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GUIDELINES FOR DRINKING WATER QUALITY

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The following is a summary of drinking water guidelines. This information has been taken from the Guidelines for Canadian Drinking Water Quality (GCDWQ), the Ontario Ministry of the Environment, Conservation and Parks (MECP) Drinking Water Objectives/Standards as well as the US-EPA and other online sources where information was not available from GCDWQ, MECP or US-EPA. (June 06, 2024).

DEFINITIONS

Maximum Acceptable Concentration (MAC)

The MAC is established for parameters which when present above a certain concentration, have known or suspected adverse health effects. The length of time the MAC can be exceeded without health effects will depend on the nature and concentration of the parameter.

Aesthetic Objective (AO)

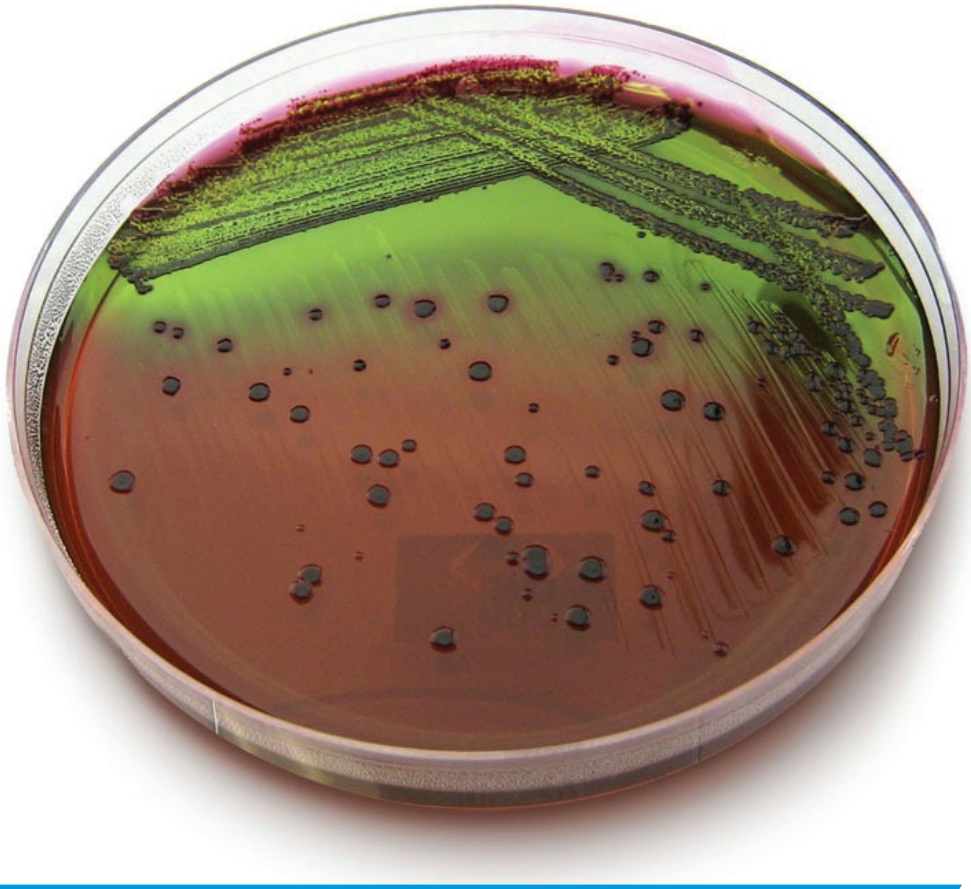
AOs are established for parameters that may impair the taste, odour or colour of water or which may interfere with good water quality control practices. For certain parameters, both aesthetic objectives and health-related MACs have been derived.

Operational Guidelines (OG)

In Ontario, Operational Guidelines for drinking water are non-regulatory benchmarks for parameters that, if not properly managed, can negatively impact the treatment, disinfection, and distribution of drinking water.

Reporting Limit (RL)

Reporting Limit – Lowest level detectable by the analyses used.



Total Coliform and E.coli

Total Coliforms and/or E.coli should not be detected in any drinking water sample. Total coliforms are a group of bacteria commonly found in the environment, for example in soil or vegetation, as well as the intestines of mammals, including humans. Total coliform bacteria are not likely to cause illness, but their presence indicates that your water supply may be vulnerable to contamination by more harmful microorganisms.

Escherichia coli (E.coli) is the only member of the total coliform group of bacteria that is found in the intestines of mammals, including humans. The presence of E.coli in water indicates recent fecal contamination and may indicate the possible presence of disease-causing pathogens, such as bacteria, viruses, and parasites. Although most strains of E.coli bacteria are harmless, certain strains, such as E.coli 0157:H7, may cause illness. Total coliforms and E.coli are used as indicators to measure the degree of pollution and sanitary quality of well water, because testing for all known pathogens is a complicated and expensive process. The main source of pathogens in drinking water is through recent contamination from human or animal waste, from improperly treated septic and sewage discharges, leaching of animal manure, stormwater runoff and/or, domestic animals or wildlife. During and after precipitation, bacteria and other harmful microorganisms from any of these sources may be washed into rivers, lakes, or groundwater. Poor well construction or poor maintenance can increase the risk of groundwater contamination.

Alkalinity as calcium carbonate (inorganic)

The operational guideline is between 30 and 500 mg/L. Alkalinity is a measure of water's ability to neutralize an acid. Water with high alkalinity, when boiled over an extended period of time, forms a deposit or may develop an unpleasant taste. Water with very low alkalinity corrodes pipes and plumbing.

Conductivity (physical-chemical)

No guideline. It is a measure of water's ability to conduct an electrical current, and it increases as the amount of dissolved minerals (ions) increases. Conductivity is measured in µS/cm (micro-Siemens/cm or µmho/cm - the µmho is the reciprocal of the measure of resistance, the ohm). Conductivity is used as a check on the total dissolved constituents in the water.

pH (physical-chemical)

pH is a parameter that indicates the acidity of a water sample. The operational guideline recommended in drinking water is to maintain a pH between 6.5 and 8.5. The principal objective in controlling pH is to produce water that is neither corrosive nor produces incrustation. Corrosion is commonly associated with pH levels below 6.5 and elevated levels of certain undesirable chemical parameters may result from corrosion of specific types of pipes. At pH levels above 8.5, mineral incrustations and bitter tastes can occur. With pH levels above 8.5, there is also a progressive decrease in the efficiency of chlorine disinfection and alum coagulation.

Total Dissolved Solids (TDS, theoretical)

Theoretically, TDS is directly proportional to conductivity and is obtained by multiplying the conductivity by a factor of 0.55-0.7. The aesthetic objective for total dissolved solids in drinking water is 500 mg/L. The term "total dissolved solids" (TDS) refers mainly to the inorganic substances dissolved in water. The principal constituents of TDS are chloride, sulphates, sodium, calcium, magnesium and bicarbonates. The effects of TDS on drinking water quality depend on the levels of the individual components. Excessive hardness, taste, mineral deposition or corrosion are common properties of highly mineralized water. The palatability of drinking water with a TDS level less than 500 mg/L is generally considered to be good.

Colour, True (physical)–True Colour Units = TCU

MECP drinking water standard is 5 TCU. Below 5 TCU, there is no noticeable colour. At 100 TCU, water is tea-coloured, possibly indicating pollution. At excessive levels of TCU, water is aesthetically unpleasant, and stains clothing, food, and plumbing fixtures. It is primarily caused by dissolved organic matter (human substances, tannins, lignins) and inorganic substances (iron, manganese). Water colour is also affected by the amount of suspended matter (turbidity) it contains.

Turbidity (physical)

Drinking water standard is 5 NTU (nephelometric turbidity unit) at the point of consumption, for aesthetic reasons. Turbidity, which is caused by suspended particles (i.e., clay, silt, algae, detritus), reduces the effectiveness of chlorination treatment by shielding the micro-organisms which may ultimately reach the consumer.

Fluoride (inorganic)

The maximum acceptable concentration for fluoride is 1.5 mg/L. Above 1.5 mg/L may cause fluorosis. Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems, and chronic issues.

Chloride (inorganic)

Chloride is a common non-toxic material present in small amounts in drinking water and produces a detectable salty taste at the aesthetic objective level of 250 mg/L. Chloride is widely distributed in nature, generally as sodium (NaCl), potassium (KCl) and calcium (CaCl2) salts. Levels above this may by an early indicator of contamination. Chloride also makes water more corrosive within a distribution system. Major sources are natural salt deposits in the aquifer, saltwater intrusion (coastal), road salt, and septic tank systems.

Nitrate (inorganic)

The maximum acceptable concentration of nitrates in drinking water is 10 mg/L as nitrogen. Nitrates are present in water (particularly ground water) because of decay of plant or animal material, the use of agricultural fertilizers, domestic sewage or treated wastewater contamination, or geological formations containing soluble

nitrogen compounds. There is a risk that babies and small children may suffer blood related problems (methaemoglobinaemia) with excess nitrate intake. The nitrate ion is not directly responsible for this condition but must first be reduced to the nitrite ion by intestinal bacteria. The nitrite reacts with the iron of haemoglobin in red blood cells which are then prevented from carrying oxygen to the body tissues. Nitrate poisoning, in terms of methaemoglobinaemia, from drinking water appears to be restricted to susceptible infants. Older children and adults drinking the same water are unaffected. Most water-related cases of methaemoglobinaemia have been associated water containing more than 10 mg/L nitrate as nitrogen. In Canada, no cases of the condition have been reported where the nitrate concentration was consistently less than the maximum acceptable concentration. Where both nitrate and nitrite are present, the total nitrate plus nitrite-nitrogen concentration should not exceed 10 mg/L. In areas where the nitrate content of water is known to exceed the maximum acceptable concentration the public should be informed by the appropriate health authority of the potential dangers of using the water for infants.

Nitrite (inorganic)

The maximum acceptable concentration of nitrite in drinking water, 1.0 mg/L as nitrogen, is based, as with nitrate, primarily on the relationship between nitrite in water and the incidence of infantile methaemoglobinaemia. Nitrite is rapidly oxidized to nitrate and is therefore seldom present in surface waters in significant concentrations. Nitrite may occur in ground water, however if chlorination is practiced the nitrite will usually be oxidized to nitrate.

Sulphate (inorganic)

The objective is 500 mg/L which is established for health and aesthetic reasons. The major physiological effects when this guideline is exceeded are catharsis (laxative effect) and gastrointestinal irritation. The presence of sulfate in drinking water above 150 mg/L may result in noticeable taste. The taste threshold concentration, however, depends on the associated metals present in the water. High levels of sulfate may be associated with calcium, which is a major component of scale in boilers and heat exchangers. In addition, sulfate can be converted into sulfide by some anaerobic bacteria creating odour problems and potentially greatly accelerating corrosion. Major sources are geological formations (i.e., gypsum) and industrial discharge, as well as wet and dry atmospheric depositions which contain sulphates from burning fossil fuels, such as coal.

TKN (organic/inorganic)

No guideline; Total Kjeldahl nitrogen is the sum of ammonia nitrogen and organic nitrogenous compounds. When present, a typical range of total nitrogen is 2 mg/L to 6 mg/L.

Ammonia (inorganic)

No guideline; however, if ammonia levels exceed 0.1 mg/L as nitrogen, the possibility and type of contamination should be investigated. Ammonia is sometimes corrosive to copper and its alloys and, as a result, may corrode pipes at higher levels.

Ortho-phosphate (inorganic)

No guideline; however, if present levels below 0.2 mg/L as phosphorus is recommended. Not commonly toxic but may produce taste or odour. Major sources are municipal/industrial effluent, agricultural run-off, and domestic sewage (i.e., septic tank seepage).

Organic Nitrogen (organic)

The operational guideline for organic nitrogen in drinking water is 0.15 mg/L. Organic nitrogen is calculated by the difference between the total Kjeldahl nitrogen and the ammonia nitrogen. High levels may be caused by septic tank or sewage effluent contamination. Organic nitrogen compounds frequently contain amine groups which can react with chlorine and severely reduce its disinfectant power. Certain chlorinated organic nitrogen compounds may be responsible for flavour problems that are associated with chlorophenol. Taste and odour problems are common with organic nitrogen levels greater than 0.15 mg/L.

Dissolved Organic Carbon (organic)

Values less than 1.0 mg/L are ideal for relatively clean water. Natural waters range from 1-30 mg/L due to decayed plant/animal matter and humic substances. Man-made sources result from industrial operations and/or municipal discharge. Photosynthesis contributes to dissolved organic carbon.

Tannins (organic)

No guideline. Tannins are created as water passes through rotting organic matter or peaty soil in the water table. They're also caused by low hanging branches, dead leaves, and trees in a water source. Tannins are basically the color left in water from the leaching of color from organic matter. Despite their staining qualities and their effects on water's taste and smell, tannins aren't dangerous to drink.

Sulfide (inorganic)

The odour related aesthetic objective for sulfide in drinking water is 0.05 mg/L as H2S (hydrogen sulphide). Although ingestion of large quantities of hydrogen sulfide gas can produce toxic effects on humans, it is unlikely that an individual would consume a harmful dose in drinking water because of the associated unpleasant taste and odour. Sulfide is also undesirable in water supplies because, in association with iron, it produces black stains on laundered items and black deposits on pipes and fixtures. Lower levels of sulfide can be removed effectively from most well water by aeration. Sulfide is oxidized to sulfate in well-aerated waters over a period of hours and consequently sulfide levels in surface supplies are usually very low.

Cyanide (inorganic)

Cyanide is widely used in the metal plating and refining industry, and industrial effluents are the major potential sources of cyanide contamination. The maximum acceptable concentration for cyanide in drinking water is 0.2 mg/L measured as free cyanide. The maximum acceptable concentration for free cyanide provides a safety factor of approximately 25 mg/L. Adequate chlorination will oxidize cyanide and reduce it to a level below this limit.

Phenol (organic)

High levels, which are not typically found in Drinking Water wells, can cause nausea, vomiting abdominal pain and diarrhea. Ingestion of phenol can also cause severe corrosive injury to the mouth, throat, esophagus, and stomach, with bleeding, perforation or scarring. Phenol is a common component of oil refinery waste. It is also produced in the conversion of coal into gaseous or liquid fuels and in the production of metallurgical coke from coal. It may enter the environment from oil refinery discharges, coal conversion plants, municipal waste treatment plant discharges, or spills.

Hardness as calcium carbonate (inorganic)

The operational guideline is 80-100 mg/L, and the cause is mainly excess calcium and magnesium. Hard water produces encrustations on pipes, tubs, sinks, utensils (as calcium carbonate), and causes excessive soap consumption. Water softeners (ion exchangers) remove calcium and magnesium but replace them with sodium which may be harmful for persons on sodium restricted diets. A summary of typical levels for regions of extensive limestone formations follows:

- Soft 0 – 75 mg/L as $CaCO_3$
- Acceptable 76 – 200 mg/L as $CaCO_3$
- Hard 201 – 300 mg/L as $CaCO_3$
- Very Hard > 300 mg/L as $CaCO_3$

Aluminum (inorganic)

The maximum acceptable concentration is 2.9 mg/L according to (GCDWQ). Aluminum in untreated water is present in the form of very fine particles of alumino-silicate clay. These clay particles are effectively removed in coagulation/filtration.

Barium (inorganic)

The maximum acceptable concentration for barium in drinking water is 1.0 mg/L. Barium is a common constituent in sedimentary rocks such as limestone and dolomite where it is accompanied by strontium and much larger amounts of calcium. As a result, hard water contains small amounts of barium but seldom at concentrations greater than 1 mg/L. Water softening methods are effective for barium removal.

Boron (inorganic)

The interim maximum acceptable concentration for boron in drinking water is 5.0 mg/L. Boron in water is most found to be borate. Acute boron poisonings have resulted from the use of borates as antiseptic agents and from accidental ingestion, however, the amount consumed was much higher than would be encountered through drinking water. Infants, the elderly and individuals with kidney diseases are most susceptible to the toxic effects of boron compounds.

Calcium (inorganic)

No guideline. It is an essential human nutrient for bones and teeth. Excessive calcium (with magnesium) produces hard water. Major sources are geological formations and road salt.

Copper (inorganic)

Drinking water standard is 1.0 mg/L. It is an essential human nutrient for enzyme function. Large doses exceeding the guideline can cause adverse health effects, such as liver damage. The most common source in drinking water is the corrosion of copper pipes within the home. When this water encounters soaps and detergents a turquoise-blue precipitate forms on clothing and plumbing fixtures. Flushing the pipes prior to use helps to minimize the problem. Major sources of copper in natural waters are industrial and manufacturing operations, smelters, acid mine drainage, and agricultural fungicides and pesticides.

Iron (inorganic)

Iron may be present in ground water because of mineral deposits and chemically reducing underground conditions. It may also be present in surface waters because of anaerobic decay in sediments and complex formation. The aesthetic objective for iron, set by appearance effects, in drinking water is 0.3 mg/L. Excessive levels of iron in drinking water supplies may impart a brownish colour to laundered goods, plumbing fixtures and the water itself; it may produce a bitter, astringent taste in water and beverages; and the precipitation of iron can also promote the growth of iron bacteria in wells, water mains and service pipes. Iron based coagulants such as ferric sulfate can be highly effective in treatment processes at removing particles from water and leave very little residual iron in the treated water. Major sources are geological formations, industrial wastes, and corrosion of man-made iron and steel.

Magnesium (inorganic)

No guideline. It is an essential human nutrient which is beneficial for the heart and the nervous system. More than 50 mg/L may have a laxative effect on first-time users. Along with calcium, magnesium contributes to water hardness. A major source is geological formations.

Manganese (inorganic)

Drinking water objective is 0.05 mg/L. It is an essential human nutrient. Manganese in water supplies stains plumbing fixtures and laundry, causes undesirable tastes in beverages and forms coatings on pipes which may give off a black precipitate. Major sources are soil, sediments and geological formations, as well as industrial and agricultural run-offs.

Nickel (inorganic)

Nickel has no guidelines. The major source of nickel in drinking water is leaching from stainless steel devices or materials used in water supply systems or nickel/chromium-plated taps used in plumbing. Flushing the tap before drinking, particularly after periods of stagnation, is recommended for nickel-sensitive people.

Potassium (inorganic)

No guideline. It is an essential human nutrient for nerve impulses. Moderate concentrations are acceptable, but more than 2,000 mg/L may be harmful to the nervous and digestive systems. Surface water rarely exceeds 20 mg/L.

Silica (SiO2): (inorganic)

No guideline, but 1-30 mg/L is normal. The major source is geological formations, although fluoridation of drinking water and aerosols are also significant sources.

Sodium (inorganic)

Sodium (inorganic) The aesthetic objective for sodium in drinking water is 200 mg/L at which it can be detected by a salty taste. Sodium is not toxic. Consumption of sodium more than 10g per day by normal adults does not result in any apparent adverse health effects. In addition, the average intake of sodium from water is only a small fraction of that consumed in a normal diet. A maximum acceptable concentration for sodium in drinking water has, therefore, not been specified. Persons suffering from hypertension or congestive heart disease may require a sodium-restricted diet, in which case, the intake of sodium from drinking water could become significant. It is therefore recommended that the measurement of sodium levels be included in routine monitoring programs of water supplies. The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L, so that this information may be passed on to local physicians. Softening using a domestic water softener increases the sodium level in drinking water and may contribute a significant percentage to the daily sodium intake for a consumer on a sodium restricted diet. It is recommended that a separate unsoftened supply be retained for cooking and drinking purposes.

Zinc (inorganic)

Drinking water standard is 5.0 mg/L. It is an essential human nutrient for enzyme function and is generally considered to be non-toxic. Usually less than 0.05 mg/L in surface and groundwater. Water with greater than 5.0 mg/L appears milky and produces a metallic or astringent taste. Major sources are industry, lead-zinc smelters, and geological formations.

Antimony (inorganic)

The maximum acceptable concentration for antimony in drinking water is 0.006 mg/L. The standard is set to protect against increased blood cholesterol and decreased blood glucose, as well as prevention of nausea, vomiting and diarrhea upon short-term exposure. Antimony is rarely detected in Ontario drinking water.

Arsenic (inorganic)

The maximum acceptable concentration for arsenic in drinking water is 0.01 mg/L. Arsenic is a known carcinogen and must therefore be removed by treatment where present at levels over this concentration. Arsenic is sometimes found at higher levels in ground water in hard rock areas (e.g. Canadian Shield) in Ontario through the natural dissolution of arsenic containing minerals, in some mine drainage waters and in some mine leachates. Arsenic is present at very low concentrations in most surface waters.

Cadmium (inorganic)

The maximum acceptable concentration for cadmium in drinking water is 0.005 mg/L. Cadmium is a relatively rare element that is extremely unlikely to be present as a significant natural contaminant in drinking water. Cadmium compounds used in electroplated materials and electroplating wastes may be a significant source of drinking water contamination. Other than occupational exposure and inhalation from cigarette smoke, food is the main source of cadmium intake.

Chromium (inorganic)

The maximum acceptable concentration for chromium in drinking water is 0.05 mg/L. Trivalent chromium, the most common and naturally occurring state of chromium, is not considered to be toxic. However, if chromium is present in raw water, it may be oxidized to a more harmful hexavalent form during chlorination. Chromium in the more highly oxidized form may be present in older yellow paints and in residues from plating operations and around old recirculating water-cooling systems.

Cobalt (inorganic)

No guideline. In most drinking water, cobalt levels are less than 0.001- 0.002mg/L. For most people, food is the largest source of cobalt intake. The average person consumes about 11 micrograms of cobalt a day in their diet. Included in this food is vitamin B12, which is found in meat and dairy products.

Lead (inorganic)

The maximum acceptable concentration for lead in drinking water is 0.01 mg/L. This applies to water at the point of consumption since lead is only present as a result of corrosion of lead solder, lead containing brass fittings or lead pipes which are found close to or in domestic plumbing and the service connection to buildings. Lead ingestion should be avoided particularly by pregnant women and young children as they are most susceptible. It is recommended that only the cold water supply be used for drinking/consumption and only after five minutes of flushing to rid the system of standing water. Corrosion inhibitor addition or other water chemistry adjustments may be made at the treatment plant to reduce lead corrosion rates where necessary.

Molybdenum (inorganic)

No guideline. Molybdenum is used in the manufacturing of special steels, in electrical contacts, spark plugs, X-ray tubes, filaments, screens and grids for radio valves. It is also used in the production of tungsten, glass-to-metal seals, non-ferrous alloys and pigments. Molybdenum compounds are used in agriculture either for the direct treatment of seeds or in the formulation of fertilizers to prevent molybdenum deficiency.

Selenium (inorganic)

The maximum acceptable concentration for selenium in drinking water is 0.05 mg/L. Occurring naturally in waters at trace levels because of geochemical processes such as weathering of rocks. It is difficult to establish levels of selenium that can be considered toxic because of the complex inter-relationships between selenium & dietary constituents such as protein, vitamin E and other trace elements. Food is the main source of selenium intake other than occupational exposure. Selenium is an essential trace element in the human diet. Drinking water containing selenium at the maximum acceptable concentration of 0.01 mg/L would be the source of only 10% of total selenium intake. The maximum acceptable concentration, therefore, is considered to provide a satisfactory factor of safety against known adverse effects.

Silver (inorganic)

No guideline. Observational data suggest that silver does not have toxic effects on humans at concentrations normally found in drinking-water. Data obtained in some animal studies indicate some toxic effects generally at high concentrations, but the relevance to humans of these effects is unclear.

Thallium (inorganic)

Thallium is regulated as a primary drinking water standard, because of health concerns. The Environmental Protection Agency (EPA) has set a maximum contaminant level for thallium of 0.002 mg/L and a maximum contaminant level goal of 0.0005 mg/L.

Uranium (inorganic)

The maximum acceptable concentration of uranium in drinking water is 0.02 mg/L. Uranium is normally present in biological systems and aqueous media like the uranyl ion (UO22+). Ingestion of large quantities of uranyl ion may result in damage to the kidneys. Exposure to high levels of uranium in drinking water for a long time could also affect bones. Exposure to uranium in drinking water for a short time should not have a negative impact on your health

Vanadium (inorganic)

No guideline. Average vanadium concentrations in tap water are approximately 0.001 mg/L or less. If you drink approximately 2 L of water a day, a daily intake of approximately 0.002 mg of vanadium from tap water can be estimated for adults. The natural release of vanadium into water and soil occurs primarily from the weathering of rocks and soil erosion.

Mercury (inorganic)

The maximum acceptable concentration for mercury in drinking water is 0.001 mg/L. Possible sources of mercury in drinking water include air pollution from coal combustion, waste incineration and from metal refining operations and from natural mineral deposits in some hard rock areas. Food is the major source of human exposure to mercury, with freshwater fish being the most significant local source.

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