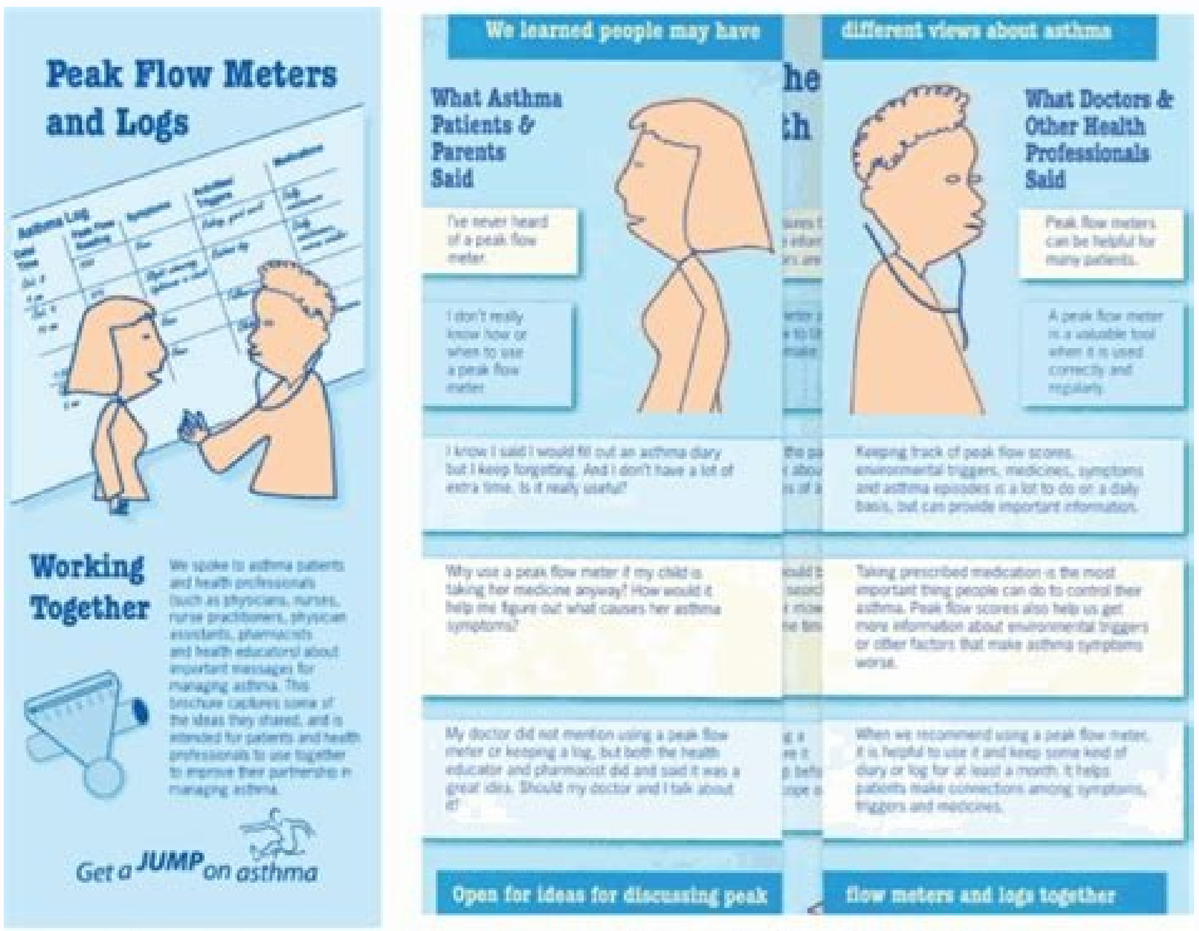
Guidelines for drinking- water quality recommendations pdf

Drinking Water Criteria (USA EPA Guidelines)

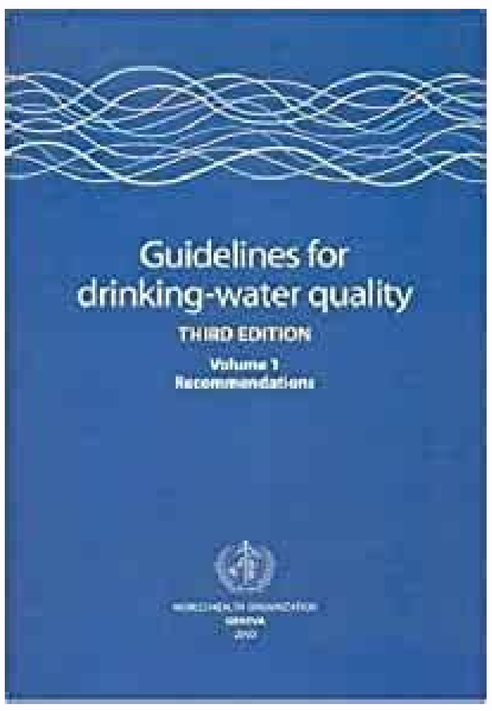
Criteria	Recommended Standard	Reason
Coliform Bacteria	0 colonies/ml	Health
pH	6.5-8.5	Aesthetic
Barium	2 mg/L	Health
Nitrate	10 mg/L	Health
Total Dissolved Solids	500 mg/L	Taste



Cover Inside fold

TECHNIQUE

- The formocresol pulpotomy technique was first advocated by SWEET [1930]
- He used a multiple sitting technique, which has been subsequently modified to either a single or two stage technique.
- FORMULA :- 19% Formaldehyde
  35% cresol
  15% Glycerin & Water
- To prepare 1.5%concentration of this formula, first mix 3 parts of glycerin with 1 part of distilled water , then add 4 parts of this preparation to 1 part buckley's formocresol , and throughly mix again.



Drinking Water Quality Standards (WHO)

Chemical Standards (Toxic elements)

Parameter	Symbol	MCL (mg/l)
Lead	Pb	0.01
Selenium	Se	0.01
Arsenic	As	0.05
Chromium	Cr	0.05
Cyanide	Cn	0.05
Cadmium	Cd	0.005
Mercury	Hg	0.001
Antimony	Sb	0.005
Nickel	Ni	0.05

Who guidelines for drinking-water quality 2020. Guidelines for drinking-water quality recommendations. Who guidelines for drinking water quality. 3rd edition vol. 1 recommendations 2008. W.h.o guidelines for drinking water quality.

JavaScript is disabled for your browser. Some features of this site may not work without it. Loading PreviewSorry, preview is currently unavailable. You can download the paper by clicking the button above. The fourth edition of the World Health Organization's (WHO) Guidelines for drinking-water quality (GDWQ) builds on over 50 years of guidance by WHO on drinking-water quality, which has formed an authoritative basis for the setting of national regulations and standards for water safety in support of public health.It is the product of significant revisions to clarify and elaborate on ways of implementing its recommendations of contextual hazard identification and risk management, through the establishment of health-based targets, catchment-to-consumer water safety plans and independent surveillance.This first addendum updates the fourth edition. Updates reflect new evidence and further, provides additional explanations to support better understanding and application of the guidance.Download individual chapters The tables in this document summarize the values and key information from each of the guidelines. Health Canada updates the summary tables regularly, but you should always consult individual guideline technical documents and guidance documents available on the website Water Quality - Reports and Publications for the most current information. Table of Contents Introduction The Guidelines for Canadian Drinking Water Quality are established by Health Canada in collaboration with the Federal-Provincial-Territorial Committee on Drinking Water (CDW) and other federal government departments. Health Canada publishes the guidelines and other information on the website Drinking water quality in Canada. Each guideline was established based on published scientific research related to health effects, aesthetic effects, and operational considerations at the time of publication. Guidelines (maximum acceptable concentrations or treatment goals) are based on 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). Guidelines for Canadian Drinking Water Quality specifically for contaminants that meet all of the following criteria: Exposure to the contaminant could lead to adverse health effects in humans; The contaminant is frequently detected or could be expected to be found in a large number of drinking water supplies throughout Canada; and 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 or issue of interest does not meet all these criteria, Health Canada and CDW may choose not to establish a numerical guideline or develop a guideline technical document. In that case, advice may be provided through a guidance document to convey operational or management information related to a contaminant or issue of concern. Guidelines are systematically reviewed to assess the need to update them. When a guideline is reaffirmed, both the year of the original publication and the year of reaffirmation are shown below after the name of the parameter. Abbreviations 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 M microbiological (parameter type) NTU nephelometric turbidity units O organic chemical (parameter type) OG operational guidance value P pesticide (parameter type) QMRA quantitative microbial risk assessment T treatment-related (parameter type) TCU true colour units Tables Table 1. Microbiological Parameters In general, the highest-priority guidelines are those dealing with microbiological contaminants, such as bacteria, protozoa and viruses. Since it is difficult to perform routine analysis of harmful microorganisms that might be present in inadequately treated drinking water, the microbiological guidelines focus on indicator organisms such as E.coli and total coliforms, and treatment goals for pathogens. The use of a source-to-tap approach that includes source water protection, adequate treatment, and a well-maintained distribution system helps reduce microorganisms to levels that have not been associated with illness, as well as meet the guidelines outlined below. Table 1. Microbiological Parameters Parameter (published, reaffirmed) Guideline Common sources Health considerations Applying the guideline Enteric protozoa: Giardia and Cryptosporidium (2019) Treatment goal: Minimum 3 log removal and/or inactivation of cysts and oocysts Human and animal faeces Giardia and Cryptosporidium are commonly associated with gastrointestinal upset (nausea, vomiting, and diarrhoea). Less common health effects vary. Giardia infections may include prolonged gastrointestinal upset, malaise and malabsorption. Cryptosporidium infections, in immunocompromised individuals, can occur outside the gastrointestinal tract Monitoring for Cryptosporidium and Giardia 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 (2019) 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. Enteric viruses have been detected in surface and groundwater sources. Routine monitoring for viruses is not practical, and assessing the vulnerability of source waters to viral contamination is difficult; thus, treatment is a way to reduce risk. Disinfection is a critical barrier. Escherichia coli (E. coli) (2020) MAC: None detectable per 100 mL Human and animal faeces E. coli is an indicator of fecal contamination that is used as a tool to verify the quality of the drinking water. Its detection indicates recent fecal contamination and that microorganisms capable of causing gastrointestinal illnesses may also be present. Pathogens in human and animal feces pose the greatest immediate danger to public health. In water leaving a treatment plant, the presence of E. coli indicates a serious breach in treatment. In a distribution or storage system, detection of E. coli can indicate that the water has become contaminated during distribution. In non-disinfected groundwater, the presence of E. coli indicates that the groundwater has been affected by fecal contamination. E. coli should be monitored in conjunction with other indicators, as part of a source-to-tap approach to producing drinking water of an acceptable quality. Total coliforms (2020) 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. Total coliforms should be monitored in the distribution system because they are used to indicate changes in water quality. In water leaving a treatment plant, 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 distribution and storage system, detection of total coliforms can indicate regrowth of the bacteria in biofilms or intrusion of untreated water. 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. In non-disinfected groundwater, 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: Naturally occurring particles: Inorganic: clays, silts, metal precipitates Organic: decomposed plant & animal debris, microorganisms 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. 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. Table 1 footnote 1 in at least 95% of measurements either per filter cycle or per month; never to exceed 1.0 NTU. Return to table 1 footnote 1 referrer Table 1 footnote 2 in at least 95% of measurements either per filter cycle or per month; never to exceed 3.0 NTU. Return to table 1 footnote 2 referrer Table 1 footnote 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. Return to table 1 footnote 3 referrer Table 2. Chemical and Physical Parameters Guidelines for chemical and physical parameters are: health based and listed as maximum acceptable concentrations (MAC); based on aesthetic considerations and listed as aesthetic objectives (AO); or 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. Table 2. Chemical and Physical Parameters TypeTable 2 footnote 1 Parameter (published, reaffirmed) MAC (mg/L) Other value (mg/L) Common sources of parameter in water Health considerations Comments T Aluminum (2021) 2.9 OG: 0.1 Aluminum salts used as coagulants in drinking water treatment; leaching from cement-based materials; dissolution of activated alumina media (where applicable); and naturally occurring Health basis of MAC: Neuromuscular effects (hind- and fore-limb grip strength, foot splay), urinary tract effects and general toxicity. The MAC and OG apply to all drinking water supplies (including groundwater) and are to be applied as locational running annual averages. The OG value is established to minimize the potential for the accumulation and release of metals in the distribution system and to avoid other operational and aesthetic issues. It takes treatment achievability into consideration. I Ammonia (2013) None required None 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. A guideline value is 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. I Antimony (1997) 0.006 None 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 None 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 None Naturally occurring (erosion of asbestos minerals and ores); decay of asbestos-cement pipes None Guideline value not necessary; no evidence of adverse health effects from exposure through drinking water. P Atrazine (1993) 0.005 None 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 N-dealkylated metabolites - diethylatrazine, deisopropylatrazine, hydroxyatrazine, diaminochlorotriazine; Persistent in source waters. I Barium (2020) 2.0 None Naturally occurring; releases or spills from industrial uses Health basis of MAC: Kidney effects MAC is for total barium and takes into consideration exposure estimates from all sources. O Benzene (2009) 0.005 None 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[a]pyrene (2016) 0.000 04 None Leaching from liners in water distribution systems Health basis of MAC: Stomach tumours (classified as human carcinogen) None I Boron (1990) 5 None 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 (2018) 0.01 None Contaminant in hypochlorite solution; by-product of drinking water disinfection with ozone Health basis of MAC: Tumours of the testicular mesothelium (classified as a possible human carcinogen) Efforts to reduce bromate concentrations must not compromise the effectiveness of disinfection. Bromate is difficult to remove from drinking water once formed. The recommended strategy is controlling the ozonation process; use of certified treatment chemicals and; appropriate handling and storage of hypochlorite. Quarterly monitoring of raw water bromide is recommended to allow correlation to bromate or brominated DBPs. P Bromoxynil (1987, 2005) 0.005 None Leaching or runoff from agricultural use Health basis of MAC: Reduced liver to body weight ratios None I Cadmium (2020) 0.007 None Leaching from galvanized pipes and solders ; industrial and municipal waste Health basis of MAC: Kidney damageOther: Bone effects (decreased bone density) MAC takes into consideration exposure estimates from all sources. Sampling should be done at the tap to reflect average exposure similar to sampling done for lead. The contribution of cadmium in drinking water is generally from the galvanized steel used in pipes and well components. The best approach to minimize exposure to cadmium from drinking water is to replace galvanized steel and components. Drinking water treatment devices are also an effective option. I Calcium (1987, 2005) None required None Naturally occurring (erosion and weathering of soils, minerals, ores) No evidence of adverse health effects from calcium in drinking water. Guideline value not necessary; calcium contributes to hardness. O Carbon tetrachloride (2010) 0.002 None Industrial effluents and leaching from hazardous waste sites Health basis of MAC: Liver toxicityOther: 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 (2020) None required None Monochloramine is used as a secondary disinfectant; formed in drinking water when chlorine is added in the presence of ammonia Guideline value not necessary due to low toxicity at concentrations found in drinking water Chloramine residuals in most Canadian drinking water distribution systems are typically below 4 mg/L DBP Chlorate (2008) 1 None 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) None AO: ≤ 250 Naturally occurring (seawater intrusion); dissolved salt deposits, highway salt, industrial effluents, oil well operations, sewage, irrigation drainage, refuse leachates A guideline value is not necessary as health effects are not of concern at levels found in drinking water. Based on taste and potential for corrosion in the distribution system. D Chlorine (2009) None required None Used as drinking water disinfectant A 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 None Used as drinking water disinfectant (primary disinfection only) A guideline value 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 None 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 None 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 (2018) 0.05 None Naturally occurring (erosion of minerals); releases or spills from industrial uses Health basis of MAC: Hyperplasia of the small intestine from chromium (VI)Other: No definitive evidence of toxicity to Chromium(III) MAC protects against both cancer and non-cancer effects from Chromium (VI) and is established for total chromium. T Colour (1979, 2005) None AO: ≤ 15 TCU Naturally occurring organic substances, metals; industrial wastes A Guideline value is not necessary as health effects are not of concern at levels found in drinking water. May interfere with disinfection; removal is important to ensure effective treatment. I Copper (2019) 2 AO: 1 Naturally occurring; leaching from copper piping Health basis of MAC: Gastronintestinal effects (short-term), liver and kidney effects (long-term). Water samples should be taken at the tap. MAC is for total copper and protects against both short- and long- term exposures. AO is based on taste and water discolouration (resulting in staining of laundry and plumbing fixtures). I Cyanide (1991) 0.2 None Industrial and mining effluents; release from organic compounds Health basis of MAC: No clinical or other changes at the highest dose tested At the levels seen in Canadian waters, cyanide is not a concern as it can be detoxified to a certain extent in the human body. O Cyanobacterial toxins (2018) 0.0015 None Naturally occurring - released from populations of cyanobacteria (planktonic blooms and benthic mats) Health basis of MAC: Liver effects MAC is for total microcystins (intra- and extra-cellular) Note that infants can ingest a significantly larger volume of water per body weight. As a precautionary measure, where levels of total microcystins in treated water are detected above a reference value of 0.4 µg/L, the public in the affected area should use an alternate suitable source of drinking water (such as bottled water) to reconstitute infant formula. P Dicamba (2021) 0.11 None Leaching or runoff from agricultural or other uses Health basis of MAC: Liver effects Readily leaches into groundwater. O 1,4-DichlorobenzeneTable 2 footnote 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 None 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 protects against 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 None Releases or spills from industrial effluents Health basis of MAC: Liver effects (fatty changes) None O Dichloromethane (2011) 0.05 None 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 protects against 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. P 2,4-Dichlorophenoxy acetic acid (2,4-D) (1991) 0.1 None Leaching and/or runoff from use as a weed controller; releases from industrial effluents Health basis of MAC: Kidney effects (tubular cell pigmentation) MAC takes into consideration exposure estimates from all sources P Dimethoate and omethoate (2022) 0.02 None Leaching and/or runoff from residential, agricultural and non-agricultural use Health basis of MAC: Nervous system effects (cholinesterase inhibition) MAC is for dimethoate. An additive approach should be taken in which the sum of the detected concentrations of dimethoate and omethoate (expressed as a dimethoate equivalent value) does not exceed the MAC for dimethoate. P 1,4-Dioxane (2021) 0.050 Generally not detected in Canadian water supplies, but there have been contaminations of drinking water supplies near landfills and industrial sites Health basis of MAC: liver effects that occur before the development of cancer 1,4-Dioxane is difficult to remove using conventional drinking water treatment. Treatment technologies using advanced oxidation processes are considered the most effective. Synthetic adsorbents are also effective. Reverse osmosis membranes may be capable of removing 1,4-dioxane at both the municipal and residential scale. P Diquat (2021) 0.05 None 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. 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 protects against 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 None 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 None By-product of disinfection with ozone; releases from industrial effluents A guideline value is not necessary as health effects are not of concern at levels found in drinking water. A 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 None 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)Table 2 footnote 3 (2008) 0.08 ALARA None By-product of drinking water disinfection with chlorine Health basis of MAC: Liver cancer (DCA); DCA is classified as probably carcinogenic to humansOther: 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 None 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 CaCO3) provide acceptable balance between corrosion and incrustation; where a water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended. I Iron (1978, 2005) None AO: ≤ 0.3 Naturally occurring (erosion and weathering of rocks and minerals); acidic mine water drainage, landfill leachates, sewage effluents and iron-related industries No evidence exists of dietary iron toxicity in the general population. Applying the guideline: Based on taste and staining of laundry and plumbing fixtures. Based on taste and staining of laundry and plumbing fixtures I Lead (2019) 0.005 ALARA None Leaching from plumbing (lead service lines, lead solder and brass fittings) Health basis of MAC: Reduced intelligence in children measured as decreases in IQ is the most sensitive and well established health effect of lead exposure. There is no known safe exposure level to lead. Other: Possible effects include behavioural effects in children. Reduced cognition, increased blood pressure, and renal dysfunction in adults are also possible;.classified as probably carcinogenic to humans MAC is for total lead. Lead levels should be kept as low as reasonably achievable. Sampling should be done at the tap to reflect average exposure. The most significant contribution of lead in drinking water is generally from the lead service line that supplies drinking water to the home. The best approach to minimize exposure to lead from drinking water is to remove the full lead service line. Drinking water treatment devices are also an effective option. I Magnesium (1978) None required None Naturally occurring (erosion and weathering of rocks and minerals) No evidence of adverse health effects from magnesium in drinking water, therefore a guideline value is not necessary. No additional comments P Malathion (1986, 2005) 0.19 None 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 (2019) 0.12 AO: ≤ 0.02 Dissolution of naturally occurring minerals commonly found in soil and rock. Other sources include industrial discharge, mining activities and leaching from landfills Health Basis of MAC: Effects on neurological development and behaviour; deficits in memory, attention, and motor skills. Other: Formula-fed infants (where water containing manganese at levels above the MAC is used to prepare formula) may be especially at risk AO based on minimizing the occurrence of discoloured water, consumer complaints and staining of laundry. I Mercury (1986) 0.001 None 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. P 2-Methyl-4-chlorophenoxyacetic acid (MCPA) (2010) 0.1 None 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) None AO: ≤ 0.015 Spills from gasoline refineries, filling stations and gasoline-powered boats; seepage into groundwater from leaking storage tanks The AO is lower than levels associated with potential toxicological effects, it is considered protective of human health. Studies on toxic effects remain inconclusive. AO based on odour; levels above the AO would render water unpalatable. P Metribuzin (2021) 0.08 None Leaching and/or runoff from agricultural use Health basis of MAC: Liver effects (increased ornithine carboxytransferase, increased incidence and severity of mucopolysaccharide droplets, hepatic necrobiosis) Leaching into groundwater depends on the topography, precipitation and site-specific soil characteristics, such as organic matter content and pH. I Nitrate (2013) 45 as nitrate; 10 as nitrate-nitrogen None Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitirification in the distribution system Health basis of MAC: Methaemoglobinaemia (blue baby syndrome) and effects on thyroid gland function in bottle-fed infantsOther: 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 Nitrilotriacetic acid (NTA) (1990) 0.4 None Sewage contamination Health basis of MAC: Kidney effects (nephritis and nephrosis)Other: Classified as possible carcinogen MAC is based upon exposure mainly attributable (80%) to drinking water with 20% of exposure attributable to food. I Nitrite (2013) 3 as nitrite; 1 as nitrite-nitrogen None Naturally occurring; leaching or runoff from agricultural fertilizer use, manure and domestic sewage; may be produced from excess ammonia or nitirification in the distribution system Health basis of MAC: Methaemoglobinaemia (blue baby syndrome) in bottle-fed infants less than 6 months of ageOther: 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 N-Nitroso dimethylamine (NDMA) (2010) 0.000 04 None 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) None Inoffensive Biological or industrial sources Not applicable Important to provide drinking water with no offensive odour, as consumers may seek alternative sources that are less safe. 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. O Perfluorooctane Sulfonate (PFOS) (2018) 0.0006 Synthetic chemical used in consumer products and fire-fighting foams for their water and oil repellant properties. Health basis of MAC: Adverse effects in the liver. Additional effects at low doses include thyroid and immune effects and changes in serum lipid levels. Additive effects with PFOA were considered. The sum of PFOS and PFOA concentrations in drinking water divided by their respective MAC should not exceed 1. O Perfluorooctanoic Acid (PFOA) (2018) 0.0002 Synthetic chemical used in consumer products and fire-fighting foams for their water and oil repellant properties. Health basis of MAC: Adverse effects in the liver. Additional effects at low doses include delay in mammary, estrogenic and developmental effects. Additive effects with PFOS were considered. The sum of PFOA and PFOS concentrations in drinking water divided by their respective MAC should not exceed 1. T pH (2015) None 7.0-10.5Table 2 footnote 4 Not applicable Not applicable The control of pH is important to maximize treatment effectiveness, control corrosion and reduce leaching from distribution system and plumbing components. I Selenium (2014) 0.05 None 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 levelsOther: 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 None Naturally occurring (erosion and weathering of rocks and soils) Not applicable Guideline value not required as drinking water contributes negligibly to an individual's daily intake. I Sodium (1979) None 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 For persons on strict sodium reduced diets applying to all sources, levels in drinking water should be below 20 mg/L Based on taste; where a sodium-based water softener is used, a separate unsoftened supply for cooking and drinking purposes is recommended. I Strontium (2019) 7.0 Naturally occurring (erosion and weathering of rocks); effluents from mining or other industries Health basis of MAC: Bone effects (adverse effects on bone formation in infants as well as rickets, osteomalacia) MAC is protective of the most sensitive sub-population, infants. I Sulphate (1994) None 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) None AO: ≤ 0.05 Can occur in the distribution system from the reduction of sulphates by sulphate-reducing bacteria; industrial wastes Not applicable Based on taste and odour; levels above the AO would render water unpalatable. A Taste (1979, 2005) None Inoffensive Biological or industrial sources Not applicable Important to provide drinking water with no offensive taste, as consumers may seek alternative sources that are less safe. O Tetrachloroethylene (2015) 0.01 None 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 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 functionsOther: 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) None AO: ≤ 500 Naturally occurring; sewage, urban and agricultural runoff, industrial wastewater Not applicable 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. O Trichloroethylene (2005) 0.005 None 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. DBP Trihalomethanes)Table 2 footnote 3 (THMs) (2006) 0.100 None 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 (2019) 0.02 None 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 Based on challenges and operational cost impacts for some private wells and small systems; MAC is for total uranium and is protective in relation to both chemical and radiological hazards. O Vinyl chloride (2013) 0.002 ALARA None 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 effectsOther: 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 Zinc is an essential element and is generally considered to be non-toxic, however levels above the AO in water would render it unpalatable. 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. 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 in drinking water is not deemed necessary and has not been established. Table 3. Radiological Parameters 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 Fixation by sediments in aquatic environments reduces its concentration in water bodies. Ingested 137Cs is readily absorbed into soft tissues but is eliminated relatively quickly. Iodine-131 (2009) 6 Sewage effluent Cancer of the lung, breast, thyroid, bone, digestive organs and skin; leukaemia No additional comments 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 No additional comments 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 Has a long residence time in bone and its beta particles have high energy. Radioactive strontium (90Sr) should not be confused with stable strontium. The two species of strontium have quite different origins, and their concentrations in drinking water are not correlated. 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 None MAC based on chemical properties See information provided in Table 2 Table 4. Guidance Documents In certain situations, Health Canada, in collaboration with the Federal-Provincial-Territorial Committee on Drinking Water may choose to develop guidance documents for issues 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. Table 4. Guidance Documents Parameter/subject (published) 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. 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. Monitoring the Biological Stability of Drinking Water in Distribution Systems (2022) Distribution systems represent a complex and dynamic environment. Monitoring changes in biological stability in these systems is important to minimize potential risks to consumers. This guidance document discusses (1) the concept of biological stability, (2) causes of water quality deterioration in the distribution system, (3) health risks (e.g., waterborne outbreaks) and aesthetic issues (e.g., colour) associated with this deterioration, (4) monitoring tools and parameters that can be used to assess biological stability, and (5) distribution system management strategies to minimize public health risks. This guidance document replaces the Guidance on the Use of Heterotrophic Plate Counts in Canadian Drinking Water Supplies. Natural organic matter in drinking water (NOM) (2020) The presence and characteristics of natural organic matter (NOM) can have significant impacts on drinking water treatment processes, and consequently the safety of drinking water. Seasonal and weather-related events can significantly affect the concentration and character of NOM. This guidance document reviews and assesses: 1) the impacts of NOM and the associated indirect health risks; 2) source-specific treatability study requirements to ensure the most appropriate process is selected to meet treated water quality goals; 3) treatment options and their effectiveness; 4) tools available to monitor raw, treated and distribution system water quality. Overview of the Microbiological Aspects of Drinking Water Quality (2021) 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 their use as part of a source-to-tap approach. 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. Temperature aspects of drinking water (2021) Water temperature affects all physical, chemical, microbiological, and biochemical processes to some extent from the source through treatment and distribution to in-building plumbing. In turn, this affects water quality and can result in issues related to health-based contaminants and aesthetics. This document summarizes how temperature is discussed in the Guidelines for Canadian Drinking Water Quality and highlights aspects that may be relevant to drinking water utilities when developing and implementing management strategies. Use of Enterococci as an indicator in Canadian drinking water supplies (2020) Enterococci are a bacteriological indicator of fecal contamination. This indicator can supplement E. coli and total coliforms monitoring programs to provide additional information into fecal contamination issues. The document provides information on how enterococci can be used in a drinking water monitoring program. Use of Quantitative Microbial Risk Assessment (QMRA) in Drinking Water (2019) Provides guidance on the use of QMRA to assist in understanding microbiological risks in Canadian water systems. Waterborne pathogens (2022) Numerous types of pathogenic microorganisms can spread through drinking water to cause human illness. Some are present in human or animal feces and can cause gastrointestinal illness when fecally contaminated water is consumed. Others are naturally found in aquatic environments and can cause opportunistic infections when the conditions in engineered water systems (e.g., drinking water distribution systems and building/premise plumbing) allow them to multiply and spread. This guidance document discusses sources of these pathogens, associated health effects, (pathogen) detection methods, treatment considerations, and management strategies to minimize public health risks. Table 5. Withdrawn Guidelines Health Canada, in collaboration with 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. Type Parameter Type Parameter P Aldicarb P Mirex P Aldrin + dieldrin O monochlorobenzene P Azinphos-methyl P paraquat P Bendiocarb P Parathion P Carbaryl P Pesticides (total) P Carbofuran O Phenols (total) P Chlordane (total isomers) P phorate P Cyanazine O Phthalic acid esters (PAE) P Diazinon P picloram O 1,2-dichlorobenzene O Polychlorinated biphenyls (PCBs) P Dichlorodiphenyltrichloroethane (DDT) + metabolites O Polycyclic aromatic hydrocarbons (PAHs) (excluding benzo[a]pyrene) O 2,4-dichlorophenol O Resin acids P Diclofop-methyl P Simazine P Dinoseb O Tannin P Diuron P Temephos P Endrin P Terbufos O Gasoline and its organic constituents O 2,3,4,6-tetrachlorophenol P Heptachlor + heptachlor epoxide O Total organic carbon O Lignin P Toxaphene P Lindane P Triallate P Methoxychlor P 2,4,5-Trichlorophenoxyacetic acid2 (2,4,5-T) P Methyl-parathion P 2,4,5-Trichlorophenoxypropionic acid (2,4,5-TP) P Metolachlor P Trifluralin Table 6. Guidelines and Guidance in Progress The following are parameters for which Health Canada is developing or updating guidelines and guidance over the next few years. Antimony Arsenic Asbestos Atrazine Boron Controlling corrosion in drinking water distribution systems Haloacetic acids Iron Malathion Operational guidance for drinking water utilities Per- and polyfluoroalkyl substances (PFAS) Premise plumbing and biofilm-associated microorganisms Radiological parameters Trihalomethanes Turbidity

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