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Guidelines for Canadian Drinking Water Quality Summary Table

Prepared by the

Federal-Provincial-Territorial Committee on Drinking Water

of the

Federal-Provincial-Territorial Committee on Health and the Environment

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Canada 

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Other documents for the Guidelines for Canadian Drinking Water Quality can be found on the following web page:
www.healthcanada.gc.ca/waterquality

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Introduction

The Guidelines for Canadian Drinking Water Quality are established by the Federal-Provincial-Territorial Committee on Drinking Water (CDW) and published by Health Canada. This summary table is updated regularly and published on Health Canada's website (www.healthcanada.gc.ca/waterquality). It supersedes all previous electronic and printed versions, including the 6th edition of the Guidelines for Canadian Drinking Water Quality (1996).

Each guideline was established based on current, published scientific research related to health effects, aesthetic effects, and operational considerations. Health-based guidelines are established on the basis of comprehensive review of the known health effects associated with each contaminant, on exposure levels and on the availability of treatment and analytical technologies. Aesthetic effects (e.g., taste, odour) are taken into account when these play a role in determining whether consumers will consider the water drinkable. Operational considerations are factored in when the presence of a substance may interfere with or impair a treatment process or technology (e.g., turbidity interfering with chlorination or UV disinfection) or adversely affect drinking water infrastructure (e.g., corrosion of pipes).

The Federal-Provincial-Territorial Committee on Drinking Water establishes the *Guidelines for Canadian Drinking Water Quality* specifically for contaminants that meet all of the following criteria:

1. Exposure to the contaminant could lead to adverse health effects in humans;
2. The contaminant is frequently detected or could be expected to be found in a large number of drinking water supplies throughout Canada; and
3. The contaminant is detected, or could be expected to be detected, in drinking water at a level that is of possible human health significance.

If a contaminant of interest does not meet all these criteria, CDW may choose not to establish a numerical guideline or develop a Guideline Technical Document. In that case, a Guidance Document may be developed.

Older guidelines are systematically reviewed in order to assess the need to update them; in the tables, guidelines that have been reaffirmed include both the original approval and reaffirmation year indicated after the name of the parameter.

Science-based documents published as part of the Guidelines for Canadian Drinking Water Quality (i.e., Guideline Technical Documents, Guidance Documents) are developed through a documented process which includes a literature review, internal and external peer-reviews, public consultations and Federal-Provincial-Territorial approval processes. For more information on specific guidelines, please refer to the guideline technical document or guidance document for the parameter of concern, available on the Health Canada website (www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/index-eng.php).

Membership of the Federal-Provincial-Territorial Committee on Drinking Water

Jurisdictional representatives

Alberta	Department of Environment and Parks.....	Dr. Donald Reid
British Columbia	Ministry of Health.....	Mr. David Fishwick
Manitoba	Manitoba Sustainable Development	Ms. Kim Philip
New Brunswick	Department of Health.....	Mr. Kevin Gould
Newfoundland and Labrador	Department of Environment and Conservation	Mr. Haseen Kahn
Northwest Territories	Department of Health and Social Services	Mr. Peter Workman
Nova Scotia	Department of Environment	Ms. Angelina Polegato
Nunavut Territory	Department of Health and Social Services	Ms. Michele LeBlanc-Havard
Ontario	Ministry of the Environment and Climate Change	Dr. Satish Deshpande
Prince Edward Island	Department of Communities, Land and Environment.....	Mr. George Somers
Québec	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques.....	Ms. Caroline Robert
Saskatchewan	Water Security Agency	Mr. Sam Ferris
Yukon Territory	Department of Health and Social Services	Ms. Patricia Brooks
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Committee coordinator

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Tables

Table 1. Microbiological Parameters

In general, the highest priority guidelines are those dealing with microbiological contaminants, such as bacteria, protozoa and viruses. As a result of challenges with routine analysis of harmful microorganisms that could potentially be present in inadequately treated drinking water, the microbiological guidelines focus on indicators (*E.coli*, total coliforms) and treatment goals. The use of a multi-barrier approach that includes source water protection, adequate treatment, including disinfection, and a well maintained distribution system can reduce microorganisms to levels that have not been associated with illness, as well as meet the guidelines outlined below.

Parameter (approval)	Guideline	Common sources	Health considerations	Applying the guideline
Enteric protozoa: <i>Giardia</i> and <i>Cryptosporidium</i> (2012)	Treatment goal: Minimum 3 log removal and/or inactivation of cysts and oocysts	Human and animal faeces	<i>Giardia</i> and <i>Cryptosporidium</i> are commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea). Less common health effects vary. <i>Giardia</i> infections may include prolonged gastrointestinal upset, malaise and malabsorption. <i>Cryptosporidium</i> infections, in immunocompromised individuals, can occur outside the gastrointestinal tract including in the lungs, middle ear, and pancreas.	Monitoring for <i>Cryptosporidium</i> and <i>Giardia</i> in source waters will provide valuable information for a risk-based assessment of treatment requirements. Depending on the source water quality, a greater log removal and/or inactivation may be required.
Enteric viruses (2011)	Treatment goal: Minimum 4 log reduction (removal and/or inactivation) of enteric viruses	Human faeces	Commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea); less common health effects can include respiratory symptoms, central nervous system infections, liver infections and muscular syndromes.	Routine monitoring for viruses is not practical; characterize source water to determine if greater than a 4 log removal or inactivation is necessary.
<i>Escherichia coli</i> (<i>E. coli</i>) (2012)	MAC: None detectable per 100 mL	Human and animal faeces	The presence of <i>E. coli</i> indicates recent faecal contamination and the potential presence of microorganisms capable of causing gastrointestinal illnesses; pathogens in human and animal faeces pose the most immediate danger to public health.	<i>E. coli</i> is used as an indicator of the microbiological safety of drinking water; if detected, enteric pathogens may also be present. <i>E. coli</i> monitoring should be used, in conjunction with other indicators, as part of a multi-barrier approach to producing drinking water of an acceptable quality.

Parameter (approval)	Guideline	Common sources	Health considerations	Applying the guideline
Total coliforms (2012)	MAC of none detectable/100 mL in water leaving a treatment plant and in non-disinfected groundwater leaving the well	Human and animal faeces; naturally occurring in water, soil and vegetation	Total coliforms are not used as indicators of potential health effects from pathogenic microorganisms; they are used as a tool to determine how well the drinking water treatment system is operating and to indicate water quality changes in the distribution system. Detection of total coliforms from consecutive samples from the same site or from more than 10% of the samples collected in a given sampling period should be investigated.	Total coliforms should be monitored in the distribution system because they are used to indicate changes in water quality. In <u>water leaving a treatment plant</u> , total coliforms should be measured in conjunction with other indicators to assess water quality; the presence of total coliforms indicates a serious breach in treatment. In a <u>distribution and storage system</u> , detection of total coliforms can indicate regrowth of the bacteria in biofilms or intrusion of untreated water. In <u>non-disinfected groundwater</u> , the presence of total coliforms may indicate that the system is vulnerable to contamination, or it may be a sign of bacterial regrowth.
Turbidity (2012)	Treatment limits for individual filters or units: - Conventional and direct filtration: ≤ 0.3 NTU ¹ - slow sand and diatomaceous earth filtration: ≤ 1.0 NTU ² - membrane filtration: ≤ 0.1 NTU ³	Naturally occurring particles: <i>Inorganic</i> : clays, silts, metal precipitates <i>Organic</i> : decomposed plant & animal debris, microorganisms	Filtration systems should be designed and operated to reduce turbidity levels as low as reasonably achievable and strive to achieve a treated water turbidity target from individual filters of less than 0.1 NTU. Particles can harbour microorganisms, protecting them from disinfection, and can entrap heavy metals and biocides; elevated or fluctuating turbidity in filtered water can indicate a problem with the water treatment process and a potential increased risk of pathogens in treated water.	Guidelines apply to individual filter turbidity for systems using surface water or groundwater under the direct influence of surface water. The decision to exempt a waterworks from filtration should be made by the appropriate authority based on site-specific considerations, including historical and ongoing monitoring data. To ensure effectiveness of disinfection and for good operation of the distribution system, it is recommended that water entering the distribution system have turbidity levels of 1.0 NTU or less. For systems that use groundwater, turbidity should generally be below 1.0 NTU.

¹ in at least 95% of measurements either per filter cycle or per month; never to exceed 1.0 NTU.

² in at least 95% of measurements either per filter cycle or per month; never to exceed 3.0 NTU.

³ in at least 99% of measurements per operational filter period or per month. Measurements greater than 0.1 NTU for a period greater than 15 minutes from an individual membrane unit should immediately trigger an investigation of the membrane unit integrity.

Table 2. Chemical and Physical Parameters

Guidelines for chemical and physical parameters are:

1. health based and listed as maximum acceptable concentrations (MAC);
2. based on aesthetic considerations and listed as aesthetic objectives (AO); or
3. established based on operational considerations and listed as operational guidance values (OG).

In general, the highest priority guidelines are those dealing with microbiological contaminants. Any measure taken to reduce concentrations of chemical contaminants should not compromise the effectiveness of disinfection.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
T	Aluminum (1998)		OG: < 0.1 (conventional treatment); < 0.2 (other treatment types)	Aluminum salts used as coagulants in drinking water treatment; naturally occurring	There is no consistent, convincing evidence that aluminum in drinking water causes adverse health effects in humans.	The operational guideline applies to treatment plants using aluminum-based coagulants; it does not apply to naturally occurring aluminum found in groundwater. For treatment plants using aluminum-based coagulants, monthly samples should be taken of the water leaving the plant; the OGs are based on a running annual average of monthly samples.
I	Ammonia (2013)	None required		Naturally occurring; released from agricultural or industrial wastes; added as part of chloramination for drinking water disinfection	Levels of ammonia, either naturally present in the source water or added as part of a disinfection strategy, can affect water quality in the distribution system (e.g., nitrification) and should be monitored.	Guideline value not necessary as it is produced in the body and efficiently metabolized in healthy people; no adverse effects at levels found in drinking water. To help prevent nitrification, limit excess free ammonia entering the distribution system to below 0.1 mg/L, and preferably below 0.05 mg/L, measured as nitrogen. Nitrification can lead to the formation of nitrite/nitrate, decreased chloramine residual and increased bacterial count.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Antimony (1997)	0.006		Naturally occurring (erosion); soil runoff; industrial effluents; leaching from plumbing materials and solder	Health basis of MAC: Microscopic changes in organs and tissues (thymus, kidney, liver, spleen, thyroid)	MAC takes into consideration analytical achievability; plumbing should be thoroughly flushed before water is used for consumption.
I	Arsenic (2006)	0.010 ALARA		Naturally occurring (erosion and weathering of soils, minerals, ores); releases from mining; industrial effluent	Health basis of MAC: Cancer (lung, bladder, liver, skin) (classified as human carcinogen) Other: Skin, vascular and neurological effects (numbness and tingling of extremities)	MAC based on treatment achievability; elevated levels associated with certain groundwaters; levels should be kept as low as reasonably achievable.
I	Asbestos (1989, 2005)	None required		Naturally occurring (erosion of asbestos minerals and ores); decay of asbestos-cement pipes		Guideline value not necessary; no evidence of adverse health effects from exposure through drinking water.
P	Atrazine (1993)	0.005		Leaching and/or runoff from agricultural use	Health basis of MAC: Developmental effects (reduced body weight of offspring) Other: Potential increased risk of ovarian cancer or lymphomas (classified as possible carcinogen)	MAC applies to sum of atrazine and its <i>N</i> -dealkylated metabolites - diethylatrazine, deisopropylatrazine, hydroxyatrazine, diaminochlorotriazine; Persistent in source waters.
P	Azinphos-methyl (1989, 2005)	0.02		Leaching and/or runoff from agricultural use	Health basis of MAC: Neurological effects (plasma cholinesterase)	All uses were phased out by 2012.
I	Barium (1990)	1.0		Naturally occurring; releases or spills from industrial uses	Health basis of MAC: Increases in blood pressure, cardiovascular disease	
O	Benzene (2009)	0.005		Releases or spills from industrial uses	Health basis of MAC: Bone marrow (red and white blood cell) changes and cancer (classified as human carcinogen) Other: Blood system and immunological responses	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
O	Benzo[<i>a</i>]pyrene (2016)	0.000 04		Leaching from liners in water distribution systems	Health basis of MAC: Stomach tumours (classified as human carcinogen)	

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Boron (1990)	5		Naturally occurring; leaching or runoff from industrial use	Health basis of MAC: Reproductive effects (testicular atrophy, spermatogenesis) Other: Limited evidence of reduced sexual function in men	MAC based on treatment achievability.
DBP	Bromate (1998)	0.01		By-product of drinking water disinfection with ozone; possible contaminant in hypochlorite solution	Health basis of MAC: Renal cell tumours (classified as probable carcinogen)	MAC based on analytical and treatment achievability.
P	Bromoxynil (1987, 2005)	0.005		Leaching or runoff from agricultural use	Health basis of MAC: Reduced liver to body weight ratios	
I	Cadmium (1986, 2005)	0.005		Leaching from galvanized pipes, solders or black polyethylene pipes; industrial and municipal waste	Health basis of MAC: Kidney damage and softening of bone	
I	Calcium (1987, 2005)	None required		Naturally occurring (erosion and weathering of soils, minerals, ores)		Guideline value not necessary, as there is no evidence of adverse health effects from calcium in drinking water; calcium contributes to hardness.
P	Carbaryl (1991, 2005)	0.09		Leaching or runoff from agricultural use	Health basis of MAC: Decreased kidney function (may be rapidly reversible after exposure ceases)	
P	Carbofuran (1991, 2005)	0.09		Leaching or runoff from agricultural use	Health basis of MAC: Nervous system effects (cholinesterase inhibition) and growth suppression	
O	Carbon tetrachloride (2010)	0.002		Industrial effluents and leaching from hazardous waste sites	Health basis of MAC: Liver toxicity Other: Kidney damage; liver tumours (classified as probable carcinogen)	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
D	Chloramines (1995)	3.0		Monochloramine is used as a secondary disinfectant; formed in presence of both chlorine and ammonia	Health basis of MAC: Reduced body weight gain Other: immunotoxicity effects	MAC is for total chloramines based on health effects associated with monochloramine and analytical achievability.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
DBP	Chlorate (2008)	1		By-product of drinking water disinfection with chlorine dioxide; possible contaminant in hypochlorite solution	Health basis of MAC: Thyroid gland effects (colloid depletion)	As chlorate is difficult to remove once formed, its formation should be controlled by respecting the maximum feed dose of 1.2 mg/L of chlorine dioxide and managing /monitoring formation in hypochlorite solutions.
I	Chloride (1979, 2005)		AO: ≤ 250	Naturally occurring (seawater intrusion); dissolved salt deposits, highway salt, industrial effluents, oil well operations, sewage, irrigation drainage, refuse leachates		Based on taste and potential for corrosion in the distribution system.
D	Chlorine (2009)	None required		Used as drinking water disinfectant	Guideline value not necessary due to low toxicity at concentrations found in drinking water	Free chlorine concentrations in most Canadian drinking water distribution systems range from 0.04 to 2.0 mg/L.
D	Chlorine dioxide (2008)	None required		Used as drinking water disinfectant (primary disinfection only)	A guideline for chlorine dioxide is not required because of its rapid reduction to chlorite in drinking water	A maximum feed dose of 1.2 mg/L of chlorine dioxide should not be exceeded to control the formation of chlorite and chlorate.
DBP	Chlorite (2008)	1		By-product of drinking water disinfection with chlorine dioxide	Health basis of MAC: Neurobehavioural effects (lowered auditory startle amplitude, decreased exploratory activity), decreased absolute brain weight, altered liver weights	Chlorite formation should be controlled by respecting the maximum feed dose of 1.2 mg/L of chlorine dioxide and managing /monitoring formation in hypochlorite solutions.
P	Chlorpyrifos (1986)	0.09		Leaching and/or runoff from agricultural or other uses	Health basis of MAC: Nervous system effects (cholinesterase inhibition)	Not expected to leach significantly into groundwater.
I	Chromium (1986)	0.05		Naturally occurring (erosion of minerals); releases or spills from industrial uses	Health basis of MAC: Enlarged liver, irritation of the skin, respiratory and gastrointestinal tracts from chromium (VI) Other: Chromium (III) is an essential element	MAC is protective of health effects from chromium (VI).

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
T	Colour (1979, 2005)		AO: ≤ 15 TCU	Naturally occurring organic substances, metals; industrial wastes		May interfere with disinfection; removal is important to ensure effective treatment.
I	Copper (1992)		AO: ≤ 1.0	Naturally occurring; leaching from copper piping	Copper is an essential element in human metabolism. Adverse health effects occur at levels much higher than the aesthetic objective	Based on taste, staining of laundry and plumbing fixtures; plumbing should be thoroughly flushed before water is used for consumption.
I	Cyanide (1991)	0.2		Industrial and mining effluents; release from organic compounds	Health basis of MAC: No clinical or other changes at the highest dose tested	Health effects from cyanide are acute; at low levels of exposure, it can be detoxified to a certain extent in the human body.
O	Cyanobacterial toxins— Microcystin-LR (2002)	0.0015		Naturally occurring (released from blooms of blue-green algae)	Health basis of MAC: Liver effects (enzyme inhibitor) Other: Classified as possible carcinogen	MAC is protective of total microcystins; avoid algacides like copper sulphate, as they may cause toxin release into water.
P	Diazinon (1986, 2005)	0.02		Runoff from agricultural or other uses	Health basis of MAC: Nervous system effects (cholinesterase inhibition)	Not expected to leach significantly into groundwater.
P	Dicamba (1987, 2005)	0.12		Leaching or runoff from agricultural or other uses	Health basis of MAC: Liver effects (vacuolization, necrosis, fatty deposits and liver weight changes)	Readily leaches into groundwater.
O	1,2-Dichlorobenzene ² (1987)	0.2	AO: ≤ 0.003	Releases or spills from industrial effluents	Health basis of MAC: Increased blood cholesterol, protein and glucose levels	AO based on odour; levels above the AO would render drinking water unpalatable.
O	1,4-Dichlorobenzene ² (1987)	0.005	AO: ≤ 0.001	Releases or spills from industrial effluents; use of urinal deodorants	Health basis of MAC: Benign liver tumours and adrenal gland tumours (classified as probable carcinogen)	AO based on odour; levels above the AO would render drinking water unpalatable.
O	1,2-Dichloroethane (2014)	0.005		Releases or spills from industrial effluents; leachate from waste disposal	Health basis of MAC: Cancer of the mammary gland (classified as probable carcinogen)	The MAC is protective of both cancer and non-cancer effects and takes into consideration all exposures from drinking water, which include ingestion as well as inhalation and dermal absorption during showering and bathing.
O	1,1-Dichloroethylene (1994)	0.014		Releases or spills from industrial effluents	Health basis of MAC: Liver effects (fatty changes)	

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Dichloromethane (2011)	0.05		Industrial and municipal wastewater discharges	Health basis of MAC: Liver effects (liver foci and areas of cellular alteration). Other: Classified as probable carcinogen	The MAC is protective of both cancer and non-cancer effects and takes into consideration all exposures from drinking water, which include ingestion as well as inhalation and dermal absorption during showering and bathing.
O	2,4-Dichlorophenol (1987, 2005)	0.9	AO: ≤ 0.0003	By-product of drinking water disinfection with chlorine; releases from industrial effluents	Health basis of MAC: Liver effects (cellular changes)	AO based on odour; levels above the AO would render drinking water unpalatable.
P	2,4-Dichlorophenoxy acetic acid (2,4-D) (1991)	0.1		Leaching and/or runoff from use as a weed controller; releases from industrial effluents	Health basis of MAC: Kidney effects (tubular cell pigmentation)	
P	Diclofop-methyl (1987, 2005)	0.009		Leaching and/or runoff from use as a weed controller; added directly to water to control aquatic weeds	Health basis of MAC: Liver effects (enlargement and enzyme changes)	Low potential for groundwater contamination.
P	Dimethoate (1986, 2005)	0.02		Leaching and/or runoff from residential, agricultural and forestry use	Health basis of MAC: Nervous system effects (cholinesterase inhibition)	
P	Diquat (1986, 2005)	0.07		Leaching and/or runoff from agricultural use; added directly to water to control aquatic weeds	Health basis of MAC: Cataract formation	Unlikely to leach into groundwater.
P	Diuron (1987, 2005)	0.15		Leaching and/or runoff from use in controlling vegetation	Health basis of MAC: Weight loss, increased liver weight and blood effects	High potential to leach into groundwater.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Ethylbenzene (2014)	0.14	AO: 0.0016	Emissions, effluents or spills from petroleum and chemical industries	Health basis of MAC: Effects on the liver and pituitary gland. Other: Tumour formation at various sites in animals, including kidney, lung, liver and testes.	MAC is protective of both cancer and non-cancer health effects. MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. AO is based on odour threshold.
I	Fluoride (2010)	1.5		Naturally occurring (rock and soil erosion); may be added to promote dental health	Health basis of MAC: Moderate dental fluorosis (based on cosmetic effect, not health)	Beneficial in preventing dental caries.
DBP	Formaldehyde (1997)	None required		By-product of disinfection with ozone; releases from industrial effluents		Guideline value not necessary, as levels in drinking water are below the level at which adverse health effects may occur.
P	Glyphosate (1987, 2005)	0.28		Leaching and/or runoff from various uses in weed control	Health basis of MAC: Reduced body weight gain	Not expected to migrate to groundwater
DBP	Haloacetic acids – Total (HAAs) ³ (2008)	0.08 ALARA		By-product of drinking water disinfection with chlorine	Health basis of MAC: Liver cancer (DCA); DCA is classified as probably carcinogenic to humans Other: Other organ cancers (DCA, DBA, TCA); liver and other organ effects (body, kidney and testes weights) (MCA)	Refers to the total of monochloroacetic acid (MCA), dichloroacetic acid (DCA), trichloroacetic acid (TCA), monobromoacetic acid (MBA) and dibromoacetic acid (DBA); MAC is based on ability to achieve HAA levels in distribution systems without compromising disinfection; precursor removal limits formation.
T	Hardness (1979)	None required		Naturally occurring (sedimentary rock erosion and seepage, runoff from soils); levels generally higher in groundwater	Although hardness may have significant aesthetic effects, a guideline has not been established because public acceptance of hardness may vary considerably according to the local conditions; major contributors to hardness (calcium and magnesium) are not of direct public health concern	Hardness levels between 80 and 100 mg/L (as CaCO ₃) provide acceptable balance between corrosion and incrustation; where a water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Iron (1978, 2005)		AO: ≤ 0.3	Naturally occurring (erosion and weathering of rocks and minerals); acidic mine water drainage, landfill leachates, sewage effluents and iron-related industries		Based on taste and staining of laundry and plumbing fixtures; no evidence exists of dietary iron toxicity in the general population.
I	Lead (1992)	0.010		Leaching from plumbing (pipes, solder, brass fittings and lead service lines)	Health basis of MAC: Biochemical and neurobehavioural effects (intellectual development, behaviour) in infants and young children (under 6 years) Other: Anaemia, central nervous system effects; in pregnant women, can affect the unborn child; in infants and children under 6 years, can affect intellectual development, behaviour, size and hearing; classified as probably carcinogenic to humans	Because the MAC is based on chronic effects, it is intended to apply to average concentrations in water consumed for extended periods. Exposure to lead should nevertheless be kept to a minimum; plumbing should be thoroughly flushed before water is used for consumption; most significant contribution is generally from lead service line entering the building.
I	Magnesium (1978)	None required		Naturally occurring (erosion and weathering of rocks and minerals)		Guideline value not necessary, as there is no evidence of adverse health effects from magnesium in drinking water.
P	Malathion (1986, 2005)	0.19		Leaching and/or runoff from agricultural and other uses	Health basis of MAC: Nervous system effects (cholinesterase inhibition)	Not expected to leach into groundwater.
I	Manganese (1987)		AO: ≤ 0.05	Naturally occurring (erosion and weathering of rocks and minerals)		Based on taste and staining of laundry and plumbing fixtures.
I	Mercury (1986)	0.001		Releases or spills from industrial effluents; waste disposal; irrigation or drainage of areas where agricultural pesticides are used	Health basis of MAC: Irreversible neurological symptoms	Applies to all forms of mercury; mercury generally not found in drinking water, as it binds to sediments and soil.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
P	2-Methyl-4-chlorophenoxyacetic acid (MCPA) (2010)	0.1		Leaching and/or runoff from agricultural and other uses	Health basis of MAC: Kidney effects (increased absolute and relative weights, urinary bilirubin, crystals and pH) Other: Systemic, liver, testicular, reproductive/developmental and nervous system effects	Can potentially leach into groundwater.
O	Methyl tertiary-butyl ether (MTBE) (2006)		AO: ≤ 0.015	Spills from gasoline refineries, filling stations and gasoline-powered boats; seepage into groundwater from leaking storage tanks	There exist too many uncertainties and limitations in the MTBE database to develop a health based guideline.	AO based on odour; levels above the AO would render water unpalatable; as the AO is lower than levels associated with potential toxicological effects, it is considered protective of human health.
P	Metolachlor (1986)	0.05		Leaching and/or runoff from agricultural or other uses	Health basis of MAC: Liver lesions and nasal cavity tumours	Readily binds to organic matter in soil; little leaching expected in soils with high organic and clay content
P	Metribuzin (1986, 2005)	0.08		Leaching and/or runoff from agricultural use	Health basis of MAC: Liver effects (increased incidence and severity of mucopolysaccharide droplets)	Leaching into groundwater depends on the organic matter content of the soil.
O	Monochlorobenzene (1987)	0.08	AO: ≤ 0.03	Releases or spills from industrial effluents	Health basis of MAC: Reduced survival and body weight gain	AO based on odour threshold.
I	Nitrate (2013)	45 as nitrate; 10 as nitrate-nitrogen		Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitrification in the distribution system	Health basis of MAC: Methaemoglobinaemia (blue baby syndrome) and effects on thyroid gland function in bottle-fed infants Other: Classified as possible carcinogen under conditions that result in endogenous nitrosation	Systems using chloramine disinfection or that have naturally occurring ammonia should monitor the level of nitrate in the distribution system. Homeowners with a well should test concentration of nitrate in their water supply.
I	Nitritotriacetic acid (NTA) (1990)	0.4		Sewage contamination	Health basis of MAC: Kidney effects (nephritis and nephrosis) Other: Classified as possible carcinogen	

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
I	Nitrite (2013)	3 as nitrite; 1 as nitrite-nitrogen		Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitrification in the distribution system	Health basis of MAC: Methaemoglobinaemia (blue baby syndrome) in bottle-fed infants less than 6 months of age Other: Classified as possible carcinogen under conditions that result in endogenous nitrosation	Systems using chloramine disinfection or that have naturally occurring ammonia should monitor the level of nitrite in the distribution system. Homeowners with a well should test concentration of nitrite in their water supply.
DBP	<i>N</i> -Nitroso dimethylamine (NDMA) (2010)	0.000 04		By-product of drinking water disinfection with chlorine or chloramines; industrial and sewage treatment plant effluents	Health basis of MAC: Liver cancer (classified as probable carcinogen)	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.; levels should be kept low by preventing formation during treatment.
A	Odour (1979, 2005)		Inoffensive	Biological or industrial sources		Important to provide drinking water with no offensive odour, as consumers may seek alternative sources that are less safe.
P	Paraquat (1986, 2005)	0.01 as paraquat dichloride; 0.007 as paraquat ion		Leaching and/or runoff from agricultural and other uses; added directly to water to control aquatic weeds	Health basis of MAC: Various effects on body weight, spleen, testes, liver, lungs, kidney, thyroid, heart and adrenal gland	Entry into drinking water unlikely from crop applications (clay binding); however, may persist in water for several days if directly applied to water.
O	Pentachlorophenol (1987, 2005)	0.06	AO: ≤ 0.03	By-product of drinking water disinfection with chlorine; industrial effluents	Health basis of MAC: Reduced body weight, changes in clinical parameters, histological changes in kidney and liver, reproductive effects (decreased neonatal survival and growth)	AO based on odour; levels above the AO would render drinking water unpalatable.
T	pH (2015)		7.0–10.5 ⁴	Not applicable		The control of pH is important to maximize treatment effectiveness, control corrosion and reduce leaching from distribution system and plumbing components.
P	Phorate (1986, 2005)	0.002		Leaching and/or runoff from agricultural and other uses	Health basis of MAC: Nervous system effects (cholinesterase inhibition)	Some potential to leach into groundwater.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
P	Picloram (1988, 2005)	0.19		Leaching and/or runoff from agricultural and other uses	Health basis of MAC: Changes in body and liver weights and clinical chemistry parameters Other: Kidney effects (liver to body weight ratios and histopathology)	Significant potential to leach into groundwater.
I	Selenium (2014)	0.05		Naturally occurring (erosion and weathering of rocks and soils) and release from coal ash from coal-fired power plants and mining, refining of copper and other metals.	Health basis of MAC: chronic selenosis symptoms in humans following exposure to high levels Other: Hair loss, tooth decay, weakened nails and nervous system disturbances at extremely high levels of exposure	Selenium is an essential nutrient. Most exposure is from food; little information on toxicity of selenium from drinking water. Selenium can be found in non-leaded brass alloy where it is added to replace lead.
I	Silver (1986, 2005)	None required		Naturally occurring (erosion and weathering of rocks and soils)		Guideline value not required as drinking water contributes negligibly to an individual's daily intake.
P	Simazine (1986)	0.01		Leaching and/or runoff from agricultural and other uses	Health basis of MAC: Body weight changes and effects on serum and thyroid gland	Extent of leaching decreases with increasing organic matter and clay content.
I	Sodium (1979)		AO: ≤ 200	Naturally occurring (erosion and weathering of salt deposits and contact with igneous rock, seawater intrusion); sewage and industrial effluents; sodium-based water softeners		Based on taste; where a sodium-based water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended.
I	Sulphate (1994)		AO: ≤ 500	Industrial wastes	High levels (above 500 mg/L) can cause physiological effects such as diarrhoea or dehydration	Based on taste; it is recommended that health authorities be notified of drinking water sources containing sulphate concentrations above 500 mg/L.
I	Sulphide (1992)		AO: ≤ 0.05	Can occur in the distribution system from the reduction of sulphates by sulphate-reducing bacteria; industrial wastes		Based on taste and odour; levels above the AO would render water unpalatable.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
A	Taste (1979, 2005)		Inoffensive	Biological or industrial sources		Important to provide drinking water with no offensive taste, as consumers may seek alternative sources that are less safe.
T	Temperature (1979, 2005)		AO: ≤ 15°C	Not applicable		Temperature indirectly affects health and aesthetics through impacts on disinfection, corrosion control and formation of biofilms in the distribution system.
P	Terbufos (1987, 2005)	0.001		Leaching and/or runoff from agricultural and other uses	Health basis of MAC: Nervous system effects (cholinesterase inhibition)	Based on analytical achievability.
O	Tetrachloroethylene (2015)	0.01		Spill or other point source of contamination	Health basis of MAC: Neurological effects (colour confusion) in humans Other: Classified as probably carcinogenic to humans, based on sufficient evidence in experimental animals and limited evidence in humans	Primarily a concern in groundwater, as it volatilizes easily from surface water; MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
O	2,3,4,6-Tetrachlorophenol (1986, 2005)	0.1	AO: ≤ 0.001	By-product of drinking water disinfection with chlorine; industrial effluents and use of pesticides	Health basis of MAC: Developmental effects (embryotoxicity)	AO based on odour; levels above the AO would render drinking water unpalatable.
O	Toluene (2014)	0.06	AO: 0.024	Emissions, effluents or spills from petroleum and chemical industries	Health basis of MAC: Adverse neurological effects, including vibration thresholds, colour discrimination, auditory thresholds, attention, memory and psychomotor functions Other: Insufficient information to determine whether toluene is carcinogenic to humans.	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. AO is based on odour threshold.
A	Total dissolved solids (TDS) (1991)		AO: ≤ 500	Naturally occurring; sewage, urban and agricultural runoff, industrial wastewater		Based on taste; TDS above 500 mg/L results in excessive scaling in water pipes, water heaters, boilers and appliances; TDS is composed of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate and nitrate.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Trichloroethylene (2005)	0.005		Industrial effluents and spills from improper disposal	Health basis of MAC: Developmental effects (heart malformations) Other: Classified as probable carcinogen	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing.
O	2,4,6-Trichlorophenol (1987, 2005)	0.005	AO: ≤ 0.002	By-product of drinking water disinfection with chlorine; industrial effluents and spills	Health basis of MAC: Liver cancer (classified as probable carcinogen)	AO based on odour; levels above the AO would render drinking water unpalatable.
P	Trifluralin (1989, 2005)	0.045		Runoff from agricultural uses	Health basis of MAC: Changes in liver and spleen weights and in serum chemistry	Unlikely to leach into groundwater.
DBP	Trihalomethanes ³ (THMs) (2006)	0.1		By-product of drinking water disinfection with chlorine; industrial effluents	Health basis of MAC: Liver effects (fatty cysts) (chloroform classified as possible carcinogen) Other: Kidney and colorectal cancers	Refers to the total of chlorodibromomethane, chloroform, bromodichloromethane and bromoform; MAC based on health effects of chloroform. MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. Utilities should make every effort to maintain concentrations as low as reasonably achievable without compromising the effectiveness of disinfection. Recommended strategy is precursor removal. The separate MAC for BDCM was rescinded in April 2009.
I	Uranium (1999)	0.02		Naturally occurring (erosion and weathering of rocks and soils); mill tailings; emissions from nuclear industry and combustion of coal and other fuels; phosphate fertilizers	Health basis of MAC: Kidney effects (various lesions); may be rapidly reversible after exposure ceases	Based on treatment achievability; MAC based on chemical effects, as uranium is only weakly radioactive; uranium is rapidly eliminated from the body.

Type ¹	Parameter (approval, reaffirmation)	MAC (mg/L)	Other value (mg/L)	Common sources of parameter in water	Health considerations	Comments
O	Vinyl chloride (2013)	0.002 ALARA		Industrial effluents; degradation product from organic solvents in groundwater; leaching from polyvinyl chloride pipes	Health basis of MAC: Liver cancer (classified as human carcinogen) Other: Raynaud's disease, effects on bone, circulatory system, thyroid, spleen, central nervous system	Based on analytical achievability. MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. Leaching from polyvinyl chloride pipe is not expected to be significant.
O	Xylenes (total) (2014)	0.09	AO: 0.02	Emissions, effluents or spills from petroleum and chemical industries	Health basis of MAC: Adverse neuromuscular effects Other: Insufficient information to determine whether xylenes are carcinogenic to humans.	MAC takes into consideration all exposures from drinking water, which include ingestion, as well as inhalation and dermal absorption during showering and bathing. AO is based on odour threshold.
I	Zinc (1979, 2005)		AO: ≤ 5.0	Naturally occurring; industrial and domestic emissions; leaching may occur from galvanized pipes, hot water tanks and brass fittings		AO based on taste; water with zinc levels above the AO tends to be opalescent and develops a greasy film when boiled; plumbing should be thoroughly flushed before water is consumed.

¹ Parameter types: A – Acceptability; D – Disinfectant; DBP – Disinfection by-product; P – Pesticide; I – Inorganic chemical; O – Organic chemical; Γ – Treatment related parameter.

² In cases where total dichlorobenzenes are measured and concentrations exceed the most stringent value (0.005 mg/L), the concentrations of the individual isomers should be established.

³ Expressed as a locational running annual average of quarterly samples.

⁴ No units.

Table 3. Radiological Parameters

Guidelines for radiological parameters focus on routine operational conditions of existing and new water supplies and do not apply in the event of contamination during an emergency involving a large release of radionuclides into the environment. MACs have been established for the most commonly detected natural and artificial radionuclides in Canadian drinking water sources, using internationally accepted equations and principles and based solely on health considerations.

The MACs are based on exposure solely to a specific radionuclide. The radiological effects of two or more radionuclides in the same drinking water source are considered to be additive. Thus, the sum of the ratios of the observed concentration to the MAC for each contributing radionuclide should not exceed 1.

Water samples may be initially analysed for the presence of radioactivity using gross alpha and gross beta screening rather than measurements of individual radionuclides. If screening levels are exceeded (0.5 Bq/L for gross alpha and 1.0 Bq/L for gross beta), then concentrations of specific radionuclides should be analysed. A guideline for radon is not deemed necessary and has not been established. Information on radon is presented because of its significance for indoor air quality in certain situations.

Parameter (approval)	MAC (Bq/L)	Common sources	Health basis of MAC	Comments
Cesium-137 (2009)	10	Nuclear weapons fallout and emissions from nuclear reactors	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Iodine-131 (2009)	6	Sewage effluent	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Lead-210 (2009)	0.2	Naturally occurring (decay product of radon)	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	Corresponds to total lead concentration of 7×10^{-8} µg/L
Radium-226 (2009)	0.5	Naturally occurring	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Radon (2009)	None required	Naturally occurring (leaching from radium-bearing rocks and soils; decay product of radium-226)	Health risk from ingestion considered negligible due to high volatility	Mainly a groundwater concern; if concentrations in drinking water exceed 2000 Bq/L actions should be taken to reduce release into indoor air (e.g. proper venting of drinking water supply)
Strontium-90 (2009)	5	Nuclear weapons fallout	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	
Tritium (2009)	7000	Naturally occurring (cosmogenic radiation); releases from nuclear reactors	Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia	Not removed by drinking water treatment
Uranium (1999)	N/A		MAC based on chemical properties	See information provided in Table 2

Table 4. Guidance Documents

In certain situations, the Federal-Provincial-Territorial Committee on Drinking Water may choose to develop guidance documents for contaminants that do not meet the criteria for guideline development and for specific issues for which operational or management guidance is warranted. These documents are offered as information for drinking water authorities and help provide guidance relating to contaminants, drinking water management issues or emergency situations.

Parameter/subject (approval)	Comments
Chloral hydrate in drinking water (2008)	Exposure levels in Canada far below concentration that would cause health effects; levels above 0.2 mg/L may indicate a concern for health effects and should be investigated.
Controlling corrosion in drinking water distribution systems (2009)	Addresses strategies to deal with leaching of lead from materials in the distribution system; sampling protocols can be used to assess corrosion and the effectiveness of remediation/control measures to reduce lead levels in drinking water; corrective measures are outlined to address lead sources.
Heterotrophic plate count (HPC) (2012)	A useful operational tool for monitoring general bacteriological water quality through the treatment process and in the distribution system. HPC results are not an indicator of water safety and should not be used as an indicator of potential adverse human health effects.
Issuing and rescinding boil water advisories in Canadian drinking water supplies (2015)	Summarizes factors for consideration when responsible authorities issue or rescind boil water advisories. Provides trend information on reasons boil water advisories are issued in Canada.
Issuing and rescinding drinking water avoidance advisories in emergency situations (2009)	Summarizes factors for consideration when responsible authorities issue or rescind drinking water avoidance advisories in emergency situations.
Potassium from water softeners (2008)	Not a concern for general population; those with kidney disease or other conditions, such as heart disease, coronary artery disease, hypertension or diabetes, and those who are taking medications that interfere with normal body potassium handling should avoid the consumption of water treated by water softeners using potassium chloride.
Use of the microbiological drinking water guidelines (2013)	Provides an overview of the microbiological considerations to ensure drinking water quality, integrating key content of the relevant guideline technical documents and guidance documents to illustrate how they fit into the multi-barrier approach.
Waterborne bacterial pathogens (2013)	Originate from human or animal faeces or may be naturally occurring in the environment. Commonly associated with gastrointestinal upset (nausea, vomiting, diarrhoea); some pathogens may infect wounds, lungs, skin, eyes, central nervous system or liver. Document provides information on these pathogens and treatment options, and recommends using the multi-barrier approach to reduce their levels.

Table 5. Withdrawn Guidelines

The Federal-Provincial-Territorial Committee on Drinking Water has established a science-based process to systematically review older guidelines and withdraw those that are no longer required. Guidelines are withdrawn for parameters that are no longer found in Canadian drinking water supplies at levels that could pose a risk to human health, including pesticides that are no longer registered for use in Canada and for mixtures of contaminants that are addressed individually.

Parameter	Type
Aldicarb	Pesticide
Aldrin + dieldrin	Pesticide
Bendiocarb	Pesticide
Cyanazine	Pesticide
Dinoseb	Pesticide
Gasoline and its organic constituents	Organic chemical
Methoxychlor	Pesticide
Parathion	Pesticide

Acronyms

A	acceptability (parameter type)
ALARA	as low as reasonably achievable
AO	aesthetic objective
CDW	Committee on Drinking Water (FPT)
D	disinfectant (parameter type)
DBP	disinfectant by-product (parameter type)
HPC	heterotrophic plate count
I	inorganic chemical (parameter type)
MAC	maximum acceptable concentration
NTU	nephelometric turbidity units
O	organic chemical (parameter type)
OG	operational guidance value
P	pesticide (parameter type)
T	treatment-related (parameter type)
TCU	true colour units