
biphenyl, 1,1'-	ethion	perchlorate
bis(2-chloroethoxy) methane	ethoxyethanol acetate, 2-	perfluorobutane sulfonate [PFBS]
bis(2-chloroethyl) ether	ethoxyethanol, 2-	phenmedipham
bis(2-chloro-1-methylethyl) ether	ethyl acetate	phenol
bis(2-ethylhexyl) adipate	ethyl acrylate	phenol, 2-methyl-4,6-dinitro [DNOC]
bis(2-ethylhexyl) phthalate [DEHP]	ethyl p-nitrophenyl benzenethionophosphonate [EPN]	phenothiazine
bisphenol A	ethylene cyanohydrin	phenylenediamine, m- [MPD]
bromo-2-chloroethane, 1-	ethylenediamine	phenylenediamine, o- [OPD]
bromobenzene	ethylene glycol	phenylenediamine, p- [PPD]
bromomethane	ethylene thiourea	phenylphenol, 2-
bromophos	ethyleneimine	phosmet
butadiene, 1,3-	fenamiphos	phthalic acid, p-
butanoic acid, 4-(4-chloro-2-methylphenoxy)- [MCPB]	fenpropathrin	picramic acid
butanol, 2-	fenvalerate	picric acid
butanol, n-	fluometuron	pirimiphos, methyl
butoxy ethanol, 2-	fluoranthene	prochloraz
butyl benzyl phthalate	fluorene	profluralin
butyl phthalyl butyl glycolate	fluridone	prometon
butylate	flurprimidol	prometryn
butylated hydroxytoluene [BHT]	flusilazole	propachlor
butylbenzene, n-	flutolanil	propanil
butylbenzene, sec-	fluvalinate	propargite
butylbenzene, tert-	folpet	propargyl alcohol
cacodylic acid	fomesafen	propazine
caprolactam	fonofos	propham

captafol	formaldehyde	propiconazole
captan	formic acid	propylbenzene, 1-
carbon disulfide	fosetyl	propylene glycol, 1,2-
carbosulfan	furan	propylene glycol monomethyl ether
carboxin	furazolidone	propylene oxide
catechol	furfural	propyzamide
chloramben	furmecyclox	pyrene
chloranil	furothiazole	pyridine
chlordane (cis + trans)	glufosinate	quinalphos
chlordecone	glycidaldehyde	quinoline
chlorfenvinphos	guanidine	quizalofop-ethyl
chlorimuron, ethyl-	haloxyfop, methyl	resmethrin
chlorine (Cl <sub>2</sub> ) <sub>25</sub>	heptachlor	ronnel
chloro-2-methylaniline, 4-	heptachlor epoxide	rotenone
chloroacetaldehyde, 2-	hexabromobiphenyl, 2,2',4,4',5,5'-	selenious acid
chloroaniline, p-	hexachlorobenzene	sethoxydim
chlorobenzilate	hexachlorobutadiene	silver
chlorobenzoic acid, 4-	hexachlorocyclohexane, alpha	silvex
chlorobenzotrichloride, 4-	hexachlorocyclohexane, beta	strontium
chlorobenzotrifluoride, 4-	hexachlorocyclohexane, gamma	strychnine
chlorobutane, 1-	hexachlorocyclopentadiene	styrene
chloroethanol, 2-	hexachloroethane	styrene-acrylonitrile [SAN] trimer (all isomers)
chloronaphthalene, 2-	hexachlorophene	sulfotep
chloronitrobenzene, 2-	hexahydro-1,3,5-trinitro-1,3,5-triazine [RDX]	TCMTB
chloronitrobenzene, 4-	hexamethylphosphoramide	tebuthiuron
chloroprene	hexanone, 2-	temephos
chlorothalonil	hexazinone	terbacil
chlorotoluene, 2-	hexythiazox	terbutryn
chlorotoluene, 4-	hydramethylnon	tetrachlorobenzene, 1,2,4,5-
chlorpropham	hydrazine	tetrachloroethane, 1,1,1,2-
chlorpyrifos-methyl	hydroquinone	tetrachloroethane, 1,1,2,2-
chlorsulfuron	imazalil	tetrachlorovinphos
chlorthal-dimethyl	imazaquin	tetraethyl lead
chlorthiophos	imazethapyr	tetrahydrofuran
chromium, trivalent <sup>28</sup>	iprodione	tetryl
chrysene	isobutanol	thifensulfuron-methyl

clofentezine	isophorone	thiobencarb
cobalt	isopropalin	thiodiglycol
crotonaldehyde, trans-	isopropanol	thiofanox
cyanazine	isopropylbenzene	thiophanate, methyl
cyanogen	isoxaben	thiophenol
cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	lactofen	thiram
cyclohexanone	linuron	tin
cyclohexene	lithium	toxaphene (all isomers)
cyclohexylamine	malononitrile	tralomethrin
cyfluthrin	mancozeb	triadimefon
cyhalothrin	maneb	triallate
cypermethrin	mecoprop [MCP]P	triasulfuron
cyromazine	merphos	tribenuron-methyl
dalapon	metalaxyl	tribromobenzene, 1,2,4-
daminozide	methacrylonitrile	tribufos
demeton	methamidophos	tributyl phosphate
diallate	methanol	trichloro-1,2,2-trifluoroethane, 1,1,2-
diaminotoluene, 2,5-	methidathion	trichloroaniline, 2,4,6-
dibenz(a,h)anthracene	methomyl	trichlorobenzene, 1,2,3-
dibenzofuran	methoxy-5-nitroaniline, 2-	trichlorobenzene, 1,2,4-
dibenzothiophene	methoxychlor	trichloroethane, 1,1,1-
dibromo-3-chloropropane, 1,2-	methoxyethanol acetate, 2-	trichloroethane, 1,1,2-
dibromobenzene, 1,3-	methoxyethanol, 2-	trichlorofluoromethane
dibromobenzene, 1,4-	methyl acetate	trichlorophenol, 2,4,5-
dibromoethane, 1,2-	methyl ethyl ketone [MEK]	trichlorophenoxy acetic acid, 2,4,5-[2,4,5-T]
dibutyl phthalate [DBP]	methyl hydrazine	trichloropropane, 1,1,2-
dichlorobenzidine, 3,3'-	methyl mercury	trichloropropane, 1,2,3-
dichlorodifluoromethane	methyl methacrylate	trichloropropene, 1,2,3-
dichlorodiphenyl sulfone, 4,4'-	methyl-5-nitroaniline, 2-	triclesyl phosphate [TCP]
dichlorodiphenyltrichloroethane, total [DDT] 31	methylaniline, 2-	tridiphan
dichloroethane, 1,1-	methylaniline, 4-	triethylene glycol
dichloroethylene, 1,2-cis-	methylaniline, N-	trimethyl phosphate
dichloroethylene, 1,2-trans-	methylcholanthrene, 3-	trimethylbenzene, 1,3,5-
dichlorophenoxy(2,4-)butyric acid, 4- [2,4-DB]	methylene-bis(2-chloroaniline), 4,4'-	trinitrobenzene, 1,3,5-

dichloropropane, 1,2-	methylene-bis(N,N-dimethyl) aniline, 4,4'-	trinitrotoluene, 2,4,6-
dichloropropane, 1,3-	methylenebisbenzenamine, 4,4'-	tris(1,3-dichloro-2-propyl)phosphate [TDCPP]
dichloropropanol, 2,3-	methylnaphthalene, 1-	tris(1-chloro-2-propyl)phosphate [TCPP]
dichloropropene, 1,3- (cis + trans)	methylnaphthalene, 2-	tris(2,3-dibromopropyl)phosphate
dichlorvos	methylphenol, 2-	tris(2-chloroethyl)phosphate [TCEP]
dicrotophos	methylphenol, 3-	tris(2-ethylhexyl)phosphate
dicyclopentadiene	methylphenol, 4-	Tungsten
dieldrin	methylphenol, 4-chloro-3-	vanadium
diethanolamine	methylnaphthalene, 1-	vernolate
diethyl ether	methylstyrene, alpha-	vinclozolin
diethyl phthalate	metsulfuron-methyl	vinyl acetate
diethyldithiocarbamate	mirex	warfarin
diethylene glycol monobutyl ether	molinate	
diethylene glycol monoethyl ether	monomethylarsonic acid	zineb
diethylformamide	myclobutanil	
	naled	

**Table 5B-2: Substances for which the 2014 Health Canada Guidelines for Canadian Drinking Water Quality were adopted as a standard**

acetic acid, 2-methyl-4-chlorophenoxy- [MCPA]	diazinon	monochloroacetic acid
antimony	dibromochloromethane [DBCM]	nitrate (as N)
arsenic	dicamba	nitrate and nitrite (as N)
atrazine	dichlorobenzene, 1,2-	nitritotriacetic acid [NTA]
azinphos-methyl	dichlorobenzene, 1,4-	nitrite (as N)
Barium	dichloroethane, 1,2-	nitrosodimethylamine, N-[NDMA]
benzene	dichloroethylene, 1,1-	paraquat (as dichloride)
benzo(a)pyrene	dichloromethane	pentachlorophenol [PCP]
boron	dichlorophenol, 2,4-	phorate
bromate	dichlorophenoxyacetic acid, 2,4-[2,4-D]	picloram
bromodichloromethane [BDCM]	diclofop-methyl	simazine
bromoform	dimethoate	sulfate
bromoxynil	diquat (as dibromide)	sulfide (as H <sub>2</sub> S)
cadmium	diuron	terbufos
carbaryl	ethylbenzene	tetrachloroethylene
carbofuran	fluoride	tetrachlorophenol, 2,3,4,6-
carbon tetrachloride	glyphosate	toluene
chloride ion	lead	trichloroethylene
chlorobenzene	malathion	trichlorophenol, 2,4,6-
chloroform	mercury	trifluralin
chlorpyrifos	metolachlor	uranium
chromium, hexavalent	metribuzin	vinyl chloride
cyanide	monochloramine	xylene, total

## Chapter 6. Derivation of Generic Vapour Standards

### 6.1 Introduction

Human health vapour standards are derived for chemicals determined to have adequate volatility to present a vapour risk. Volatility is defined as those substances generally exhibiting:

- Henry's Law Constant  $> 1.0 \times 10^{-5}$  atm-m<sup>3</sup>/mol, and
- Vapour Pressure  $> 0.05$  Torr (@ 1 atm, 25°C)

This chapter describes the derivation methods for human health vapour standards, which are contained in CSR Schedule 3.3.

### 6.2 Vapour uses

Vapour standards are derived for exposure scenarios that generally correspond to the land uses defined under the CSR for soil, with the following exceptions:

- Residential vapour use does not distinguish between low- and high-density residential land uses,
- There are no vapour standards for wildlands land uses,
- Generic numerical vapour standards are specific to human health, and
- Parkade vapour use is a unique exposure scenario which is not limited to one specific land use.

While vapour standards are derived based on exposure scenarios that most closely match land (soil), water and sediment uses, vapour standards apply to situations that give to contaminated vapour as follows:

- To water at any site, irrespective of the water or site use;
1. Agricultural, urban park and residential vapour standards apply to soil vapour at agricultural land use, urban park land use and residential land use sites, as well as freshwater or marine sediment at sensitive sediment use sites;
  2. Residential use vapour standards apply to soil vapour at both residential low density land use and residential high density land use sites;
  3. Commercial use vapour standards apply to soil vapour at commercial land use sites;
  4. Industrial use vapour standards apply to soil vapour at industrial land use sites, as well as to freshwater or marine sediment at typical sediment use sites; and
  5. Parkade use vapour standards apply to soil vapour adjacent to parkades, irrespective of the site use.

### 6.3 Exposure assumptions

Vapour standards are specific to human health only. Exposure assumptions include toddlers with a body weight of 16.5 kg and an inhalation rate of 8.3 m<sup>3</sup>/d, and adults with a body weight of 70.7 kg and an inhalation rate of 16.6 m<sup>3</sup>/d. An adult lifespan in the derivation of generic numerical vapour standards is 70 years.

### 6.4 Exposure durations

The exposure durations are summarized as an exposure term as shown in Table 6-1.

The exposure term for parkades is as described in Table 6-1:

- During weekdays (5 days/week 52 weeks/year) – a total of 1 hour per day based on four 15-minute exposures to parkade air, and
- During weekends (2 days/week, 52 weeks/year) – a total of 8 hours per day.

**Table 6-1. Vapour use-specific exposure durations**

CSR Vapour Use	Exposure Term
AL, PL, RL	(24hr/24hr x 7d/7d x 52 wk/52wk x 70 yr/70yr)
CL	(12hr/24hr x 5d/7d x 48 wk/52wk x 70 yr/70yr)
IL	(8hr/24hr x 5d/7d x 48 wk/52wk x 35 yr/70yr)
Parkade Use	[(1hr/24hr x 5d/7d x 52wk/52wk) + (8hr/24hr x 2d/7d x 52wk/52wk)] x (70yr/70yr)

### 6.5 Toxicity reference values

Toxicity reference values for use in the derivation of human health vapour standards were selected using the ministry developed hierarchy described in Chapter 8.

### 6.6 Standards derivation procedures

The derivation protocol for non-carcinogenic (threshold) and carcinogenic (non-threshold) substances are described in Sections 6.6.1 and 6.6.2, respectively, as outlined below.

#### 6.6.1 Derivation non-carcinogenic (threshold) substances

Vapour standards for non-carcinogenic substances are derived by:

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

Where: GVS Generic Vapour Standard (mg/m<sup>3</sup>)

HQ <sup>T</sup>	Target Hazard Quotient for substance = 1.0
RfC	Reference Concentration (mg/m <sup>3</sup> ): substance specific
ET	Exposure Term

For substances where inhalation TRVs are unavailable, oral TRVs are substituted using the following equation:

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

Where:	RfC <sub>calc</sub>	Reference Concentration calculated (mg/m <sup>3</sup> )
	RfD	Reference Dose (mg/kg/d): substance specific
	BW	Body weight (kg)
	IR	Inhalation Rate (m <sup>3</sup> /d)

### 6.6.2 Derivation carcinogenic (non-threshold) substances

Vapour standards for carcinogenic substances are derived by:

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

Where:	GVS	Generic Vapour Standard (mg/m <sup>3</sup> )
	ILCR <sup>T</sup>	Target Incremental Lifetime Cancer Risk = 1.0x 10 <sup>-5</sup>
	UR	Cancer Unit Risk (mg/m <sup>3</sup> ) <sup>-1</sup>
	ET	Exposure Term

For substances where inhalation unit risk values are unavailable, oral slope factors are substituted using the following equation.

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

Where:	SF	Slope Factor (mg/kg/d) <sup>-1</sup> : substance specific
	BW	Body weight (kg)
	IR	Inhalation Rate (m <sup>3</sup> /d)

## 6.7 Final standards setting

All final standards are rounded according to rules described in Chapter 10. Where standards were found to be greater than the flammability or lower explosion limit, standards were adjusted to equal the corresponding substance-specific flammability or lower explosion limit. Standards for some substances were adjusted based on the 2016 British Columbia Environmental Laboratory Technical Advisory Committee reference analytical detection limit for the substance. These include:

- acrolein
- acrylonitrile (Al/PL/RL, CL)
- benzotrichloride
- bis(2-chloroethyl) ether
- bis(2-chloromethyl) ether
- butadiene, 1,3- (Al/PL/RL, CL)
- chlorine (Cl<sub>2</sub>)
- chloronitrobenzene, 4- (Al/PL/RL)
- chloroprene
- cyanide (Al/PL/RL)
- cyanogen (Al/PL/RL, CL)
- dibromo-3-chloropropane, 1,2- (Al/PL/RL, CL)
- dibromoethane, 1,2-
- dichloro-2-butene, 1,4- (cis or trans)
- dicyclopentadiene (Al/PL/RL, CL)
- dimethylamine
- ethylene oxide
- hexachlorobutadiene (Al/PL/RL)
- hexachlorocyclopentadiene (Al/PL/RL, CL)
- methyl mercaptan (Al/PL/RL)
- nitrobenzene (Al/PL/RL, CL)
- phosphine
- trichloroethane, 1,1,2- (Al/PL/RL)
- trichloropropane, 1,2,3- (Al/PL/RL)
- trichloropropene, 1,2,3- (Al/PL/RL)
- vinyl bromide (Al/PL/RL, CL)

## Chapter 7. Derivation of Generic Sediment Standards

### 7.1 Introduction

The CSR contains standards for sediment that are derived in consideration of the toxic effects from direct contact with contaminants in sediments by aquatic life species. The standards distinguish between two distinct sediment uses (sensitive sediment and typical sediment) and include standards for both freshwater and marine/estuarine aquatic life environments. The sediment standards are contained in CSR Schedule 3.4.

### 7.2 Standards derivation procedures

Generic numerical sediment standards are derived by multiplying a probable effect level from the Canadian Council for Ministers of the Environment, 1999, Environmental Quality Guidelines, for a substance by a defined probability of observing an EC<sub>20</sub> in selected toxicity tests. Selected toxicity tests included a 28 to 42-day test for the freshwater amphipod, *Hyalella azteca*, and 10-day tests for two the marine amphipods *Ampelisca abdita*, and *Rhepoxynius abronius*. The probability is dependant on sediment use, resulting in the following use-specific criteria:

1. Generic numerical sediment standards, for sensitive sediment: a 20% probability of observing an EC<sub>20</sub> (P20) (equal to 0.62 for freshwater, none derived for marine), and
2. Generic numerical sediment standards, for typical sediment: a 50% probability of observing an EC<sub>20</sub> (P50) (equal to 1.2 for both freshwater and marine).

Sediment standards are derived based on exposure scenarios for ecological organisms and are not considered protective of human health; therefore, CSR soil standards should be applied to sediment for risk assessment purposes (refer to [Protocol 1 “Detailed Risk Assessment”](#) for more information).

## Chapter 8. Toxicity Reference Value Database

### 8.1 Introduction

The ministry has a database of toxicity reference values (TRVs) for prescribed substances in the CSR. The crystallization date of TRVs and guidelines used to develop standards for amendments to the CSR was November 30, 2015. For future CSR amendments, TRV crystallization dates will be published as a part of that particular amendment package.

### 8.2 Human health TRV database compilation procedure

#### 8.2.1 Human health TRV hierarchy

The human health soil and vapour TRV hierarchy is:

1. United States Environmental Protection Agency, [Integrated Risk Information System](#);
2. Health Canada, Federal Contaminated Site Risk Assessment in Canada Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors (Version 2.0) [\(link to Version 3.0\)](#);
3. World Health Organization, [International Programme on Chemical Safety](#).

The following supplemental sources were used:

- United States [Agency for Toxic Substances and Disease Registry, Toxic Substances Portal](#);
- Oak Ridge National Laboratory, [Risk Assessment Information System](#);
- Netherlands National Institute of Public Health and the Environment: [Re-evaluation of Human Toxicological Maximum Permissible Risk Levels](#);
- California Environmental Protection Agency: [Toxic Criteria Database](#);
- United States Environmental Protection Agency, 2015, [Regional Screening Levels](#);
- European Chemicals Agency, [Registered Substances](#); and
- Other Canadian Provinces or US state agencies.

The TRV hierarchy for drinking water use standards differs from the list above; see Section 5.2.3.

The following sources were used to classify substances as carcinogenic:

- United States Environmental Protection Agency, [Integrated Risk Information System](#);
- [International Agency for Research on Cancer](#);
- Health Canada, Federal Contaminated Site Risk Assessment in Canada Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors (Version 2.0) [\(link to Version 3.0\)](#).

### **8.3 Ecological health TRV database compilation procedure**

Ecological health TRVs for soil were retrieved and compiled as described in Chapter 3.

### **8.4 Database resources**

The finalized ministry approved TRVs can be found in the Appendices of this protocol:

- Appendix 8A: TRVs used to derive human health soil standards;
- Appendix 8B: TRVs used to derive ecological health soil standards;
- Appendix 8C: TRVs used to derive human health drinking water use standards;
- Appendix 8D: TRVs used to derive human health vapour standards.

## APPENDIX 8A

## TRVs Used to Derive Human Health Soil Standards

Substance name	Chemical Abstract Service # (CAS)	Schedule	TRV value	Units	TRV type	IARC/IRIS carcinogenicity classification
anthracene	120-20-7	Schedule 3.1, Part 1	3.00E-01	mg/kg/d	RfD	3; D
antimony	7440-36-0	Schedule 3.1, Part 2	6.00E-03	mg/kg/d	RfD	D
arsenic	7440-38-2	Schedule 3.1, Part 1	3.00E-04	mg/kg/d	RfD	1; A
			1.50	(mg/kg/d) <sup>-1</sup>	SFO	
barium	7440-39-3	Schedule 3.1, Part 1	2.00E-01	mg/kg/d	RfD	N/A
benz(a)anthracene	56-55-3	Schedule 3.1, Part 2	0.1	-	TEF	2B; B2
benzene	71-43-2	Schedule 3.1, Part 1	4.00E-03	mg/kg/d	RfD	1; A
			5.50E-02	(mg/kg/d) <sup>-1</sup>	SFO	
benzo(a)pyrene	50-32-8	Schedule 3.1, Part 1	7.30	(mg/kg/d) <sup>-1</sup>	SFO	1; B1
benzo(b+j)fluoranthenes	205-99-2 & 205-82-3	Schedule 3.1, Part 2	0.1	-	TEF	2B; B2
benzo(k)fluoranthene	207-08-9	Schedule 3.1, Part 2	0.1	-	TEF	2B; B2
beryllium	7440-41-7	Schedule 3.1, Part 1	2.00E-03	mg/kg/d	RfD	1; B1
bis(2-ethylhexyl)phthalate [DEHP]	117-81-7	Schedule 3.1, Part 2	4.00E-03	mg/kg/d	RfD	2B; B2
boron	7440-42-8	Schedule 3.1, Part 2	2.00E-01	mg/kg/d	RfD	N/A
cadmium	7440-43-9	Schedule 3.1, Part 1	5.00E-04	mg/kg/d	RfD	1; B1
carbon tetrachloride	56-23-5	Schedule 3.1, Part 2	4.00E-03	mg/kg/d	RfD	2B; B1
chloride ion	7647-14-5	Schedule 3.1, Part 1	5.15E+01	mg/kg/d	RfD	N/A
chlorobenzene	108-90-7	Schedule 3.1, Part 2	2.00E-02	mg/kg/d	RfD	D
chloroform	67-66-5	Schedule 3.1, Part 2	1.00E-02	mg/kg/d	RfD	2B; B2
chlorophenol, 2-	95-57-8	Schedule 3.1, Part 2	5.00E-03	mg/kg/d	RfD	2B
chlorophenol, 3-	108-43-0	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	TDI	N/A
chlorophenol, 4-	106-48-9	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	TDI	N/A
chromium	7440-47-3	Schedule 3.1, Part 1	3.00E-03	mg/kg/d	RfD	1; 3

Substance name	Chemical Abstract Service # (CAS)	Schedule	TRV value	Units	TRV type	IARC/IRIS carcinogenicity classification
cobalt	7440-48-4	Schedule 3.1, Part 1	3.00E-04	mg/kg/d	RfD	2B
copper	7440-50-8	Schedule 3.1, Part 1	9.00E-02	mg/kg/d	RfD	D
cyanide	57-12-5	Schedule 3.1, Part 2	6.00E-04	mg/kg/d	RfD	N/A
dibenz(a,h)anthracene	53-70-3	Schedule 3.1, Part 2	7.30	(mg/kg/d) <sup>-1</sup>	SFO	2A; B2
dibutyl phthalate [DBP]	84-74-2	Schedule 3.1, Part 2	1.00E-01	mg/kg/d	RfD	2B; D
dichlorobenzene, 1,2-	95-50-1	Schedule 3.1, Part 2	9.00E-02	mg/kg/d	RfD	3; D
dichlorobenzene, 1,3-	541-73-1	Schedule 3.1, Part 2	3.00E-02	mg/kg/d	RfD	3; D
dichlorobenzene, 1,4-	106-46-7	Schedule 3.1, Part 2	1.10E-01	mg/kg/d	RfD	2B
dichlorodiphenyltrichloroethane, total (DDT)	N/A	Schedule 3.1, Part 1	5.00E-04	mg/kg/d	RfD	2A; B2
			3.40E-1	mg/kg/d	SFO	
dichloroethane, 1,1-	75-34-3	Schedule 3.1, Part 2	2.00E-01	mg/kg/d	RfD	C
dichloroethane, 1,2-	107-06-2	Schedule 3.1, Part 2	9.10E-02	(mg/kg/d) <sup>-1</sup>	SFO	2B; B2
dichloroethylene, 1,1-	75-35-4	Schedule 3.1, Part 2	5.00E-02	mg/kg/d	RfD	3; C
dichloroethylene, 1,2-cis-	156-59-2	Schedule 3.1, Part 2	2.00E-03	mg/kg/d	RfD	N/A
dichloroethylene, 1,2-trans-	156-60-5	Schedule 3.1, Part 2	2.00E-02	mg/kg/d	RfD	N/A
dichloromethane	75-09-2	Schedule 3.1, Part 2	6.00E-03	mg/kg/d	RfD	2A; Likely to be carcinogenic to humans
			2.00E-3	(mg/kg/d) <sup>-1</sup>	SFO	
dichlorophenol, 2,3-	576-24-9	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	TDI	2B
dichlorophenol, 2,4-	120-83-2	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	RfD	2B
dichlorophenol, 2,5-	583-78-8	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	TDI	2B
dichlorophenol, 2,6-	87-65-0	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	TDI	2B
dichlorophenol, 3,4-	95-77-2	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	TDI	2B
dichlorophenol, 3,5-	591-35-5	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	TDI	2B
dichloropropane, 1,2-	78-87-5	Schedule 3.1, Part 2	1.40E-02	mg/kg/d	RfD	1
dichloropropene, 1,3- (cis + trans)	542-75-6	Schedule 3.1, Part 2	3.00E-02	mg/kg/d	RfD	2B; B2
diisopropanolamine [DIPA]	100-97-4	Schedule 3.1, Part 1	3.90E-01	mg/kg/d	RfD	N/A
dimethylphenol, 2,4-	105-67-9	Schedule 3.1, Part 2	2.00E-02	mg/kg/d	RfD	N/A
dimethylphenol, 2,6-	576-26-1	Schedule 3.1, Part 2	6.00E-04	mg/kg/d	RfD	N/A
dimethylphenol, 3,4-	95-65-8	Schedule 3.1, Part 2	1.00E-03	mg/kg/d	RfD	N/A
dinitrophenol, 2,4-	51-28-5	Schedule 3.1, Part 2	2.00E-03	mg/kg/d	RfD	N/A

Substance name	Chemical Abstract Service # (CAS)	Schedule	TRV value	Units	TRV type	IARC/IRIS carcinogenicity classification
endosulfan (I+II)	115-29-7	Schedule 3.1, Part 2	6.00E-03	mg/kg/d	RfD	N/A
ethylbenzene	100-41-4	Schedule 3.1, Part 1	1.00E-01	mg/kg/d	RfD	2B; D
ethylene glycol	107-21-1	Schedule 3.1, Part 1	2.00	mg/kg/d	RfD	N/A
fluoranthene	206-44-0	Schedule 3.1, Part 1	4.00E-02	mg/kg/d	RfD	3; D
fluoride	16984-48-8	Schedule 3.1, Part 2	1.05E-01	mg/kg/d	RfD	3
hexachlorobenzene	118-74-1	Schedule 3.1, Part 2	8.00E-04	mg/kg/d	RfD	2B; B2
			8.30E-01	(mg/kg/d) <sup>-1</sup>	SFO	
hexachlorocyclohexane, gamma	58-89-9	Schedule 3.1, Part 2	3.00E-04	mg/kg/d	RfD	1
			1.30	(mg/kg/d) <sup>-1</sup>	SFO	
indeno(1,2,3-cd)pyrene	193-39-5	Schedule 3.1, Part 2	0.1	-	TEF	2B; B2
lead	7439-92-1	Schedule 3.1, Part 1	6.00E-04	mg/kg/d (toddler)	TDI	2A; B2
			1.30E-03	mg/kg/d (adult)		
manganese	7439-96-5	Schedule 3.1, Part 1	1.40E-01	mg/kg/d	RfD	D
mercury	7439-97-6	Schedule 3.1, Part 1	3.00E-04	mg/kg/d	RfD	3; D
methanol	67-56-1	Schedule 3.1, Part 1	5.00E-01	mg/kg/d	RfD	N/A
methylphenol, 2-	95-48-7	Schedule 3.1, Part 2	5.00E-02	mg/kg/d	RfD	C
methylphenol, 3-	108-39-4	Schedule 3.1, Part 2	5.00E-02	mg/kg/d	RfD	C
methylphenol, 4-	106-44-5	Schedule 3.1, Part 2	5.00E-03	mg/kg/d	RfD	C
molybdenum	7439-98-7	Schedule 3.1, Part 1	5.00E-03	mg/kg/d	RfD	N/A
naphthalene	91-20-3	Schedule 3.1, Part 1	2.00E-02	mg/kg/d	RfD	2B; C
nickel	7440-02-0	Schedule 3.1, Part 1	1.10E-02	mg/kg/d	RfD	N/A
nonylphenol and nonylphenol ethoxylates	84852-15-3	Schedule 3.1, Part 1	4.90E-03	mg/kg/d	RfD	N/A
pentachlorobenzene, 1,2,3,4,5-	608-93-5	Schedule 3.1, Part 2	8.00E-04	mg/kg/d	RfD	D
pentachlorophenol [PCP]	87-86-5	Schedule 3.1, Part 1	4.00E-01	(mg/kg/d) <sup>-1</sup>	SFO	2B; Likely to be carcinogenic to humans
perfluorooctane sulfonate [PFOS]	1763-23-1	Schedule 3.1, Part 1	3.00E-05	mg/kg/d	RfD	N/A

Substance name	Chemical Abstract Service # (CAS)	Schedule	TRV value	Units	TRV type	IARC/IRIS carcinogenicity classification
phenanthrene	85-01-8	Schedule 3.1, Part 2	4.00E-02	mg/kg/d	RfD	3; D
phenol	108-95-2	Schedule 3.1, Part 1	3.00E-01	mg/kg/d	RfD	3; D
polychlorinated biphenyls, total [PCBs]	1336-36-3	Schedule 3.1, Part 1	1.30E-04	mg/kg/d	RfD	Inadequate data; B2
polychlorinated dioxins and furans, total [PCDDs AND PCDFs]	1746-01-6	Schedule 3.1, Part 1	2.30E-09	mg/kg/d	RfD	1; A
pyrene	129-00-0	Schedule 3.1, Part 2	3.00E-02	mg/kg/d	RfD	3; D
selenium	7782-49-2	Schedule 3.1, Part 1	5.00E-03	mg/kg/d	RfD	3; D
silver	7440-22-4	Schedule 3.1, Part 2	5.00E-03	mg/kg/d	RfD	D
sodium ion	7440-23-5	Schedule 3.1, Part 1	3.43E+01	mg/kg/d	RfD	N/A
styrene	100-42-5	Schedule 3.1, Part 2	2.00E-01	mg/kg/d	RfD	2B
sulfolane	126-33-0	Schedule 3.1, Part 1	9.70E-03	mg/kg/d	RfD	N/A
tetrachlorobenzene, 1,2,3,4-	634-66-2	Schedule 3.1, Part 2	3.40E-03	mg/kg/d	RfD	N/A
tetrachlorobenzene, 1,2,3,5-	634-90-2	Schedule 3.1, Part 2	5.00E-04	mg/kg/d	RfD	N/A
tetrachloroethylene	127-18-4	Schedule 3.1, Part 1	6.00E-03	mg/kg/d	RfD	2A; B1
tetrachlorophenol, 2,3,4,5-	4901-51-3	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	RfD	2B
tetrachlorophenol, 2,3,4,6-	58-90-2	Schedule 3.1, Part 2	3.00E-02	mg/kg/d	RfD	2B
tetrachlorophenol, 2,3,5,6-	935-95-5	Schedule 3.1, Part 2	3.00E-03	mg/kg/d	RfD	2B
thallium	7440-28-0	Schedule 3.1, Part 1	1.00E-05	mg/kg/d	RfD	N/A
tin	7440-31-5	Schedule 3.1, Part 2	6.00E-01	mg/kg/d	RfD	N/A
toluene	108-88-3	Schedule 3.1, Part 1	8.00E-02	mg/kg/d	RfD	3
trichlorobenzene, 1,2,3-	87-61-6	Schedule 3.1, Part 2	1.50E-03	mg/kg/d	RfD	N/A
trichlorobenzene, 1,2,4-	120-82-1	Schedule 3.1, Part 2	1.00E-02	mg/kg/d	RfD	D
trichlorobenzene, 1,3,5-	108-70-3	Schedule 3.1, Part 2	8.00E-03	mg/kg/d	RfD	N/A
trichloroethane, 1,1,1	71-55-6	Schedule 3.1, Part 2	2.00	mg/kg/d	RfD	3
trichloroethane, 1,1,2-	79-00-5	Schedule 3.1, Part 2	4.00E-03	mg/kg/d	RfD	3; C
trichloroethylene	79-01-6	Schedule 3.1, Part 1	5.00E-04	mg/kg/d	RfD	1; Carcinogenic to humans
trichlorophenol, 2,3,4-	15950-66-0	Schedule 3.1, Part 2	1.00E-03	mg/kg/d	RfD	2B; B2

Substance name	Chemical Abstract Service # (CAS)	Schedule	TRV value	Units	TRV type	IARC/IRIS carcinogenicity classification
trichlorophenol, 2,3,5-	933-78-8	Schedule 3.1, Part 2	1.00E-03	mg/kg/d	RfD	2B; B2
trichlorophenol, 2,3,6-	933-75-5	Schedule 3.1, Part 2	1.00E-03	mg/kg/d	RfD	2B; B2
trichlorophenol, 2,4,5-	95-95-4	Schedule 3.1, Part 2	1.00E-01	mg/kg/d	RfD	2B
trichlorophenol, 2,4,6-	88-06-2	Schedule 3.1, Part 2	1.00E-03	mg/kg/d	RfD	2B; B2
trichlorophenol, 3,4,5-	609-19-8	Schedule 3.1, Part 2	1.00E-03	mg/kg/d	RfD	2B; B2
uranium	7440-61-1	Schedule 3.1, Part 1	3.00E-03	mg/kg/d	RfD	N/A
vanadium	7440-62-2	Schedule 3.1, Part 1	5.04E-03	mg/kg/d	RfD	N/A
xylene	1330-20-7	Schedule 3.1, Part 1	2.00E-01	mg/kg/d	RfD	3
zinc	7440-66-6	Schedule 3.1, Part 1	3.00E-01	mg/kg/d	RfD	D

## APPENDIX 8B

## TRVs Used to Derive Ecological Health Soil Standards

## Arsenic (Chemical Abstract Service Number 7440-38-2)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>Raphanus sativus</i> )	Plant	Seed emergence	EC	12	25
Radish ( <i>R. sativus</i> )	Plant	Seed emergence	EC	13	44
Radish ( <i>R. sativus</i> )	Plant	Seed emergence	EC	14	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seed emergence	EC	32	25
Lettuce ( <i>L. sativa</i> )	Plant	Seed emergence	EC	36	30
Lettuce ( <i>L. sativa</i> )	Plant	Seed emergence	EC	46	50
Green beans ( <i>Phaseolus vulgaris</i> )	Plant	Yield reduction	EC	10	42
Lima beans ( <i>Phaseolus linensis</i> )	Plant	Yield reduction	EC	50	99
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Yield reduction	EC	50	42
Cabbage ( <i>Brassica oleracea</i> )	Plant	Yield reduction	EC	100	68
Green beans ( <i>P. vulgaris</i> )	Plant	Yield reduction	EC	50	29
Lima beans ( <i>P. linensis</i> )	Plant	Yield reduction	EC	100	16
Spinach ( <i>Spinacia oleracea</i> )	Plant	Yield reduction	EC	50	22
Radish ( <i>R. sativus</i> )	Plant	Yield reduction	EC	50	25
Tomato ( <i>L. esculentum</i> )	Plant	Yield reduction	EC	500	77
Cabbage ( <i>B. oleracea</i> )	Plant	Yield reduction	EC	500	73
Green beans ( <i>P. vulgaris</i> )	Plant	Yield reduction	EC	10	22
Lima beans ( <i>P. linensis</i> )	Plant	Yield reduction	EC	10	19
Spinach ( <i>S. oleracea</i> )	Plant	Yield reduction	EC	10	33
Radish ( <i>R. sativus</i> )	Plant	Yield reduction	EC	10	17
Tomato ( <i>L. esculentum</i> )	Plant	Yield reduction	EC	500	97
Cabbage ( <i>B. oleracea</i> )	Plant	Yield reduction	EC	10	26

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Snap peas ( <i>Phaseolus vulgaris</i> )	Plant	Weight reduction	EC	26	54
Peas ( <i>Pisium sativum</i> )	Plant	Weight reduction	EC	63	54
Corn ( <i>Zea mays</i> )	Plant	Weight reduction	EC	63	54
Potato ( <i>Solanum dulce</i> )	Plant	Weight reduction	EC	250	76
Corn ( <i>Z. mays</i> )	Plant	Weight reduction	EC	42	50
Blueberry ( <i>Vaccinium angustifolium</i> )	Plant	Length reduction	EC	69.5	22
Blueberry ( <i>V. angustifolium</i> )	Plant	Weight reduction	EC	69.5	30
Corn ( <i>Z. mays</i> )	Plant	Dry weight yield	EC	1000	97
Oats ( <i>Avena sativa</i> )	Plant	Dry weight yield	EC	100	94
Corn ( <i>Z. mays</i> )	Plant	Dry weight yield	EC	100	86
Oats ( <i>A. sativa</i> )	Plant	Dry weight yield	EC	100	94
Oats ( <i>A. sativa</i> )	Plant	Straw yield	EC	40	39
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	100	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	142	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	163	42
Alfalfa ( <i>Medicago sativa</i> )	Plant	Biomass	EC	30	30
Bean	Plant	Yield reduction	EC	22	94
Corn ( <i>Z. mays</i> )	Plant	Biomass	EC	500	67
Radish ( <i>R. sativus</i> )	Plant	Yield reduction	EC	10	23
Red clover ( <i>Trifolium pratense</i> )	Plant	Biomass	EC	30	57
Rice	Plant	Biomass	EC	25	33
Spinach ( <i>S. oleracea</i> )	Plant	Yield reduction	EC	22	23
Earthworm ( <i>E. fetida</i> )	Invertebrate	Cocoons/worm	EC	68	56

**Barium (Chemical Abstract Service Number 7440-39-3)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Pot worm ( <i>Enchytraeus crypticus</i> )	Invertebrate	Reproduction	EC	585	20
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Reproduction	EC	165	20
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Reproduction	EC	370	20
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	2390	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	2952	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	3754	50
Beans ( <i>Phaseolus vulgaris</i> )	Plant	Relative yield	EC	2000	63
Barley ( <i>Hordeum vulgare</i> )	Plant	Relative yield	EC	500	38
Beans ( <i>P. vulgaris</i> )	Plant	Relative yield	EC	400	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Relative yield	EC	440	NOEC
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	1055	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	1064	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	2944	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	177	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	325	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	868	50

**Benzene (Chemical Abstract Service Number 71-43-2)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Northern wheatgrass ( <i>Agropyron dasyst</i> )	Plant	Shoot length	EC	404	25
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Shoot dry mass	EC	110	25
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root length	EC	245	25
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root dry mass	EC	73	25
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Shoot length	EC	936	25
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Shoot dry mass	EC	495	25
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root length	EC	544	25
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root dry mass	EC	344	25
Alfalfa ( <i>Medicago sativa</i> )	Plant	Shoot length	EC	297	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	237	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	276	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	235	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	391	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	280	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	265	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	350	25
Collembolan ( <i>Onychiurus folsomi</i> )	Invertebrate	Mortality	LC	63	25
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	169	NOEC
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	99	25
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	63	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	666	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	730	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	462	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	394	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1593	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	573	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	586	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	506	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Shoot length	EC	1001	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Shoot dry mass	EC	339	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root length	EC	633	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root dry mass	EC	257	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Shoot length	EC	1663	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Shoot dry mass	EC	1442	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root length	EC	3450	50
Northern wheatgrass ( <i>A. dasyst</i> )	Plant	Root dry mass	EC	724	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	202	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	212	50
Common oat ( <i>Avena sativa</i> )	Plant	Growth	EC	1000	50 GM
Common oat ( <i>A. sativa</i> )	Plant	Growth	EC	1000	50 GM
Geometric mean				1000	50
Bird rape ( <i>Brassica rapa</i> )	Plant	Growth	EC	1000	50 GM
Bird rape ( <i>B. rapa</i> )	Plant	Growth	EC	1000	50 GM
Geometric mean				1000	50
Earthworm ( <i>Eisenia fetida</i> )	Invertebrate	Mortality	LC	1000	50

**Notes:**

Geometric mean (GM) – For redundant data, a single composite response concentration was calculated as the geometric mean of the individual values.

**Beryllium (Chemical Abstract Service Number 7440-41-7)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Pot worm ( <i>Enchytraeus crypticus</i> )	Invertebrate	Reproduction	EC	45	20
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Reproduction	EC	28	20
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Reproduction	EC	52	20
Barley ( <i>Hordeum vulgare</i> L.)	Plant	Shoot length	EC	297	25
Barley ( <i>H. vulgare</i> L.)	Plant	Shoot length	EC	628	50
Barley ( <i>H. vulgare</i> L.)	Plant	Root length	EC	479	25
Barley ( <i>H. vulgare</i> L.)	Plant	Root length	EC	587	50
Barley ( <i>H. vulgare</i> L.)	Plant	Shoot biomass	EC	222	25
Barley ( <i>H. vulgare</i> L.)	Plant	Shoot biomass	EC	485	50
Barley ( <i>H. vulgare</i> L.)	Plant	Root biomass	EC	355	25
Barley ( <i>H. vulgare</i> L.)	Plant	Root biomass	EC	550	50
Alfalfa ( <i>Medicago sativa</i> )	Plant	Shoot length	EC	182	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	287	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	237	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	288	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot biomass	EC	103	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot biomass	EC	176	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root biomass	EC	161	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root biomass	EC	214	50
Northern wheatgrass ( <i>Agropyron dasystachyum</i> )	Plant	Shoot length	EC	413	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	593	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	527	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	597	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot biomass	EC	413	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot biomass	EC	513	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root biomass	EC	562	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root biomass	EC	562	50

**Cadmium (Chemical Abstract Service Number 7440-43-9)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Oats ( <i>Avena sativa</i> )	Plant	Weight	EC	10	NOEC
Oats ( <i>A. sativa</i> )	Plant	Weight	EC	159	50
Oats ( <i>A. sativa</i> )	Plant	Weight	EC	10	NOEC
Oats ( <i>A. sativa</i> )	Plant	Weight	EC	97	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Weight	EC	3.2	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Weight	EC	33	50
Lettuce ( <i>L. sativa</i> )	Plant	Weight	EC	32	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Weight	EC	136	50
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Weight	EC	32	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Weight	EC	171	50
Tomato ( <i>L. esculentum</i> )	Plant	Weight	EC	16	50
Earthworm ( <i>Dendrobaena rubida</i> )	Invertebrate	Cocoon production	EC	100	60
Tomato ( <i>L. esculentum</i> )	Plant	Ripe fruit yield	EC	160	25
Lettuce ( <i>L. sativa</i> )	Plant	Head yield	EC	13	25
Zucchini squash ( <i>Cucurbita pepo</i> )	Plant	Fruit yield	EC	160	25
Radish ( <i>Raphanus sativus</i> )	Plant	Tuber yield	EC	96	25
Wheat ( <i>Triticum aestivum</i> )	Plant	Grain yield	EC	50	25
Field bean ( <i>Phaseolus vulgaris</i> )	Plant	Dry bean yield	EC	40	25
Corn ( <i>Zea mays</i> )	Plant	Kernel yield	EC	18	25
Carrot ( <i>Daucus carota</i> )	Plant	Tuber yield	EC	20	25
Turnip ( <i>Brassica rapa</i> )	Plant	Tuber yield	EC	28	25
Cabbage ( <i>Brassica oleracea</i> )	Plant	Head yield	EC	170	25
Soybean ( <i>Glycine max</i> )	Plant	Dry bean yield	EC	5	25
Rice ( <i>Oryza sativa</i> )	Plant	Grain yield	EC	640	25
Curlycress ( <i>Lepidium sativum</i> )	Plant	Shoot yield	EC	8	25
Spinach ( <i>Spinacia oleracea</i> )	Plant	Shoot yield	EC	4	25

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Ryegrass ( <i>Lolium perenne</i> )	Plant	Growth	EC	100	26
Fescue ( <i>Festuca rubra</i> )	Plant	Growth	EC	60	27
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Body weight	EC	541	50 GM
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Body weight	EC	566	50 GM
Springtail ( <i>F. candida</i> )	Invertebrate	Body weight	EC	376	50 GM
Geometric mean				486	50
Springtail ( <i>F. candida</i> )	Invertebrate	Survival	LC	778	50 GM
Springtail ( <i>F. candida</i> )	Invertebrate	Survival	LC	822	50 GM
Springtail ( <i>F. candida</i> )	Invertebrate	Survival	LC	893	50 GM
Geometric mean				830	50
Springtail ( <i>F. candida</i> )	Invertebrate	Number of offspring	EC	159	50 GM
Springtail ( <i>F. candida</i> )	Invertebrate	Number of offspring	EC	204	50 GM
Springtail ( <i>F. candida</i> )	Invertebrate	Number of offspring	EC	227	50 GM
Geometric mean				195	50
Jack Pine ( <i>Pinus Banksiana</i> )	Plant	Shoot dry weight	EC	20	51
Jack Pine ( <i>P. Banksiana</i> )	Plant	Root dry weight	EC	20	13
White Spruce ( <i>Picea glauca</i> )	Plant	Shoot dry weight	EC	20	35
Red Oak ( <i>Quercus rubra</i> )	Plant	Dry weight	EC	20	28
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	44	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	94	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	102	29
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	143	50
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	99	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	157	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	174	40
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	205	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Survival	LC	430	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Survival	LC	1033	54

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Survival	LC	700	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Survival	LC	1100	50
Turnip ( <i>B. rapa</i> )	Plant	Growth	EC	111.5	50
Beech ( <i>Fagus sylvatica</i> )	Plant	Shoot elongation	EC	20.2	61
Soybean ( <i>G. max</i> )	Plant	Yield	EC	2.5	14
Wheat ( <i>T. aestivum</i> )	Plant	Yield	EC	2.5	21
Maize ( <i>Zea mays</i> )	Plant	Root elongation	EC	25	43
Peas ( <i>Pisium sativum</i> )	Plant	Vine yield	EC	200	87
Peas ( <i>Pisium sativum</i> )	Plant	Seed yield	EC	200	99
Peas ( <i>P. sativum</i> )	Plant	Root yield	EC	200	72
Radish ( <i>R. sativus</i> )	Plant	Top yield	EC	40	24
Radish ( <i>R. sativus</i> )	Plant	Top yield	EC	200	82
Radish ( <i>R. sativus</i> )	Plant	Tuber yield	EC	200	93
Cauliflower ( <i>Brassica oleracea</i> )	Plant	Leaf yield	EC	200	97
Cauliflower ( <i>Brassica oleracea</i> )	Plant	Root yield	EC	200	90
Carrot ( <i>D. carota</i> )	Plant	Tuber yield	EC	200	96
Carrot ( <i>D. carota</i> )	Plant	Root yield	EC	200	86
Lettuce ( <i>L. sativa</i> )	Plant	Leaf yield	EC	200	91
Broccoli ( <i>Brassica oleracea</i> )	Plant	Leaf yield	EC	200	63
Spinach ( <i>S. oleracea</i> )	Plant	Leaf yield	EC	40	96
Spinach ( <i>S. oleracea</i> )	Plant	Root yield	EC	40	96
Oats ( <i>A. sativa</i> )	Plant	Grain yield	EC	40	36
Yellow poplar ( <i>Liriodendron tulipifera</i> )	Plant	Root dry weight	EC	133.5	77
White pine ( <i>Pinus strobus</i> )	Plant	Root dry weight	EC	133.5	49
Choke cherry ( <i>Prunus virginiana</i> )	Plant	Root dry weight	EC	133.5	87
Yellow birch ( <i>Betula alleghaniensis</i> )	Plant	Root dry weight	EC	133.5	73
Radish ( <i>R. sativus</i> )	Plant	Root growth	EC	170	50
Radish ( <i>R. sativus</i> )	Plant	Shoot growth	EC	190	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>R. sativus</i> )	Plant	Root growth	EC	70	50
Radish ( <i>R. sativus</i> )	Plant	Shoot growth	EC	44	50
Oats ( <i>A. sativa</i> )	Plant	Root biomass	EC	10	25
Radish ( <i>R. sativus</i> )	Plant	Root biomass	EC	50	32
Wheat ( <i>T. aestivum</i> )	Plant	Root biomass	EC	50	61
Earthworm ( <i>Lumbricus rubellus</i> )	Invertebrate	Mortality	LC	150	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	1000	100
Corn ( <i>Z. mays</i> )	Plant	Yield	EC	5.4	21
Wild bergamot ( <i>Monarda fistulosa</i> )	Plant	Shoot Growth	EC	10	23
Bluegrass ( <i>Poa pratensis</i> )	Plant	Shoot Growth	EC	30	90
Blazing-star ( <i>Liatris spicata</i> )	Plant	Shoot Growth	EC	30	80
Thimbleweed ( <i>Anemone cylindrica</i> )	Plant	Shoot Growth	EC	30	30
Little bluestem ( <i>Andropogon scoparius</i> )	Plant	Shoot Growth	EC	10	21
Poison-ivy ( <i>Rhus radicans</i> )	Plant	Shoot Growth	EC	30	63
Black-eyed susan ( <i>Rudbeckia hirta</i> )	Plant	Shoot Growth	EC	10	79
Little bluestem ( <i>A. scoparius</i> )	Plant	Total weight	EC	27.57	25
Little bluestem ( <i>A. scoparius</i> )	Plant	Total weight	EC	21.75	25
Little bluestem ( <i>A. scoparius</i> )	Plant	Root growth	EC	18.62	25
Soybean ( <i>G. max</i> )	Plant	Shoot yield	EC	10	77
Soybean ( <i>G. max</i> )	Plant	Shoot yield	EC	10	33
Soybean ( <i>G. max</i> )	Plant	Shoot yield	EC	100	34
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	2.5	28
Rice ( <i>O. sativa</i> )	Plant	P growth	EC	1000	31
Rice ( <i>O. sativa</i> )	Plant	P growth	EC	30	8
Wheat ( <i>T. aestivum</i> )	Plant	P growth	EC	100	85
Wheat ( <i>T. aestivum</i> )	Plant	P growth	EC	30	30
Earthworm ( <i>E. foetida</i> )	Invertebrate	Survival	LC	1843	50
Cotton ( <i>Gossypium hirsutum</i> cv. <i>Acala SJ2</i> )	Plant	Leaf yield	EC	300	60

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Cotton ( <i>G. hirsutum</i> cv. <i>Acala SJ2</i> )	Plant	Stem yield	EC	300	78
Cotton ( <i>Gossypium</i> spp. Cv <i>Giza 45</i> )	Plant	Leaf yield	EC	300	75
Wheat ( <i>T. aestivum</i> )	Plant	Dry matter production	EC	100	79
Wheat ( <i>T. aestivum</i> )	Plant	Grain yield	EC	100	58
Wheat ( <i>T. aestivum</i> )	Plant	Dry matter production	EC	12.5	75
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	39.2	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	46.3	50
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Growth	EC	33	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Survival	LC	253	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Sexual development	EC	10	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Growth	EC	18	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Sexual development	EC	27	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Growth	EC	100	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Cocoon production	EC	10	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	% fertile cocoons	EC	100	NOEC
Onion ( <i>Allium cepa</i> )	Plant	Biomass	EC	24	10
Onion ( <i>A. cepa</i> )	Plant	Biomass	EC	50	LOEC (20%)
Fenugreek ( <i>Trigonella foenumgraecum</i> )	Plant	Biomass	EC	10	10
Garlic ( <i>Allium sativum</i> )	Plant	Biomass	EC	100	LOEC (40%)
Corn ( <i>Z. mays</i> )	Plant	Biomass	EC	100	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	10	NOEC (9%)
Alyssum ( <i>Allysum pintodasilvae</i> )	Plant	Weight	EC	5	LOEC (19%)
Worm ( <i>Aporrectodea caliginosa</i> )	Invertebrate	Weight	EC	68.5	50
Oats ( <i>A. sativa</i> )	Plant	Biomass	EC	2.5	LOEC (29%)
Corn ( <i>Z. mays</i> )	Plant	Biomass	EC	40	LOEC (40%)
Chard ( <i>Beta vulgaris cicla</i> )	Plant	Biomass	EC	10	NOEC (3%)
Clusterbean ( <i>Cyamopsis tetragonoloba</i> )	Plant	Biomass	EC	2.5	LOEC (23%)
Broomcorn ( <i>Sorghum bicolor</i> )	Plant	Biomass	EC	2.5	LOEC (15%)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Mungbean ( <i>Vigna radiata</i> )	Plant	Biomass	EC	2.5	LOEC (33%)
Cowpea ( <i>Vigna unguiculata</i> )	Plant	Biomass	EC	2.5	LOEC (57%)
Earthworm ( <i>E. andrei</i> )	Invertebrate	Sexual development	EC	108	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Weight	EC	96	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	303	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Weight	EC	32	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Weight	EC	215	50
Springtail ( <i>F. candida</i> )	Invertebrate	Weight	EC	84	10
Springtail ( <i>F. candida</i> )	Invertebrate	Weight	EC	427	50
Springtail ( <i>F. candida</i> )	Invertebrate	Population growth	EC	71	50
Springtail ( <i>F. candida</i> )	Invertebrate	Weight	EC	247	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Population	EC	6	10
Cotton ( <i>Gossypium barbadense</i> )	Plant	Biomass	EC	300	LOEC (60%)
Cotton ( <i>Gossypium hirsutum</i> )	Plant	Biomass	EC	300	LOEC (77%)
Common annual sunflower ( <i>Helianthus annuus</i> )	Plant	Biomass	EC	10	NOEC (1%)
Barley ( <i>Hordeum vulgare</i> )	Plant	Biomass	EC	10	LOEC (18%)
Barley ( <i>H. vulgare</i> )	Plant	Biomass	EC	25	NOEC
Ryegrass ( <i>Lolium</i> sp)	Plant	Biomass	EC	50	LOEC (42%)
Spinach ( <i>S. oleracea</i> )	Plant	Biomass	EC	2	NOEC (23%)
Spinach ( <i>S. oleracea</i> )	Plant	Biomass	EC	4	LOEC (23%)
Spinach ( <i>S. oleracea</i> )	Plant	Biomass	EC	4	NOEC (12%)
Red clover ( <i>Trifolium pratense</i> )	Plant	Biomass	EC	30	LOEC (56%)
Bread wheat ( <i>T. aestivum</i> )	Plant	Biomass	EC	25	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	123	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	298	50
Oats ( <i>A. sativa</i> )	Plant	Growth	EC	239	50
Turnip ( <i>B. rapa</i> )	Plant	Growth	EC	69	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1000	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>Medicago Sativa</i> )	Plant	Growth	EC	250	NOEC
Yellow poplar ( <i>L. tulipifera</i> )	Plant	Growth	EC	100	NOEC
Black-eyed susan ( <i>R. hirta</i> )	Plant	Growth	EC	10	25
Wild bergamot ( <i>M. fistulosa</i> )	Plant	Growth	EC	6	25
Little bluestem ( <i>A. scoparius</i> )	Plant	Growth	EC	12	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	876	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	200	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	46	50
Nematode (Total nematode fauna)	Invertebrate	Reproduction	EC	160	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	40	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	125	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	49	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Growth	EC	393	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Growth	EC	332	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	120	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	112	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	110	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	223	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Growth	EC	410	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Growth	EC	358	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Growth	EC	343	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	21	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	67	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	67	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	210	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	380	NOEC
Nematode ( <i>Caenorhabditis elegans</i> )	Invertebrate	Mortality	LC	7	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	268	50 GM

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	371	50 GM
Geometric mean				315	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	937	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1215	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1641	50 GM
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1642	50 GM
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1852	50 GM
Geometric mean				1709	50
<i>Picea sitchensis</i>	Plant	Root length	EC	2.8	59
<i>T. aestivum</i>	Plant	Shoot dry weight	EC	14.3	15
<i>T. aestivum</i>	Plant	Shoot dry weight	EC	57	15
<i>T. aestivum</i>	Plant	Shoot dry weight	EC	3.6	11
<i>G. max</i>	Plant	Shoot dry weight	EC	100	22
<i>G. max</i>	Plant	Shoot dry weight	EC	100	69
<i>G. max</i>	Plant	Shoot dry weight	EC	10	26
<i>G. max</i>	Plant	Shoot dry weight	EC	10	12
<i>G. max</i>	Plant	Shoot dry weight	EC	100	66
<i>Z. mays</i>	Plant	Shoot dry weight	EC	2.5	47
<i>R. sativus</i>	Plant	Shoot dry weight	EC	50	30
<i>R. sativus</i>	Plant	Shoot dry weight	EC	100	29
<i>L. sativa</i>	Plant	Shoot dry weight	EC	32	30
<i>A. sativa</i>	Plant	Root dry weight	EC	10	24
<i>T. aestivum</i>	Plant	Root dry weight	EC	100	47
<i>L. sativa</i>	Plant	Shoot dry weight	EC	80	20
<i>Beta vulgaris</i>	Plant	Shoot dry weight	EC	80	35
<i>L. sativa</i>	Plant	Shoot dry weight	EC	80	25
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	160	40
<i>L. sativa</i>	Plant	Shoot dry weight	EC	80	35

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	160	25
<i>L. sativa</i>	Plant	Shoot dry weight	EC	40	38
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	320	50
<i>L. sativa</i>	Plant	Shoot dry weight	EC	260	50
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	110	50
<i>L. sativa</i>	Plant	Shoot dry weight	EC	160	50
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	185	50
<i>L. sativa</i>	Plant	Shoot dry weight	EC	195	50
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	320	50
<i>L. sativa</i>	Plant	Shoot dry weight	EC	58	50
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	40	NOEC
<i>G. max</i>	Plant	Shoot dry weight	EC	10	50
<i>G. max</i>	Plant	Shoot dry weight	EC	10	52
<i>G. max</i>	Plant	Shoot dry weight	EC	100	50
<i>L. sativa</i>	Plant	Shoot dry weight	EC	20	NOEC
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	40	NOEC
<i>L. sativa</i>	Plant	Shoot dry weight	EC	20	NOEC
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	40	NOEC
<i>L. sativa</i>	Plant	Shoot dry weight	EC	20	NOEC
<i>B. vulgaris</i>	Plant	Shoot dry weight	EC	80	NOEC
<i>L. sativa</i>	Plant	Shoot dry weight	EC	10	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	22	NOEC
Earthworm ( <i>D. rubida</i> )	Invertebrate	Cocoon production hatching success	EC	10	NOEC
Earthworm ( <i>D. rubida</i> )	Invertebrate	Cocoon production hatching success	EC	10	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Fresh weight at 25%MC	EC	160	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Fresh weight at 35%MC	EC	320	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Fresh weight at 45%MC	EC	80	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Fresh weight at 55%MC	EC	160	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Springtail ( <i>F. candida</i> )	Invertebrate	Number of offspring	EC	148	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	5	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Juvenile/adult ratio	EC	10	NOEC
<i>Plectus acuminatus</i>	Invertebrate	Juvenile/adult ratio	EC	32	NOEC
<i>Picea sitchensis</i>	Plant	Root length	EC	1.8	NOEC
<i>Glycine max</i>	Plant	Shoot dry weight	EC	10	NOEC
<i>G. max</i>	Plant	Shoot dry weight	EC	10	NOEC
<i>G. max</i>	Plant	Shoot dry weight	EC	5	NOEC
<i>G. max</i>	Plant	Shoot dry weight	EC	10	NOEC
<i>R. sativus</i>	Plant	Shoot dry weight	EC	10	NOEC
<i>L. sativa</i>	Plant	Shoot dry weight	EC	2	NOEC
Field bean ( <i>P. vulgaris</i> )	Plant	Bean dry weight	EC	20	NOEC
<i>G. max</i>	Plant	Bean dry weight	EC	2.5	NOEC
Wheat ( <i>T. aestivum</i> )	Plant	Grain weight	EC	20	NOEC
<i>Z. mays</i>	Plant	Kernel weight	EC	10	NOEC
<i>L. esculentum</i>	Plant	Ripe fruit weight	EC	80	NOEC
Zucchini squash ( <i>C. pepo</i> )	Plant	Fruit weight	EC	80	NOEC
<i>L. sativa</i>	Plant	Head weight	EC	5	NOEC
Curlycress ( <i>L. sativum</i> )	Plant	Shoot weight	EC	5	NOEC
<i>Brassica rapa</i>	Plant	Tuber weight	EC	10	NOEC
<i>B. rapa</i>	Plant	Tuber weight	EC	40	NOEC
Carrot ( <i>D. carota</i> )	Plant	Tuber weight	EC	10	NOEC
<i>G. max</i>	Plant	Shoot dry weight	EC	100	47
<i>G. max</i>	Plant	Shoot dry weight	EC	100	66
<i>A. caliginosa</i>	Invertebrate	Cocoon production	EC	10	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Cocoons/worm	EC	18	23
Earthworm ( <i>E. andrei</i> )	Invertebrate	Juveniles/worm	EC	18	22
Earthworm ( <i>E. andrei</i> )	Invertebrate	Growth	EC	32	40

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. andrei</i> )	Invertebrate	Growth	EC	100	44
Earthworm ( <i>D. rubida</i> )	Invertebrate	Cocoons/worm	EC	100	62
Earthworm ( <i>D. rubida</i> )	Invertebrate	Cocoons/worm	EC	100	78
Earthworm ( <i>D. rubida</i> )	Invertebrate	Hatchlings/cocoon	EC	100	71
Earthworm ( <i>D. rubida</i> )	Invertebrate	Total hatchlings	EC	100	74
Earthworm ( <i>D. rubida</i> )	Invertebrate	% Cocoon hatching success	EC	100	47
Earthworm ( <i>D. rubida</i> )	Invertebrate	Hatchlings/cocoon	EC	100	38
Earthworm ( <i>D. rubida</i> )	Invertebrate	Total hatchlings	EC	100	30
<i>A. caliginosa</i>	Invertebrate	Cocoon production	EC	10	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Growth	EC	10	NOEC
Earthworm ( <i>D. rubida</i> )	Invertebrate	Cocoons/worm	EC	10	NOEC
Earthworm ( <i>D. rubida</i> )	Invertebrate	Cocoons/worm hatchlings/cocoon	EC	10	NOEC
Earthworm ( <i>D. rubida</i> )	Invertebrate	% Cocoon hatching success	EC	10	NOEC

**Notes:**

Geometric mean (GM) – For redundant data, a single composite response concentration was calculated as the geometric mean of the individual values.

**Chromium (Chemical Abstract Service Number 7440-47-3)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Growth	EC	287	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Growth	EC	972	34
Earthworm ( <i>E. andrei</i> )	Invertebrate	Cocoon production	EC	287	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Cocoon production	EC	972	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	900	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1733	LOEC (72%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1133	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1400	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	323	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	677	LOEC (80%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	423	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	573	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seed germination	EC	230	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	510	LOEC (82%)
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	297	25
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	397	50
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	57	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	113	LOEC (26%)
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	106	25
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	146	50
Radish ( <i>Raphanus sativus</i> )	Plant	Seed germination	EC	117	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	243	LOEC (58%)
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	150	25
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	207	50
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	56	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	107	LOEC (41%)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	82	25
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	127	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	748	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1579	LOEC (90%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	956	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1195	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	235	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	466	LOEC (10%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	543	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	671	50
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	97	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	205	LOEC (33%)
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	146	25
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	274	50
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	49	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	100	LOEC (49%)
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	64	25
Lettuce ( <i>L. sativa</i> )	Plant	Seed germination	EC	100	50
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	23	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	45	LOEC (23%)
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	51	25
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	116	50
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	24	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	49	LOEC (14%)
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	59	25
Radish ( <i>R. sativus</i> )	Plant	Seed germination	EC	81	50
Corn ( <i>Zea mays</i> )	Plant	Forage yield	EC	80	NOEC
Corn ( <i>Z. mays</i> )	Plant	Forage yield	EC	320	LOEC (55%)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Oats ( <i>Avena sativa</i> )	Plant	Yield	EC	11	NOEC
Oats ( <i>A. sativa</i> )	Plant	Yield	EC	31	50
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Yield	EC	10	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Yield	EC	21	50
Ryegrass ( <i>Lolium perenne</i> )	Plant	Dry matter yield	EC	500	68
Ryegrass ( <i>L. perenne</i> )	Plant	Dry matter yield	EC	500	45
Ryegrass ( <i>L. perenne</i> )	Plant	Dry matter yield	EC	500	68
Ryegrass ( <i>L. perenne</i> )	Plant	Dry matter yield	EC	500	45

**Cobalt (Chemical Abstract Service Number 7440-48-4)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>Raphanus sativus</i> L.)	Plant	Shoot length	EC	488	50
Radish ( <i>R. sativus</i> L.)	Plant	Root length	EC	243	50
Radish ( <i>R. sativus</i> L.)	Plant	Shoot dry weight	EC	2213	50
Radish ( <i>R. sativus</i> L.)	Plant	Root dry weight	EC	741	50
Red Clover ( <i>Trifolium pratense</i> L.)	Plant	Emergence	EC	865	50
Red Clover ( <i>T. pratense</i> L.)	Plant	Shoot length	EC	914	50
Red Clover ( <i>T. pratense</i> L.)	Plant	Root length	EC	163	50
Red Clover ( <i>T. pratense</i> L.)	Plant	Shoot dry weight	EC	783	50
Red Clover ( <i>T. pratense</i> L.)	Plant	Root dry weight	EC	69.5	50
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Shoot length	EC	673	50
Tomato ( <i>L. esculentum</i> )	Plant	Root length	EC	561	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot dry weight	EC	847	50
Tomato ( <i>L. esculentum</i> )	Plant	Root dry weight	EC	220	50
Northern Wheatgrass ( <i>Elymus lanceolatus</i> )	Plant	Shoot length	EC	1364	50
Northern Wheatgrass ( <i>E. lanceolatus</i> )	Plant	Root length	EC	271	50
Northern Wheatgrass ( <i>E. lanceolatus</i> )	Plant	Shoot dry weight	EC	1175	50
Northern Wheatgrass ( <i>E. lanceolatus</i> )	Plant	Root dry weight	EC	250	50
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Juvenile (# produced)	EC	16.4	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Juvenile dry weight	EC	70.5	50
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Juvenile	EC	432	50
Radish ( <i>R. sativus</i> L.)	Plant	Shoot length	EC	119	10
Radish ( <i>R. sativus</i> L.)	Plant	Root length	EC	22.2	10
Radish ( <i>R. sativus</i> L.)	Plant	Shoot dry weight	EC	452	10
Radish ( <i>R. sativus</i> L.)	Plant	Root dry weight	EC	407	10
Red Clover ( <i>T. pratense</i> L.)	Plant	Emergence	EC	287	10
Red Clover ( <i>T. pratense</i> L.)	Plant	Shoot length	EC	102	10

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Red Clover ( <i>T. pratense</i> L.)	Plant	Root length	EC	93	10
Red Clover ( <i>T. pratense</i> L.)	Plant	Shoot dry weight	EC	516	10
Red Clover ( <i>T. pratense</i> L.)	Plant	Root dry weight	EC	11.9	10
Northern Wheatgrass ( <i>E. lanceolatus</i> )	Plant	Shoot length	EC	189	10
Northern Wheatgrass ( <i>E. lanceolatus</i> )	Plant	Root length	EC	64.6	10
Northern Wheatgrass ( <i>E. lanceolatus</i> )	Plant	Shoot dry weight	EC	524	10
Northern Wheatgrass ( <i>E. lanceolatus</i> )	Plant	Root dry weight	EC	44.4	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot length	EC	98	10
Tomato ( <i>L. esculentum</i> )	Plant	Root length	EC	267	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot dry weight	EC	426	10
Tomato ( <i>L. esculentum</i> )	Plant	Root dry weight	EC	49.7	10
Springtail ( <i>F. candida</i> )	Invertebrate	Juvenile production	EC	181	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Juvenile production	EC	4.23	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Individual juvenile dry mass	EC	57.27	10
Alfalfa ( <i>Medicago sativa</i> )	Plant	Growth	EC	0.6	20
Barley ( <i>Hordeum vulgare</i> )	Plant	Growth	EC	29.8	20
Radish ( <i>R. sativus</i> L.)	Plant	Growth	EC	14.5	20
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	13.4	20
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	36.4	20
Radish ( <i>R. sativus</i> L.)	Plant	Growth	EC	45.2	20
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	62.7	20
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot height	EC	15.3	20
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	9.4	20
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry weight	EC	6.3	20
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry weight	EC	5.2	20
Alfalfa ( <i>M. sativa</i> )	Plant	Nodule number	EC	0.6	20
Barley ( <i>H. vulgare</i> )	Plant	Emergence	EC	118	20
Barley ( <i>H. vulgare</i> )	Plant	Shoot height	EC	44.7	20

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Barley ( <i>H. vulgare</i> )	Plant	Root length	EC	34.2	20
Barley ( <i>H. vulgare</i> )	Plant	Shoot dry weight	EC	29.5	20
Barley ( <i>H. vulgare</i> )	Plant	Root dry weight	EC	47.4	20
Radish ( <i>R. sativus</i> L.)	Plant	Emergence	EC	496.2	20
Radish ( <i>R. sativus</i> L.)	Plant	Mortality	EC	360.2	20
Radish ( <i>R. sativus</i> L.)	Plant	Shoot height	EC	59.7	20
Radish ( <i>R. sativus</i> L.)	Plant	Root length	EC	41.2	20
Radish ( <i>R. sativus</i> L.)	Plant	Shoot dry weight	EC	13.9	20
Radish ( <i>R. sativus</i> L.)	Plant	Root dry weight	EC	20.7	20
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	62.6	20
Alfalfa ( <i>M. sativa</i> )	Plant	Mortality	EC	2362.4	20
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot height	EC	15.9	20
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	22.1	20
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry weight	EC	11.5	20
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry weight	EC	15.3	20
Alfalfa ( <i>M. sativa</i> )	Plant	Nodule number	EC	12.4	20
Barley ( <i>H. vulgare</i> )	Plant	Emergence	EC	536.2	20
Barley ( <i>H. vulgare</i> )	Plant	Mortality	EC	1082.5	20
Barley ( <i>H. vulgare</i> )	Plant	Shoot height	EC	108.9	20
Barley ( <i>H. vulgare</i> )	Plant	Root length	EC	37.5	20
Barley ( <i>H. vulgare</i> )	Plant	Shoot dry weight	EC	164.2	20
Barley ( <i>H. vulgare</i> )	Plant	Root dry weight	EC	130	20
Radish ( <i>R. sativus</i> L.)	Plant	Emergence	EC	393.2	20
Radish ( <i>R. sativus</i> L.)	Plant	Mortality	EC	203.5	20
Radish ( <i>R. sativus</i> L.)	Plant	Shoot height	EC	94	20
Radish ( <i>R. sativus</i> L.)	Plant	Root length	EC	45.3	20
Radish ( <i>R. sativus</i> L.)	Plant	Shoot dry weight	EC	72.7	20
Radish ( <i>R. sativus</i> L.)	Plant	Root dry weight	EC	130.1	20

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	120	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	79	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	224	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	10	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	13	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	45	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	10	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	18	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	49	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	80	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	73	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	171	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	160	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	154	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	519	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	160	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	255	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	567	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	160	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	153	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	404	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	160	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	106	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	312	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	50	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	116	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	529	50
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	200	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	227	10
Barley ( <i>H. vulgare</i> )	Plant	Root growth	EC	863	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	28	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	26	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	136	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	9	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	9	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	40	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	12	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	10	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	42	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	39	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	68	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	139	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	34	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	23	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	288	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	37	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	220	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	532	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	18	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	23	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	317	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	156	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	198	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	374	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	366	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	308	10

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	1621	50
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	821	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	617	10
Barley ( <i>H. vulgare</i> )	Plant	Shoot biomass	EC	1708	50
Rapeseed ( <i>Brassica napus</i> )	Plant	Shoot biomass	EC	11	NOEC
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	19	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	82	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	1	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	7	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	2	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	9	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	21	NOEC
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	17	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	59	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	21	NOEC
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	4	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	129	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	37	NOEC
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	25	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	220	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	41	NOEC
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	19	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	118	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	83	NOEC
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	20	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	231	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	182	NOEC
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	102	10

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	812	50
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	28	10
Rapeseed ( <i>B. napus</i> )	Plant	Shoot biomass	EC	966	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	28	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	21	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	57	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	9	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	1	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	7	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	10	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	8	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	22	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	34	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	19	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	50	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	37	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	68	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	142	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	43	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	90	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	42	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	82	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	140	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	44	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	113	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	436	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	379	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	192	10

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Tomato ( <i>L. esculentum</i> )	Plant	Shoot biomass	EC	733	50
Barley ( <i>H. vulgare</i> )	Plant	Root inhibition	EC	341	50
Barley ( <i>H. vulgare</i> )	Plant	Root inhibition	EC	180	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Root inhibition	EC	166	50
Barley ( <i>H. vulgare</i> )	Plant	Root inhibition	EC	180	NOEC

## Copper (Chemical Abstract Service Number 7440-50-8)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Yield	EC	175	30
Tomato ( <i>L. esculentum</i> )	Plant	Yield	EC	700	50
Snap bean ( <i>Phaseolus vulgaris</i> )	Plant	Growth	EC	200	26
Snap bean ( <i>P. vulgaris</i> )	Plant	Growth	EC	500	100
Radish ( <i>Raphanus sativus</i> )	Plant	Seed emergence	LC	31	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seed emergence	LC	62	25
Radish ( <i>R. sativus</i> )	Plant	Seed emergence	LC	90	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seed emergence	LC	47	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seed emergence	LC	67	25
Lettuce ( <i>L. sativa</i> )	Plant	Seed emergence	LC	97	50
Snap bean ( <i>P. vulgaris</i> )	Plant	Yield	EC	36	NOEC
Snap bean ( <i>P. vulgaris</i> )	Plant	Yield	EC	329	50
<i>Banksia ericifolia</i>	Plant	Emergence	LC	1520	50
<i>B. ericifolia</i>	Plant	Growth	EC	610	50
<i>Casuarina distyla</i>	Plant	Emergence	LC	580	50
<i>C. distyla</i>	Plant	Growth	EC	205	50
<i>Eucalyptus exima</i>	Plant	Emergence	LC	1845	50
<i>E. exima</i>	Plant	Growth	EC	560	50
<i>Avena sativa</i>	Plant	Emergence	LC	1765	50
<i>A. sativa</i>	Plant	Growth	EC	535	50
<i>Cucumis sativa</i>	Plant	Emergence	LC	1725	50
<i>C. sativa</i>	Plant	Growth	EC	540	50
<i>Glycine max</i>	Plant	Emergence	LC	1140	50
<i>G. max</i>	Plant	Growth	EC	550	50
Jack pine ( <i>Pinus banksiana</i> )	Plant	Radicle (root) elongation	EC	100	24
White pine ( <i>Pinus strobus</i> )	Plant	Radicle (root) elongation	EC	50	NOEC
White pine ( <i>P. strobus</i> )	Plant	Radicle (root) elongation	EC	100	15

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
White spruce ( <i>Picea glauca</i> )	Plant	Radicle (root) elongation	EC	50	NOEC
White spruce ( <i>P. glauca</i> )	Plant	Radicle (root) elongation	EC	100	16
Red pine ( <i>Pinus resinosa</i> )	Plant	Radicle (root) elongation	EC	50	NOEC
Red pine ( <i>P. resinosa</i> )	Plant	Radicle (root) elongation	EC	250	33
Paper birch ( <i>Betula papyrifera</i> )	Plant	Radicle (root) elongation	EC	50	18
Earthworm ( <i>Eisenia foetida andrei</i> )	Invertebrate	Cocoon production (Phase	EC	62	50
Earthworm ( <i>E. foetida andrei</i> )	Invertebrate	Cocoon hatching (Phase A)	EC	300	NOEC
Earthworm ( <i>E. foetida andrei</i> )	Invertebrate	Cocoon production (Phase	EC	191	50
Earthworm ( <i>E. foetida andrei</i> )	Invertebrate	Cocoon production (Phase	EC	120	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	643	50
Earthworm ( <i>Lumbricus rubellus</i> )	Invertebrate	Body weight	EC	131	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Body weight	EC	372	19
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Litter activity	EC	63	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Litter activity	EC	136	23
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	13	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	63	41
Earthworm ( <i>Aporrectodea caliginosa</i> )	Invertebrate	Cocoon production	EC	27	10
Earthworm ( <i>A. caliginosa</i> )	Invertebrate	Cocoon production	EC	68	50
Earthworm ( <i>Allolobophora chlorotica</i> )	Invertebrate	Cocoon production	EC	28	10
Earthworm ( <i>A. chlorotica</i> )	Invertebrate	Cocoon production	EC	51	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	80	10
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	122	50
Earthworm ( <i>Octolasion cyaneum</i> )	Invertebrate	Mortality	LC	181	50
Nematode ( <i>Caenorhabditis elegans</i> )	Invertebrate	Mortality	LC	619	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	175	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	380	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	280	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	447	70

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	210	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality (56 day)	LC	555	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality (14 day)	LC	683	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	53.5	50
Earthworm ( <i>E. foetida andrei</i> )	Invertebrate	Growth	EC	56	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	150	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	1000	50
Earthworm ( <i>A. caliginosa</i> )	Invertebrate	Weight	EC	81.8	50
Citrus hybrid	Plant	Biomass	EC	100	NOEC (7%)
Citrus hybrid	Plant	Biomass	EC	200	LOEC (17%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1460	50
Springtail ( <i>Folsomia candida</i> )	Invertebrate	General reproduction	EC	519	50
Springtail ( <i>F. candida</i> )	Invertebrate	General reproduction	EC	50	10
Springtail ( <i>Folsomia fimetaria</i> )	Invertebrate	General reproduction	EC	657	50
Springtail ( <i>F. fimetaria</i> )	Invertebrate	General reproduction	EC	141	10
Bindweed ( <i>Fallopia convolvulus</i> )	Plant	Biomass (root)	EC	275	50
Cotton ( <i>Gossypium barbadense</i> )	Plant	Biomass (leaf)	EC	400	LOEC (35%)
Cotton ( <i>G. barbadense</i> )	Plant	Biomass (leaf)	EC	200	NOEC (5%)
Cotton ( <i>Gossypium hirsutum</i> )	Plant	Biomass (stem)	EC	200	NOEC (10%)
Cotton ( <i>G. hirsutum</i> )	Plant	Biomass (leaf)	EC	400	LOEC (49%)
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Weight	EC	148	NOEC
Alfalfa ( <i>Medicago Sativa</i> )	Plant	Biomass (shoot)	EC	113	LOEC (30%)
Red clover ( <i>Trifolium pratense</i> )	Plant	Biomass (shoot)	EC	113	LOEC (37%)
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass (above ground)	EC	257	10
Snap bean ( <i>P. vulgaris</i> )	Plant	Biomass	EC	74	NOEC (2%)
Snap bean ( <i>P. vulgaris</i> )	Plant	Biomass	EC	222	LOEC (97%)
Bindweed ( <i>Polygonum convolvulus</i> L.)	Plant	Biomass	EC	200	NOEC (8%)
Bindweed ( <i>P. convolvulus</i> L.)	Plant	Mortality	LC	125	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Bindweed ( <i>P. convolvulus</i> L.)	Plant	Biomass	EC	315	LOEC (62%)
Bindweed ( <i>F. convolvulus</i> )	Plant	Germination	LC	391	NOEC
Bindweed ( <i>F. convolvulus</i> )	Plant	Mortality	LC	232	NOEC
Wheat ( <i>Triticum aestivum</i> )	Plant	Biomass	EC	20	NOEC
Wheat ( <i>T. aestivum</i> )	Plant	Biomass	EC	40	LOEC (13%)
Corn ( <i>Zea mays</i> )	Plant	Biomass	EC	180	NOEC
Corn ( <i>Z. mays</i> )	Plant	Biomass	EC	375	LOEC (17%)
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	115	10
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	58	10
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	32	10
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	1253	10
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	821	10
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	41	10
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	326.4	20
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	674	20
Barley ( <i>Hordeum vulgare</i> var. <i>Chapais</i> )	Plant	Growth	EC	143	20
Barley ( <i>H. vulgare</i> var. <i>Chapais</i> )	Plant	Growth	EC	0.74	20
Barley ( <i>H. vulgare</i> var. <i>Chapais</i> )	Plant	Growth	EC	234.8	20
Carrot ( <i>Daucus carota</i> var. <i>Royal Chatenay</i> )	Plant	Growth	EC	659	20
Corn ( <i>Zea mays</i> var. <i>Kandy Korn</i> )	Plant	Growth	EC	407.6	20
Corn ( <i>Z. mays</i> var. <i>Kandy Korn</i> )	Plant	Growth	EC	776.2	20
Cucumber ( <i>Cucumis sativa</i> var. <i>Marketer</i> )	Plant	Growth	EC	506	20
Cucumber ( <i>C. sativa</i> var. <i>Marketer</i> )	Plant	Growth	EC	804.9	20
Grama grass ( <i>Bouteloua graciiss</i> )	Plant	Growth	EC	471.3	20
Northern wheatgrass ( <i>Agropyron dasystachyum</i> )	Plant	Growth	EC	151.7	20
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Growth	EC	391.3	20
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Growth	EC	801.6	20
Radish ( <i>Raphanus sativus</i> var. <i>Champion</i> )	Plant	Growth	EC	347.3	20

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>R. sativus</i> var. <i>Champion</i> )	Plant	Growth	EC	322.7	20
Bindweed ( <i>P. convolvulus</i> )	Plant	Growth	EC	272	50
Bindweed ( <i>F. convolvulus</i> )	Plant	Growth	EC	284	50
Bindweed ( <i>F. convolvulus</i> )	Plant	Growth	EC	258	50
Bindweed ( <i>F. convolvulus</i> )	Plant	Growth	EC	259	50
Bindweed ( <i>F. convolvulus</i> )	Plant	Growth	EC	329	50
Bindweed ( <i>F. convolvulus</i> )	Plant	Growth	EC	260	50
Bindweed ( <i>F. convolvulus</i> )	Plant	Growth	EC	291	50
Jack pine ( <i>Pinus banksiana</i> Lamb.)	Plant	Growth	EC	400	NOEC
Black spruce ( <i>Pinus mariana</i> (Mill) B.S.P.)	Plant	Growth	EC	400	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	1600	NOEC
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Reproduction	EC	38	10
Springtail ( <i>Onychiurus folsomi</i> )	Invertebrate	Reproduction	EC	425	20
Nematode	Invertebrate	Population	EC	168	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	29	NOEC
Earthworm ( <i>Lumbricus terrestris</i> )	Invertebrate	Mortality	LC	98	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	20	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	25	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	186	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	252	50
Earthworm ( <i>Enchytraeus crypticus</i> )	Invertebrate	Mortality	LC	477	50
Earthworm ( <i>E. crypticus</i> )	Invertebrate	Mortality	LC	873	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	53	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	643	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1272	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	431	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	463	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	632	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>L. terrestris</i> )	Invertebrate	Mortality	LC	456	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	721	50
Earthworm ( <i>L. terrestris</i> )	Invertebrate	Mortality	LC	313	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	596	50
Earthworm ( <i>L. terrestris</i> )	Invertebrate	Mortality	LC	486	50
<i>Dendrobaena rubida</i>	Invertebrate	Cocoons/worm	EC	100	70
<i>D. rubida</i>	Invertebrate	Hatchlings/cocoon	EC	100	64
Earthworm ( <i>E. foetida andrei</i> )	Invertebrate	Growth	EC	100	32
<i>A. caliginosa</i>	Invertebrate	Cocoon production	EC	100	36
<i>Allolobophora caliginosa</i>	Invertebrate	Cocoon production	EC	110	27
<i>A. caliginosa</i>	Invertebrate	Total hatchlings	EC	110	74
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	148	26
<i>O. cyaneum</i>	Invertebrate	Survival	LC	180	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	180	36
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	278	33
<i>D. rubida</i>	Invertebrate	Cocoons/worm	EC	500	96
<i>D. rubida</i>	Invertebrate	Hatchlings/cocoon%	EC	500	100
<i>D. rubida</i>	Invertebrate	Hatching success	EC	500	100
<i>D. rubida</i>	Invertebrate	Cocoons/worm	EC	500	90
<i>D. rubida</i>	Invertebrate	Hatchlings/cocoon	EC	500	100
<i>D. rubida</i>	Invertebrate	% Hatching success	EC	500	100
Earthworm ( <i>E. foetida</i> )	Invertebrate	Growth	EC	601	50
<i>O. cyaneum</i>	Invertebrate	Survival	LC	850	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Survival	LC	1000	82
Earthworm ( <i>E. foetida andrei</i> )	Invertebrate	Growth	EC	32	NOEC
<i>A. caliginosa</i>	Invertebrate	Cocoon production	EC	50	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	83	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	120	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Cocoon production	EC	148	NOEC
<i>D. rubida</i>	Invertebrate	Cocoons/worm	EC	100	NOEC
<i>D. rubida</i>	Invertebrate	Cocoons/worm	EC	100	NOEC

## Cyanide (Chemical Abstract Service Number 57-12-5)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Bush Beans ( <i>Phaseolus vulgaris</i> )	Plant	Leaf yield reduction	EC	26.54	50
Bush Beans ( <i>P. vulgaris</i> )	Plant	Leaf yield reduction	EC	53.09	75
Bush Beans ( <i>P. vulgaris</i> )	Plant	Leaf yield reduction	EC	13.27	56
Bush Beans ( <i>P. vulgaris</i> )	Plant	Leaf yield reduction	EC	26.54	42
Bush Beans ( <i>P. vulgaris</i> )	Plant	Leaf yield reduction	EC	13.27	52
Bush Beans ( <i>P. vulgaris</i> )	Plant	Leaf yield reduction	EC	26.54	44
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	0.9	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	1.2	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	2.9	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	8	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	12	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	16	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	12	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	14	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	18	50
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	1	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	1	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	2	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	2	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	2	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	10	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	3	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	4	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	5	50

**Diisopropanolamine [DIPA] (Chemical Abstract Service Number 110-97-4)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>Lactuca sativa</i> )	Plant	Emergence	EC	6300	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	7400	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	9400	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	1750	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	1310	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	3840	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	10400	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	15400	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	20400	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	1700	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	1700	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	2260	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	3480	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	4830	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	6210	50
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	3490	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	4530	25
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	10400	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	15800	25
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	1700	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	3480	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	810	25
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	5480	50
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	873	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	1220	25
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	3750	50
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	2600	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	5660	25
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	14000	50
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	212	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	635	25
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	1391	50
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	1740	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	2930	50
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	3490	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	5820	25
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	20800	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	1700	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	3480	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	5230	25
Carrot ( <i>Daucus carota</i> )	Plant	Emergence	EC	3490	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	4280	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	6980	50
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	5460	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	8700	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	24600	50
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	1700	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	2280	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	2870	50
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	3480	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	4290	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	5180	50
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	6980	NOEC
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	21900	NOEC
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	3390	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	3480	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	873	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	1880	25
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	3670	50
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	5460	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	8510	25
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	12000	50
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	212	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	355	25
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	1810	50
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	1710	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	2050	25
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	3490	NOEC
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	4890	25
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	10900	NOEC
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	17000	25
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	1700	NOEC
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	2140	25
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	3360	50
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	3480	NOEC
Alfalfa ( <i>Medicago Sativa</i> )	Plant	Emergence	EC	6980	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	7310	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	9540	50
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	10400	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	14300	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	20400	50
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1700	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	2000	25

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	2460	50
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	3480	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	3620	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	4740	50
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	6980	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	10400	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	14200	25
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	1700	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	3480	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	810	25
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	5480	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	873	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	1590	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	2780	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	650	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	1580	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	9240	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	424	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	718	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	871	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	1410	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	2780	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1750	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	4760	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	20800	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	17800	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1700	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	3480	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Timothy grass ( <i>Phleum pratense</i> )	Plant	Emergence	EC	3480	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	5850	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	8430	50
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	21900	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	25600	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	32200	50
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	1700	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	2340	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	2980	50
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	3480	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	6530	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	9070	50
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	1750	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	1950	25
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	3230	50
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	10900	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	9680	25
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	424	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	606	25
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	1680	50
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	6970	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	1750	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	4080	25
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	5290	50
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	10900	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	1820	25
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	20900	50
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	424	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	1590	25
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	2260	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	1750	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	3830	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	5700	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	10900	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	15200	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	19600	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	847	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	1870	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	2790	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	3480	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	4490	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	6090	50
Earthworm ( <i>Eisenia fetida</i> )	Invertebrate	Survival	LC	5000	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	7600	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	11000	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	3440	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	8540	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	10230	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	18470	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	23100	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	27700	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	1670	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	2070	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	2490	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	1670	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	2090	25

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	2510	50

## Ethylbenzene (Chemical Abstract Service Number 100-41-4)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Northern wheatgrass ( <i>Agropyron dasystachyum</i> )	Plant	Shoot length	EC	870	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	150	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	274	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	112	25
Alfalfa ( <i>Medicago Sativa</i> )	Plant	Shoot length	EC	1178	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	506	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	462	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	560	25
Collembolan ( <i>Orchesella folsomi</i> )	Invertebrate	Mortality	LC	576	25
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	594	NOEC
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Mortality	LC	16	NOEC
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	2416	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	664	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	652	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	545	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	503	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	321	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	316	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	372	25
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	259	25
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	16	25
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	112	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1701	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	830	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	1013	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	816	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	7038	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	620	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	681	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	681	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	2244	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	565	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	1474	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	483	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	6233	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	1613	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	2626	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	1260	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	982	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	1713	50

**Ethylene Glycol (Chemical Abstract Service Number 107-21-1)**

<b>Species</b>	<b>Receptor Category</b>	<b>Endpoint</b>	<b>EC/LC</b>	<b>Concentration (mg/kg)</b>	<b>Effect (%)</b>
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	3500	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	7400	LOEC (41%)
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	5300	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	7300	25
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	5700	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	11700	LOEC (64%)
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	7300	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	10000	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality (14d)	LC	16000	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality (14d)	LC	20000	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality (14d)	LC	25000	50

**Lead (Chemical Abstract Service Number 7439-92-1)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alyssum ( <i>Alyssum pintodasilvae</i> )	Plant	Growth	EC	100	LOEC (9%)
Nematode ( <i>Caenorhabditis elegans</i> )	Invertebrate	Mortality	LC	2293	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	3240	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Weight	EC	1886	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Weight	EC	2249	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	1940	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	4726	50
Barley ( <i>Hordeum vulgare</i> )	Plant	Biomass	EC	232	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Length	EC	559	NOEC
Ryegrass ( <i>Lolium</i> sp)	Plant	Biomass	EC	50	NOEC
Earthworm ( <i>Lumbricus rubellus</i> )	Invertebrate	Mortality	LC	1000	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Weight	EC	1000	NOEC
Loblolly pine ( <i>Pinus taeda</i> )	Plant	Biomass	EC	600	NOEC (25%)
Loblolly pine ( <i>P. taeda</i> )	Plant	Biomass	EC	1200	LOEC (60%)
Northern red oak ( <i>Quercus rubra</i> )	Plant	Biomass	EC	100	NOEC
Annual sow thistle ( <i>Sonchus oleraceus</i> )	Plant	Biomass	EC	1600	NOEC (16%)
Annual sow thistle ( <i>S. oleraceus</i> )	Plant	Biomass	EC	3200	LOEC (32%)
Fenugreek ( <i>Trigonella foenum-graceum</i> )	Plant	Biomass	EC	200	NOEC (10%)
Fenugreek ( <i>T. foenum-graceum</i> )	Plant	Biomass	EC	400	LOEC (20%)
Corn ( <i>Zea mays</i> )	Plant	Length	EC	125	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	2190	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	4480	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	3760	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	1810	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	1940	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Growth	EC	1000	NOEC
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Growth	EC	3000	LOEC (41%)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>D. rubida</i> )	Invertebrate	Total # hatchlings	EC	100	11
Earthworm ( <i>D. rubida</i> )	Invertebrate	Total # hatchlings	EC	100	22
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	5914	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1433	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	2067	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	2500	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	2967	70
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	421	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	808	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	1236	50
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	917	LOEC (31%)
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	416	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	654	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	876	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	791	LOEC (50%)
Red oak ( <i>Q. rubra</i> )	Plant	Total dry weight	EC	20	NOEC
Red oak ( <i>Q. rubra</i> )	Plant	Total dry weight	EC	50	LOEC (26%)
Oats ( <i>Avena sativa</i> )	Plant	Seed yield	EC	250	NOEC
Ryegrass ( <i>Lolium hybridum</i> )	Plant	Yield	EC	250	NOEC
Loblolly pine ( <i>P. taeda</i> )	Plant	Height	EC	556.5	NOEC
Loblolly pine ( <i>P. taeda</i> )	Plant	Height	EC	1179	LOEC (30%)
Loblolly pine ( <i>P. taeda</i> )	Plant	Dry shoot weight	EC	556.5	NOEC
Loblolly pine ( <i>P. taeda</i> )	Plant	Dry shoot weight	EC	1179	LOEC (38%)
Loblolly pine ( <i>P. taeda</i> )	Plant	Dry root weight	EC	556.5	NOEC
Loblolly pine ( <i>P. taeda</i> )	Plant	Dry root weight	EC	1179	LOEC (61%)
Oats ( <i>A. sativa</i> )	Plant	Root biomass	EC	100	NOEC
Oats ( <i>A. sativa</i> )	Plant	Root biomass	EC	500	LOEC (37%)
Wheat ( <i>Triticum aestivum</i> )	Plant	Root biomass	EC	500	LOEC (15%)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Dry fruit weight	EC	300	NOEC
Tomato ( <i>L. esculentum</i> )	Plant	Dry fruit weight	EC	600	LOEC (25%)
Eggplant ( <i>Solanum melongena</i> )	Plant	Dry shoot weight	EC	300	NOEC
Eggplant ( <i>S. melongena</i> )	Plant	Dry shoot weight	EC	600	LOEC (42%)
Corn ( <i>Z. mays</i> )	Plant	Root elongation	EC	100	NOEC
Corn ( <i>Z. mays</i> )	Plant	Root elongation	EC	250	LOEC (19%)
Corn ( <i>Z. mays</i> )	Plant	Dry shoot weight	EC	125	LOEC (18%)
Corn ( <i>Z. mays</i> )	Plant	Dry shoot weight	EC	125	LOEC (29%)
Corn ( <i>Z. mays</i> )	Plant	Dry shoot weight	EC	125	LOEC (13%)
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	25	8
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	50	12
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	100	23
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	400	33
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	25	3
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	50	21
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	100	35
Tomato ( <i>L. esculentum</i> )	Plant	Dry weight	EC	400	40
Onion ( <i>Allium cepa</i> )	Plant	Dry weight	EC	50	LOEC (11%)
Fenugreek ( <i>T. foenum-graceum</i> )	Plant	Dry weight	EC	200	NOEC
Fenugreek ( <i>T. foenum-graceum</i> )	Plant	Dry weight	EC	400	LOEC (20%)
Radish ( <i>R. sativus</i> )	Plant	Shoot growth reduction	EC	2000	50
Radish ( <i>R. sativus</i> )	Plant	Shoot growth reduction	EC	1800	50
Radish ( <i>R. sativus</i> )	Plant	Shoot growth reduction	EC	12000	50
Radish ( <i>R. sativus</i> )	Plant	Shoot growth reduction	EC	10000	50
Wheat ( <i>T. estiva</i> )	Plant	Dry stem weight	EC	300	15
Wheat ( <i>T. estiva</i> )	Plant	Dry stem weight	EC	1000	7
Wheat ( <i>T. estiva</i> )	Plant	Dry stem weight	EC	3000	24
Wheat ( <i>T. estiva</i> )	Plant	Dry stem weight	EC	10000	34

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Wheat ( <i>T. estiva</i> )	Plant	Dry root weight	EC	300	13
Wheat ( <i>T. estiva</i> )	Plant	Dry root weight	EC	1000	12
Wheat ( <i>T. estiva</i> )	Plant	Dry root weight	EC	3000	37
Wheat ( <i>T. estiva</i> )	Plant	Dry root weight	EC	10000	44
Wheat ( <i>T. estiva</i> )	Plant	Dry grain weight	EC	300	NOEC
Wheat ( <i>T. estiva</i> )	Plant	Dry grain weight	EC	1000	3
Wheat ( <i>T. estiva</i> )	Plant	Dry grain weight	EC	3000	NOEC
Wheat ( <i>T. estiva</i> )	Plant	Dry grain weight	EC	10000	29
Loblolly pine ( <i>P. taeda</i> )	Plant	Growth	EC	480	NOEC
Spinach ( <i>Spinacia oleracea</i> )	Plant	Growth	EC	600	NOEC
Alfalfa ( <i>Medicago sativa</i> )	Plant	Growth	EC	250	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	250	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	250	NOEC
Radish ( <i>R. sativus</i> )	Plant	Growth	EC	600	NOEC
Carrot ( <i>Daucus carota</i> )	Plant	Growth	EC	85	NOEC
Peas ( <i>Pisum sativum</i> )	Plant	Growth	EC	85	NOEC
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	1000	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	250	NOEC
Spinach ( <i>S. oleracea</i> )	Plant	Growth	EC	600	NOEC
Radish ( <i>R. sativus</i> )	Plant	Growth	EC	600	NOEC
Radish ( <i>R. sativus</i> )	Plant	Growth	EC	600	NOEC
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	285	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	297	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	847	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1341	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1554	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	891	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	13.9	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	11.6	50
<i>Dendrobaena rubida</i>	Invertebrate	Cocoons/worm	EC	100	NOEC
<i>D. rubida</i>	Invertebrate	Cocoons/worm	EC	500	75
<i>D. rubida</i>	Invertebrate	Hatchlings/cocoon	EC	500	100
Earthworm ( <i>E. foetida</i> )	Invertebrate	Survival	LC	5941	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	5000	80

**Manganese (Chemical Abstract Service Number 7439-96-5)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Potworm ( <i>Enchytraeus crypticus</i> )	Invertebrate	Adult survival	LC	191	NOEC (3%)
Potworm ( <i>E. crypticus</i> )	Invertebrate	Adult survival	LC	267	LOEC (5%)
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	116	20
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	192	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	157	NOEC (5%)
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	191	LOEC (43%)
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Reproduction	EC	1209	20
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	1663	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	1067	NOEC (17%)
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	1100	LOEC (22%)
Springtail ( <i>F. candida</i> )	Invertebrate	Survival	LC	1667	NOEC (12%)
Springtail ( <i>F. candida</i> )	Invertebrate	Survival	LC	2444	LOEC (57%)
Earthworm ( <i>Eisenia fetida</i> )	Invertebrate	Cocoon production	EC	629	20
Earthworm ( <i>E. fetida</i> )	Invertebrate	Cocoon production	EC	927	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Cocoon production	EC	1111	NOEC (60%)
Earthworm ( <i>E. fetida</i> )	Invertebrate	Cocoon production	EC	1236	LOEC (79%)
Earthworm ( <i>E. fetida</i> )	Invertebrate	Adult survival	LC	1718	20
Earthworm ( <i>E. fetida</i> )	Invertebrate	Adult survival	LC	1970	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Adult survival	LC	1444	NOEC (4%)
Earthworm ( <i>E. fetida</i> )	Invertebrate	Adult survival	LC	2222	LOEC (84%)
Common bean ( <i>Phaseolus vulgaris</i> )	Plant	Vigor	EC	80	30
Common bean ( <i>P. vulgaris</i> )	Plant	Vigor	EC	120	42
Common bean ( <i>P. vulgaris</i> )	Plant	Growth (# of leaves)	EC	80	24
Common bean ( <i>P. vulgaris</i> )	Plant	Growth (# of leaves)	EC	120	34
Common bean ( <i>P. vulgaris</i> )	Plant	Reproduction (# of pods)	EC	80	14
Common bean ( <i>P. vulgaris</i> )	Plant	Reproduction (# of pods)	EC	120	21
Common bean ( <i>P. vulgaris</i> )	Plant	Reproduction (# of seeds)	EC	80	19

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Common bean ( <i>P. vulgaris</i> )	Plant	Reproduction (# of seeds)	EC	120	35
Cotton ( <i>Gossypium</i> spp.)	Plant	Leaf yield	EC	1000	58
Cotton ( <i>Gossypium</i> spp.)	Plant	Leaf yield	EC	2000	84
Cotton ( <i>Gossypium</i> spp.)	Plant	Stem yield	EC	1000	68
Cotton ( <i>Gossypium</i> spp.)	Plant	Stem yield	EC	2000	92

**Mercury (Chemical Abstract Service Number 7439-97-6)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	51	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	103	52
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	73	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	103	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	7	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	12	27
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	11	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	15	50
Turnip ( <i>Brassica rapa</i> )	Plant	Seedling emergence	EC	50	50
Turnip ( <i>B. rapa</i> )	Plant	First bloom	EC	7	50
Turnip ( <i>B. rapa</i> )	Plant	Plant height	EC	70	50
Turnip ( <i>B. rapa</i> )	Plant	Stem dry weight	EC	40	50
Turnip ( <i>B. rapa</i> )	Plant	First bloom	EC	550	50
Turnip ( <i>B. rapa</i> )	Plant	Plant height	EC	850	50
Turnip ( <i>B. rapa</i> )	Plant	First bloom, stem dw and # of pods	EC	1000	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	30	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	500	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	200	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	96	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	194	58
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	130	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	181	50
Earthworm ( <i>Lumbricus terrestris</i> )	Invertebrate	Mortality	LD	60	50
Earthworm ( <i>L. terrestris</i> )	Invertebrate	Mortality	LD	700	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	100	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	250	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	300	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Bermuda-grass ( <i>Cynodon dactylon</i> )	Plant	Plant	EC	50	NOEC
Bent grass ( <i>Agrostis canina</i> )	Plant	Plant	EC	455	NOEC
<i>Octochaetus pattoni</i>	Invertebrate	Survival	LC	0.5	65
<i>O. pattoni</i>	Invertebrate	Cocoon production	EC	0.5	40
Earthworm ( <i>E. foetida</i> )	Invertebrate	Survival	LC	12.5	21
Earthworm ( <i>E. foetida</i> )	Invertebrate	Segment regeneration	EC	12.5	69
Earthworm ( <i>E. foetida</i> )	Invertebrate	Survival/segment regeneration	LC	2.5	NOEC

**Molybdenum (Chemical Abstract Service Number 7439-98-7)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Rapeseed ( <i>Brassica napus</i> )	Plant	Shoot yield	EC	79	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	38	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	52	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	314	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	20	50
Ryegrass ( <i>Lolium perenne</i> )	Plant	Shoot yield	EC	71	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	38	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	12	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	8	50
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	61	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	31	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	49	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	180	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	15	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	34	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	33	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	9	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	6	30
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	40	10
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	23	10
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	43	10
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	74	10
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	9	10
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	26	10
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	5	10
Ryegrass ( <i>B. napus</i> )	Plant	Shoot yield	EC	4	10
Red clover ( <i>Trifolium pratense</i> )	Plant	Shoot yield	EC	81	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	66	50
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	70	50
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	281	50
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	77	50
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	37	50
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	15	50
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	24	50
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	60	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	43	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	54	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	206	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	56	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	27	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	8	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	13	30
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	38	10
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	22	10
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	36	10
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	125	10
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	33	10
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	17	10
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	3	10
Red clover ( <i>T. pratense</i> )	Plant	Shoot yield	EC	5	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	124	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	217	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	167	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	740	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	142	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	667	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	90	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	73	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	226	50
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	72	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	175	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	134	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	542	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	72	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	286	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	67	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	41	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	79	30
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	30	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	124	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	94	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	330	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	24	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	74	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	42	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	16	10
Ryegrass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	15	10
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Shoot yield	EC	67	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	127	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	76	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	72	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	172	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	101	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	52	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	16	50
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	45	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	60	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	32	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	248	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	55	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	132	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	35	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	28	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	9	30
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	24	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	19	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	8	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	105	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	36	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	87	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	7	10
Tomato ( <i>L. esculentum</i> )	Plant	Shoot yield	EC	10	10
Barley ( <i>Hordeum vulgare</i> )	Plant	Root elongation	EC	123	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	183	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	184	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	560	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	139	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	66	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	136	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	64	50
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	51	30

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	113	30
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	136	30
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	464	30
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	86	30
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	47	30
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	77	30
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	19	30
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	52	10
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	83	10
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	344	10
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	40	10
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	868	10
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	27	10
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	31	10
Potworm ( <i>Enchytraeus crypticus</i> )	Invertebrate	Reproduction	EC	349	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	231	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	336	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	1289	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	1183	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	1603	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	984	50
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	269	30
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	141	30
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	308	30
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	1023	30
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	921	30
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	1293	30
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	703	30

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	177	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	64	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	268	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	708	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	617	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	1377	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	918	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	1092	10
Potworm ( <i>E. crypticus</i> )	Invertebrate	Reproduction	EC	411	10
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Reproduction	EC	128	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	174	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	206	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	783	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	536	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	2374	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	214	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	2730	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	935	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	813	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	95	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	122	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	163	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	437	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	98	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	1643	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	66	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	210	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	109	30

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	509	30
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	59	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	70	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	113	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	172	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	8	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	914	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	10	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	78	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	24	10
Earthworm ( <i>E. andrei</i> )	Invertebrate	Reproduction	EC	242	10
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Reproduction	EC	71	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	2001	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	934	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	56	30
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	1914	30
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	849	30
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	38	10
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	1784	10
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	729	10

## Nickel (Chemical Abstract Service Number 7440-02-0)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Corn ( <i>Zea mays</i> )	Plant	Shoot growth	EC	100	NOEC
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	250	LOEC (72%)
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	161	25
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	100	NOEC
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	250	LOEC (81%)
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	100	NOEC
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	250	LOEC (47%)
Corn ( <i>Z. mays</i> )	Plant	Shoot growth	EC	182	25
Soybean ( <i>Glycine max</i> )	Plant	Leaf yield	EC	1000	32
Soybean ( <i>G. max</i> )	Plant	Stem yield	EC	1000	28
Bush bean ( <i>Phaseolus vulgaris</i> )	Plant	Leaf weight	EC	100	LOEC (64%)
Bush bean ( <i>P. vulgaris</i> )	Plant	Leaf weight	EC	100	NOEC
Bush bean ( <i>P. vulgaris</i> )	Plant	Leaf weight	EC	250	LOEC (36%)
Bush bean ( <i>P. vulgaris</i> )	Plant	Leaf weight	EC	25	NOEC
Bush bean ( <i>P. vulgaris</i> )	Plant	Leaf weight	EC	100	LOEC (45%)
Bush bean ( <i>P. vulgaris</i> )	Plant	Stem yield	EC	25	NOEC
Barley ( <i>Hordeum vulgare</i> )	Plant	Growth	EC	50	70
Rye grass ( <i>Lolium perenne</i> )	Plant	Growth rate	EC	90	14
Rye grass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	30	NOEC
Rye grass ( <i>L. perenne</i> )	Plant	Shoot yield	EC	109	25
Red oak ( <i>Quercus rubra</i> )	Plant	Total leaf area	EC	20	NOEC
Red oak ( <i>Q. rubra</i> )	Plant	Total leaf area	EC	57	50
Red oak ( <i>Q. rubra</i> )	Plant	Total dry weight	EC	42	25
Onion ( <i>Allium cepa</i> )	Plant	Total dry weight	EC	50	20
Onion ( <i>A. cepa</i> )	Plant	Total dry weight	EC	70	25
Onion ( <i>A. cepa</i> )	Plant	Mortality	LC	400	100
Fenugreek ( <i>Trigonella foenum-graceum</i> )	Plant	Total dry weight	EC	50	21

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Fenugreek ( <i>T. foenum-graceum</i> )	Plant	Mortality	LC	400	100
Cotton P ( <i>Gossypium hirsutum</i> )	Plant	Leaf growth	EC	100	44
Cotton P ( <i>G. hirsutum</i> )	Plant	Stem growth	EC	100	59
Alfalfa ( <i>Medicago sativa</i> )	Plant	Growth	EC	86	NOEC (23%)
Alfalfa ( <i>M. sativa</i> )	Plant	Mortality	LC	319.7	20
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	201.1	20
Alfalfa ( <i>M. sativa</i> )	Plant	Total dry weight	EC	33.9	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	124.6	20
Alfalfa ( <i>M. sativa</i> )	Plant	Mortality	LC	176.5	20
Alfalfa ( <i>M. sativa</i> )	Plant	Total dry weight	EC	29.8	25
Barley ( <i>H. vulgare</i> )	Plant	Mortality	LC	593.6	20
Barley ( <i>H. vulgare</i> )	Plant	Emergence	EC	256.2	20
Barley ( <i>H. vulgare</i> )	Plant	Total dry weight	EC	20.2	25
Barley ( <i>H. vulgare</i> )	Plant	Mortality	LC	760.7	20
Barley ( <i>H. vulgare</i> )	Plant	Emergence	EC	179.8	20
Barley ( <i>H. vulgare</i> )	Plant	Total dry weight	EC	88.8	25
Brassica ( <i>Brassica rapa</i> )	Plant	Emergence	EC	43.2	20
Brassica ( <i>B. rapa</i> )	Plant	Total dry weight	EC	26.2	25
Brassica ( <i>B. rapa</i> )	Plant	Mortality	LC	4001.9	20
Brassica ( <i>B. rapa</i> )	Plant	Emergence	EC	63	20
Brassica ( <i>B. rapa</i> )	Plant	Total dry weight	EC	39.4	20
Tomato ( <i>Solanum lycopersicum</i> )	Plant	Shoot growth	EC	11	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	18	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	126	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	148	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	131	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	206	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	162	10

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	205	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	192	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	273	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	32	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	43	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	221	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	275	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	22	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	26	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	252	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	367	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	330	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	415	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	47	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	92	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	45	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	59	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	629	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	777	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	56	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	77	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	637	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	961	50
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	199	10
Tomato ( <i>S. lycopersicum</i> )	Plant	Shoot growth	EC	415	50
Oat ( <i>Avena sativa</i> var. <i>cascade</i> )	Plant	Dry matter yield	EC	139.4	27
Oat ( <i>A. sativa</i> var. <i>cascade</i> )	Plant	Dry matter yield	EC	63.4	NOEC
Radish ( <i>Raphanus sativus</i> var. <i>bell</i> )	Plant	Dry matter yield	EC	63.4	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>R. sativus</i> var. <i>bell</i> )	Plant	Dry matter yield	EC	139.4	LOEC
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	18	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	30	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	913	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	792	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	480	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	238	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	328	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	702	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	1029	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	889	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	688	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	544	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	475	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	936	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	551	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	911	20
Barley ( <i>H. vulgare</i> )	Plant	Root elongation	EC	256	20
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	243	50
Earthworm ( <i>Lumbricus rubellus</i> )	Invertebrate	Mortality (6 week)	EC	1007	20
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality (6 week)	LC	2240	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality (12 week)	LC	305	20
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality (12 week)	LC	821	50
Earthworm ( <i>Eisenia veneta</i> )	Invertebrate	Mortality	LC	247	10
Earthworm ( <i>E. veneta</i> )	Invertebrate	Mortality	LC	684	50
Earthworm ( <i>E. veneta</i> )	Invertebrate	Mortality	LC	1000	100
Earthworm ( <i>E. veneta</i> )	Invertebrate	Reproduction	EC	100	NOEC
Earthworm ( <i>E. veneta</i> )	Invertebrate	Reproduction	EC	300	64

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. veneta</i> )	Invertebrate	Reproduction	EC	186	25
Earthworm ( <i>E. veneta</i> )	Invertebrate	Reproduction	EC	85	10
Earthworm ( <i>E. veneta</i> )	Invertebrate	Reproduction	EC	300	50
Springtail ( <i>Folsomia fimetaria</i> )	Invertebrate	Mortality	LC	786	50
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Mortality	LC	922	50
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Mortality	LC	859	50
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Reproduction	EC	173	10
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Mortality	LC	645	10
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Reproduction	EC	450	50
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Growth	EC	480	10
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Growth	EC	300	NOEC
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Mortality	LC	427	10
Springtail ( <i>F. fimetaria</i> )	Invertebrate	Mortality	LC	701	10
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Reproduction	EC	320	NOEC
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	476	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	560	43
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	266	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	362	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	180	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	320	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	223	25
Earthworm ( <i>Enchytraeus albidus</i> )	Invertebrate	Reproduction	EC	180	NOEC
Earthworm ( <i>E. albidus</i> )	Invertebrate	Reproduction	EC	168	25
Earthworm ( <i>E. albidus</i> )	Invertebrate	Reproduction	EC	320	68
Earthworm ( <i>E. albidus</i> )	Invertebrate	Mortality	LC	510	50
Nematode ( <i>Caenorhabditis elegans</i> )	Invertebrate	Mortality	LC	2493	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1188	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	1202	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	348	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	165	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	387	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	44	50
Nematode ( <i>C. elegans</i> )	Invertebrate	Mortality	LC	144	50
Nematode (multiple sp.)	Invertebrate	Abundance	EC	100	LOEC (18%)
Nematode (multiple sp.)	Invertebrate	Abundance	EC	138	25

**Pentachlorophenol [PCP] (Chemical Abstract Service Number 87-86-5)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>Lactuca sativa</i> )	Plant	Growth	EC	1	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	4.8	50
Lettuce ( <i>L. sativa</i> )	Plant	Germination	EC	3.2	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Germination	EC	31.6	50
Oats ( <i>Avena sativa</i> )	Plant	Growth	EC	10	NOEC
Oats ( <i>A. sativa</i> )	Plant	Growth	EC	32	21
Oats ( <i>A. sativa</i> )	Plant	Growth	EC	57	50
Turnip ( <i>Brassica rapa</i> )	Plant	Growth	EC	11.32	50
Radish ( <i>Raphanus sativa</i> )	Plant	Seedling emergence	EC	17	NOEC
Radish ( <i>R. sativa</i> )	Plant	Seedling emergence	EC	30	33
Radish ( <i>R. sativa</i> )	Plant	Seedling emergence	EC	28	25
Radish ( <i>R. sativa</i> )	Plant	Seedling emergence	EC	48	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	7	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	11	23
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	13	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	20	50
Earthworm ( <i>Eisenia fetida</i> )	Invertebrate	Mortality	LC	44	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	97	60
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	52	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	111	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	87	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	50	50 GM
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	15	50 GM
Geometric mean				27	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	10	NOEC
Worm ( <i>Enchyrtaeus albidus</i> )	Invertebrate	Mortality	LC	136	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	10	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	94	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	143	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	68.87	50
Earthworm ( <i>Lumbricus rubellus</i> )	Invertebrate	Mortality	LC	1094	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	883	50
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Mortality	LC	28.5	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	52	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	16	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	87	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Cocoon production	EC	32	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Cocoon production	EC	58	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Reproduction	EC	10	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Reproduction	EC	100	100
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	84	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	142	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	83	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	502	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	1206	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	1013	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	362	50
Earthworm ( <i>L. rubellus</i> )	Invertebrate	Mortality	LC	2298	50
Alfalfa ( <i>Medicago sativa</i> )	Plant	Growth	EC	5	20
Turnip ( <i>B. rapa</i> )	Plant	Growth	EC	5	20
Radish ( <i>R. sativa</i> )	Plant	Growth	EC	5	20
Thale cress ( <i>Arabidopsis thaliana</i> )	Plant	Growth	EC	3	50
Thale cress ( <i>A. thaliana</i> )	Plant	Growth	EC	9	50
Nematode ( <i>Globodera Rostochiensis</i> )	Invertebrate	Mortality	LC	130	50
Nematode ( <i>G. Rostochiensis</i> )	Invertebrate	Mortality	LC	310	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. andrei</i> )	Invertebrate	Growth	EC	32	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	87	50
Nematode ( <i>G. Rostochiensis</i> )	Invertebrate	Mortality	LC	310	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	28	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	27	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	37	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality	LC	72	50
Bird Rape ( <i>Brassica rapa</i> )	Plant	Emergency	EC	27.6	20
Bird Rape ( <i>B. rapa</i> )	Plant	Height	EC	17	20
Bird Rape ( <i>B. rapa</i> )	Plant	Biomass	EC	10	20
Alfalfa ( <i>M. sativa</i> )	Plant	Emergency	EC	31	20
Alfalfa ( <i>M. sativa</i> )	Plant	Height	EC	31	20
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	33	20
Radish ( <i>R. sativa</i> )	Plant	Emergency	EC	56	20
Radish ( <i>R. sativa</i> )	Plant	Height	EC	17	20
Radish ( <i>R. sativa</i> )	Plant	Biomass	EC	13	20
Earthworm ( <i>E. andrei</i> )	Invertebrate	General growth	EC	60	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Fertile cocoons	EC	40	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Fertile cocoons	EC	55	50

**Notes:**

Geometric mean (GM) – For redundant data, a single composite response concentration was calculated as the geometric mean of the individual values.

**Perfluorooctane Sulfonate [PFOS] (Chemical Abstract Service Number 1763-23-1)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>Lactuca sativa</i> )	Plant	Growth (plant height- 21 days)	EC	3.91	23
Lettuce ( <i>L. sativa</i> )	Plant	Growth (plant height- 21 days)	EC	6.79	25
Lettuce ( <i>L. sativa</i> )	Plant	Growth (shoot weight-21 days)	EC	8.92	25
Lettuce ( <i>L. sativa</i> )	Plant	Growth (shoot weight-21 days)	EC	20.1	50
Lettuce ( <i>L. sativa</i> )	Plant	Growth (plant height- 21 days)	EC	39.9	50
Lettuce ( <i>L. sativa</i> )	Plant	Mortality (21 days)	LC	62.5	3
Lettuce ( <i>L. sativa</i> )	Plant	Emergence (21 days)	EC	250	6
Lettuce ( <i>L. sativa</i> )	Plant	Mortality (21 days)	LC	257	25
Lettuce ( <i>L. sativa</i> )	Plant	Mortality (21 days)	LC	386	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence (21 days)	EC	393	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence (21 days)	EC	564	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence (21 days)	EC	1000	86
Alfalfa ( <i>Medicago sativa</i> )	Plant	Growth (shoot weight-21 days)	EC	53.3	25
Alfalfa ( <i>M. sativa</i> )	Plant	Growth (plant height- 21 days)	EC	62.5	6
Alfalfa ( <i>M. sativa</i> )	Plant	Growth (shoot weight-21 days)	EC	62.5	11
Alfalfa ( <i>M. sativa</i> )	Plant	Mortality (21 days)	LC	62.5	9
Alfalfa ( <i>M. sativa</i> )	Plant	Growth (plant height- 21 days)	EC	102	25
Alfalfa ( <i>M. sativa</i> )	Plant	Growth (shoot weight-21 days)	EC	146	50
Alfalfa ( <i>M. sativa</i> )	Plant	Growth (plant height- 21 days)	EC	249	50
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence (21 days)	EC	250	19
Alfalfa ( <i>M. sativa</i> )	Plant	Mortality (21 days)	LC	250	29
Alfalfa ( <i>M. sativa</i> )	Plant	Growth (shoot weight-21 days)	EC	250	78
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence (21 days)	EC	372	25
Alfalfa ( <i>M. sativa</i> )	Plant	Mortality (21 days)	LC	452	50
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence (21 days)	EC	745	50
Flax ( <i>Linum usitatissimum</i> )	Plant	Growth (plant height- 21 days)	EC	62.5	8
Flax ( <i>L. usitatissimum</i> )	Plant	Growth (shoot weight-21 days)	EC	62.5	18

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Flax ( <i>L. usitatissimum</i> )	Plant	Growth (shoot weight-21 days)	EC	81.6	25
Flax ( <i>L. usitatissimum</i> )	Plant	Growth (plant height- 21 days)	EC	97.6	25
Flax ( <i>L. usitatissimum</i> )	Plant	Growth (shoot weight-21 days)	EC	119	50
Flax ( <i>L. usitatissimum</i> )	Plant	Growth (plant height- 21 days)	EC	140	50
Flax ( <i>L. usitatissimum</i> )	Plant	Growth (plant height- 21 days)	EC	250	86
Flax ( <i>L. usitatissimum</i> )	Plant	Growth (shoot weight-21 days)	EC	250	91
Onion ( <i>Allium cepa</i> )	Plant	Growth (shoot weight-21 days)	EC	3.91	15
Onion ( <i>A. cepa</i> )	Plant	Growth (shoot weight-21 days)	EC	15.6	31
Onion ( <i>A. cepa</i> )	Plant	Growth (plant height- 21 days)	EC	15.6	10
Onion ( <i>A. cepa</i> )	Plant	Mortality (21 days)	LC	15.6	6
Onion ( <i>A. cepa</i> )	Plant	Growth (shoot weight-21 days)	EC	28.1	50
Onion ( <i>A. cepa</i> )	Plant	Growth (plant height- 21 days)	EC	29.1	25
Onion ( <i>A. cepa</i> )	Plant	Growth (plant height- 21 days)	EC	46.5	50
Onion ( <i>A. cepa</i> )	Plant	Emergence (21 days)	EC	50.8	25
Onion ( <i>A. cepa</i> )	Plant	Mortality (21 days)	LC	57.3	50
Onion ( <i>A. cepa</i> )	Plant	Emergence (21 days)	EC	62.5	19
Onion ( <i>A. cepa</i> )	Plant	Emergence (21 days)	EC	208	50
Ryegrass ( <i>Lolium perenne</i> )	Plant	Growth (plant height- 21 days)	EC	3.91	9
Ryegrass ( <i>L. perenne</i> )	Plant	Growth (shoot weight-21 days)	EC	3.91	12
Ryegrass ( <i>L. perenne</i> )	Plant	Growth (shoot weight-21 days)	EC	15.6	39
Ryegrass ( <i>L. perenne</i> )	Plant	Growth (plant height- 21 days)	EC	46.3	25
Ryegrass ( <i>L. perenne</i> )	Plant	Growth (plant height- 21 days)	EC	131	50
Ryegrass ( <i>L. perenne</i> )	Plant	Emergence (21 days)	EC	250	28
Ryegrass ( <i>L. perenne</i> )	Plant	Mortality (21 days)	LC	250	34
Soybean ( <i>Glycine max</i> )	Plant	Growth (shoot weight-21 days)	EC	160	25
Soybean ( <i>G. max</i> )	Plant	Growth (plant height- 21 days)	EC	250	21
Soybean ( <i>G. max</i> )	Plant	Growth (plant height- 21 days)	EC	284	25
Soybean ( <i>G. max</i> )	Plant	Growth (shoot weight-21 days)	EC	326	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Soybean ( <i>G. max</i> )	Plant	Growth (plant height- 21 days)	EC	464	50
Soybean ( <i>G. max</i> )	Plant	Emergence (21 days)	EC	1000	0
Soybean ( <i>G. max</i> )	Plant	Mortality (21 days)	LC	1000	0
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Growth (shoot weight-21 days)	EC	11.7	25
Tomato ( <i>L. esculentum</i> )	Plant	Growth (plant height- 21 days)	EC	15.6	9
Tomato ( <i>L. esculentum</i> )	Plant	Growth (shoot weight-21 days)	EC	15.6	19
Tomato ( <i>L. esculentum</i> )	Plant	Mortality (21 days)	LC	15.6	14
Tomato ( <i>L. esculentum</i> )	Plant	Growth (shoot weight-21 days)	EC	28.5	50
Tomato ( <i>L. esculentum</i> )	Plant	Mortality (21 days)	LC	62.5	27
Tomato ( <i>L. esculentum</i> )	Plant	Growth (plant height- 21 days)	EC	62.5	50 GM
Tomato ( <i>L. esculentum</i> )	Plant	Growth (plant height- 21 days)	EC	93.9	50 GM
Geometric mean				76.6	50
Tomato ( <i>L. esculentum</i> )	Plant	Growth (shoot weight-21 days)	EC	62.5	79
Tomato ( <i>L. esculentum</i> )	Plant	Mortality (21 days)	LC	68.7	25
Tomato ( <i>L. esculentum</i> )	Plant	Mortality (21 days)	LC	105	50
Tomato ( <i>L. esculentum</i> )	Plant	Emergence (21 days)	EC	250	22
Tomato ( <i>L. esculentum</i> )	Plant	Emergence (21 days)	EC	311	25
Tomato ( <i>L. esculentum</i> )	Plant	Emergence (21 days)	EC	474	50
Tomato ( <i>L. esculentum</i> )	Plant	Emergence (21 days)	EC	1000	89
Pak choi ( <i>Brassica chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	40	10
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	95	50
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	50	NOEC
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	107	50
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	72	10
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	122	50
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	83	10
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	119	50
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	90	10

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Pak choi ( <i>B. chinensis</i> )	Plant	Growth (root elongation- 7 days)	EC	178	50
Earthworm ( <i>Eisenia fetida</i> )	Invertebrate	Number of cocoons (28 days)	EC	40	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Number of cocoons (28 days)	EC	67	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Number of cocoons (28 days)	EC	103	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Average weight/juvenile (56 days)	EC	10	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Average weight/juvenile (56 days)	EC	12	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Average weight/juvenile (56 days)	EC	131	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Number of juveniles (56 days)	EC	25	10
Earthworm ( <i>E. fetida</i> )	Invertebrate	Number of juveniles (56 days)	EC	48	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Number of juveniles (56 days)	EC	80	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality (7 days)	LC	160	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality (14 days)	LC	256	20
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality (14 days)	LC	365.4	50 GM
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality (7 days)	LC	405.3	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Growth (14 days)	EC	289	7.5
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality (14 days)	LC	542.1	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Mortality (14 days)	LC	955.3	50 GM
Geometric mean				591	50

**Notes:**

Geometric mean (GM) – For redundant data, a single composite response concentration was calculated as the geometric mean of the individual values.

**Phenol (Chemical Abstract Service Number 108-95-2)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Radish ( <i>Raphanus sativus</i> L)	Plant	Emergence	EC	125	25
Radish ( <i>R. sativus</i> L)	Plant	Emergence	EC	170	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Emergence	EC	83	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	131	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	210	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	320	74
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	270	50 GM
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	401	50 GM
Geometric mean				329	50
Lettuce ( <i>L. sativa</i> )	Plant	Germination	EC	87	50
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	157	50
Earthworm	Invertebrate	Mortality	LC	450	50
Earthworm	Invertebrate	Mortality	LC	188	50
Earthworm	Invertebrate	Mortality	LC	258	50
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	149	50
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	408	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	136	50

**Notes:**

Geometric mean (GM) – For redundant data, a single composite response concentration was calculated as the geometric mean of the individual values.

**Selenium (Chemical Abstract Service Number 7782-49-2)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Bread wheat ( <i>Triticum aestivum</i> )	Plant	Reduced biomass	EC	2.5	22
Wheat ( <i>T. aestivum</i> )	Plant	Reduced grain yield	EC	2.5	28
Alfalfa ( <i>Medicago sativa</i> )	Plant	Reduced shoot weight	EC	2	91
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	2	74
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	2	23
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	2	27
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	2	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	4	94
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	0.5	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	1.5	83
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	1.5	33
Alfalfa ( <i>M. sativa</i> )	Plant	Reduced shoot weight	EC	1.5	56
Sorghass ( <i>Sorghum vulgare</i> )	Plant	Reduced shoot weight	EC	1	59
Sorghass ( <i>S. vulgare</i> )	Plant	Reduced shoot weight	EC	1	53
Sorghass ( <i>S. vulgare</i> )	Plant	Reduced shoot weight	EC	4	NOEC
Sorghass ( <i>S. vulgare</i> )	Plant	Reduced shoot weight	EC	1	64
Sorghass ( <i>S. vulgare</i> )	Plant	Reduced shoot weight	EC	2	61
Sorghass ( <i>S. vulgare</i> )	Plant	Reduced shoot weight	EC	4	NOEC
Cowpea ( <i>Vigna sinensis</i> )	Plant	Dry matter yield	EC	1	NOEC
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Cocoon/worm	EC	77	69
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	0.1	20
Alfalfa ( <i>M. sativa</i> )	Plant	Growth	EC	0.2	20
Barley ( <i>Hordeum vulgare</i> )	Plant	Growth	EC	0.2	20
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	1	20
Brassica ( <i>Brassica rapa</i> )	Plant	Growth	EC	3	20
Brassica ( <i>B. rapa</i> )	Plant	Growth	EC	1	20
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	3.4	20

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Enchytraeidae ( <i>Enchytraeus crypticus</i> )	Invertebrate	Reproduction	EC	4.4	20
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Reproduction	EC	4.7	20

**Sulfolane (Chemical Abstract Service Number 126-33-0)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>Lactuca sativa</i> )	Plant	Emergence	EC	23	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	59	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	145	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	279	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	452	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	795	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	1596	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	1966	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	2906	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	269	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	304	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	423	50
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	130	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	278	25
Lettuce ( <i>L. sativa</i> )	Plant	Emergence	EC	417	50
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	279	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	137	25
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	526	50
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	3192	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	538	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Biomass	EC	556	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	279	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	405	25
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	730	50
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	798	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	2069	25
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	2909	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	134	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	155	25
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	316	50
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	130	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	156	25
Lettuce ( <i>L. sativa</i> )	Plant	Root length	EC	372	50
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	559	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	745	25
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	6385	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	134	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	192	25
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	278	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Shoot length	EC	500	25
Carrot ( <i>Daucus carota</i> )	Plant	Emergence	EC	1117	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	1310	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	1874	50
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	3192	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	3429	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	5735	50
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	538	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	674	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	1014	50
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	556	NOEC
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	1008	25
Carrot ( <i>D. carota</i> )	Plant	Emergence	EC	1428	50
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	559	NOEC
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	757	25
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	2217	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	6385	NOEC
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	1076	NOEC
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	819	25
Carrot ( <i>D. carota</i> )	Plant	Biomass	EC	1111	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	279	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	361	25
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	706	50
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	798	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	4168	25
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	5114	50
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	134	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	151	25
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	532	50
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	130	NOEC
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	239	25
Carrot ( <i>D. carota</i> )	Plant	Root length	EC	706	50
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	263	NOEC
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	1194	25
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	2004	50
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	3192	NOEC
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	3488	25
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	538	NOEC
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	715	25
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	556	NOEC
Carrot ( <i>D. carota</i> )	Plant	Shoot length	EC	907	25
Alfalfa ( <i>Medicago sativa</i> )	Plant	Emergence	EC	1117	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1703	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	2418	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	7006	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	8809	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	10612	50
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1076	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1277	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1697	50
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1111	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1236	25
Alfalfa ( <i>M. sativa</i> )	Plant	Emergence	EC	1579	50
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	279	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	653	25
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	7006	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	2155	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Biomass	EC	1111	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	279	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	535	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	922	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	1750	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	2480	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	3281	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	269	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	275	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	440	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	69	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	145	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	452	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	2232	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	7006	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	538	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1242	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1794	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1111	NOEC
Timothy grass ( <i>Phleum pratense</i> )	Plant	Emergence	EC	559	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	884	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	1369	50
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	3192	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	4138	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	5912	50
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	134	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	686	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	934	50
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	556	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	636	25
Timothy grass ( <i>P. pratense</i> )	Plant	Emergence	EC	907	50
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	2232	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	964	25
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	1989	50
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	200	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	310	25
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	875	50
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	67	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	114	25
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	1111	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	423	25
Timothy grass ( <i>P. pratense</i> )	Plant	Biomass	EC	866	50
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	140	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	304	25
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	588	50
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	399	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	1197	25
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	2764	50
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	134	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	166	25
Timothy grass ( <i>P. pratense</i> )	Plant	Root length	EC	269	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	559	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	978	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	1567	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	1596	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	3872	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	5439	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	269	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	452	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	757	50
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	278	NOEC
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	538	25
Timothy grass ( <i>P. pratense</i> )	Plant	Shoot length	EC	919	50
Earthworm ( <i>Eisenia fetida</i> )	Invertebrate	Survival	LC	739	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	1123	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	1567	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	1097	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	1363	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	1641	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	3201	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	4496	25

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	5859	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	544	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	671	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	810	50
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	532	NOEC
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	665	25
Earthworm ( <i>E. fetida</i> )	Invertebrate	Survival	LC	798	50

**Tetrachloroethylene (Chemical Abstract Service Number 127-18-4)**

<b>Species</b>	<b>Receptor Category</b>	<b>Endpoint</b>	<b>EC/LC</b>	<b>Concentration (mg/kg)</b>	<b>Effect (%)</b>
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	19	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	41	100
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	22	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	29	50
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	13	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	19	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	28	60
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	30	50
Radish ( <i>R. sativus</i> )	Plant	Root elongation	EC	14	NOEC
Radish ( <i>R. sativus</i> )	Plant	Root elongation	EC	31	40
Radish ( <i>R. sativus</i> )	Plant	Root elongation	EC	18	25
Radish ( <i>R. sativus</i> )	Plant	Root elongation	EC	35	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	EC	84	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	EC	165	100
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	EC	95	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	EC	118	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	577	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	945	50
Carabid beetle ( <i>Poecilus cupreus</i> )	Invertebrate	Mortality	LC	5	NOEC
Oat ( <i>Avena sativa</i> )	Plant	Growth	EC	100	NOEC
Oat ( <i>A. sativa</i> )	Plant	Sublethal effects	EC	1	NOEC
Oat ( <i>A. sativa</i> )	Plant	Growth	EC	580	50

**Thallium (Chemical Abstract Service Number 7440-28-0)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Height	EC	6.9	40
Tobacco ( <i>Nicotiana tabacum</i> )	Plant	Height	EC	6.9	40
Tobacco ( <i>N. tabacum</i> )	Plant	Height	EC	2.4	25
Buckwheat ( <i>Fagopyrum</i> )	Plant	Yield	EC	1.6	32
Corn ( <i>Zea mays</i> )	Plant	Height	EC	1.6	19
Tomato ( <i>Lycopersicon esculentum</i> )	Plant	Height	EC	1.6	13
Beans	Plant	Height	EC	4.8	NOEC
Turkish tobacco	Plant	Size	EC	11.05	66
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	3.3	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	5.8	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	11.4	50
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	89.4	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	155	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	402	50
Earthworm	Invertebrate	Mortality (7 day)	LC	27	NOEC
Earthworm	Invertebrate	Mortality (7 day)	LC	40	25
Earthworm	Invertebrate	Mortality (7 day)	LC	59	50
Earthworm	Invertebrate	Mortality (14 day)	LC	12	NOEC
Earthworm	Invertebrate	Mortality (14 day)	LC	21	25
Earthworm	Invertebrate	Mortality (14 day)	LC	30	50

**Toluene (Chemical Abstract Service Number 108-88-3)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Northern wheatgrass ( <i>Agropyron dasystachyum</i> )	Plant	Shoot length	EC	525	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	242	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	157	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	55	25
Alfalfa ( <i>Medicago sativa</i> )	Plant	Shoot length	EC	396	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	234	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	253	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	305	25
Collembolan ( <i>Onychiurus folsomi</i> )	Invertebrate	Mortality	LC	521	25
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	1011	NOEC
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Mortality	LC	80	NOEC
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	991	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	620	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	236	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	558	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	377	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	120	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	148	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	159	25
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	406	25
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	172	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1199	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	518	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	691	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	338	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	3825	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	368	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	413	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	468	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	3412	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	547	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	905	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	246	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	2610	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	1113	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	1338	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	1002	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	1173	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	955	50
<i>Zea mays</i>	Plant	Yield	EC	200	10
<i>Glycine max</i>	Plant	Yield	EC	800	10
<i>Festuca</i> sp.	Plant	Yield	EC	2000	10

**Trichloroethylene (Chemical Abstract Service Number 79-01-6)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	16	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	26	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	37	50
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	9	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	14	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	53	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	60	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	79	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	106	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	105	50

**Vanadium (Chemical Abstract Service Number 7440-62-2)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality (14 days)	LC	207	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality (14 days)	LC	287	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality (14 days)	LC	370	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality (14 days)	LC	417	66
Cabbage ( <i>Brassica oleracea</i> )	Plant	Aboveground biomass (98 days)	EC	60	NOEC
Cabbage ( <i>B. oleracea</i> )	Plant	Aboveground biomass (98 days)	EC	80	24
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence (5 days)	EC	55	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence (5 days)	EC	134	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence (5 days)	EC	251	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence (5 days)	EC	127	29
Radish ( <i>Raphanus sativa</i> )	Plant	Seedling emergence (3 days)	EC	200	NOEC
Radish ( <i>R. sativa</i> )	Plant	Seedling emergence (3 days)	EC	330	25
Radish ( <i>R. sativa</i> )	Plant	Seedling emergence (3 days)	EC	577	50
Radish ( <i>R. sativa</i> )	Plant	Seedling emergence (3 days)	EC	410	33
Broccoli ( <i>Brassica oleracea</i> )	Plant	Growth	EC	100	NOEC

**Xylenes(Chemical Abstract Service Number 1330-20-7)**

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Northern wheatgrass ( <i>Agropyron dasystachyum</i> )	Plant	Shoot length	EC	430	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	167	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	608	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	196	25
Alfalfa ( <i>Medicago sativa</i> )	Plant	Shoot length	EC	1200	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	421	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	480	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	442	25
Collembolan ( <i>Onychiurus folsomi</i> )	Invertebrate	Mortality	LC	733	25
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	570	NOEC
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Mortality	LC	8	NOEC
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	443	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	367	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	241	25
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	282	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	593	25
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	92	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	101	25
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	111	25
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	835	25
Earthworm ( <i>E. andrei</i> )	Invertebrate	Mortality	LC	8	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	1704	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	789	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	941	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	730	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot length	EC	3784	50
Alfalfa ( <i>M. sativa</i> )	Plant	Shoot dry mass	EC	749	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Alfalfa ( <i>M. sativa</i> )	Plant	Root length	EC	921	50
Alfalfa ( <i>M. sativa</i> )	Plant	Root dry mass	EC	654	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	1771	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	554	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	1035	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	484	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot length	EC	4549	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Shoot dry mass	EC	2150	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root length	EC	2618	50
Northern wheatgrass ( <i>A. dasystachyum</i> )	Plant	Root dry mass	EC	1648	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	953	50
Collembolan ( <i>O. folsomi</i> )	Invertebrate	Mortality	LC	997	50

# Zinc (Chemical Abstract Service Number 7440-66-6)

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Onion ( <i>Allium cepa</i> )	Plant	Dry matter yield	EC	400	18
Jack Pine ( <i>Pinus banksiana</i> )	Plant	Root yield	EC	50	36
White Spruce ( <i>Picea glauca</i> )	Plant	Shoot yield	EC	50	13
White Spruce ( <i>P. glauca</i> )	Plant	Root yield	EC	50	28
Radish ( <i>Raphanus sativus</i> )	Plant	Seedling emergence	EC	100	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	160	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	200	LOEC (37%)
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	280	50
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	230	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	420	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	490	LOEC (34%)
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	670	50
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	130	NOEC
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	240	LOEC (11%)
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	320	25
Radish ( <i>R. sativus</i> )	Plant	Seedling emergence	EC	520	50
Lettuce ( <i>Lactuca sativa</i> )	Plant	Seedling emergence	EC	220	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	350	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	490	LOEC (49%)
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	500	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	250	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	470	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	720	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	200	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	280	25
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	400	50
Earthworm ( <i>Eisenia foetida</i> )	Invertebrate	Mortality	LC	500	NOEC

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	700	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	800	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	400	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	500	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	700	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	300	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	500	25
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	600	LOEC (40%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	700	50
Beech ( <i>Fagus grandifolia</i> )	Plant	Shoot growth	EC	65.4	21
Beech ( <i>F. grandifolia</i> )	Plant	Shoot growth	EC	65.4	39
Blackgram ( <i>Vigna mungo</i> )	Plant	Yield	EC	200	22
Blackgram ( <i>V. mungo</i> )	Plant	Yield	EC	250	45
Corn ( <i>Zea mays</i> )	Plant	Yield	EC	303	13
Corn ( <i>Z. mays</i> )	Plant	Yield	EC	329	NOEC
Corn ( <i>Z. mays</i> )	Plant	Yield	EC	328	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Dry matter yield	EC	329	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Dry matter yield	EC	328	NOEC
Alfalfa ( <i>Medicago sativa</i> )	Plant	Dry matter yield	EC	329	NOEC
Alfalfa ( <i>M. sativa</i> )	Plant	Dry matter yield	EC	328	NOEC
Corn ( <i>Z. mays</i> )	Plant	Yield	EC	240	50
Rice ( <i>Oryza sativa</i> )	Plant	Yield	EC	10 000	23
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	662	50
Turnip ( <i>Brassica rapa</i> )	Plant	First bloom	EC	600	50
Turnip ( <i>B. rapa</i> )	Plant	Seed yield	EC	700	50
Turnip ( <i>B. rapa</i> )	Plant	Seedling emergence	EC	1000	NOEC
Turnip ( <i>B. rapa</i> )	Plant	First bloom	EC	25	50
Turnip ( <i>B. rapa</i> )	Plant	Seed yield	EC	25	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Turnip ( <i>B. rapa</i> )	Plant	Seedling emergence	EC	65	50
Turnip ( <i>B. rapa</i> )	Plant	First bloom	EC	650	50
Turnip ( <i>B. rapa</i> )	Plant	Seed yield	EC	700	50
Turnip ( <i>B. rapa</i> )	Plant	Seedling emergence	EC	650	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	1000	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	200	50
Lettuce ( <i>L. sativa</i> )	Plant	Seedling emergence	EC	1000	NOEC
Earthworm ( <i>Lumbricus terrestris</i> )	Invertebrate	Mortality	LC	80	50
Earthworm ( <i>L. terrestris</i> )	Invertebrate	Mortality	LC	600	50
Earthworm ( <i>L. terrestris</i> )	Invertebrate	Mortality	LC	600	50
Spinach ( <i>Spinacia oleracea</i> )	Plant	Yield	EC	80	27
Spinach ( <i>S. oleracea</i> )	Plant	Yield	EC	20	NOEC
Spinach ( <i>S. oleracea</i> )	Plant	Yield	EC	160	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	1010	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	745	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Mortality	LC	289	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	276	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	199	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	136	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	462	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Cocoon production	EC	592	50
Earthworm ( <i>Eisenia andrei</i> )	Invertebrate	Cocoon production	EC	320	NOEC
Earthworm ( <i>E. andrei</i> )	Invertebrate	Cocoon production	EC	560	LOEC (31%)
Earthworm ( <i>E. andrei</i> )	Invertebrate	Cocoon production	EC	659	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Number of juveniles	EC	512	50
Earthworm ( <i>E. andrei</i> )	Invertebrate	Body weight gain	EC	560	NOEC
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	276	50
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	10	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	383	50
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	328	50
Lettuce ( <i>L. sativa</i> )	Plant	Growth	EC	274	50
Wheat ( <i>Triticum aestivum</i> L.)	Plant	Growth	EC	980	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	275	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	300	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	6140	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	880	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	1100	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	1000	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	710	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	400	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	685	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	825	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	860	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	615	20
Wheat ( <i>T. aestivum</i> L.)	Plant	Growth	EC	460	20
Chinese cabbage ( <i>Brassica Chinensis</i> L.)	Plant	Shoot dry matter yield	EC	244	10
Pak choi ( <i>B. Chinensis</i> L.)	Plant	Shoot dry matter yield	EC	277	10
Celery ( <i>Apium graveolens</i> L.)	Plant	Shoot dry matter yield	EC	204	10
White clover ( <i>Trifolium repens</i> )	Plant	Biomass	EC	460	LOEC (36%)
Rapeseed ( <i>Brassica napus</i> )	Plant	Biomass	EC	460	LOEC (53%)
Creeping bent grass ( <i>Argostis stolonifera</i> )	Plant	Biomass	EC	460	LOEC (19%)
Barley ( <i>Hordeum vulgare</i> )	Plant	Root dry weight	EC	229	25
Jack bean	Plant	Shoot dry weight	EC	298	25
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	2040	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	3600	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	1750	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	5200	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	1870	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	240	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	140	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	4080	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	920	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	7300	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	2170	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	6100	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	790	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	1260	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	230	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	1490	50
Barley ( <i>H. vulgare</i> )	Plant	Growth	EC	450	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	705	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	764	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	587	50
Potworm ( <i>Enchytraeus albidus</i> )	Invertebrate	Reproduction	EC	271	50
Potworm ( <i>E. albidus</i> )	Invertebrate	Reproduction	EC	461	50
Potworm ( <i>E. albidus</i> )	Invertebrate	Reproduction	EC	302	50
Springtail ( <i>Folsomia candida</i> )	Invertebrate	Reproduction	EC	391	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	461	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	393	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	704	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	294	50
Potworm ( <i>E. albidus</i> )	Invertebrate	Reproduction	EC	267	50
Potworm ( <i>E. albidus</i> )	Invertebrate	Mortality	LC	147	50
Potworm ( <i>E. albidus</i> )	Invertebrate	Reproduction	EC	92	50

Species	Receptor Category	Endpoint	EC/LC	Concentration (mg/kg)	Effect (%)
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	375	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	78	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	522	50
Roundworm ( <i>Caenorhabditis elegans</i> )	Invertebrate	Mortality	LC	1915	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	683	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	1898	50
Red worm ( <i>Lumbricus terrestris</i> )	Invertebrate	Reproduction	EC	1029	50
Reddish brown worm ( <i>Lumbricus rubellus</i> )	Invertebrate	Reproduction	EC	599	50
Grey worm ( <i>Aporrectodea caliginosa</i> )	Invertebrate	Reproduction	EC	442	50
Springtail ( <i>F. candida</i> )	Invertebrate	Reproduction	EC	1749	50
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	250	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	500	LOEC (20%)
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	250	NOEC
Earthworm ( <i>E. foetida</i> )	Invertebrate	Reproduction	EC	500	LOEC (12%)
Springtail ( <i>Proisotoma minuta</i> )	Invertebrate	Reproduction	EC	283	50

## APPENDIX 8C

### TRVs Used to Derive Human Health Water Use Standards

Substance name	Chemical Abstract Service Number (CAS)	TRV value	Units	TRV type	IARC/IRIS carcinogenicity classification
aluminum	7429-90-5	1.00E+00	mg/kg/d	RfD	N/A
chlorophenol, 2-	95-57-8	5.00E-03	mg/kg/d	RfD	N/A
copper	7440-50-8	1.41E-01	mg/kg/d	RfD	D
diisopropanolamine [DIPA]	100-97-4	3.90E-01	mg/kg/d	RfD	N/A
iron	7439-89-6	8.00E-01	mg/kg/d	RfD	B2
manganese	7439-96-5	1.40E-01	mg/kg/d	RfD	D
methyl tert-butyl ether [MTBE]	1634-04-4	1.00E-02	mg/kg/d	RfD	3
nonylphenol and nonylphenol ethoxylates	84852-15-3	4.90E-03	mg/kg/d	RfD	N/A
perfluorooctane sulfonate [PFOS]	1763-23-1	3.00E-05	mg/kg/d	RfD	N/A
perfluorooctanoic acid [PFOA]	335-67-1	2.00E-05	mg/kg/d	RfD	2B
permethrin (cis + trans)	52645-53-1	5.00E-02	mg/kg/d	RfD	3
resorcinol	108-46-3	5.00E-01	mg/kg/d	RfD	N/A
sodium ion	7440-23-5	2.12E+01	mg/kg/d	RfD	N/A
sulfolane	126-33-0	9.70E-03	mg/kg/d	RfD	N/A
zinc	7440-66-6	3.00E-01	mg/kg/d	RfD	D

## APPENDIX 8D

## TRVs Used to Derive Human Health Vapour Standards

Substance name	Chemical Abstract Service Number (CAS)	TRV value	TRV units	TRV type	IRIS/IARC carcinogenicity classification
acetaldehyde	75-07-0	2.20E-06	µg/m <sup>3</sup>	Unit Risk	B2; 2B
acetone	67-64-1	9.00E-01	mg/kg/d	RfD	N/A
acetone cyanohydrin	75-86-5	2.00	µg/m <sup>3</sup>	RfC	N/A
acetonitrile	1975-05-08	6.00E+01	µg/m <sup>3</sup>	RfC	D
acrolein	107-02-8	2.00E-02	µg/m <sup>3</sup>	RfC	3
acrylonitrile	107-13-1	6.80E-05	µg/m <sup>3</sup>	Unit Risk	B1; 2B
allyl chloride	107-05-1	1.00	µg/m <sup>3</sup>	RfC	C
ammonia (as N)	7664-41-7	1.00	µg/m <sup>3</sup>	RfC	N/A
benzene	71-43-2	7.80E-06	µg/m <sup>3</sup>	Unit Risk	A; 1
benzotrichloride	1998-07-07	1.30E+01	mg/kg/d	Slope Factor	B2; 2A
benzyl chloride	100-44-7	4.90E-05	µg/m <sup>3</sup>	Unit Risk	B2; 2A
bis(2-chloro-1-methylethyl) ether	108-60-1	4.00E-02	mg/kg/d	RfD	3
bis(2-chloroethyl) ether	111-44-4	3.30E-04	µg/m <sup>3</sup>	Unit Risk	B2; 3
bis(2-chloromethyl) ether	542-88-1	6.20E-02	µg/m <sup>3</sup>	Unit Risk	A
bromobenzene	108-86-1	6.00E+01	µg/m <sup>3</sup>	RfC	N/A
bromodichloromethane	75-27-4	2.00E-02	mg/kg/d	RfD	B2; 2B
bromoform	75-25-2	1.10E-06	µg/m <sup>3</sup>	Unit Risk	B2; 3
bromomethane	74-83-9	5.00	µg/m <sup>3</sup>	RfC	D; 3
butadiene, 1,3-	106-99-0	3.00E-05	µg/m <sup>3</sup>	Unit Risk	1
carbon disulfide	75-15-0	7.00E+02	µg/m <sup>3</sup>	RfC	N/A
carbon tetrachloride	56-23-5	6.00E-06	µg/m <sup>3</sup>	Unit Risk	2B
chlorine (Cl <sub>2</sub> )	7782-50-5	2.00E-01	µg/m <sup>3</sup>	RfC	N/A
chloro-1,1-difluoroethane, 1-	75-68-3	5.00E+04	µg/m <sup>3</sup>	RfC	N/A
chlorobenzene	108-90-7	1.00E+01	µg/m <sup>3</sup>	RfC	D
chlorobenzotrifluoride, 4-	98-56-6	1.30E+01	µg/m <sup>3</sup>	RfC	N/A

Substance name	Chemical Abstract Service Number (CAS)	TRV value	TRV units	TRV type	IRIS/IARC carcinogenicity classification
chlorobutane, 1-	109-69-3	4.00E-02	mg/kg/d	RfD	D
chlorodifluoromethane	75-45-6	5.00E+04	µg/m <sup>3</sup>	RfC	3
chloroethane	75-00-3	1.00E+04	µg/m <sup>3</sup>	RfC	3
chloroform	67-66-3	9.77E+01	µg/m <sup>3</sup>	RfC	B2; 2B
chloromethane	74-87-3	9.00E+01	µg/m <sup>3</sup>	RfC	D; 3
chloronitrobenzene, 4-	100-00-5	6.00E-01	µg/m <sup>3</sup>	RfC	3
chlorophenol, 2-	95-57-8	5.00E-03	mg/kg/d	RfD	N/A
chloroprene	126-99-8	3.00E-04	µg/m <sup>3</sup>	Unit Risk	2B
chloropropane, 2-	75-29-6	2.90E-02	mg/kg/d	RfD	N/A
chlorotoluene, 2-	95-49-8	2.00E-02	mg/kg/d	RfD	N/A
crotonaldehyde, trans-	123-73-9	1.00E-03	mg/kg/d	RfD	C; 3
cyanide	74-90-8	6.00E-04	mg/kg/d	RfD	N/A; N/A
cyanogen	460-19-5	1.00E-03	mg/kg/d	RfD	N/A
cyanogen bromide	506-68-3	9.00E-02	mg/kg/d	RfD	N/A
cyanogen chloride	506-77-4	5.00E-02	mg/kg/d	RfD	N/A
dibromo-3-chloropropane, 1,2-	1996-12-08	2.00E-01	µg/m <sup>3</sup>	RfC	2B
dibromobenzene, 1,4-	106-37-6	1.00E-02	mg/kg/d	RfD	N/A
dibromochloromethane	124-48-1	2.00E-02	mg/kg/d	RfD	C; 3
dibromoethane, 1,2-	106-93-4	3.00E-04	µg/m <sup>3</sup>	Unit Risk	2A
dibromomethane	74-95-3	4.00	µg/m <sup>3</sup>	RfC	N/A
dichloro-2-butene, 1,4-	764-41-0	4.20E-03	µg/m <sup>3</sup>	Unit Risk	N/A
dichlorobenzene, 1,2-	95-50-1	2.00E+02	µg/m <sup>3</sup>	RfC	D; 3
dichlorobenzene, 1,3-	541-73-1	3.00E-02	mg/kg/d	RfD	D; 3
dichlorobenzene, 1,4-	106-46-7	8.00E+02	µg/m <sup>3</sup>	RfC	2B
dichlorodifluoromethane	75-71-8	1.00E+02	µg/m <sup>3</sup>	RfC	N/A
dichloroethane, 1,1-	75-34-3	5.00E+02	µg/m <sup>3</sup>	RfC	C
dichloroethane, 1,2-	107-06-2	7.00	µg/m <sup>3</sup>	RfC	B2; 2B
dichloroethylene, 1,1-	75-35-4	2.00E+02	µg/m <sup>3</sup>	RfC	C; 3
dichloroethylene, 1,2- cis	156-59-2	6.00E+01	µg/m <sup>3</sup>	RfC	N/A
dichloroethylene, 1,2- trans	156-60-5	6.00E+01	µg/m <sup>3</sup>	RfC	N/A

Substance name	Chemical Abstract Service Number (CAS)	TRV value	TRV units	TRV type	IRIS/IARC carcinogenicity classification
dichloromethane	1975-09-02	6.00E+02	µg/m <sup>3</sup>	RfC	2A
dichloropropane, 1,2-	78-87-5	4.00	µg/m <sup>3</sup>	RfC	1
dichloropropane, 1,3-	142-28-9	2.00E-02	mg/kg/d	Slope Factor	N/A
dichloropropene, 1,3- (cis + trans)	542-75-6	4.00E-06	µg/m <sup>3</sup>	Unit Risk	B2; 2B
dicyclopentadiene	77-73-6	3.00E-01	µg/m <sup>3</sup>	RfC	N/A
diethyl ether	60-29-7	2.00E-01	mg/kg/d	RfD	N/A
dimethylamine	124-40-3	5.70E-06	mg/kg/d	RfD	N/A
dimethylaniline, N,N- [DMA]	121-69-7	2.00E-03	mg/kg/d	RfD	3
epichlorohydrin	106-89-8	1.00	µg/m <sup>3</sup>	RfC	B2; 2A
epoxybutane, 1,2-	106-88-7	2.00E+01	µg/m <sup>3</sup>	RfC	2B
ethyl acetate	141-78-6	7.00E+01	µg/m <sup>3</sup>	RfC	N/A
ethyl acrylate	140-88-5	8.00	µg/m <sup>3</sup>	RfC	2B
ethyl methacrylate	97-63-2	3.00E+02	µg/m <sup>3</sup>	RfC	N/A
ethylbenzene	100-41-4	1.00E+03	µg/m <sup>3</sup>	RfC	D; 2B
ethylene oxide	75-21-8	8.80E-05	µg/m <sup>3</sup>	Unit Risk	1
furan	110-00-9	1.00E-03	mg/kg/d	RfD	2B
hexachlorobutadiene	87-68-3	2.20E-05	µg/m <sup>3</sup>	Unit Risk	C; 3
hexachlorocyclopentadiene	77-47-4	2.00E-01	µg/m <sup>3</sup>	RfC	E
hexachloroethane	67-72-1	3.00E+01	µg/m <sup>3</sup>	RfC	2B
isopropylbenzene	98-82-8	4.00E+02	µg/m <sup>3</sup>	RfC	D; 2B
methacrylonitrile	126-98-7	3.00E+01	µg/m <sup>3</sup>	RfC	N/A
methyl acetate	79-20-9	1.00	mg/kg/d	RfD	N/A
methyl acrylate	96-33-3	2.00E+01	µg/m <sup>3</sup>	RfC	D; 3
methyl ethyl ketone [MEK]	78-93-3	5.00E+03	µg/m <sup>3</sup>	RfC	N/A
methyl isobutyl ketone [MIBK]	108-10-1	3.00E+03	µg/m <sup>3</sup>	RfC	2B
methyl mercaptan	74-93-1	5.70E-04	mg/kg/d	RfD	N/A
methyl methacrylate	80-62-6	7.00E+02	µg/m <sup>3</sup>	RfC	E; 3
methyl tert-butyl ether [MTBE]	1634-04-4	3.00E+03	µg/m <sup>3</sup>	RfC	3

Substance name	Chemical Abstract Service Number (CAS)	TRV value	TRV units	TRV type	IRIS/IARC carcinogenicity classification
methylcyclohexane	108-87-2	8.60E-01	mg/kg/d	RfD	N/A
methylstyrene, alpha-	98-83-9	7.00E-02	mg/kg/d	RfD	2B
naphthalene	91-20-3	3.00	µg/m <sup>3</sup>	RfC	C; 2B
n-decane	124-18-5	2.60E+03	µg/m <sup>3</sup>	RfC	N/A
n-hexane	110-54-3	7.00E+02	µg/m <sup>3</sup>	RfC	N/A
nitrobenzene	98-95-3	4.00E-05	µg/m <sup>3</sup>	Unit Risk	2B
nitrotoluene, 2-	88-72-2	9.00E-04	mg/kg/d	RfD	2A
phosphine	7803-51-2	3.00E-01	µg/m <sup>3</sup>	RfC	D
propylene oxide	75-56-9	3.70E-06	µg/m <sup>3</sup>	Unit Risk	B2; 2B
pyridine	110-86-1	1.20E+02	µg/m <sup>3</sup>	RfC	3
styrene	100-42-5	1.00E+03	µg/m <sup>3</sup>	RfC	2B
tetrachloroethane, 1,1,1,2-	630-20-6	7.40E-06	µg/m <sup>3</sup>	Unit Risk	C; 2B
tetrachloroethane, 1,1,2,2-	79-34-5	2.00E-02	mg/kg/d	RfD	2B
tetrachloroethylene	127-18-4	2.60E-07	µg/m <sup>3</sup>	Unit Risk	2A
tetrahydrofuran	109-99-9	3.00E-06	µg/m <sup>3</sup>	Unit Risk	N/A
toluene	108-88-3	5.00E+03	µg/m <sup>3</sup>	RfC	3
trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1	3.00E+04	µg/m <sup>3</sup>	RfC	N/A
trichlorobenzene, 1,2,4-	120-82-1	7.00	µg/m <sup>3</sup>	RfC	D
trichloroethane, 1,1,1-	71-55-6	5.00E+03	µg/m <sup>3</sup>	RfC	3
trichloroethane, 1,1,2-	79-00-5	2.00E-01	µg/m <sup>3</sup>	RfC	C; 3
trichloroethylene	1979-01-06	2.00	µg/m <sup>3</sup>	RfC	1
trichlorofluoromethane	75-69-4	7.00E+02	µg/m <sup>3</sup>	RfC	N/A
trichloropropane, 1,1,2-	598-77-6	5.00E-03	mg/kg/d	RfD	N/A
trichloropropane, 1,2,3-	96-18-4	3.00E-01	µg/m <sup>3</sup>	RfC	2A
trichloropropene, 1,2,3-	96-19-5	3.00E-01	µg/m <sup>3</sup>	RfC	N/A
triethylamine	121-44-8	7.00	µg/m <sup>3</sup>	RfC	N/A
trimethylbenzene, 1,2,4-	95-63-6	7.00	µg/m <sup>3</sup>	RfC	N/A
trimethylbenzene, 1,3,5-	108-67-8	1.70E-03	mg/kg/d	RfD	N/A
vinyl acetate	108-05-4	2.00E+02	µg/m <sup>3</sup>	RfC	2B
vinyl bromide	593-60-2	3.20E-05	µg/m <sup>3</sup>	Unit Risk	2A

Substance name	Chemical Abstract Service Number (CAS)	TRV value	TRV units	TRV type	IRIS/IARC carcinogenicity classification
vinyl chloride	1975-01-04	8.80E-06	µg/m <sup>3</sup>	Unit Risk	A; 1
VPHv	NA				N/A
xylenes	1330-20-7	1.00E+02	µg/m <sup>3</sup>	RfC	3

## Chapter 9. Background Adjusting Soil Standards

### 9.1 Introduction

The ministry collected soil samples from the Province's eight administrative regions for the purposes of determining naturally occurring (background) concentrations of metals in soil. Additional sampling was done in the Greater Vancouver area within the Lower Mainland Region, in recognition of the active redevelopment in this area. Collected samples are analysed using the provincially accepted method, the "[British Columbia Environmental Laboratory Manual, Section C, Strong Acid Leachable Metals \(SALM\) in Soil](#)". Further information on the data, and the database of soil samples is found in "[Background Concentrations Databases](#)".

### 9.2 Provincial background estimates derivation

#### 9.2.1 General sampling methodology

For each locale a total of 8 soil samples for metals assay, 16 sub-samples for organics assay, and 8 samples for archival purposes were collected. Note, certain organic substances were quantified but background concentrations were not established for these parameters.

#### 9.2.2 Provincial background estimate derivation procedure

A total of 487 soil samples from 63 background sites were analysed using the SALM method. The provincial soil background concentration was estimated by calculation of the 95<sup>th</sup> percentile of the data set, with some exceptions (see Section 9.2.3). Provincial estimates were then rounded in accordance with the rounding rule (see Chapter 10).

#### 9.2.3 Exceptions to the general methodology

As described in Section 9.2.2, the provincial background estimate is calculated using the rounded 95<sup>th</sup> percentile of the entire data set, with the following exceptions:

- Surficial soil samples at some locations (e.g. Trail and Castlegar) were known to have been influenced by deposition from a point source (Trail smelter). As it is not the intent of the CSR to dismiss contamination from anthropogenic sources, the results in the surficial soil samples from the Trail and Castlegar sample locales were removed from the Provincial data set before calculating 95<sup>th</sup> percentiles, due to historical smelting operations in these areas.
- Antimony, boron, selenium, silver, thallium and zirconium had insufficient data sets ( $n < 10$ ) from the SALM method so previous estimates were retained.

- The official method for sodium ion is the “[British Columbia Environmental Laboratory Manual Saturated Paste Extraction for Soils](#)” method, rather than SALM. As no saturated paste background data was available, no Provincial Background Estimate in soil for sodium ion was calculated.

#### **9.2.4 Outcome**

Newly derived soil standards using this protocol were compared to the corresponding Provincial Background Estimates (Table 9-1); where the standards were lower than the Provincial Background Estimates, the standards were set as equivalent to the background soil estimate.

**Table 9-1. Provincial background estimates in soil**

<b>Substance</b>	<b>BC Provincial Background Estimate (units µg/g)</b>	<b>Notes</b>
aluminum	<b>40 000</b>	
antimony	<b>4.5</b>	n < 10
arsenic	<b>10</b>	*
barium	<b>300</b>	
beryllium	<b>1</b>	*
boron	<b>35</b>	n < 10
cadmium	<b>1</b>	*
calcium	<b>30 000</b>	
chromium	<b>60</b>	*
cobalt	<b>25</b>	*
copper	<b>75</b>	*
iron	<b>35 000</b>	
lead	<b>120</b>	*
magnesium	<b>15 000</b>	
manganese	<b>2 000</b>	*
mercury	<b>0.2</b>	
molybdenum	<b>3</b>	*
nickel	<b>70</b>	*
selenium	<b>1</b>	n < 10*
silver	<b>2</b>	n < 10
sodium ion	-	official method is saturated paste
strontium	<b>150</b>	
sulfur	<b>2 000</b>	
thallium	<b>2</b>	not analysed by SALM
tin	<b>5</b>	n < 10
vanadium	<b>100</b>	*
zinc	<b>150</b>	*
zirconium	<b>15</b>	not analysed by SALM

**Notes:**

\* Denotes a substance with soil standards adjusted to the 2016 background estimates listed in this table.

## Chapter 10. Additional Information

### 10.1 Introduction

This chapter describes the additional qualitative standards contained in the CSR, as well as the adjustments that were consistently made to all calculated and adopted quantitative standards.

### 10.2 Qualitative standards

The CSR includes two qualitative standards:

- Odorous substances – not present
- Nonaqueous phase liquids – not present

The "Odorous substances – not present" standard is designed to account for objectionable odour as an aesthetic concern and only applies to those substances that are considered "volatile" under the CSR (see Chapter 6). The CSR states that *"soil must be remediated so that odorous substances are not present in quantities in excess of that acceptable to a director"*.

The "Nonaqueous phase liquids – not present" standard is to minimize the potential for a source of soil or water contamination to remain in place. The CSR states that *"not present in quantities in excess of that acceptable to a director"*.

The requirements regarding the environmental quality standards for odorous substances and nonaqueous phase liquids are found in [Protocol 16, "Determining the Presence and Mobility of Non aqueous phase liquids and Odorous Substances"](#).

### 10.3 Rounding rule

Standards in the CSR are subject to a ministry "rounding-off" rule, which states that standards are to be expressed as one significant digit, followed by a second significant digit of either a 0 or 5, whichever is closer. When calculating local background concentrations, site specific soil standards and risk-based standards, qualified professionals must not round the substance concentration or standard.

In this protocol, exceptions to the rounding rule are noted in respective chapters. For example, Health Canada Canadian Drinking Water Guidelines are never rounded (see Chapter 5).

**Revision history**

<b>Approved Date</b>	<b>Effective Date</b>	<b>Document Version</b>	<b>Notes</b>
November 12, 2017	November 1, 2017	1.0	Chapter 4 released
February 1, 2021	February 1, 2021	2.0	Release of all chapters as part of CSR Stage 13 amendment
April 30, 2024	May 1, 2024	3.0	Updated to reflect CSR Stage 14 amendment