Supporting Documentation for Drinking Water Standards and Guidelines

Supporting Documentation for Drinking Water Standards and Guidelines

1,1,1-TRICHLOROETHANE	CASRN: 71556	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL: 0.2 mg/L. ORS has adopted the MCL published by the U.S. EPA (52 FR 25689 (7/8/87)).

Federal Regulatory Limit: The MCL of 0.2 mg/L is equal to its MCLG of 0.2 mg/L.

Basis for Criteria: The MCLG is based on a mouse inhalation study (49 FR 24329). The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

***RfD** = 0.035 mg/kg/day

UF: 1000 (10 = subchronic to chronic; 10 = interspecies; 10 = intraspecies)

The dose associated with inhaling the minimum effect level (MEL) discussed below was derived, assuming that a 70 kg adult inhales continuously at a rate of 1 m^3/hr. A 6-hour duration is assumed for this calculation as this is the exposure assumed to be saturable and therefore equivalent to exposure for a 24-hour period. An absorption factor of 0.3 is also applied. Thus, the inhalation MEL of 1365 mg/m^3 is converted to an ingestion MEL dose:

(1365 mg/m^3 x 1 m^3/hr x 6 hrs/day x 0.3)/70 kg = 35.1 mg/kg/day

(U.S. EPA, 1984)

Critical Effects: The critical effect is liver toxicity in mice. McNutt *et al*. (1975) exposed male mice continuously via inhalation to 250 ppm (1365 mg/m^3) or 1000 ppm (5460 mg/m^3) 1,1,1-trichloroethane for 14 weeks. Significant changes were noted in centrilobular hepatocytes (including vesiculation of rough endoplasmic reticulum, with loss of attached polyribosomes, increased smooth endoplasmic reticulum, microbodies and triglyceride droplets). 250 ppm was assumed to be a minimum effect level (MEL) and was used as the basis upon which to derive an *RfD (U.S. EPA, 1984).

Cancer Assessment: D.

There are no data indicating that 1,1,1-trichloroethane is carcinogenic either in humans or animals.

Class: VOC

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Analytical Methods:

PQL: 0.005 mg/L

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Analytical Methods: U.S. EPA 502.1; gas chromatography
U.S. EPA 503.1; gas chromatography
U.S. EPA 524.2; gas chromatography-mass spectrometry

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. June 12, 1984. Part V. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Volatile Synthetic Organic Chemicals; Proposed Rulemaking. (49 FR 24329).

Federal Register. July 8, 1987. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25689).

McNutt, NS; Amster, RL; McConnell, EE; *et al*. 1975. Hepatic lesions in mice after continuous inhalation exposure to 1,1,1-trichloroethane. Lab Invest. 32:642—654.

U.S. EPA (U.S. Environmental Protection Agency). February 1984. Draft Criteria Document for 1,1,1-Trichloroethane. Health Effects Branch. Criteria and Standards Division. Office of Drinking Water.

* In the February 1984 Draft Criteria Document for 1,1,1-Trichloroethane, an Adjusted Allowable Daily Intake (AADI) is described as: (NOAEL or MEL in mg/kg)(70 kg)/(Uncertainty Factor)(2 liters/day). What we refer today as the RfD is referred to as the ADI (Allowable Daily Intake) in the document cited above and can be back calculated from the AADI by multiplying it by the ingestion rate divided by the body weight for an adult (i.e., 2 liters/day/70 kg. This value has been back calculated from the AADI of 1.22 mg/L (rounded to 1.0 mg/L).

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1,1,2-TRICHLORO-1,2,2-TRIFLUORO-ETHANE (Freon 113)	CASRN: 76131	Update: March 1996

Current Massachusetts Regulatory Limit: ORSGL = 210 mg/L

Federal Regulatory Limit: The U.S. EPA has not published an MCL for 1,1,2-trichloro-1,2,2-trifluoroethane.

Basis for Criteria: The ORSGL is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 30 mg/kg/day (U.S. EPA, 1996)

UF: 10 **MF:** 1

Critical Effects: In male volunteers acutely exposed for 2.75 hours to 19,161 mg/m^3, slight impairment of psychomotor function was noted (Stopps and McLaughlin, 1967). In humans occupationally exposed by inhalation to 500 mg/m^3 for 11 years or 5358 mg/m^3 for 2.77 years, no apparent adverse effects were noted (Imbus and Adkins, 1972). The NOAEL of 5358 mg/m^3 identified from this study was converted to an oral dose and used as the basis for the oral RfD presented above. The confidence in the RfD is low because the route of exposure in the study is inhalation not ingestion.

Cancer Assessment: NA

The U.S. EPA has not evaluated this chemical for carcinogenicity.

Class: VOC

Analytical Information:

PQL: 0.01 mg/L

Analytical Methods: U.S. EPA 524.2; GC-MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Imbus, H.R., and C. Adkins. 1972. Physical examination of workers exposed to trichlorotrifluoroethane. Arch. Environ. Health. 24(4): 257-261.

Stopps, G.J. and M. McLaughlin. 1967. Psychophysiological testing of human subjects exposed to solvent vapors. Amer. Ind. Hyg. Assoc. J. 28: 43-50.

U.S. EPA (U.S. Environmental Protection Agency). 1996. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

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1,1,2-TRICHLOROETHANE	CASRN: 79005	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776).

Federal Regulatory Limit: The MCL for 1,1,2-trichloroethane is based on its detection limit of 0.005 mg/L. The MCLG is equal to 0.003 mg/L.

Basis for Criteria: The MCLG of 0.003 mg/L for 1,1,2-trichloroethene has been set based on noncancer effects. The MCL has been set at the PQL for 1,1,2-trichloroethane of 0.005 mg/L because the U.S. EPA believes that the PQL is as close to the MCLG as is feasible. The MCLG of 0.003 mg/L is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. The MCLG incorporates a relative source contribution factor of 0.2 and an uncertainty factor of 10 to account for potential carcinogenicity.

The derivation of the MCLG for 1,1,2-trichloroethane is consistent with U.S. EPA's process for deriving an MCLG for a Group C carcinogen (as described on page 46949 of 50 FR 46936). If available, the primary option is to set the MCLG based on noncarcinogenic endpoints and to account for potential carcinogenicity by applying an additional uncertainty factor of up to 10 to the final value. If adequate noncancer data are not available to permit the derivation of an RfD, the second option is to set the MCLG to fall within an excess lifetime cancer risk (ELCR) range of 10^{-5} – 10^{-6}. Since adequate noncancer data are available for 1,1,2-trichloroethane, the MCLG for this chemical is based on noncancer effects. U.S. EPA also determined that the MCLG of 0.003 mg/L corresponds to a theoretical cancer risk limit of 1 x 10^{-5}.

RfD: 4 x 10^{-3} mg/kg/day

UF: 1000 (10 intraspecies; 10 intraspecies; 10 subchronic to chronic)

MF: 1 **Confidence:** Medium

Critical Effects: 1,1,2-trichloroethane has been shown to target the liver and kidney in laboratory animals. Subchronic studies in mice (White *et al*. 1985; Sanders *et al*., 1985), in which 1,1,2-trichloroethane was administered in the diet at concentrations of 0, 20, 200 or 1,000 ppm of 1,1,2-tricloroethane in water, indicated adverse effects in livers of mid- and high-dose males and high-dose females. A NOAEL of 20 ppm (corresponding to dose levels of 4.4 and 3.9 mg/kg/day for males and females, respectively) was identified from this study.

Cancer Assessment: C (possible human carcinogen)

Oral Cancer Slope Factor: 5.7×10^{-2} $(mg/kg/day)^{-1}$
Hepatocellular carcinomas and pheochromocytomas in one strain of mice form the basis of the C classification. Carcinogenicity was not shown in rats.

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA 502.2; gas chromatography
U.S. EPA 503.1; gas chromatography
U.S. EPA 524.2; gas chromatography-mass spectrometry

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*.. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule.

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Sanders, V.M., K.L. White, *et al*. 1985. Humoral and cell-mediated immune status of mice exposed to 1,1,2-trichloroethane. Drug Chem. Toxicol. 8 (5): 357-372.

White, K.L, V.M. Sanders *et al*. 1985. Toxicology of 1,1,2-trichloroethane in the mouse. Drug Chem Toxicol. 8(5): 333-355.

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1,1-DICHLOROETHANE	CASRN: 75343	Update: August 1993

Current Massachusetts Regulatory Limit: ORSGL = 0.07 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for 1,1-dichloroethane. This chemical is listed in 1/91 Drinking Water Priority List and may be regulated in the future (56 FR 14703) (Fed Reg, 1991).

Basis for Criteria: The ORSGL was developed based on the RfD presented below and assuming that a 70 kg adult ingests 2 L/day of water. A safety factor of 10 was added to calculation of non-cancer effects to account for possible cancer effects in humans. A relative source contribution factor of 20% is incorporated into this value.

RfD: 0.1 mg/kg/day (U.S. EPA, 1991)

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = subchronic to chronic)

MF: 1

(U.S. EPA, 1991)

Critical Effects: 1,1-dichloroethane has produced kidney damage in rats after long-term exposure to high concentrations in air. In addition, delayed growth of offspring occurred when animals inhaled 1,1-dichloromethane during pregnancy. Long-term oral exposure to very high concentrations of 1,1-dichloromethane has produced cancer (hemangiosarcomas) in rats. A NOAEL of 500 ppm (138 mg/kg/day) was identified from the rat inhalation study referenced above (U.S. EPA, 1991).

Cancer Assessment: C

U.S. EPA currently classifies 1,1-dichloroethane as a group C carcinogen. There is currently no potency factor available. The cancer classification is based on no evidence of cancer in human and limited data in animals. An NCI bioassay (1978) shows significant dose-related increases in the incidences of hemangiosarcoma at various rates and mammary carcinoma.

Class: VOC

Analytical Information:

PQL: 0.0005 mg/L

Analytical Methods: 524.2

PQLs and analytical methods may have been updated since this guidance value was last

revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 14, 1991. Drinking Water Priority List. (56 FR 1470).

NCI (National Cancer Institute) 1978. Bioassay for 1,1-dichloroethane for possible carcinogenicity.

U.S. EPA (U.S. Environmental Protection Agency). 1991. HEAST (Health Effects Assessment Summary Tables). Office of Research and Development. Office of Emergency and Remedial Response.

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1,1-DICHLOROETHYLENE	**CASRN: 75354**	March 1989

Current Massachusetts Regulatory Limit: MMCL = 0.007 mg/L. ORS has adopted the MCL published by U.S. EPA.

Federal Regulatory Limit: The MCL for 1,2-dichloroethane is based on its detection limit of 0.007 mg/L. The MCLG for 1,1-dichloroethylene is zero based on the evidence for carcinogenic potential. This value was promulgated as part of the National Primary Drinking Water Regulations: Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule on July 8, 1987 (52 FR 25690).

Basis for Criteria: An MCLG of zero is assigned for 1,1-dichloroethylene based on carcinogenic effects. The MCL is based on the 1,1-dichloroethylene PQL.

Critical Effects: Acute exposure to 1,1-dichloroethylene for relatively short periods of time at levels above the MCL may cause liver toxicity. Chronic exposure to 1,1-dichloroethylene may cause liver and kidney damage, fetal toxicity and cancer. A 2-year chronic study in which rats were exposed to 0, 50, 100 and 200 ppm of 1,1-dichloroethylene produced mid-zonal fatty accumulation in liver although no liver degeneration. A LOAEL of 100 mg/kg/day was identified from this study (Fed. Reg., 1985).

Cancer Assessment: U.S. EPA has classified 1,1-dichloroethylene as a C (possible) human carcinogen under the 1986 Carcinogen Risk Assessment Guidelines.

Class: Volatile Organic Compound

Analytical Information:

PQL: 0.007 mg/L

Analytical Methods: U.S. EPA Methods 502.2; 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. July 8, 1987. National Primary Drinking Water Regulations—Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25690).

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1,2,4-TRICHLOROBENZENE	CASRN: 120821	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.07 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL for 1,2,4-trichlorobenzene is equal to its MCLG of 0.07 mg/L.

Basis for Criteria: The MCLG is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 0.01 mg/kg/day

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = lack of chronic studies)

MF: 1 **Confidence in the RfD:** Medium

Critical Effects: : Acute exposure to 1,2,4-trichlorobenzene for relatively short periods of time at levels above the MCL could result in changes in liver, kidneys and adrenal glands. Chronic lifetime exposure to concentrations above the MCL may result in increased adrenal gland weights.

In multi-generation reproductive study, rats were given 0, 25, 100 and 400 ppm 1,2,4-trichlorobenzene added to drinking water for 95 days per generation for two generations, and F_1 offspring were examined. A compound-related significant increase in adrenal gland weights was seen in P_0 and F_1 generations. Increased adrenal weights were associated with the histopathologic lesion, vacuolization of the zona fasciculata of the cortex. A NOAEL of 100 ppm (14.8 mg/kg/day) was identified from this study.

Cancer Assessment: D

There is presently no evidence that 1,2,4-trichlorobenzene has the potential to cause cancer from a lifetime exposure in drinking water. The U.S. EPA has classified this chemical as a D carcinogen (not classifiable as to human carcinogenicity based on inadequate data) under the 1986 Carcinogen Risk Assessment Guidelines.

Class: Chlorinated Organic

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Analytical Information:

PQL: 0.0005 mg/L

Analytical Methods: U.S. EPA Methods 502.2; 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*.. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule.

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

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1,2-DIBROMO-3-CHLOROPROPANE	CASRN: 96128	Update: March 1993

Current Massachusetts Regulatory Limit: MMCL = 0.0002 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule (56 FR 3526; 1-30-91).

Federal Regulatory Limit: The MCL for 1,2-dibromo-3-chloropropane is based on its detection limit of 0.0002 mg/L. The MCLG is equal to zero.

Basis for Criteria: The U.S. EPA currently classifies DBCP as a B2 carcinogen and therefore establishes an MCLG of zero. The MCL is established as close to the MCLG as feasible, therefore, the regulatory limit is set at the PQL of 0.0002 mg/L.

Critical Effects: Non-cancer effects that are associated with exposures to DBCP include hepatic, CNS, and testicular effects.

Cancer Assessment: B2
There is sufficient evidence from animal studies that exposure to DBCP causes an increase in tumors. There is currently no oral potency listed in IRIS (4-10-91).

Class: VOC

Analytical Information:

PQL: The PQL used as the basis for the MCL is 0.0002 mg/L .

Analytical Methods: 504 GC w/ microextract.
524.2 GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

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1,2-DICHLOROBENZENE (o-DCB)	CASRN: 95501	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.6 mg/L. ORS has adopted the MCL promulgated by the U.S. EPA as part of the Phase II rule 56 FR 3526 (1-30-91); FR 30266; (7-1-91).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.6 mg/L.

Basis for Criteria: The MCLG is based on the potential for hepatic toxicity reported in subchronic rat and mouse studies (NTP, 1985). The MCLG assumes that a 70 kg adult ingests 2 L/day of water and incorporates a relative source contribution factor of 0.2.

RfD: 9×10^{-2} mg/kg/day

UF: 1000 (10 = intraspecies; 10 = interspecies; 10 = no repro. studies or 2nd chronic study)
MF: 1

Critical Effects: Exposure to 1,2-dichlorobenzene at high doses produces a variety of toxic effects, including central nervous system depression, kidney and liver damage. In a study in which mice and rats were given 1,2-dichlorobenzene by gavage at doses of 30, 60, 125, 250 and 500 mg/kg/day, five days per week for thirteen weeks, no effects were noted at the three lowest doses (NTP, 1985). A NOAEL of 125 mg/kg/day was identified from these studies. Since animals were only dosed five days per week, the NOAEL was time-adjusted to 89.2 mg/kg/day by multiplying by 5 days/7 days.

Cancer Assessment: D
Data are inadequate to make a judgment regarding the potential for increased cancer in humans or animals.

Class: VOC

Analytical Information:

Analytical Methods: 502.1; Purge and trap

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Federal Register. July 1, 1991. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Monitoring for Volatile Organic Chemicals; MCLGs and MCLs for Aldicarb, Aldicarb Sulfoxide, Aldicarb Sulfone, Pentachlorophenol, and Barium; Final Rule. (56 FR 30266).

National Toxicology Program (NTP) 1985. Toxicology and Carcinogenesis studies of 1,2-dichlorobenzene (o-dichlorobenzene) in R344/N rats and B6C3R1 mice (gavage studies). NTP R 255 NIH Publ. No. 86-2511

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1,2-DICHLOROETHANE	**CASRN: 107-06-2**	March 1989

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by U.S. EPA in the Phase I rule (52 FR 25690; 7/8/87).

Federal Regulatory Limit: The MCL for 1,2-dichloroethane is based on its detection limit of 0.005 mg/L. The MCLG is zero. This value was promulgated as part of the National Primary Drinking Water Regulations: Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule on July 8, 1987 (FR25690).

Basis for Criteria: An MCLG of zero is assigned for 1,2-dichloroethane based on the evidence for carcinogenic potential. The MCL is based on the 1,2-dichloroethane PQL.

Critical Effects: Acute exposure to 1,2-dichloroethane for relatively short periods of time at levels above the MCL may produce effects on the central nervous system, lung, kidney, liver, circulatory system and gastrointestinal tract. There is some evidence indicating that chronic exposure to 1,2-dichloroethane at concentrations above the MCL may cause cancer.

Cancer Assessment: Hemangiosarcomas were produced in male Osborne Mendel rats exposed to 1,2-dichoroethane via gavage.

U.S. EPA has classified 1,2-dichloroethane as a B2 (probable) human carcinogen. The oral cancer slope factor of $9.1 \times 10^{-2}(mg/kg/day)^{-1}$ was issued on 1/1/91.

Class: Chlorinated hydrocarbon

Analytical Methods:

PQL: The PQL used as the basis for the MCL is 0.005 mg/l.

Analytical Methods: 502.2, 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 8, 1987. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations-Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25690).

Supporting Documentation for Drinking Water Standards and Guidelines

cis-1,2-DICHLOROETHYLENE	CASRN: 156592	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.07 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule (56 FR 3526; 1-30-91).

Federal Regulatory Limit: The MCL is equal to its MCLG of 0.07 mg/L.

Basis for Criteria: The MCLG is based on the potential for hepatic toxicity reported for compound-specific studies. The MCLG is derived using the 1,1-dichloroethylene RfD presented below and assuming that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% is incorporated into this value.

RfD: 0.01 mg/kg/day

UF: 1000 (10 = LOAEL to NOAEL; 10 = interspecies; 10 = intraspecies)

There are limited data on the toxicity of cis-1,2-dichloroethylene. An *AADI was developed based on the toxicity of 1,1-dichloroethylene in response to data suggesting that the non-carcinogenic toxicity induced by the two isomers of dichloroethylene is likely to be no more severe than that of 1,1-dichloroethylene.

Critical Effects: Exposure to cis-1,2-dichloroethylene at high dose levels may result in liver and kidney effects. Because no satisfactory dose-response data are available from which to derive an AADI, the AADI for cis-1,2-dichloroethylene was derived based on data for 1,1-dichloroethylene and assuming 20% of the exposure is via drinking water:

Acute exposure to 1,1-dichloroethylene for relatively short periods of time at levels above the MCL may cause liver toxicity. Chronic exposure to 1,1-dichloroethylene may cause liver and kidney damage, fetal toxicity and cancer. A 2-year chronic study in which rats were exposed to 0, 50, 100 and 200 ppm of 1,1-dichloroethylene produced mid-zonal fatty accumulation in liver although no liver degeneration. A LOAEL of 100 ppm (i.e., 10 mg/kg/day) was identified from this study (Fed. Reg., 1985).

Cancer Assessment: No long-term studies have been carried out on the carcinogenic potential of cis-1,2-dichloroethylene and there are generally non-positive results in mutagenic assays. This chemical has been classified under U.S. EPA's Group D, not classifiable as to human carcinogenicity.

Class: VOC

Supporting Documentation for Drinking Water Standards and Guidelines

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA Methods 502.2 (purge and trap GC)
524 (purge and trap GC/MS)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. July 8, 1987. National Primary Drinking Water Regulations—Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25690).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

*In the November 13, 1985 Federal Register, what we refer to today as the RfD was known as the ADI (Allowable Daily Intake. The term AADI (Adjusted Allowable Daily Intake) was used to describe the concentration value derived from the ADI and assuming the weight of a consumer and the amount of drinking water consumed per day (i.e., in this case, a 70 kg adult who ingests 2 L/day of water). The AADI is equivalent to what is today known as the DWEL.

trans-1,2-DICHLOROETHYLENE	CASRN: 156605	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.1 mg/L. ORS has adopted the MCL issued by the U.S. EPA as part of the Phase II rule. (56 FR 3526; 1-30-91)

Federal Regulatory Limit: The MCL for trans-1,2-dichloroethylene is equal to its MCLG of 0.1 mg/L.

Other Regulatory Data: The MCL is equal to the MCLG of 0.1 mg/L, which was derived based on hepatic toxicity reported from compound-specific data. The MCLG was derived using the RfD presented below and assuming that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% was incorporated into this value.

RfD: 2×10^{-2} mg/kg/day

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = subchronic to chronic)

MF: 1

(U.S. EPA, 1989)

Critical Effects: CD-1 mice were given trans-1,2-dichloroethylene for 90 days in drinking water. Significant increases in serum alkaline phosphatase were noted at the two highest dose in male mice. A NOAEL of 17 mg/kg/d was identified in male mice[(1)] based on normal serum chemistry values.

Cancer Assessment: This chemical has been classified under U.S. EPA's Group D, not classifiable as to human carcinogenicity.

Class: VOC

PQL: 0.005 mg/l

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA Methods 503.1 (purge and trap GC)
524.2 (purge and trap GC/MS)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Barnes, D.W., VM. Sanders, K.L. White, Jr., G.M. Shopp and A.E. Munson. 1985. Toxicology of trans-1,2-dichloroethylene in the mouse. Chem. Toxicol. 8:373-392.

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142 and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule.

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

U.S. EPA (U.S. Environmental Protection Agency). IRIS (Integrated Risk Information System). U.S. Environmental Protection Agency. Washington, D.C.. http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

1,2-DICHLOROPROPANE	CASRN: 78875	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL issued by the U.S. EPA as part of the Phase II rule. (56 FR 3526; 1-30-91).

Federal Regulatory Limit: The MCL of 0.005 mg/L is based on the PQL for 1,2-dichloropropane. The MCLG is set to zero based on the evidence for carcinogenic potential.

Basis for Criteria: An MCLG of zero is assigned for 1,2-dichloropropane based on carcinogenic effects. The MCL is based on the 1,2-dichloropropane PQL.

Critical Effects: Liver toxicity (centrilobular necrosis, liver congestion and hepatic fatty changes reported in animals); kidney effects; lung effects; liver cancer (statistically significant increased incidence of hepatocelleular neoplasms and primary adenomas in male and female B6C3F1 mice); and mammary tumors (dose-related trend in mammary adenocarcinoma in female F344 rats, considered significant since these tumors have a low background rate).

Cancer Assessment: B2

The U.S. EPA has revised the cancer classification for 1,2-dichloropropane from a group C to a group B2 based on the results of a 1986 NTP report. The report cited increases in liver carcinomas and also a dose-related trend in mammary carcinomas in female rats. Other considerations include: positive mutagenic activity in short-term assays, and the metabolism of the compound to suspected carcinogenic compounds.

The MCL of 0.005 mg/L is associated with a maximum individual Excess Lifetime Cancer Risk* of 1 x 10^{-5} (56 FR 3526).

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA Methods 503.1 P/T
524.1 GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142 and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule.

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

*This information on risk is extrapolated from information provided in the July 7, 1992 Federal Register that a 1 x 10^{-4} Excess Lifetime Cancer Risk (ELCR) is associated with a concentration of 0.05 mg/L.

Supporting Documentation for Drinking Water Standards and Guidelines

1,3-DICHLOROPROPENE	CASRN: 542756	Update: May 2004

Current Massachusetts Regulatory Limit: ORSGL = 0.0004 mg/L

Federal Regulatory Limit: The U.S. EPA has not published an MCL for 1,3-dichloropropene.

Basis for Criteria: 1,3-dichloropropene is likely to be carcinogenic to humans. Under the old U.S. EPA classification system, it was designated as a B2 carcinogen. The ORSGL is calculated based on the IRIS chronic oral cancer potency factor and corresponding to the Drinking Water Program's target excess lifetime cancer risk of one in a million.

Calculation:

- Oral Cancer Potency Factor = 1×10^{-1} $(mg/kg/day)^{-1}$ (U.S. EPA, 2004)
- Converted to Unit Risk factor for ingestion of drinking water:
  1 µg/L x 1 mg/1000 µg x 2 L/day/70 kg x 0.1 $(mg/kg/day)^{-1}$ = 2.8571×10^{-6}
- One in a million risk level calculated: 1×10^{-6} x 1 µg/L/2.8571×10^{-6} = 0.35 µg/L
  (0.0004 mg/L)

Critical Effects: carcinogenicity (see below)

Cancer Assessment: Likely To Be Carcinogenic to Humans/B2

The cancer classification is based on observations in F344 rats (forestomach, adrenal and thyroid tumors and liver nodules) and B6C3F1 mice (forestomach, urinary bladder and lung tumors), positive mutagenic activity, and structural similarity to known oncogens that produce similar types of tumors in rodents.

The U.S. EPA recommended a cancer slope factor of 0.1 $(mg/kg/day)^{-1}$ on 5/25/00.

Class: VOC

Analytical Information:

PQL: 0.0005 mg/L

Analytical Methods: 503; GC-purge and trap
524; GC/MS-purge and trap

PQLs and analytical methods may have been updated since this guidance value was last

revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

U.S. EPA (U.S. Environmental Protection Agency). 2004. Integrated Risk Information System (IRIS). Washington, D.C http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

1,4-DICHLOROBENZENE (p-DCB)	CASRN: 106467	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L.

Federal Regulatory Limit: The MCL for 1,4-dichlorobenzene is 0.075 mg/L.

Basis for Criteria: In 1988, ORS determined that there were sufficient data to classify p-dichlorobenzene as a group B2 (probable) human carcinogen (ORS 1988). In keeping with the U.S. EPA evaluation protocol, the standard for B2 carcinogens is set as close to zero as feasible. Feasibility is determined by considering treatment costs of reducing the concentration, the availability of Best Available Technology (BAT) and the lowest practical quantitation limit (PQL) available from the existing analytical methods. ORS determined that 0.005 mg/L was feasible.

The U.S. EPA promulgated an MCL for p-dichlorobenzene of 0.075 mg/L on January 31, 1991. The MCL is based on an MCLG of 0.075 mg/L derived from a long-term study in dogs where liver effects were the critical effect. Since the U.S. EPA classifies this compound as a group C (possible) human carcinogen, a safety factor of 10 was added to the usual calculation for non-cancer effects to account for possible cancer effects in humans.

ORS has calculated an Excess Lifetime Cancer Risk (ELCR) of approximately one in one hundred thousand from ingestion, inhalation and dermal exposures to p-dichlorobenzene at the ORS standard of 0.005 mg/L. A Cancer Potency Factor (CPF) of 0.024 $(mg/kg/day)^{-1}$ was used for the calculation (U.S. EPA 1988, 1994).

Critical Effects: non-cancer: liver effects; cancer

Cancer Assessment: B2/C

Class: VOC

Analytical Information:

PQL: The PQL used as the basis for the MMCL is 0.005 mg/L.

Analytical Methods: 502.1 GC purge and trap
503.1 GC

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

U.S. EPA (U.S. Environmental Protection Agency). 1988. Health Effects Assessment Summary Tables (HEAST).

U.S. EPA (U.S. Environmental Protection Agency). 1994. Health Effects Assessment Summary Tables (HEAST).

ORS (Office of Research and Standards). March 4, 1998. Memorandum from Carol Rowan West.

Supporting Documentation for Drinking Water Standards and Guidelines

1,4-DIOXANE	CASRN: 123911	Update: May 2011

Current Massachusetts Regulatory Limit: ORSGL = 0.0003 mg/L

Federal Regulatory Limit: The U.S. EPA has not published an MCL for 1,4-dioxane.

Basis for Criteria: 1,4-dioxane is likely to be carcinogenic to humans. Under the old U.S. EPA classification system, it was designated a B2 carcinogen. The ORSGL is calculated based on the IRIS chronic drinking water unit risk value and corresponds to the Drinking Water Program's target excess lifetime cancer risk of one in a million.

Calculation:

- Oral Drinking Water Cancer Unit Risk: 2.9×10^{-6} $(mg/kg/day)^{-1}$ (U.S. EPA, 2010)
- One in a million risk level calculated: $1 \times 10^{-6} \times 1$ (mg/L)/2.9×10^{-6} = 0.34 µg/L **(0.0003 mg/L)**

Oral RfD: 0.03 mg/kg/day (US EPA, 2010)

Critical Effects: liver and kidney toxicity; carcinogenicity.

Cancer Assessment: Likely to Be Carcinogenic to Humans/B2
The human data are inadequate for cancer risk assessment. Supporting data for the cancer classification comes from sufficient evidence for carcinogenicity in animal studies, including hepatic tumors in multiple species (three strains of rats, two strains of mice, and in guinea pigs); mesotheliomas of the peritoneum, mammary, and nasal tumors have also been observed in rats following 2 years of oral exposure to 1,4-dioxane.

The Kano et al., (2009) drinking water study was used as the principal study for derivation of an oral drinking water unit risk value. This study contained three dose groups and a control at lower doses than those used in previous studies. The most sensitive target organ for tumor formation was the liver. In addition, this study also noted increased incidence of peritoneal and mammary gland tumors. At a much lower incidence, nasal cavity tumors were also observed in high-dose male and female rats.

Several studies conducted in mouse skin and rat liver suggested that 1,4-dioxane does not initiate the carcinogenic process but is a promoter (Bull et al., 1986; King et al., 1973; Lundberg et al., 1987).

Class: VOC; solvent

Analytical Information:

*LCMRL: 0.00004 mg/L

Analytical Methods: GC/MS methods
U.S. EPA Method 522
Modified SW-846 8260 SIM
Modified SW-846 8270 SIM

*In the late 1980's, the U.S. EPA replaced their designation of the PQL as a quantitation limit with the LCMRL. The LCMRL is defined as "the lowest true concentration for which the future recovery is predicted to fall, with high confidence (99% between 50% and 150% recovery)". The Agency has also developed a procedure for use in the drinking water program which allows laboratories to confirm that they can achieve a required Minimum Reporting Level (MRL) during their initial demonstration of capability. The U.S. EPA anticipates using standardized LCMRL/MRL procedures to support monitoring required under the Safe Drinking Water Act for unregulated contaminants (U.S. EPA, 2004).

EPA method 522 may be found at http://www.epa.gov/microbes/ordmeth.htm; however, there are a variety of alternative analytical protocols available that are based on existing modified methods that may be used to achieve a similar level of detection.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments, Cancer Potency Factors (CPFs) or Unit Risk (UR) values referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments, CPFs and URs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that

used in the derivation process as published in the Federal Register notice.

References:

Bull RJ; Robinson M; Laurie RD. 1986. Association of carcinoma yield with early papilloma development in SENCAR mice. Environ Health Perspect, 68: 11-17.

Kano H, Umeda Y, Kasai T, Sasaki T, Matsumoto M, Yamazaki K, Nagano K, Arito H, Fukushima S. 2009. Carcinogenicity studies of 1,4-dioxane administered in drinking-water to rats and mice for 2 years. Food Chem Toxicol, 47: 2776-2784.

King, M.E., Shefner, A.M. and Bates, R.R. 1973. Carcinogenesis bioassay of chlorinated dibenzodioxins and related chemicals. Env. Health Persp. 5:163-170.

Kociba, R.J., McCollister, S.B., Park, C., Torkelson, C.R. and Gehring, P.J. 1974. 1,4-dioxane. I. Results of a 2-year ingestion study in rats. Toxicol. Appl. Pharmacol. 30:275-286.

Lundberg, I., Hogberg, J., Kronevi, T., Holmberg, B. 1987. Three industrial solvents investigated for tumor promoting activity in the rat liver. Cancer Lett, 36: 29-33.

National Cancer Institute. (NCI) 1978. Bioassay of 1,4-dioxane for possible carcinogenicity, CAS No. 123-91-1. NCI Carcinogenesis Tech. Rep. Ser. No. 80. DHEW Publications NO. (NIH) PB-285-711.

U.S. EPA (U.S. Environmental Protection Agency). 2004. Revised Assessment of Detection and Quantitation Approaches. EPA 821-B-04-005. Engineering and Analysis Division. Office of Science and Technology. Office of Water.

U.S. EPA (U.S. Environmental Protection Agency). 2010. Integrated Risk Information System (IRIS). Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm (date accessed: May 2011).

Supporting Documentation for Drinking Water Standards and Guidelines

2,3,7,8-TCDD (Dioxin)	**CASRN: 1746016**	August 1993

Current Massachusetts Regulatory Limit: MMCL = 3 x 10^{-8} mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL of 3 x 10^{-8} mg/L is set at the PQL for TCDD of 3 x 10^{-8} mg/L. The MCLG is set to zero.

Basis for Criteria: An MCLG of zero is assigned for TCDD based on the evidence for carcinogenic potential. The MCL is based on the TCDD PQL.

Critical Effects: Acute exposure to 2,3,7,8-TCDD, for relatively short periods of time, at levels above the MCL, could result in liver damage, weight loss, wasting of the thymus gland and immunosuppression. Chronic lifetime exposure to concentrations above the MCL may result in a variety of reproductive effects, from reduced fertility to birth defects and cancer.

Cancer Assessment: 2,3,7,8-TCDD is a potent carcinogen in rats and mice. A number of bioassays have produced adenomas or carcinomas of the thyroid, hepatocellular carcinomas, carcinomas of the tongue and hard palate, and adenomas of the adrenal gland (Kociba *et al*., 1978a; Toth *et al*., 1979; NTP, 1980).

The U.S. EPA derived an oral cancer slope factor for 2,3,7,8-TCDD of 1.56 x 10^{-5} $(mg/kg/day)^{-1}$ (U.S. EPA, 1987).

Class: Chlorinated Organic

Analytical Information:

PQL: 3 x 10^{-8} mg/L

Analytical Methods: U.S. EPA Method 1613

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MMCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 et al. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Kociba, R.J., D.G. Keyes. J.E. Beyer et al. 1978a. Results of a two-year chronic toxicity and oncogenicity study of 2,3,7,8-tetrachlorodibenzo-p-dioxin in rats. Toxicol. Appl. Pharmacol. 46(2):279-303.

NTP (National Toxicology Program). 1980. Bioassay of 2,3,7,8-tetrachloro-dibenzo-p-dioxin for possible carcinogenicity (gavage study). Carcinogenesis testing program, NCI, NIH, Bethesda, MD. NTP, Research Triangle Park, NC. DHHS Publ. No. (NIH) 82-1765.

Toth, K., S. Somfai-Relle, J. Sugar and J. Bence. 1979. Carcinogenicity testing of herbicide 2,4,5-trichlorophenoxyethanol containing dioxin and of pure dioxin in Swiss mice. Nature. 278(5704):548-549.

U.S. EPA. March 31, 1987. 2,3,7,8-Tetrachlorodibenzo-p-dioxin Health Advisory.

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Office of Drinking Water.

SILVEX (2,4,5-TP) ((2,4,5-Trichlorophenoxy)Propionic Acid)	CASRN: 93721	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.05 mg/L. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for silvex is equal to its MCLG of 0.05 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 7×10^{-3} mg/kg/day

UF: 100 (10 = intraspecies; 10 = interspecies) **MF:** 1

Critical Effects: The RfD is based on a two-year dog feeding study from which a NOAEL of 0.75 mg/kg/day in the diet was reported (Mullison, 1966; Gehring and Betso, 1978). Histopathological changes in the liver were noted at higher doses.

Cancer Assessment: D

Human data are not available and the available animal cancer bioassay studies are considered to be inadequate. Thus, U.S. EPA has determined that silvex is non-classifiable as to human carcinogenicity.

Class: Phenoxy Pesticide

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA 515.1; Electron capture/GC

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Gehring, P.J. and J.E. Betso. 1978. Phenoxy acids: Effects and fate in mammals. In: Chlorinated Phenoxy Acids and Their Dioxins. v. 27c. Ramuel Ed. Ecol. Bill. Stockholm. P. 122-133.

Mullison, W.R. 1966. Some toxicological aspects to silvex. In: 19th Ann. Meet., Southern Weed Science Society. Raleigh, NC. p. 420-435.

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DICHLOROPHENOXYACETIC ACID (2,4-D)	CASRN: 94757	Update: November 1993

Current Massachusetts Regulatory Limit: MMCL: 0.07 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule (56 FR 3526; 1/30/91).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.07 mg/kg/day.

Basis for Criteria: The MCLG is based on liver and kidney effects seen in test animals. The MCLG of 0.07 mg/L is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. The MCLG incorporates a relative source contribution factor of 0.2.

RfD: 1×10^{-2} mg/kg/day

UF: 100 (10 = intraspecies; 10 = interspecies) **MF:** 1

Critical Effects: The RfD is based on the results of a 90 day rat oral bioassay. (Dow 1983) In this study, hematological, hepatic and renal toxicity were demonstrated. 2,4-D was fed to rats at doses of 0, 1, 5, 15 or 45 mg/kg/day. A NOAEL of 1 mg/kg/day was identified from this study.

Cancer Assessment: 2,4-D has been classified in U.S. EPA's Group D for carcinogenicity, based upon inadequate data from animal studies.

Class: Phenoxy herbicide

Analytical Information:

Analytical Methods: 515.1 GC/ECD

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Dow Chemical Company. 1983. Accession No. 251473. Available from U.S. EPA. Write to FOI, U.S. EPA, Washington, D.C..

Federal Register. July 1, 1991. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Monitoring for Volatile Organic Chemicals; MCLGs and MCLs for Aldicarb, Aldicarb Sulfoxide, Aldicarb Sulfone, Pentachlorophenol, and Barium; Final Rule. (56 FR 30266).

Supporting Documentation for Drinking Water Standards and Guidelines

ACETONE	CASRN: 67641	Update: May 2004

Current Massachusetts Regulatory Limit: ORSGL = 6.3 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for tetrahydrofuran.

Basis for Criteria: The ORSGL is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 9×10^{-1} mg/kg/day

UF: 1000 (10 = intraspecies; 3 = interspecies; 3 = subchronic to chronic;

10 = database deficiency)

MF: 1

Critical Effects: The RfD is based on a 13-week rat study by Dietz *et al.* (1991) in which male and female F344/N rats and B6C3F1 mice were exposed to acetone in their drinking water for 13 weeks at concentrations of 0, 2,500, 5,000, 10,000, 20,000 or 50,000 ppm. Male rats were the most sensitive group with the kidney, hematologic system and testes identified as target organs. Effects noted at 1700 mg/kg/day included mild nephropathy, macrocytic anemia and a depressed regenerative response. Effects noted at 3400 mg/kg/day included depressed sperm motility, caudal and epididymal weights and an increased incidence of abnormal sperm. A NOAEL of 900 mg/kg/day was identified based on mild nephropathy in male rats (converted from the concentration of 10,000 ppm for a male rat).

Cancer Assessment: Data are inadequate for assessment of human carcinogenic potential.

Acetone is currently classified as a group D carcinogen based on a lack of adequate carcinogenicity data in animals and humans. Acetone has been negative in several mutagenicity assays.

Class: VOC

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Analytical Information:

PQL: 10 µg/L

Analytical Methods: 502.1; GC
524.2; GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Dietz, D.D., Leininger, J.R., Rauckman, E.J., Thompson, M.B., Chapin, R.E. Morrissey, R.L. and Levine, B.S. 1991. Toxicity studies of acetone administered in the drinking water of rodents. Fund. Appl. Toxicol. 17:347-360.

NTP (National Toxicology Program). 1991. Toxicity studies of acetone (CAS No. 67-64-1) in F344/N rats and B6C3F1 mice (drinking water studies). NTP, Research Triangle Park, NC. NTP TOX 3, NIH Publication No. 91-3122.

U.S. EPA (U.S. Environmental Protection Agency). 2004. Integrated Risk Information System (IRIS). Web-based database.

Supporting Documentation for Drinking Water Standards and Guidelines

ACRYLAMIDE	CASRN: 79061	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL: Treatment Technique.
ORS has adopted the MCL published by U.S. EPA under the Phase II rule.

Federal Regulatory Limit: Under the Phase II rule (56 FR 3526), no numerical MCL is provided for acrylamide and epichlorohydrin. If detected, a treatment technique is specified. Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:

- Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)
- Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

Basis for Criteria: The MCLG for acrylamide is zero based on its classification as a B-2 Carcinogen. The MCL is based on treatment technique. There are no standardized analytical methods for acrylamide at low levels in drinking water.

Critical Effects: Nerve damage. The RfD is based on NOAEL of 0.2 mg/kg/day derived from a subchronic drinking water study in rats. (Burek *et al*., 1980).

Cancer Assessment: B2
The cancer assessment is based on a study by Johnson *et al*. (1986) where the authors reported an increase in the incidence of actual cancers, mammillary gland tumors, thyroid tumors, uterine adenomas, clitoral gland adenomas and oral papillomas.

Class: VOC

Analytical Information:

Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

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Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Burek, J.D., R.R. Albee, J.E. Beyer, *et al*. 1980. Subchronic toxicity of acrylamide administered to rats in the drinking water followed by up to 144 days of recovery. J. Environ. Pathol. Toxicol. 4:157-182.

Federal Register. January 30, 1991. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Proposed Rule. (56 FR 3526).

Johnson, K., S. Gazinski, K. Bodnur *et al*. 1986. Chronic toxicity and oncogenicity study on acrylamide incorporated in the drinking water of Fisher 344 rats. Toxicol. Appl. Pharmacol. 85:154-168.

Supporting Documentation for Drinking Water Standards and Guidelines

ALACHLOR	CASRN: 15972608	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.002 mg/L. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for alachlor is set at the PQL of 0.002 mg/L. **FINAL** 56 FR 3526 (1/30/91). The MCLG is set at zero (50 FR 46936 (11/13/85)).

Basis for Criteria: The MCL for alachlor is set as close to the MCLG as possible, considering the ability of public water systems to detect and remove contaminants using suitable treatment technologies.

Critical Effects: An MCLG for alachlor is set at zero based on carcinogenic effects. Alachlor feeding studies have produced carcinogenic effects, including lung tumors in mice, and stomach, thyroid, and nasal turbinate tumors in rats (50 FR 46936 (11/13/85)).

Cancer Assessment: B2
The cancer risk assessment is currently under review by an U.S. EPA workgroup. Drinking water concentration at 1 x 10^{-4} cancer risk = 0.04 mg/l (54 FR 22062 (5/22/89)).

Class: Organochlorine Pesticide

Analytical Information:

PQL: The PQL used as the basis for the MCL is 0.002 mg/L.

Analytical Methods: U.S. EPA 505, 507 and 525

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of

drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. 40 CFR Part 141. National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. 40 CFR parts 141, 142 and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Monsanto Company. 1984. MRID No. 00148923. This document is available from EPA.

Supporting Documentation for Drinking Water Standards and Guidelines

ALDICARB	CASRN: 116063	Update: March 1996

Current Massachusetts Regulatory Limit: The ORSGL = 0.003 mg/L. ORS has adopted the MCL for aldicarb originally published by the U.S. EPA under the Phase II Rule (56 FR 30266) as an ORSGL.

Federal Regulatory Limit: The MCL for aldicarb was set at the PQL of 0.003 mg/L. Although U.S. EPA considers aldicarb a regulated contaminant, its MCL has been stayed, meaning that the effective date for these standards was postponed (57 FR 22178). Currently, there is no new effective date for these regulations.

Basis for Criteria: U.S. EPA considered several factors in determining an MCL for aldicarb, including: 1) the effectiveness of the best available technology (BAT) (granulated active charcoal) in removing aldicarb to levels at or below the proposed MCL of 0.003 mg/L; 2) the feasibility (including costs) of applying BAT for large systems; and 3) the PQL. U.S. EPA concluded by setting the MCL for aldicarb at the PQL of 0.003 mg/L, which it considers the lowest level feasible.

Critical Effects: The principal toxic effect of aldicarb and its sulfoxide and sulfone metabolites is cholinesterase inhibition as measured in plasma, erythrocyte and brain (50 FR 46936).

Cancer Assessment: D

Aldicarb has been identified in U.S. EPA's Group D, based upon inadequate human evidence of carcinogenicity.

Class: Pesticide

Analytical Information:

PQL: 0.003 mg/L

Analytical Methods: 531.1; Derivitization GC

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Proposed Rule. (56 FR 3526).

Federal Register. July 1, 1991. Part XII. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 30266).

Federal Register. May 27, 1992. Drinking Water; National Primary Drinking Water Regulations: Aldicarb, Aldicarb Sulfoxide, and Aldicarb Sulfone. (57 FR 22178).

Rhone-Poulenc Ag Company. 1992. A safety and tolerability study of aldicarb at various dose levels in healthy, female and male volunteers. Inversek Clinical Research Report No. 7786. MRID No. 423730-01; HED Doc. No. 0010459. Available from U.S. EPA.

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ALDICARB SULFONE	CASRN: 1646884	Update: March 1996

Current Massachusetts Regulatory Limit: The ORSGL = 0.002 mg/L. ORS has adopted the MCL for aldicarb sulfone originally published by the U.S. EPA under the Phase II Rule (56 FR 3526; 56 FR 30266) as an ORSGL.

Federal Regulatory Limit: The MCL for aldicarb sulfone was set at the PQL of 0.002 mg/L. Although U.S. EPA considers aldicarb sulfone a regulated contaminant, its MCL has been stayed, meaning that the effective date for these standards was postponed (57 FR 22178). Currently, there is no new effective date for these regulations.

Basis for Criteria: U.S. EPA considered several factors in determining an MCL for aldicarb sulfone, including: 1) the effectiveness of the best available technology (BAT) (granulated active charcoal) in removing aldicarb sulfone to levels at or below the proposed MCL of 0.002 mg/L; 2) the feasibility (including costs) of applying BAT for large systems; and 3) the PQL. U.S. EPA concluded by setting the MCL for aldicarb sulfone at the PQL of 0.002 mg/L, which it considers the lowest level feasible.

Critical Effects: The principal toxic effect of aldicarb and its sulfoxide and sulfone metabolites is cholinesterase inhibition as measured in plasma, erythrocyte and brain (50 FR 46936).

Cancer Assessment: D

Aldicarb sulfone has been identified in U.S. EPA's Group D, based upon inadequate human evidence of carcinogenicity.

Class: Pesticide

Analytical Information:

PQL: 0.002 mg/L

Analytical Methods: 531.1; HPLC post-column derivitization

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Proposed Rule. (56 FR 3600).

Federal Register. July 1, 1991. Part XII. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 30266).

Federal Register. May 27, 1992. Drinking Water; National Primary Drinking Water Regulations: Aldicarb, Aldicarb Sulfoxide, and Aldicarb Sulfone. (57 FR 22178).

Union Carbide Agricultural Products Company. 1987. MRID No. 40259901. Available from U.S. EPA. Write to: FOI, EPA, Washington, DC 20460.

Supporting Documentation for Drinking Water Standards and Guidelines

ALDICARB SULFOXIDE	CASRN: 1646873	Update: March 1993

Current Massachusetts Regulatory Limit: The ORSGL = 0.004 mg/L. ORS has adopted the MCL for aldicarb sulfoxide originally published by the U.S. EPA under the Phase II Rule (56 FR 3526; 56 FR 30266) as an ORSGL.

Federal Regulatory Limit: The MCL for aldicarb sulfoxide is set at the PQL of 0.002 mg/L. Although U.S. EPA considers aldicarb sulfoxide a regulated contaminant, its MCL has been stayed, meaning that the effective date for these standards was postponed (57 FR 22178). Currently, there is no new effective date for these regulations.

Basis for Criteria: U.S. EPA considered several factors in determining an MCL for aldicarb sulfoxide, including: 1) the effectiveness of the best available technology (BAT) (granulated active charcoal) in removing aldicarb sulfoxide to levels at or below the proposed MCL of 0.002 mg/L; 2) the feasibility (including costs) of applying BAT for large systems; and 3) the PQL. U.S. EPA concluded by setting the MCL for aldicarb sulfoxide at the PQL of 0.002 mg/L, which it considers the lowest level feasible.

Critical Effects: The principal toxic effect of aldicarb and its sulfoxide and sulfone metabolites is cholinesterase inhibition as measured in plasma, erythrocyte and brain (50 FR 46936).

Cancer Assessment: D

Aldicarb sulfoxide has been identified in U.S. EPA's Group D, based upon inadequate human evidence of carcinogenicity.

Class: Pesticide

Analytical Information:

PQL: 0.004 mg/L

Analytical Methods: 508 GC-ECD

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Proposed Rule. (56 FR 3600).

Federal Register. July 1, 1991. Part XII. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 30266).

Federal Register. May 27, 1992. Drinking Water; National Primary Drinking Water Regulations: Aldicarb, Aldicarb Sulfoxide, and Aldicarb Sulfone. (57 FR 22178).

Union Carbide Agricultural Products Company. 1987. MRID No. 40259901. Available from U.S. EPA. Write to: FOI, U.S. EPA, Washington, DC 20460.

Supporting Documentation for Drinking Water Standards and Guidelines

ANTIMONY	CASRN: 7440360	Update: 8/93

Current Massachusetts Regulatory Limit: MMCL = 0.006 mg/L. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.006 mg/L. (57 FR 31776 (7-17-92)).

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. The MCLG assumes a relative source contribution factor of 40%.

RfD: 4×10^{-4} mg/kg/day

UF: 1000 (10 = intraspecies; 10 = interspecies; 10 = LOAEL to NOAEL)
MF: 1 **Confidence in RfD:** Low

The MCL has also been set at 6 ppb because U.S. EPA believes, given present technology and resources, this is the lowest level to which water systems can reasonably be required to remove this contaminant should it occur in drinking water.

Critical Effects: In a lifetime oral exposure study in rats, antimony produced decreased longevity, changes in blood cholesterol and glucose levels. A LOAEL of 0.43 mg/kg/day was identified from this study (Schroeder et. al., 1970) (55 FR 30370 (7-25-90).

Cancer Assessment: D

Class: Heavy metal

Analytical Information:

Analytical Methods: U.S. EPA Methods: 200.8 (ICP-MS); 200.9 (AA)
ASTM: D3697-92
Standard Methods: 3113B

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370).

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule.

Schroeder, H.A., M. Mitchner and A.P. Nasor. 1970. Zirconium, Niobium, Antimony, Vanadium and lead in rats: Life term Studies J. Nutr. 100 59-68.

Supporting Documentation for Drinking Water Standards and Guidelines

ARSENIC (INORGANIC)	CASRN: 7440382	February 2006

Current Massachusetts Regulatory Limit: MMCL = 0.010 mg/L. ORS has adopted the MCL published by U.S. EPA.

Federal Regulatory Limit: The U.S. EPA conducted an extensive reevaluation of arsenic and published its results in the January 22, 2001 Federal Register (Volume 66, Number 14). The MCLG is equal to zero based on the fact that arsenic is a carcinogen. A proposed revised MCL was identified using the Agency's benefit/cost provisions of the Safe Drinking Water Act (SDWA). U.S. EPA proposed 0.003 mg/L as the feasible MCL, after considering treatment costs and efficiency under field conditions as well as considering the appropriate analytical methods. U.S. EPA determined that the benefits of regulating arsenic at the feasible level would not justify the costs. The promulgated MCL of 0.010 mg/L (based on the discussion below) went into effect on January 23, 2006.

Basis for Criteria: The promulgated MCL of 0.010 mg/L was derived based on the RfD presented below and assuming a 70 kg adult drinks 2 L water per day.

RfD oral = 3×10^{-4} mg/kg/day (U.S EPA 02/01/93)

UF: 3 (for the uncertainty as to whether the NOAEL accounts for all sensitive individuals and to preclude reproductive toxicity as a critical effect)

MF: 1

Oral Cancer Potency Factor = 1.5 $(mg/kg/day)^{-1}$

Critical Effects: Hyper-pigmentation, keratosis and possible vascular effects were reported. The RfD is based on an adjusted NOAEL of 0.0008 mg/kg/d derived from a chronic exposure study done in humans (Tseng *et al.*, 1968).

Cancer Assessment: Carcinogenic to Humans/A
The cancer classification is based on observations of increased lung cancer mortality in multiple human populations exposed primarily via inhalation and also increased skin cancer incidence from ingestion in several human populations comparing drinking water with high levels of arsenic (Tseng, 1977).

Class: Heavy metal

Analytical Information:

PQL: The PQL considered in setting the MCL is 0.003 mg/L.

Analytical Methods: 206.2 AA – Furnace
206.3 AA – Gaseous Hydride
ASTMD -2972-78 B " "
200.9 ICP

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 22, 2001. Part VIII. Environmental Protection Agency. 40 CFR Parts 9, 141 and 142. National Primary Drinking Water Regulations; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring; Final Rule. (66 FR 6976).

Tseng, W.P., H.M. Chu, S.W. How, J.M. Fong, C.S. Lin and S. Weh. 1968. Prevalence of Skin Cancer in an endemic area of chronic arsenism in Taiwan. J. Natl. Cancer Inst. 40(3):453-463.

Tseng, W.P. 1977. Effects and dose response relationships of skin cancer and Blackfoot disease with arsenic. Environ. Health Perspect. 10:109-119.

U.S. EPA (U.S. Environmental Protection Agency). February 1, 1993. Integrated Risk information System (IRIA). U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

ASBESTOS	CASRN: 1332214	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 7 million fibers per liter. ORS has adopted the MCL published by U.S. EPA under the Phase II rule. (56 FR 3526; 1-30-91).

Federal Regulatory Limit: The MCL is 7 million fibers per liter based on its potential to produce cancer.

Basis for Criteria: The MCL is based on the observation that benign polyps in male rats were statistically elevated from controls when the animals were exposed to fibers greater than ten (10) microns. The Science Advisory Board found it difficult to dismiss the possibility of increased gastric tumors given historical inhalation data and the rat ingestion data. There are insufficient data upon which to base a non-cancer risk assessment.

Critical Effects: Increased cancer rates

Cancer Assessment: A

Observations of increased mortality and incidence of lung cancer, mesotheliomas and gastrointestinal cancer in occupationally exposed individuals.

Animal studies by inhalation in two strains of rats showed similar findings for lung cancer and mesotheliomas. Animal evidence for carcinogenicity via ingestion is limited (male rats fed intermediate range chrysotile fibers, i.e. > 10 um length, developed benign polyps), and epidemiological data in this regard are inadequate. (Unit risk for Inhalation: 2.3×10^{-1} per (fibers/ml).)

Asbestos drinking water concentration at an Excess Lifetime Cancer Risk (ELCR) of:

- 1×10^{-4} = 700 million fibers per liter
- 1×10^{-5} = 70 million fibers per liter
- 1×10^{-6} = 7 million fibers per liter

Class: Inorganic

Analytical Information:

Analytical Method: TEM (transmission electron microcopy)

Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Elmes, P.C. and M.J. Simpson. 1971. Insulation workers in Belfast. III. Mortality 1940-AGG. Br. J. Ind. Med. 28:226-236.

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526)

Selikoff, I.J. 1976. Lung cancer and mesothelioma during prospective surveillance of 1249 asbestos insulation workers, 1963-1974. Ann. N.Y. Acad. Sci. 271:448-456.

Supporting Documentation for Drinking Water Standards and Guidelines

ATRAZINE	CASRN: 1912249	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.003 mg/L. ORS has adopted the MCL published by the U.S. EPA under the Phase II rule. (56 FR 3526; 1-30-91)

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.003 mg/L.

Basis for Criteria: The MCLG is based on its potential for adverse health effects (liver and kidney damage) reported in dog and rat studies (Ciba-Geigy, 1987). The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. The MCLG assumes a drinking water contribution of 20% and incorporates a 10-fold uncertainty factor to account for potential carcinogenicity (Fed. Reg., 1991).

RfD = 5 x 10^{-3} mg/kg/day

UF = 100 (10 – intraspecies; 10 = interspecies); **MF** = 1

This RfD was developed based on a one-year feeding study in dogs. A NOAEL of 0.48 mg/kg/day was identified from this study.

Critical Effects: A 1-year feeding study in dogs (CIBA-Geigy, 1987) indicated discrete myocardial degeneration at the highest dose and several findings at the middle dose suggestive of a trend toward the development of cardiac pathology.

Cancer Assessment: The U.S. EPA has classified atrazine as a Group C carcinogen (Fed. Reg., 1991). A risk assessment is currently underway through the U.S. EPA for this chemical.

Class: Pesticide

Analytical Information:

Analytical Methods: 505; Microextraction GC
507 - GC
525; GCMS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Ciba-Geigy Corporation, Agricultural Division. 1987. MRID No. 00141874, 0057875, 00158930, 40629302. HED Doc. No. 005940, 006937. Available from U.S. EPA. Write to: FOI, U.S. EPA, Washington, DC 20460.

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526)

U.S. Environmental Protection Agency. 1993. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

BARIUM	CASRN: 7440393	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 2 mg/L. ORS has adopted the MCL that U.S. EPA promulgated as part of the Phase II Rule.

Federal Regulatory Limit: The MCL of 2 mg/L is equal to the MCLG (Fed. Reg. 1991a, 1991b, 1991c).

Basis for Criteria: The MCLG is based on the RfD (presented below) derived from the Wones *et al*., study. It assumes that a 70 kg adult ingests 2 L/day of water. Since this value is based on a human study that considers contributions from food and air, no relative source contribution was applied for drinking water exposures.

RfD: 7×10^{-2} mg/kg/day

UF: 3 **MF:** 1 **Confidence in RfD:** Medium

The MCLG is based on a NOAEL of 7.5 mg/L identified from the Wones *et al*., 1990 study in humans (Fed. Reg. 1991c).

Critical Effects: The critical effect is increased blood pressure in human subjects. The RfD is based on an adjusted NOAEL of 0.21 mg/kg/d derived from a subchronic drinking water study in humans (Wones *et al*., 1990).

Cancer Assessment: D
There is currently no cancer assessment for barium.

Class: Heavy metal

Analytical Information:

Analytical Methods: 208.2 GF AA
200.7A ICP

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 30, 1991a. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Federal Register. January 30, 1991b. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Proposed Rule. (56 FR 3600).

Federal Register. July 1, 1991c. Part XII. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 30266).

Wones, R.G., B.L. Stapler and L.P. Frohman. 1990. Lack of Effect of Drinking Water Barium on Cardiovascular Risk Factor. Environ. Health Perspect. 85: 1-13.

Supporting Documentation for Drinking Water Standards and Guidelines

BENZENE	CASRN: 71432	Update: August 1993
Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by U.S. EPA in the Phase I rule. (52 FR 25690; 7/8/87)		
Federal Regulatory Limit: The MCL for benzene is based on its detection limit of 0.005 mg/L. The MCLG is equal to zero.		
Basis for Criteria: An MCLG of zero is assigned for benzene based on the evidence for carcinogenic potential. The MCL is based on the benzene PQL.		
Critical Effects: In humans, exposure to benzene is associated with myelocytic anemia, thrombocytopenia and leukemia. In animals, an increase in tumors and leukemia have been reported.		
Cancer Assessment: Benzene is currently classified as a group A, human carcinogen. Slope factor = 2.9×10^{-2} $(mg/kg/day)^{-1}$ from the one-hit model.		
Class: VOC		
Analytical Information: **PQL:** The PQL used as the basis for the MCL is 0.005 mg/l . **Analytical Methods:** 502.1, 502.2, 503.1, 524.1, 524.2 PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.		

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Aksoy, M., S. Erdem and E.G. Dincol. 1974. Leukemia in shoeworkers exposed to benzene. Mood. 44(6): 837-841.

Federal Register. July 8, 1987. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations-Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25690).

IARC (International Agency for Research on Cancer). 1982. Benzene. In: Some industrial chemicals and dye stuffs. IARC Monographs on the evaluation of carcinogenic risk of chemicals to humans. IARC. WHO. Lyn Frand. 29:93-148.

Supporting Documentation for Drinking Water Standards and Guidelines

BENZO[A]PYRENE	CASRN: 50328	August 1993

Current Massachusetts Regulatory Limit: : MMCL = 0.0002 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL for benzo(a)pyrene is based on its detection limit of 0.0002 mg/L. The MCLG is zero.

Basis for Criteria: The MCLG is zero based on its classification as a B2 carcinogen. The MCL is set at the PQL of 0.0002 mg/L.

Critical Effects: Acute exposure to benzo[a]pyrene for relatively short periods of time at levels above the MCL may cause red blood cell damage, leading to anemia and a suppressed immune system. Upon longer-term exposure to levels above the MCL, benzo[a]pyrene may cause developmental and reproductive effects and cancer.

Cancer Assessment: Forestomach tumors, squamous cell papillomas and carcinomas were produced in CFW mice exposed to benzo[a]pyrene in the diet.

Benzo[a]pyrene has been classified as a B2 (probable) human carcinogen via the older U.S. EPA cancer classification system. Under U.S. EPA's Proposed Guidelines for Carcinogen Risk Assessment (U.S. EPA, 1999), this classification would correspond to the descriptor "likely to be carcinogenic to humans".

U.S. EPA developed an oral cancer slope factor for benzo[a]pyrene of 5.76 $(mg/kg/day)^{-1}$.

Class: Polycyclic aromatic hydrocarbon (PAH)

Analytical Information:

PQL: The PQL used as the basis for the MCL is 0.0002 mg/L.

Analytical Methods: U.S. EPA Methods 525.1; 550; 550.1

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

U.S. EPA. (Last updated 4/27/04). Consumer Factsheet on: Benzo[a]pyrene. Office of Groundwater and Drinking Water.

U.S. EPA. (Last updated 11/26/02). Technical Factsheet on: Benzo[a]pyrene. Office of Groundwater and Drinking Water.

U.S. EPA. (Last updated 11/18/04). Benzo[a]pyrene, (CASRN: 50-32-8). Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

U.S. EPA (U.S. Environmental Protection Agency). July 1999. Guidelines for Carcinogen Risk Assessment. Review Draft. NCEA-F-0644. Risk Assessment Forum.

Documentation was rewritten for clarification on 12/1/04. The data reflect information available during the period the criteria was last updated.

Supporting Documentation for Drinking Water Standards and Guidelines

BERYLLIUM	CASRN: 7440417	Update: January 1995

Current Massachusetts Regulatory Limit: MMCL = 0.004 mg/L. ORS has adopted the MCL published by U.S. EPA under the Phase II rule (55FR 30370; 7-25-90).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.004 mg/L. (Fed Reg., 1992).

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. The MCLG incorporates a relative source contribution factor of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity.

RfD: $5x10^{-3}$ mg/kg/day

UF: 100 (10 = interspecies; 10 = intraspecies) **M.F.:** 1

Critical Effects: The RfD is based on an adjusted NOAEL of 0.54 mg/kg/day derived from a chronic oral bioassay in rats. In this study, rats received beryllium in their drinking water over a lifetime. The only significant change noted in the study was a slight reduction in body weight in males from 2 to 6 months of age.

Cancer Assessment: B2

Beryllium has been shown to be carcinogenic in laboratory animals via inhalation, intratracheal instillation or intravenous injection. Only limited information is available on long-term oral exposure to beryllium. U.S. EPA derived an oral slope factor of 4.3 $(mg/kg/day)^{-1}$ for beryllium. The drinking water concentration of beryllium at 1 x 10^{-4} cancer risk = 0.0008 mg/L.

Class: metal

Analytical Information:

Analytical Methods: 200.7 ICP
200.8 ICP/MS
210.2 AA Furnace

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Schroeder, H.A., and M. Mitchener. 1975. Lifeterm Studies in Rats: Effects of Aluminum, Barium, Beryllium and Tungsten. J. Nutr. 165: 421-427.

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Supporting Documentation for Drinking Water Standards and Guidelines

BETA PARTICLES AND PHOTON RADIOACTIVITY	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: The MMCL = the concentration which produces an annual dose of 4 millirem/year. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: : The MCL for beta particles and photon emitters is a concentration which produces an annual dose of 4 millirem (mrem) effective dose equivalent (ede) per year (i.e., 4 mrem-ede) (65 FR 76708).

There is no MCLG for beta particles and photon emitters since MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act.

Basis for Criteria: U.S. EPA has retained the original MCL and methodology for deriving concentration limits for individual beta particles and photon emitters developed when the radionuclides rule was first promulgated in 1976. Appendix B of 56 FR 33050 lists the concentrations in pCi/L that correspond to 4 mrem-ede for each beta emitter, assuming lifetime intake of 2 L/day of drinking water. Based on the latest dosimetry model, as contained in U.S. EPA's Federal Guidance Report-13, the newest risk estimates for the beta emitter concentration limits fall within the U.S. EPA's target excess lifetime cancer risk (ELCR) range for drinking water contaminants of $10^{4} – 10^{-6}$ (while some are slightly above and some are slightly below, all round to values within these orders of magnitude) (56 FR 33050).

Critical Effects: A number of human epidemiological studies indicate increasing risks of various types of cancer associated with increasing doses of ionizing radiation. The most notable of these studies pertain to the Japanese atomic bomb survivors. These results are supported by animal toxicological results (56 FR 33050).

Cancer Assessment: A

Beta particles and photon emitters are ionizing radiation that decays primarily by electron and photon emissions. U.S. EPA has classified ionizing radiation as a Group A human carcinogen.

Class: Radionuclide

Analytical Information:

PQL: 4 pCi/L

Analytical Methods: U.S. EPA 900.0
00-01
SM 302
7110 B
USGS 1120-76

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. December 7, 2000. Part II. Environmental Protection Agency. Parts 9, 141, and 142. National Primary Drinking Water Regulations; Radionuclides; Final Rule. (65 FR 76708).

Federal Register. April 21, 2000. Part IV. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Radionuclides; Notice of Data Availability; Proposed Rule. (65 FR 21576).

Federal Register. July 18, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Radionuclides; Proposed Rule. (56 FR 33050).

U.S. Environmental Protection Agency. September 1999. Cancer Risk Coefficients for Environmental Exposure to Radionuclides. Federal Guidance Report No. 13. Air and Radiation. U.S. EPA-402-R-99-001.

Supporting Documentation for Drinking Water Standards and Guidelines

BROMATE	CASRN: 7789380	Update: May 2004
Current Massachusetts Regulatory Limit: MMCL = 0.010 mg/L. ORS has adopted the MCL adopted by U.S. EPA under the Disinfectants and Disinfection Byproducts Rule (Fed/ Reg. 1998).		
Federal Regulatory Limit: The MCL for bromate was set at its detection limit of 0.010 mg/L. The MCLG for bromate is zero (Fed. Reg., 1998).		
Basis for Criteria: Bromate is one of the principal byproducts of ozonation in bromide-containing source waters and is addressed under the EPA's Disinfectants and Disinfection Byproducts Rule. Bromate is likely to be carcinogenic in humans. An MCLG of zero is assigned for bromate based on carcinogenic effects. The MCL is based on the bromate PQL.		
Critical Effects: Potassium bromate was fed to male F344/N rats at dose levels of 0, 1.1, 6.1, 12.9, and 28.7 mg BrO_3^-/kg-day and to B6C3F1 mice at dose levels of 0, 6.9, 32.5, and 59.6 mg BrO_3^-/kg-day. The Maximum Tolerated Dose was reached in the rat study. Statistically significant increases occurred in absolute liver weight, relative and absolute kidney and thyroid weight, and relative spleen weight. A significant dose-dependent increase in the incidence of urothelial hyperplasia in rats was seen in dose groups of 6.1 mg/kg-day and higher. Other effects noted in rats included foci of mineralization of the renal papilla and eosinophilic droplets in the proximal tubule epithelium. A NOAEL of 1.1 mg BrO_3^-/kg-day and a LOAEL of 6.1 mg BrO_3^-/kg-day were identified from this study. No effects other than a statistically increased drinking water consumption rate at the highest dose was observed in the mouse study. A NOAEL of 59.6 mg BrO_3^-/kg-day is the freestanding NOAEL in mice (DeAngelo *et al*.,1998).		
Cancer Assessment: Likely To Be Carcinogenic to Humans/B2 Oral cancer risk was calculated based on the incidence of renal tubular tumors, thyroid follicular tumors, and testicular mesotheliomas from the DeAngelo *et al*. (1998) study. **Oral Cancer Potency Factor** = 7×10^{-1} $(mg/kg/day)^{-1}$ (U.S. EPA, 2001)		
Class: inorganic ion		

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Analytical Information:

PQL: The PQL used as the basis for the MCL is 0.010 mg/L.

Analytical Methods: U.S. EPA Method 300.1

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

DeAngelo, A.B., George, M.H., Kilburn, S.R. *et al*. 1998. Carcinogenicity of potassium bromate administered in the drinking water to male B6C3F1 mice and F344/N rats. Toxicol Pathol 26(5):587-594.

Federal Register. December 16, 1998. Part IV. Environmental Protection Agency. 40 CFR Parts 9, 141, and 142. National Primary Drinking Water Regulations; Disinfectants and Disinfection Byproducts; Final Rule. (63 FR 69390).

U.S. EPA. June 6, 2001. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov.ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

BROMOMETHANE	CASRN: 74839	Update: August 1993

Current Massachusetts Regulatory Limit: ORSGL = 0.01 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for bromomethane.

Basis for Criteria: The ORSGL is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value (U.S. EPA, 1991).

RfD: 1.4×10^{-3} mg/kg/day

UF: 1000 (10 = intraspecies; 10 = interspecies; 10 = subchronic to chronic)

MF: 1 **Confidence in RfD:** Medium

Critical Effects: The RfD is based on results from a subchronic gavage study in rats (Danse *et al* 1984). Groups of 10 male and 10 female Wistar rats were treated by gavage 5 days/week for 13 weeks to doses of 0, 0.4, 2, 10 or 50 mg/kg/day. Severe hyperplasia of the stratified squamous epithelium of the forestomach was reported. A NOAEL of 2.0 mg/kg/day was identified from this study and used to develop the RfD. The NOAEL was adjusted to 1.4 mg/kg/day by extrapolating to a 7-day/week exposure from a 5-day per week exposure (i.e., by multiplying the dose by 5/7).

Cancer Assessment: D

Bromomethane has been identified in U.S. EPA's Group D based on inadequate human evidence of carcinogenicity.

Class: VOC

Analytical Information:

PQL: 0.5 µg/L

Analytical Methods: U.S. EPA 502.1, 502.2, 502.3, GC
U.S. EPA 524.1, 524.2, GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Danse, L.H., F.L. Von Vehran and C.A. Van der Heijden. 1984. Methylbromide carcinogenic effects in the rat forestomach. Toxicol. Appl. Pharmacol. 72:262-271.

U.S. EPA (U.S. Environmental Protection Agency). April 10, 1991. Integrated Risk Information System (IRIS). Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

CADMIUM	CASRN: 7440439	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule.

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.005 mg/L (56 FR 3526) (Fed. Reg., 1991).

Basis for Criteria: The MCLG is based on reports of renal toxicity in humans, specifically proteinuria (U.S. EPA 1985). The MCLG was derived from the DWEL of 0.018 mg/L which is based on an RfD of 5×10^{-4} and assumes that a 70 kg adult drinks 2 L/day of water. The MCLG incorporates a relative source contribution factor of 25% (U.S. EPA, 1987).

RfD 5×10^{-4} mg/kg/day

UF: 10 (intraspecies) **MF:** 1

Critical Effects: In human studies involving chronic exposure, significant proteinuria was noted at a concentration of 200 μg cadmium per gram of wet renal cortex (USEPA 1985). Using a toxicokinetic model, a value of 0.352 mg/day was calculated as a reasonable estimate of the daily cadmium intake that would result in renal dysfunction. For a 70 kg adult ingesting 2 L/day of water, this translates to a dose of 0.005 mg/kg/day. The RfD was calculated assuming an uncertainty factor of 10 for intraspecies toxicity. Although the use of a LOAEL as a basis would normally require application of an additional uncertainty factor of 10, given the relatively low level of uncertainty regarding cadmium toxicity, the EPA decided that a total uncertainty factor of 100 would be too high in this case and that a total of 10 would be more appropriate (U.S. EPA, 1987).

Cancer Assessment: B1 (inhalation) / D (oral)

There is limited evidence of carcinogenicity from occupational epidemiological studies. There is sufficient evidence of carcinogenicity in rats and mice by inhalation and intramuscular and subcutaneous injection. There is no evidence that cadmium is carcinogenic by the oral routes in rodents.

Class: Heavy metal

Analytical Information:

Analytical Methods: 200.7 ICP
213.2; AA Furnace

PQLs and analytical methods may have been updated since this guidance value was last

revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

U.S. EPA. 1985. Drinking Water Criteria Document on Cadmium. Office of Drinking Water, Washington, D.C. (Final Draft).

U.S. EPA . March 31, 1987. Cadmium. Health Advisory Draft. Office of Drinking Water.

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

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CARBOFURAN	CASRN: 1563662	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.04 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule (56 FR 3526) (Fed. Reg. 1991).

Current Federal Regulatory Limit: The MCL is equal to the MCLG of 0.04 mg/L.

Basis for Criteria: The MCLG is based on the potential for adverse health effects reported in a 2 year dietary study in rats. The MCLG was derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. The MCLG incorporates a relative source contribution factor for drinking water of 20%.

RfD: 5×10^{-3} mg/kg/day

UF: 100 (10 – interspecies; 10 – intraspecies) **MF:** 1
Confidence in RfD: high

Critical Effects: Decreased plasma and RBC acetylcholinesterase and testicular seminiferous tubule degeneration were reported in beagle dogs that were fed carbofuran at up to 12.5 mg/kg/day for one year. A NOAEL of 0.5 mg/kg/day was identified from the study.

Cancer Assessment: Carbofuran is currently classified as a Group E (i.e., no evidence of carcinogenicity).

Class: carbamate pesticide

Analytical Information:

Analytical Methods: 531.1; Derivitization-GC

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

FMC Corporation. 1983. MRID No. 00129507. Available from U.S. EPA. Write to FOI, U.S. EPA, Washington, DC 20460.

Supporting Documentation for Drinking Water Standards and Guidelines

CARBON TETRACHLORIDE	CASRN: 56235	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL is based on the 1987 PQL. The MCLG is equal to zero (Fed. Reg. 1987; Fed. Reg. 1991).

Basis for Criteria: The MCLG of zero is based on carcinogenic effects reported in animals. Carbon tetrachloride has been shown to be carcinogenic in rats, mice and hamsters through oral exposure. Hepatocellular carcinomas in several study groups have been observed.

Critical Effects: Liver lesions. The RfD is based on an adjusted NOAEL of 0.71 mg/kg/day derived from a subchronic gavage study in rats (Bruckner *et al*., 1986).

Cancer Assessment: The classification of carbon tetrachloride as a possible human carcinogen is based on evidence in rats, mice and hamsters. Slope factor: 1.3×10^{-1} $(mg/kg/day)^{-1}$.

Class: VOC

Analytical Information:

PQL: The PQL used as the basis for the MCL is 0.005 mg/L.

Analytical Methods: 502.1, 502.2, 503.1; GC
524.2; GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Bruckner, J.V., W.F. MacKenzie, S. Muraldihara, R. Luthra, G.M. Kyle and D.A. Costa. 1986. Oral Toxicity of Carbon Tetrachloride: Acute, Subacute and Subchronic studies in rats. Fund. Appl. Toxicol. 6 (1) : 16-39.

Federal Register. July 8, 1987. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations-Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25690).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

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CHLORAMINES (as Cl_2)	CASRN: 10599903	Update: May 2004

Current Massachusetts Regulatory Limit: The MMCL is the MRDL 4 mg/L (monochloramine, measured as free chlorine). ORS has adopted the MRDL for chloramines published by the U.S. EPA. Although this standard is termed an MMCL, the basis of this value is still the U.S. EPA MRDL.

Federal Regulatory Limit: The Maximum Residual Disinfectant Level (MRDL) for chloramines of 4 mg/L (monocloramine measured as free chlorine) was established under the U.S. EPA's Disinfection Byproducts Rule (Federal Register, December 16, 1998 – Volume 63, Number 241). An MRDL is an enforceable standard, analogous to an MCL, which recognizes the benefit of adding a disinfectant to drinking water on a continuous basis and maintaining a residual to control for pathogens in the distribution system. The MRDL is set as close as feasible to the Maximum Residual Disinfection Level Goal (MRDLG). The MRDLG is a nonenforceable health goal based only on health effects and does not reflect the benefit of the addition of the chemical for control of waterborne microbial contaminants. The MRDL for chloramines is equal to the MRDLG for chloramines.

Basis for Criteria: Chloramines are formed when chlorination is conducted in the presence of ammonia. U.S. EPA has set an MRDLG for chloramines of 4 mg/L, assuming a 70 kg adult ingests 2 L/day water, based on the RfD presented below.

RfD oral = 0.1 mg/kg/day (U.S. EPA, 1994; U.S. EPA, 1998)

UF: 100 (10 = interspecies; 10 = intraspecies)
MF: **1**

The MRDLG is based on a NOAEL of 9.5 mg/kg/day for lack of toxicity in a chronic rodent drinking water study to which was applied an uncertainty factor of 100 to account for inter- and intra- species differences (U.S. EPA, 1994). Derivation of the MRDLG is: MRDLG = 0.1 mg/kg/day x 70 kg/2 L/day = 3.5 mg/L (4.0 mg/L).

Critical Effects: Although short-term single-dose exposures to chloramines in drinking water have not resulted in adverse effects in human subjects, in another study acute hemolytic anemia was reported in hemodialysis patients when tap water used for dialysis baths was disinfected with chloramines. Chloramines produced oxidant damage to red blood cells and inhibited the metabolic pathway used by red blood cells to prevent and repair such damages. Longer-term oral studies in rodents showed decrease body and organ weights, effects to the liver appearing to be related to decreased water consumption due to unpalatability of chloramines in water and a suggestion of immunotoxicity. Chloramines appear to be weakly mutagenic based on positive results in two bacterial assays (U.S. EPA, 1994).

Cancer Assessment: U.S. EPA believes that the available cancer epidemiological data provides important information that contributes towards the weight-of-evidence evaluation of the potential health risks associated with chlorinated drinking water. However, U.S. EPA does not believe at this time that the cancer studies are sufficient to establish a causal relationship between exposure to chlorinated drinking water and cancer.

Class: disinfectant byproduct

Analytical Information:

Analytical Methods: Free, combined, and total chlorine: ASTM Method D1253-86; Standard Methods 4500-Cl D, 4500-Cl F and 4500-Cl G.
Total chlorine: Standard Methods 4500-Cl E and 4500-Cl I

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Supporting Documentation for Drinking Water Standards and Guidelines

Federal Register. December 16, 1998. Part IV. 40 CFR Parts 9, 141, and 142. National Primary Drinking Water Regulations. Disinfectants and Disinfection Byproducts. Final Rule. (63 FR 69390).

U.S. EPA. 1994. Draft Drinking Water Health Criteria Document for Chloramines. Office of Science and Technology. Office of Water.

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CHLORDANE	CASRN: 57749	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.002 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule. (56 FR 3526; 1-30-91).

Federal Regulatory Limit: The MCL is set equal to the PQL of 0.002 mg/L.

The MCLG is equal to zero. The MCL for chlordane of 0.002 mg/L was promulgated by the U.S. EPA on January 30, 1991 as part of the Phase II Rule. U.S. EPA has set the MCL at 0.002 mg/L to reduce the risk of cancer or other adverse health effects which have been observed in laboratory animals (Fed. Reg., 1991).

Basis for Criteria: The concentration of 0.002 mg/L may also be calculated, assuming a 70 kg adult drinks 2 L water per day, using the Reference Dose (RfD) presented below (Fed Reg, 1991).

RfD: 6×10^{-5} mg/kg/day

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = lack of a second chronic study)

MF: 1

Critical Effects: Fisher 344 rats (80/sex/dose) were fed technical chlordane at dietary levels of 0,1,5, and 25 ppm for 130 weeks. Liver hypertrophy was noted in female rats at a dosage of 0.273 mg/kg/day. A NOAEL of 0.055 mg/kg/day was established based on liver hypertrophy.

Cancer Assessment: B2. Based on potential cancer effects there is sufficient animal evidence of cancer (Becker and Sell 1979). Inadequate evidence exists in humans. A cancer potency factor (CPF) of 1.3 $(mg/kg/day)^{-1}$ was used to calculate an Excess Lifetime Cancer Risk (ELCR) of approximately six in one hundred thousand at the standard of 0.002 mg/L.

Class: Organochlorine Pesticide

Analytical Information:

PQL: The PQL used as the basis for the MCL is 0.002 mg/L.

Analytical Methods: U.S. EPA 508 (GC-ECD)
505 (microextraction GC)
525 (GC/MS)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may

be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Becker, F.F. and S. Sell. 1979. alpha-Fetoprotein levels and hepatic alterations during chemical carcinogenesis in C57BL/6N mice. Cancer Research 39:3491-3494.

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Velsicol Chemical Co. 1983. MRID No. 00138591, 00144313. Available from U.S. EPA. Write to U.S. EPA, Washington, DC 20460.

Supporting Documentation for Drinking Water Standards and Guidelines

CHLORINE (as Cl_2)	CASRN: 7782505	Update: May 2004

Current Massachusetts Regulatory Limit: The MMCL is equal to the MRDL of 4 mg/L. ORS has adopted the MRDL for chlorine published by the U.S. EPA. Although this standard is termed an MMCL, this is really an MRDL value.

Federal Regulatory Limit: The Maximum Residual Disinfectant Level (MRDL) for chlorine of 4 mg/L was established under the U.S. EPA's Disinfection Byproducts Rule (Federal Register, December 16, 1998 – Volume 63, Number 241). An MRDL is an enforceable standard, analogous to an MCL, which recognizes the benefit of adding a disinfectant to drinking water on a continuous basis and maintaining a residual to control for pathogens in the distribution system. The MRDL is set as close as feasible to the Maximum Residual Disinfection Level Goal (MRDLG). The MRDLG is a nonenforceable health goal based only on health effects and does not reflect the benefit of the addition of the chemical for control of waterborne microbial contaminants. The MRDL for chlorine is equal to the MRDLG for chlorine.

Basis for Criteria: Chlorine is a very effective disinfectant that is widely used for disinfection of water supplies. The U.S. EPA has set an MRDLG for chlorine of 4 mg/L (assuming a 70 kg adult ingests 2 L/day water) based on the RfD presented below.

RfD oral = 0.1 mg/kg/day (U.S. EPA, 1994; U.S. EPA, 1998)

UF: 100 (10 = interspecies; 10 = intraspecies)
MF: 1

The MRDLG is based on a NOAEL of 14 mg/kg/day identified in a two-year rat study in which rats were given chlorine at doses ranging from 4 to 14 mg/kg/day and mice at doses ranging from 8 to 24 mg/kg/day. Neither systemic toxicity nor change in body weight and survival were noted. An uncertainty factor of 100 was applied to account for inter- and intra- species differences (U.S. EPA, 1994). Since most exposure to chlorine dioxide is likely to come from ingestion of drinking water, a relative source contribution factor of 0.8 is applied to this value. Derivation of the MRDLG is:

MRDLG = 14 mg/kg/day x 70 kg x 0.8/(100 x 2 L/day) = 3.9 mg/L (4.0 mg/L).

CRITICAL EFFECTS: Chlorine is very reactive and thus the health effects associated with the administration of high levels of chlorine may be due to its reaction by-products. Effects noted in animals after short-term oral exposure include decreases in blood-glutathione levels, hemolysis and biochemical changes in liver. Chlorinated water has been shown to be mutagenic to bacterial strains and mammalian cells (U.S. EPA, 1994).

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Cancer Assessment: The U.S. EPA believes that the available cancer epidemiological data provides important information that contributes towards the weight-of-evidence evaluation of the potential health risks associated with chlorinated drinking water. However, U.S. EPA does not believe at this time that the cancer studies are sufficient to establish a causal relationship between exposure to chlorinated drinking water and cancer.

Class: disinfectant byproduct

Analytical Information:

Analytical Methods: Free, combined, and total chlorine: ASTM Method D1253-86; Standard Methods 4500-Cl D, 4500-Cl F and 4500-Cl G.
Total chlorine: Standard Methods 4500-Cl E and 4500-Cl I
Free chlorine: Standard method 4500-Cl H

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

U.S. EPA. 1994. National Primary Drinking Water Regulations. Disinfectants and Disinfection Byproducts. Proposed Rule. Fed. Reg. 59:145:38668. (July 29, 1994).

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U.S. EPA. December 16, 1998. National Primary Drinking Water Regulations. Disinfectants and Disinfection Byproducts. Final Rule. Fed. Reg. 63:241:69406.

Supporting Documentation for Drinking Water Standards and Guidelines

CHLORINE DIOXIDE (as ClO_2)	CASRN: 10049044	Update: May 2004

Current Massachusetts Regulatory Limit: The MMCL is equal to the MRDL of 0.8 mg/L. ORS has adopted the MRDL for chlorine dioxide published by the U.S. EPA. Although this standard is termed an MMCL, this is really an MRDL value.

Federal Regulatory Limit: The Maximum Residual Disinfectant Level (MRDL) for chlorine dioxide was established under the Disinfectants and Disinfection Byproducts Rule (Federal Register, December 16, 1998 – Volume 63, Number 241). An MRDL is an enforceable standard, analogous to an MCL, which recognizes the benefit of adding a disinfectant to drinking water on a continuous basis and maintaining a residual to control for pathogens in the distribution system. The MRDL is set as close as feasible to the Maximum Residual Disinfection Level Goal (MRDLG). The MRDLG is a non-enforceable health goal based only on health effects and does not reflect the benefit of the addition of the chemical for control of waterborne microbial contaminants. The MRDL should not be exceeded even for short periods of time due to potential health concerns.

Basis for Criteria: Chlorine dioxide is added to water for the oxidation of taste and odor-causing organic compounds in water. It is also used for the oxidation of reduced iron and manganese and color, and as a disinfectant and algicide. It reacts with impurities in water and is quickly dissipated. U.S. EPA has set an MRDLG for chlorine dioxide of 0.8 mg/L based on the assumption that a 70 kg adult ingests 2 L/day of water. Since most exposure to chlorine dioxide is likely to come from ingestion of drinking water, a relative source contribution factor of 0.8 is applied to this value.

RfD oral = 0.03 mg/kg/day (U.S. EPA, 2000)

UF: 100 (10 = interspecies; 10 = intraspecies) **MF:** 1

Confidence in RfD: Medium to High

Numerous animal studies have examined the neurodevelopmental toxicity of chlorite. These studies consistently show a LOAEL of 14 mg/kg-day and NOAEL of 3 mg/kg-day for multiple neurodevelopmental endpoints (CMA, 1996; U.S. EPA, 2000) An uncertainty factor of 3 was applied to account for inter- and intra-species differences. Derivation of the MRLDG is: MRLDG = 0.03 mg/kg/day x 70 kg/2 L/day x 0.8 = 0.8 mg/L.

Critical Effects: Chlorine dioxide in drinking water rapidly degrades to chlorite, chlorate, and chloride ion. In an epidemiology study, chlorine dioxide rapidly (within 2-4 hours) disappeared from stored water and concentrations of chlorite simultaneously increased (Michael *et al*., 1981, as cited in U.S. EPA, 2000). Once absorbed, chlorine dioxide and chlorite are cleared from the blood at similar rates and are similarly distributed throughout the body (Abdel-Rahman *et al*., 1979, 1982, as cited in IRIS, 2000). Additionally, chloride is the major in vivo degradation product for chlorine

dioxide, chlorite, and chlorate. Due to these similarities, U.S. EPA has concluded that the toxicity information for chlorite is relevant to deriving an RfD for chlorine dioxide (U.S. EPA, 2000).

Cancer Assessment: Data are inadequate for assessment of human carcinogenic potential.

U.S. EPA believes that the available cancer epidemiological data provides important information that contributes towards the weight-of-evidence evaluation of the potential health risks associated with chlorinated drinking water. However, U.S. EPA does not believe at this time that the cancer studies are sufficient to establish a causal relationship between exposure to chlorinated drinking water and cancer.

Class: disinfectant byproduct

Analytical Information:

Analytical Methods: Standard Methods 4500-ClO_2 D and 4500-ClO_2 E

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Abdel-Rahman, M.S., Couri, D., and Jones, J.D. 1979. Chlorine dioxide metabolism in rat. J Environ Pathol Toxicol. 3:421-430.

Abdel-Rahman, M.S , Couri, D., Bull, R.J. 1982. Metabolism and pharmacokinetics of alternate drinking water disinfectants. Environ Health Perspect. 46:19-23.

CMA (Chemical Manufacturers Association). 1996. Sodium chlorite: drinking water rat two-generation reproductive toxicity study. Quintiles Report Ref. CMA/17/96.

Federal Register. December 16, 1998. Part IV. Environmental Protection Agency. 40 CFR Parts 9, 141, and 142. National Primary Drinking Water Regulations: Disinfectants and Disinfection Byproducts; Final Rule. (63 FR 69391).

U.S. EPA (U.S. Environmental Protection Agency). October 12, 2000. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

Michael, G.E., Miday, R.K., Bercz, J.P., *et al*. 1981. Chlorine dioxide water disinfection: a prospective epidemiology study. Arch Environ Health. 36:20-27.

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CHLORITE	CASRN: 7758192	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = 1 mg/L. ORS has adopted the MCL published by the U.S. EPA in its Disinfectants and Disinfection Byproducts Rule (Federal Register, December 16, 1998 – Volume 63, Number 241).

Federal Regulatory Limit: Under its Disinfectants and Disinfection Byproducts Rule (Federal Register, December 16, 1998 – Volume 63, Number 241), U.S. EPA set the MCLG for chlorite at 0.8 mg/L. The MCL was set at 1.0 mg/L based on feasibility. 1.0 mg/L is the lowest level considered practically achievable by typical systems using chlorine dioxide, from both treatment and monitoring perspectives.

Basis for Criteria: Because chlorine dioxide is rapidly reduced to chlorite, U.S. EPA believes that data on chlorite are relevant to assessing the risks of chlorine dioxide. The MCLG for this chemical was derived U.S. EPA has set an MCLG for chlorite of 0.8 mg/L based on the assumption that a 70 kg adult ingests 2 L/day of water. Since most exposure to chlorite is likely to come from ingestion of drinking water, a relative source contribution factor of 0.8 is applied to this value.

RfD oral = 0.03 mg/kg/day (U.S. EPA, 2000)

UF: 100 (10 = interspecies; 10 = intraspecies) **MF:** 1

Confidence in RfD: Medium to High

The MCLG was derived using the following equation:

MCLG = 0.03 mg/kg/day x 70 kg/2 L/day x 0.8 = 0.8 mg/L

Critical Effects: Numerous animal studies have examined neurodevelopmental toxicity of chlorite. These studies consistently show a LOAEL of 14 mg/kg-day and NOAEL of 3 mg/kg-day for multiple neurodevelopmental endpoints (CMA, 1996; U.S. EPA, 2000).

Cancer Assessment: Data are inadequate for assessment of human carcinogenic potential.

U.S. EPA believes that the available cancer epidemiological data provides important information that contributes towards the weight-of-evidence evaluation of the potential health risks associated with chlorinated drinking water. However, U.S. EPA does not believe at this time that the cancer studies are sufficient to establish a causal relationship between exposure to chlorinated drinking water and cancer.

Class: disinfectant byproduct

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Analytical Information:

Analytical Methods: U.S. EPA Methods 300.0 and 300.1

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

CMA (Chemical Manufacturers Association). 1996. Sodium chlorite: drinking water rat two-generation reproductive toxicity study. Quintiles Report Ref. CMA/17/96.

Federal Register. December 16, 1998. Part IV. Environmental Protection Agency. 40 CFR Parts 9, 141, and 142. National Primary Drinking Water Regulations: Disinfectants and Disinfection Byproducts; Final Rule. (63 FR 69391).

U.S. EPA (U.S. Environmental Protection Agency). October 10, 2000. Integrated Risk Information System (IRIS). Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

CHLOROBENZENE	CASRN: 108907	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.1 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule (56 FR 3526; 1/30/91); (56 FR 30266; 7/1/91).

Federal Regulatory Limit: The final MCL is based on the MCLG of 0.1 mg/L (56 FR 3526; 1/30/91); (56 FR 30266; 7/1/91).

Basis for Criteria: The MCLG is based on hepatic toxicity reported in dog studies and was derived assuming a 70 kg adult ingests 2 L/day water. The MCLG assumes a relative source contribution factor of 20%.

RfD: 2×10^{-2} mg/kg/day

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = subchronic to chronic)

MF: 1

Critical Effects: Histopathological liver changes. The RfD is based on a NOAEL (adjusted) of 19 mg/kg/d identified in a 13 week dog study where the animals were given a capsule containing chlorobenzene. (Knapp *et al*., 1971; Monsanto, 1967).

Cancer Assessment: D
Chlorobenzene is currently classified as a group D, not classifiable as to human carcinogenicity (Fed. Reg., 1989).

Class: VOC (chlorinated aromatic)

Analytical Information:

Analytical Methods: 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Supporting Documentation for Drinking Water Standards and Guidelines

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Federal Register. July 1, 1991. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Monitoring for Volatile Organic Chemicals; MCLGs and MCLs for Aldicarb, Aldicarb Sulfoxide, Aldicarb Sulfone, Pentachlorophenol, and Barium; Final Rule. (56 FR 30266).

Knapp, W.K., W.M. Busey, and W. Kundzins. 1971. Subacute oral toxicity of monochlorobenzene in dogs and rats. Tox. Appl. Pharmacol. 19:393 (abstract).

Monsanto Chemical Company. 1967. 13 week oral administration -- dogs. Monochlorobenzene. Final Report. Prepared by Hazelton Lab. Proj. No. 249-105.

Supporting Documentation for Drinking Water Standards and Guidelines

CHLOROFORM	CASRN: 67663	Update: May 2004

Current Massachusetts Regulatory Limit: This document addresses chloroform in **non-chlorinated** water supplies. Please consult the supporting documentation for Total Trihalomethanes (TTHMs) for guidance on chloroform in **chlorinated** water supplies.

For non-chlorinated supplies, the ORSGL = 0.07 mg/L. Documentation is provided below.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for chloroform in non-chlorinated water supplies.

Basis for Criteria: For a non-chlorinated water supply, a guideline of 0.07 mg/L has been established based on the potential for noncancer and cancer effects. The ORSGL is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 0.01 mg/kg/day

UF: 1000 (10 = intraspecies; 10 = interspecies; 10 = LOAEL to NOAEL)

MF: 1 **Confidence in RfD:** Medium

(U.S. EPA, 2001)

Critical Effects: The RfD is based upon the results of a chronic study (Heywood *et al*., 1979) in which beagle dogs were exposed to chloroform at either 15 or 30 mg/kg/day in gelatin capsules in a toothpaste base 6 days per week for 7.5 years, followed by a 20 to 24-week recovery period. Effects noted (in a dose-dependent manner) included moderate/marked fatty cyst formation in the liver and elevated serum glutamate pyruvate transaminase (SGPT), both indicators of liver effects (U.S. EPA, 2001). No NOAEL was identified in this study. A LOAEL of 15 mg/kg/day was identified based on elevated serum SGPT levels and increased incidence and severity of fatty cysts (U.S. EPA, 2001).

(A benchmark approach was also used to arrive at the same RfD. The benchmark dose ($BMDL_{10}$) of 1.2 mg/kg/day (time adjusted to 1.0 mg/kg/day) was derived from the same chronic oral bioassay in dogs (U.S. EPA, 2001). A total uncertainty factor of 100 (10 for interspecies; 10 for intraspecies) was applied to the adjusted $BMDL_{10}$ to derive the RfD.)

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Cancer Assessment: B2/Likely to be carcinogenic to humans

Under the Proposed Guidelines for Carcinogen Risk Assessment, chloroform is likely to be carcinogenic to humans by all routes of exposure under high-dose conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues. Chloroform is not likely to be carcinogenic to humans by any route of exposure at a dose level that does not cause cytotoxicity and cell regeneration. This conclusion is based upon the results of a number of studies in animals exposed both via inhalation and oral routes, in which sustained or repeated cytotoxicity with secondary regenerative hyperplasia precedes and is probably a causal factor for hepatic and renal neoplasia (U.S. EPA, 2001). Because these data indicate that chloroform is carcinogenic via a nongenotoxic mechanism of toxicity, U.S. EPA considers a dose of 0.01 mg/kg/day (equal to the RfD) to be protective against cancer risk (U.S. EPA, 2001).

Class: VOC

Analytical Information:

PQL: 0.5 µg/L

Analytical Methods: U.S. EPA Methods 502.2; 524.2; 551.1

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Heywood, R., Sortwell, R.J., Noel, PRB *et al*. 1979. Safety evaluation of toothpaste containing chloroform: III. Long-term study in beagle dogs. J Environ Pathol Toxicol. 2:835-851.

U.S. EPA (U.S. Environmental Protection Agency). October 19, 2001. IRIS (Integrated Risk Information System). Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

U.S. EPA (U.S. Environmental Protection Agency). October 19, 2001. Toxicological review of chloroform (CAS No. 6766-3) – in support of summary information on the Integrated Risk Information System. EPA/635/R-01/001.

Supporting Documentation for Drinking Water Standards and Guidelines

CHROMIUM (total)	CASRN: 7440508	August 1993

Current Massachusetts Regulatory Limit: MMCL: 0.1 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule (56 FR 3526, 1-30-91).

Federal Regulatory Limit: The MCL for total chromium is equal to its MCLG of 0.1 mg/L (56 FR 3526, 1-30-91).

Basis for Criteria: There are two forms of chromium that are of toxicological importance: chromium III and chromium VI. chromium VI is believed to be the form responsible for the carcinogenic responses seen when animals and humans are exposed to chromium by inhalation. Chromium III is oxidized to the VI valence state and is therefore, important for the overall assessment of the potential for adverse health effects. The MCL however is based on the potential for adverse non-cancer effects of chromium VI and is consistent with the National Research Council's recommended daily intake range of 50 to 200 μg per day. Information on human exposure to chromium was used to determine a relative source contribution of 0.71 for chromium in drinking water. The MCL was developed based on the RfD presented below, assuming that a 70 kg adult ingests 2 L/day of drinking water and that 0.71 of the total exposure to chromium is through drinking water (Fed Reg, 1985).

RfD: 5×10^{-3} mg/kg/day

UF = 500 (5 = an additional safety factor for less than lifetime exposure of the principal study; 10 = intraspecies; 10 = interspecies)

MF: 1 **Confidence in RfD:** Low

Critical Effects: Groups of eight male and eight female Sprague-Dawley rats were supplied with drinking water containing 0-11 ppm (0-11 mg/L) hexavalent chromium for 1 year (McKenzie *et al*, 1958). No significant adverse effects were seen in appearance, weight gain or food consumption, and there were no pathological changes in the blood or other tissues in any treatment groups. A NOAEL of 2.41 mg/kg/day was identified from this study.

Cancer Assessment: A – inhalation/D - ingestion.

Through inhalation studies, dose-response relationships have been established for chromium exposure and lung cancer. These relationships were established from occupational epidemiological studies of exposed workers. Only chromium VI is classified as a human carcinogen. There is no definitive evidence for the carcinogenicity of chromium VI by ingestion.

Class: heavy metal

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Analytical Information:

Analytical Methods: 200.7A (inductively coupled plasma)
U.S. EPA 218.2 (A.A.1 Furnace Technique)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

MacKenzie, R.D., R.U. Bierrum, C.F. Decker, C.A. Hoppert and R.F. Langham. 1958. Chronic Toxicity Studies. II. Hexavalent and trivalent chromium administered in drinking water to rats. Am. Med. Assoc. Arch. Ind. Health. 18:232-234.

Supporting Documentation for Drinking Water Standards and Guidelines

COPPER	CASRN: 7440508	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. Action Level = 1.3 mg/L. ORS has adopted the Action Level published by the U.S. EPA (FR 6/7/91, 56 FR 32112; 7-15-91).

Federal Regulatory Limit: The Action Level for copper is 1.3 mg/L. The Treatment Technique for copper requires public water supply systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the copper Action Level of 1.3 mg/L, water systems must take additional steps (U.S. EPA, 2002). The MCLG for copper is equivalent to the Action Level of 1.3 mg/L.

An action level is different from an MCL. Exceeding the action level for copper triggers one or more of the following options:

(1) replacement of service lines,
(2) corrosion control,
(3) treatment of the source,
(4) public education.

Basis for Criteria: There are no data currently in the RfD development stage of the regulations.

RfD: LOAEL is 5.3 mg/day

UF: 2 **MF:** 1

Based on a LOAEL of 5.3 mg/day from human clinical case studies in which 5.3 mg was the lowest acute oral dose at which gastrointestinal effects were seen (Chuttani *et al*, 1965 as cited in Federal Register, 1991). The MCLG and Action Level are derived using the following approach:

$$\frac{5.3 \text{ mg/day}}{2 \text{ x } 2 \text{ L/day}} = 1.3 \text{ mg/L}$$

Critical Effects: The Action Level is based on a Lowest Observed Adverse Effect Level (LOAEL) of 5.3 mg/L identified from a clinical study of humans exposed to copper. Humans given 5.3 mg of copper orally as an acute dose demonstrated gastrointestinal effects.

Cancer Assessment: Data Are Inadequate for the Assessment of Human Carcinogenic Potential/D

Copper is currently classified as a Group D, not classifiable as to human carcinogenicity based on inadequate animal data and equivocal mutagenicity data.

Class: Naturally occurring metal

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Analytical Information:

PQL: Method dependent

Analytical Methods: U.S. EPA 220.2 GFAA
220.1 DAAA
200.7 ICP
200.8 ICP/MS
200.9 AA/Platform Furnace.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

> **Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MMCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.**

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Chuttani, H.K. *et al*. Acute Copper Sulfate Poisoning. American Journal of Medicine. Vol. 39. (November 1965). pp 849-854.

Federal Register. Friday, June 7, 1991. Vol. 56, No. 110. Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper; Final Rule.

U.S. EPA (U.S. Environmental Protection Agency). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

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Cryptosporidium	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. (Refer to 310 CMR 22.20.) ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for *Cryptosporidium* is a Treatment Technique. Under U.S. EPA's Surface Water Treatment Rule, systems using surface water or groundwater under the direct influence of surface water must achieve a 99% removal of *Cryptosporidium* (as of 1/1/02 for systems serving greater than 10,000 and 1/14/05 for systems serving less than 10,000). The MCLG is equal to zero.

Basis for Criteria: The MCL for *Cryptosporidium* is based on a Treatment Technique as described above.

Critical Effects: *Cryptosporidium* is an organism found in rivers and lakes especially in those contaminated with human or animal wastes. It is fairly resistant to disinfection and even a well-operated facility cannot ensure that the water will not contain this organism. The water treatment technique is based on filtration. *Cryptosporidium* has produced several large waterborne disease outbreaks with gastrointestinal symptoms including diarrhea, nausea, and/or stomach cramps (US. EPA, 1999).

Cancer Assessment: NA

Class: Biological Pathogen

Analytical Information:

PQL: See U.S. EPA Method 1623 (U.S. EPA, 2001)

Analytical Methods: U.S. EPA Method 1623

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

References:

Federal Register. January 14, 2002. Environmental Protection Agency. Parts 9, 141 and 142. National Primary Drinking Water Regulations: Long Term 1 Enhanced Surface Water Treatment Rule. Final Rule. (67 FR 1811).

U.S. Environmental Protection Agency (U.S. EPA). June 1999. Guidance for People With Severely Weakened Immune Systems. U.S. EPA-816-F-99-005. Office of Water.

U.S. Environmental Protection Agency (U.S. EPA). April 2001. Method 1623: *Cryptosporidium* and *Giardia* in Water by Filtration/IMS/FA. EPA-821-R-01-025. Office of Water.

U.S. Environmental Protection Agency (U.S. EPA). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

CYANIDE (as free cyanide)	CASRN: 57125	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = 0.2 mg/L. ORS has adopted the MCL published by the U.S. EPA (55 FR 30370; 7/25/91).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.2 mg/L.

Basis for Criteria: The MCLG is based on the potential for adverse health effects as demonstrated in rat studies. The MCLG assumes that a 70 kg adult ingests 2 L/day of water and incorporates a relative source contribution factor of 0.2.

RfD: 2×10^{-2} mg/kg/day (RfD for hydrogen cyanide)

UF: 100 (10 = intraspecies; 10 = interspecies)

MF: 5 **Confidence in RfD:** medium

A modifying factor of 5 is used to account for the apparent tolerance to cyanide when it is ingested with food rather than in water.

Critical Effects: In a two-year study, cyanide was administered to rats in feed that had been fumigated with HCN. No treatment related effects on growth rate, no gross signs of toxicity, and no histopathologic lesions were seen (Howard and Hanzal, 1955). In another rat study, decreased weight gain and thyroxin levels as well as myelin degeneration in rats was noted at 30 mg/kg/day (Philbrick et al., 1979). Other chronic studies identified either used the subcutaneous route or had higher effect levels. The Howard and Hanzal and the Philbrick rat studies were used to identify a LOAEL of 30 mg/kg/d and a NOAEL of 10.8 mg/kg/day. The RfD (of 0.022 mg/kg/day) was derived based on the NOAEL of 10.8 mg/kg/day.

Cancer Assessment: Data are Inadequate for the Assessment of Human Carcinogenic Potential/D

There are not enough available data upon which to classify the carcinogen potential of cyanide.

Class: inorganic; nitrile

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Analytical Information:

Analytical Methods: 335.2; distillation titermetric
335.3; distillation, automated
spectrometric others

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Howard, J.W., and Hanzal, R.F. 1955. Chronic toxicity for rats of food treated with hydrogen cyanide. Agric. Food Chem. 3:325-329.

Philbrick, D.J., Hopkins, J.B., Hill, D.C., Alexander, J.C. and Thomson, J.C. 1979. Effects of prolonged cyanide and thiocyanate feeding in rats. J. Toxicol. Environ. Health. 5: 579-592.

Supporting Documentation for Drinking Water Standards and Guidelines

DALAPON (sodium salt)	**CASRN: 75990**	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.2 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.2 mg/L.

Basis for Criteria: The MCLG is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 0.2 is incorporated into the MCLG.

RfD: 3×10^{-2} mg/kg/day

UF: 300 (10 = interspecies; 10 = intraspecies; 3 = incomplete database on chronic toxicity)

MF: 1 **Confidence in RfD:** Low

In a study in which Paynter *et al*. (1960) exposed albino rats for two years to 5, 15 and 50 mg/kg/day of dalapon sodium, the average kidney weights of male rats at the highest dose showed a statistically significant increase compared to male controls. The level of 15 mg/kg/day was identified as a NOAEL for this study. Since the NOAEL was based on the sodium salt of dalapon that was 65% pure, the NOAEL was corrected to 8 mg/kg/day to represent the equivalent value for the pure acid.

Critical Effects: Dalapon is not known to cause health effects upon acute exposure, although it is readily absorbed and widely distributed throughout the body. Upon longer-term exposure to levels above the MCL, dalapon has the potential to cause an increased kidney to-body-weight.

Cancer Assessment: There is inadequate evidence to state whether dalapon has the potential to cause cancer from lifetime exposure in drinking water. U.S. EPA has classified dalapon as a Group D chemical.

Class: chlorinated pesticide

Analytical Information:

Analytical Methods: U.S. EPA Method 515.1; 552.1

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*.. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule.

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Paynter, O.E., Tusing, T.W., McCollister, D.D. and Rowe, V.K. 1960. Toxicology of Dalapon Sodium (2,2-Dichloropropionic Acid, Sodium Salt). Agric. Food Chem. 8:47-51.

Supporting Documentation for Drinking Water Standards and Guidelines

DI(2-ETHYLHEXYL)ADIPATE (DEHA)	CASRN: 103231	Update: August 1995

Current Massachusetts Regulatory Limit: MMCL = 0.4 mg/L. ORS has adopted the MCL published by U.S. EPA (55 FR 30370 (7/25/90); 57 FR 31776 (7/17/92)).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.4 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. The MCLG incorporates a relative source contribution factor of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity (55 FR 30370).

RfD: 6×10^{-1} mg/kg/day

UF: 300 (10 = interspecies; 10 = intraspecies;
3 = lack of multigenerational reproductive study, lack of data)
MF: 1 **Confidence in RfD:** Medium

The RfD is based on a NOAEL of 1800 ppm (corresponding to a dose of 170 mg/kg/day) identified from a teratogenicity study done in rats.

Critical Effects: The oral RfD is based upon two studies that used dietary administration of DEHA to rats; one assessed the effects of DEHA on gestating females and their developing fetuses (ICI 1988a). The other study examined the effects on fertility, reproductive outcome and gross and histological parameter in parents of both sexes. (ICI, 1988b).

Cancer Assessment: C

The designation of a class C carcinogen is based on an absence of human data and increased liver tumors on female mice (NTP, 1982). The MCLG of 0.4 mg/L corresponds to a theoretical cancer risk level of 1.3×10^{5} (57 FR 31776).

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA 506 CRID/GC
525 GC/MS

PQLs and analytical methods may have been updated since this guidance value was last

revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

ICI. (ICI Central Toxicology Laboratory). 1988a. Di(2-ethylhexyl)adipate teratogenic study in the rat. Report CTL/p/2118. Unpublished study.

ICI. (ICI Central Toxicology laboratory). 1988b). Di(2-ethylhexyl)adipate (DEHA) fertility study in rats. Report CTL/p/2229. Unpublished study.

NTP. (National Toxicology Program). 1982. Carcinogenesis Bioassay of di(2-ethylhexyl)adipate (CAS No. 102-23-10 IN f344 RATS B6C3F1 mice. NTP = 80-29. NIH Publication No. 81-1768.

Supporting Documentation for Drinking Water Standards and Guidelines

DI(2-ETHYL)HEXYLPHTHALATE (DEHP)	CASRN: 117817	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.006 mg/L. ORS has adopted the MCL published by the U.S. EPA (55 FR 30370 (7/25/90)).

Federal Regulatory Limit: The MCLG for DEHP is zero, based on its classification as a B2 carcinogen. The MCL of 0.006 mg/L is based on the PQL for DEHP.

Basis for Criteria: An MCLG of zero is assigned for DEHP based on carcinogenic effects. The MCL is based on the DEHP PQL. The U.S. EPA has set the PQL for DEHP at ten times its Method Detection Limit (MDL).

Critical Effects: Toxic effects associated with subchronic and chronic exposure include hepatoxicity and testicular toxicity.

Cancer Assessment: DEHP is classified as a group B2, probable human carcinogen. Increases in relative liver weights were observed in groups of treated females (64 and 19 mg/kg/day).

Orally administered DEHP produced significant dose-related increase in liver tumor responses in rats and mice of both sexes (NTP, 1992). The concentration associated with a 1×10^{-4} Excess Lifetime Cancer Risk (ELCR) is 0.4 mg/L (57 FR 31776 (7/17/92).

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA 502.2 GC
525 GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Carpenter, C.P., C.S. West and H.F. Smyth. 1953. Chronic oral toxicity of di(ethylhexyl)phthalate for rats and guinea pigs. Arch. Indust. Hyd. Occup. Med 8:219-226.

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

NTP. (National Toxicology Program) 1992. Carcinogenesis bioassay of di(2-ethylhexyl)phthalate (CAS no. 117-81-7) in F344 rats and B6C3F1 mice (feed study). NTP Technical Rep. Ser. TR No. 217, Research T.P., NC.

Supporting Documentation for Drinking Water Standards and Guidelines

DICHLORODIFLUOROMETHANE	CASRN: 75718	Update: August 1993

Current Massachusetts Regulatory Limit: ORSGL = 1.4 mg/L

Federal Regulatory Limit: The U.S. EPA has not published an MCL for dichlorodifluoromethane. This chemical is listed in 1/91 Drinking Water Priority List and may be regulated in the future (56 FR 14703) (Fed Reg, 1991).

Basis for Criteria: The ORSGL of 1.4 mg/L is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value. The RfD is based on a long-term feeding study in rats and dogs (Sherman, 1974). There are no data for classification of the potential for cancer effects of dichlorodifluoromethane.

RfD: 2×10^{-1} mg/kg/day

UF: 100 (10 = interspecies; 10 = intraspecies) **MF:** 1

Confidence in RfD: Medium

(U.S. EPA, 1990)

Critical Effects: The RfD of 0.2 mg/kg/day is based on a long-term feeding study in rats and dogs (Sherman 1974). Clinical biomedical, urological, hematological or histopathological evaluations were performed. The only reported effect was decreased body weight gain in female rats receiving 3000 ppm (150 mg/kg/day) of dichlorodifluoromethane. No other adverse effects were attributed to this compound in rats or dogs. A NOAEL of 300 ppm (15 mg/kg/day) was identified from this study.

Cancer Assessment: D

Dichlorodifluoromethane has been identified in U.S. EPA's Group D based on inadequate human evidence of carcinogenicity.

Class: Chlorofluorocarbon (CFC), VOC

Analytical Information:

PQL: 0.0003 mg/L

Analytical Methods: 524.2; purge and trap GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 14, 1991. Drinking Water Priority List. (56 FR 1470).

Sherman, H. 1974. Long-term feeding studies in rats and dogs with dichlorodifluoromethane (Freon 12 Freezant). Haskill Laboratory for Toxicology and Industrial Medicine Report No. 24-74.

U.S. EPA (U.S. Environmental Protection Agency). August 1, 1990. Integrated Risk Information System (IRIS). Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

DICHLOROMETHANE	CASRN: 75092	Update: January 1995

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776; 7-17-92).

Federal Regulatory Limit: The MCL of 0.005 mg/L is based on the PQL for dichloromethane. The MCLG is set to zero based on the evidence for carcinogenic potential.

Basis for Criteria: An MCLG of zero is assigned for dichloromethane based on carcinogenic effects. The MCL is based on the dichloromethane PQL.

Critical Effects: Liver Toxicity. In a two-year study conducted in rats, treatment-related histological alterations of the liver were evident at doses of 50 mg/kg/day or higher. A NOAEL of 5.85 mg/kg/day was identified from this study (NCA, 1982).

Cancer Assessment: B2

The cancer classification is based on inadequate human data and sufficient evidence of carcinogenicity in animals; increased incidence of hepatocellular neoplasms and alveolar/bronchiolar neoplasms in male and female mice, and increased incidence of benign mammary tumors in both sexes of rats; salivary gland sarcomas in male rats and leukemia in female rats were reported (NCA, 1982, 1983). This classification is supported by some positive genotoxicity data, although results in mammalian systems are generally negative.

The MCL of 0.005 mg/L is associated with a maximum individual excess lifetime cancer risk* of 1 x 10^{-5} (57 FR 31776).

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA Methods 503.1 P/T
524.2 GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

NCA (National Coffee Association). 1982. 24 month chronic toxicity and oncogenicity study of methylene chloride in rats. Final Report. Prepared by Hazelton books of America, Inc. Vienna,VA. Unpublished.

NCA (National Coffee Association) 1983. Twenty four month oncogenicity study of methylene chloride in mice. Final Report. Prepared by Hazelton Literature of America. Inc. Vienna, VA.

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

*This information on risk is extrapolated from information provided in the July 7, 1992 Federal Register that a 1 x 10^{-4} Excess Lifetime Cancer Risk (ELCR) is associated with a concentration of 0.05 mg/L.

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DINOSEB	CASRN: 88857	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.007 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776; 7-17-92).

Federal Regulatory Limit: The MCL is based on the MCLG of 0.007 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assuming that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated in the final value.

RfD: 1×10^{-3} mg/kg/day (U.S. EPA, 1989)

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = Lack of NOAEL in repro. study)
M.F.: 1 **Confidence in RfD:** Low

Critical Effects: The RfD is based on a two-year dietary study in rats in which groups of 60 rats/sex were fed dinoseb at 0, 1, 3 or 10 mg/kg/day in the diet. Effects included hunched appearance and staining of fur, polypnea and lower mean body weight gains. A statistically significant decrease in mean thyroid weight at all dose levels tested in male rats was also seen as well as a dose-related trend in decreased thyroid weight. A LOAEL of 1 mg/kg/day was identified from this study (Fed Reg 1990, 1992). The LOAEL was also supported by a 100-week mouse study (Brown, 1981as cited by Fed Reg, 1992) and a 3-generation reproductive study in rats (Irvine, 1981 as cited by Fed Reg, 1992).

Cancer Assessment: D

The cancer classification for dinoseb is based on the lack of positive tumor data, in three rodent studies.

Class: Herbicide

Analytical Information:

PQL: 0.002 mg/L

Analytical Methods: U.S. EPA 508; GC/ECD

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

U.S. EPA (United States Environmental Protection Agency). August 1, 1989. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, D.C. http:cfpub.epa.gov/ncea/iris/index.cfm.

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DIQUAT	CASRN: 85007	Updated: January 1996

Current Massachusetts Regulatory Limit: MMCL = 0.02 mg/L. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL is based on the MCLG of 0.02 mg/L.

Basis for Criteria: The MCLG of 0.02 mg/L is derived based on the RfD presented below and assuming that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is also incorporated into this value (57 FR 31776 (7-17-92)).

RfD: 2.2×10^{-3} mg/kg/day

UF: 100 (10 for intra-species; 10 for inter-species) **MF:** 1

Critical Effects: The RfD is based on the formation of cataracts in the eyes of rats. A No Observed Adverse Effects Level (NOAEL) of 0.22 mg/kg/day was identified from a 2-year dietary study in rats (Chevron Chemical Company, 1985). The NOAEL of 0.22 mg/kg/day is supported by the data from a study by Clark and Hurst (1970) which also established 0.22 mg/kg/day as the NOAEL in rats from a two-year feeding study (Fed Reg, 1990).

Cancer Assessment: D

Diquat has been designated a Group D carcinogen based on a lack of information on its carcinogenicity.

Class: Herbicide

Analytical Information:

PQL: 0.004 mg/L

Analytical Methods: U.S. EPA Method 549 (HPLC)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Chevron Chemical Company. 1985. MRDI No. 00145885, 00155474, 00160673. Available from U.S. EPA.

Clark, DG and Hurst, EW. January 1970. The toxicity of diquat. British Journal of Industrial Medicine. 27(1): 51-55.

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Supporting Documentation for Drinking Water Standards and Guidelines

ENDOTHALL	CASRN: 145733	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.1 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL for endothall is equal to the MCLG of 0.1 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assuming that a 70 kg adult ingests 2 L/day drinking water. A 20% relative source contribution factor is incorporated in this value.

RfD: 2×10^{-2} mg/kg/day

UF: 100 (10 = interspecies; 10 = intraspecies)
MF: 1 **Confidence in RfD:** Medium

Purebread beagle dogs were fed diets containing 1, 100, 300 or 800 mg disodium endothall per kg of diet for 24 months. The intermediate and high dose levels dogs exhibited increased organ weight and organ to body weight ratios of stomach and small intestine. A NOAEL of 2 mg/kg/day was identified from this study (Fed Reg, 1992).

Critical Effects: Acute exposure to endothall for relatively short periods of time at levels above the MCL may cause depressed breathing and heart rate. Longer-term exposure at levels above the MCL may result in increased organ weights and increased organ to body weight ratios of stomach and intestine.

Cancer Assessment: D

There is inadequate evidence to state whether endothall has the potential to cause cancer from lifetime exposure in drinking water.

Class: Pesticide

Analytical Information:

PQL: 0.009 mg/L

Analytical Methods: U.S. EPA Method 548.1

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

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ENDRIN	CASRN: 72208	Update: November 1993

Current Massachusetts Regulatory Limit: MMCL = 0.002 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776; 7-17-92).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.002 mg/L.

Basis for Criteria: The MCLG is based on potential adverse effects (clinical signs, mortality) reported in animal studies. It is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A 20% relative source contribution factor is incorporated into this value.

RfD: 3×10^{-4} mg/kg/day

UF: 100 (10 = intraspecies; 10 = interspecies) **M.F.** 1

Confidence in RfD: Medium

Critical Effects: The RfD is based on the results of a chronic oral bioassay in dogs (Velsicol 1969) where mild histological lesions in the liver and occasional convulsions were reported. No other adverse health effects were reported. A NOAEL of 0.025 mg/k/day was identified from this study (Fed Reg, 1990, 1992).

Cancer Assessment: D

The database for evaluating the potential cancer effects of exposure to Endrin is inadequate to make either qualitative or quantitative decisions.

Class: Chlorinated pesticide

Analytical Information:

PQL: 0.1 mg/L

Analytical Methods: U.S. EPA 505; microextraction GC
U.S. EPA 508; GC/ECD
U.S. EPA 525; GCMS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Velsicol Chemical Corporation. 1969. MRID No. 00030198. Available from U.S. EPA. Write FOI, U.S. EPA, Washington, D.C. 20460.

Supporting Documentation for Drinking Water Standards and Guidelines

EPICHLOROHYDRIN	CASRN: 106898	Update: January 1995

Current Massachusetts Regulatory Limit: MMCL = Treatment technique. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: Under the Phase II rule (56 FR 3526), no numerical MCL is provided for acrylamide and epichlorohydrin. If detected, a treatment technique is specified. Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:

- Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)
- Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

Basis for Criteria: The MCLG for epichlorohydrin is zero, based on its classification as a group B2 carcinogen. The MCL is based on treatment technique. There are no standardized analytical methods for epichlorohydrin at low levels in drinking water.

Critical Effects: The major target organs for toxicity upon chronic exposure to epichlorohydrin are the nasal turbinates, lungs, kidneys, male reproductive organs and the central nervous system. Tumors were observed in several species by several different routes of administration.

Cancer Assessment: B2

There are no human data for exposure to epichlorohydrin in humans and cancer. In animals, epichlorohydrin has produced cancers of various types at the sites of application when administered by several routes. Webster *et al*. (1985) administered 0, 2 or 10 mg/kg/d of epichlorohydrin by gavage to groups of Wistar rats (50 rats/groups/sex). The incidence of forestomach carcinomas was significantly increased in the high-dosed rats. Konishi *et al*. (1980) reported similar results in male Wistar rats given epichlorohydrin in their drinking water.

The U.S. EPA CAG estimated an upper limit 1 x 10^{-6} excess lifetime cancer risk-associated concentration in drinking water of 0.00354 mg/L based on the Konishi *et al* (1980) study (Fed Reg. 1985). The Konishi *et al*. study (1980) was the only drinking water study available and the data from the study were used to derive the slope factor. The tumor types were papillomas and carcinomas of the forestomach (Fed Reg, 1985).

Class: VOC

Analytical Information:

PQL: N/A

Analytical Methods: There are no standardized analytical methods for epichlorohydrin in drinking water. Instead, the monomer of epichlorohydrin is limited to 0.01% residual concentration dosed at 20 ppm.

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142 and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule.

Konishi, T., A. Kawabata, A. Denda. 1980. Forestomach tumors induced by orally administered epichlorohydrin in male wistar rats. Gann. 71:922-923.

Webster, P.W., C.A.Vander Heijden, A. Bisschop and G.J. Van Erch. 1985. Carcinogenicity study with epichlorohydrin, (CEP) by gavage in rats. Toxicology. 36:325-339.

Supporting Documentation for Drinking Water Standards and Guidelines

ETHYLBENZENE	CASRN: 100414	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.7 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase II rule (56 FR 3526; 1-30-91).

Federal Regulatory Limit: The MCL is based on the MCLG of 0.7 mg/L.

Basis for Criteria: The MCLG is derived using the RfD presented below and assuming that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD 1×10^{-1} mg/kg/day

UF: 1000 (10 = intraspecies; 10 = interspecies; 10 = subchronic to chronic extrapolation)
MF: 1

Critical Effects: Liver and kidney toxicity. The RfD is based on the results of a 182 day oral bioassay in which ethylbenzene was given to rats by gavage. There were 10 albino rats/sex/dose at doses of 13.6, 136, 408 or 680 mg/kg/day. A LOAEL of 408 mg/kg/day was associated with histopathological changes in the liver and the kidneys. The reference dose is based on an adjusted NOAEL of 97.1 mg/kg/day identified from a rat subchronic to chronic oral bioassay. (Wolf *et al*. 1956).

Cancer Assessment: Ethylbenzene has been identified in U.S. EPA's Group D, based upon inadequate evidence of carcinogenicity in animals.

Class: VOC

Analytical Information:

PQL: 0.0005 mg/L

Analytical Methods: 502.2; GC/PID
503.1; GC/PID-FID in series
524.2; GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Wolf, MA., V.K. Rowe, D.D. McCollister, R.C. Hollingsworth and F. Oyer. 1956. Toxicological studies of certain alkylates, benzenes and benzene. Arch. Ind. Health. 14:387-398.

Supporting Documentation for Drinking Water Standards and Guidelines

ETHYLENE DIBROMIDE	CASRN: 106934	Update: September 2004

Current Massachusetts Regulatory Limit: MMCL = 0.02 µg/L. ORS has lowered the MCL of 0.05 µg/L published by the U.S. EPA as part of the Phase II rule (56 FR 3526; 1/30/91) to 0.02 µg/L.

Federal Regulatory Limit: The MCLG is set to zero based on evidence of carcinogenic potential of ethylene dibromide (EDB). The U.S. EPA MCL is based on the PQL of EDB.

Basis for Criteria: The U.S. EPA promulgated an MCL for EDB of 0.05 µg/L as part of the SDWA Phase II Standards. The Office of Research and Standards (ORS) decided to establish an MMCL lower than the U.S. EPA MCL based on the ability of laboratories in Massachusetts to achieve the 0.02 µg/L detection limit. Establishing a lower limit for the EDB standard is consistent with the goal of ORS to set levels of potentially carcinogenic compounds in Massachusetts drinking waters as close to the concentration which produces an Excess Lifetime Cancer Risk of one in one million or less as is feasible.

In July 2004, the U.S. EPA developed a cancer slope factor of 2 $(mg/kg/day)^{-1}$ based on an oral gavage study in rats (NCI, 1978) and using the benchmark dose model. Coincidentally, the updated MMCL based on a 1×10^{-6} risk level is identical to the old value set at the PQL.

Critical Effects: The target organs affected by EDB exposure include the lung, liver, spleen, kidney and central nervous system. Repeat exposure may produce effects on the liver, stomach and adrenal cortex along with significant reproductive system toxicity (Fed Reg, 1985).

Cancer Assessment: B2

The group B2 cancer classification is based on evidence of increased tumor incidence in rodents. EDB has been tested for carcinogenicity by gavage, inhalation and dermal administration. The NCI (1978), administered TWA doses of 27 and 29 mg/kg/d to male and 26 and 28 mg/kg/d to female rats by gavage for 49 and 61 weeks respectively. Significant increased incidence of squamous cell carcinomas of the stomach (both sexes), hepatocellular carcinomas and neoplastic nodules in the liver (females) and angiosarcomas of the circulatory system (males) were observed upon histological evaluation. The stomach tumors developed after a short latency period and were observed to metastasize to multiple sites.

Class: Dibrominated Nematocide

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Analytical Information:

PQL: 0.02 µg/L

Analytical Methods: U.S. EPA 504; microextraction GC

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

NCI (National Cancer Institute) 1978. Bioassay of 1,2-dibromoethane for possible carcinogenicity, CAS No. 106934. NCI Carcinogenicity Tech. Rep. Sec. No. 86 PB-288-428, p. 64. [Also published in CHHA (NIH) 78-1336].

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ETHYLENE GLYCOL	CASRN: 107211	Update: August 1993

Current Massachusetts Regulatory Limit: ORSGL = 14 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for ethylene glycol.

Basis for Criteria: The ORSGL is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 2 mg/kg/day (U.S. EPA, 1996)

UF: 100 (10 = interspecies; 10 = intraspecies) **MF:** 1

Critical Effects: The RfD is based on a chronic rat oral feeding study in which rats were exposed to 50, 200, or 1000 mg/kg/day ethylene glycol. High-dosed rats had increased mortality, neutrophil count, water intake, kidney hemoglobin and hemotoxicant oral chronic nephritis. Female rats at the high dose had mild fatty changes in the liver. A NOAEL of 200 was identified from this study (U.S. EPA, 1996).

Cancer Assessment: D

The U.S. EPA currently classifies ethylene glycol as a group D (not classified) carcinogen (U.S. EPA, 1996).

Class: Dihydroxy alcohol

Analytical Information:

PQL: See method

Analytical Methods: gas chromatography

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

U.S. EPA (U.S. Environmental Protection Agency). January 1996. IRIS (Integrated Risk Information System). Washington, D.C. http://cfpub.epa.gov.ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

FLUORIDE	CASRN: 7782414	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 4 mg/L (51 FR 11396; 4-2-86).

Federal Regulatory Limit: The MCL is equal to the MCLG of 4 mg/L. U.S. EPA set a secondary standard of 2 mg/L to prevent the majority of cases of water-related objectionable dental fluorosis while allowing for the beneficial effect of the reduced incidence of dental caries (51 FR 11396).

Basis for Criteria: The MCLG is based on the results of epidemiological studies of crippling skeletal fluorosis. The MCL was derived on the U.S. EPA's determination that the best technology generally available (BTGA) for removing fluoride from public water supplies is capable of reaching the MCLG of 4 mg/L (51 FR 11396).

Critical Effects: The MCLG is based on prevention of crippling skeletal fluorosis. Based on a report by the U.S. Surgeon General, crippling skeletal fluorosis is an adverse effect resulting from intakes of fluoride of 20 mg/day over periods of 20 years or more. For an individual ingesting 2 L drinking water per day, this daily dose would correspond to a fluoride drinking water concentration of 10 mg/L. In studies conducted in other countries, levels of fluoride in drinking water between 10-40 mg/L have been associated with rheumatic attack, pain and stiffness, as well as crippling skeletal fluorosis in a large number of individuals. U.S. EPA concluded that the MCL of 4 mg/L, which includes a safety factor of less than 10, would be protective against crippling skeletal fluorosis with an adequate margin of safety (50 FR 47141; 51 FR 11396).

Cancer Assessment: The U.S. EPA agrees with findings of the Knox Report (the Working Party on the Fluoridation of Water and Cancer) commissioned by the government of Great Britain (Knox, 1985), which concludes that "nothing in any of the major classes of epidemiological evidence which could lead us to conclude that either fluoride occurring naturally in water, or fluoride added to water supplies is capable of inducing cancer or of increasing the mortality from cancer".

Class: Elemental halogen

Analytical Methods:

PQL: 0.5 mg/L.

Analytical Methods: 340.1; colorimetric
340.2; ion selective electrode

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. April 30, 1985. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Fluoride; Proposed Rules. (50 FR 20164).

Federal Register. November 14, 1985. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Fluoride; Final Rule and Proposed Rule. (50 FR 47141).

Federal Register. April 2, 1986. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Fluoride; Final Rule. (51 FR 11396).

Hodge, H.C. 1950. The concentration of fluorides in drinking water to give the point of minimum carries with maximum safety. J. Am. Dent. Assoc. 40:436. Cited in: Underwood, E.S. 1977. Trace Elements in Human and Animal Nutrition. Academic Press. NY.

Knox, E.G., "Fluoridation of Water and Cancer: A Review of the Epidemiological Evidence," Report of the Working Party on Fluoridation of Water and Cancer, London: Her Majesty's Stationery Office, 1985.

Supporting Documentation for Drinking Water Standards and Guidelines

Giardia lamblia	CASRN: NA	Update: May 2004
Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. (Refer to 310 CMR 22.20.) ORS has adopted the MCL published by the U.S. EPA.		
Federal Regulatory Limit: The MCL for *Giardia lamblia* is a Treatment Technique. Under U.S. EPA's Surface Water Treatment Rule, systems using surface water or groundwater under the direct influence of surface water must achieve a 99.9% removal/inactivation of *Giardia lamblia*. The MCLG for *Giardia lamblia* is zero.		
Basis for Criteria: The MCL for *Giardia lamblia* is based on a Treatment Technique as described above.		
Critical Effects: *Giardia lamblia* is a waterborne protozoan parasite that can be transmitted via the fecal-oral route and can cause waterborne illness. Although 50-75% of giardiasis cases can be asymptomatic, symptoms of giardiasis can include chronic diarrhea, abdominal cramps, weight loss, nausea, vomiting, and malabsorption of fats, among other symptoms. Transmission via water, especially in unfiltered water systems is one way in which *Giardia* is spread.		
Cancer Assessment: NA		
Class: Biological Pathogen		
Analytical Information: **PQL:** See U.S. EPA Method 1623 (U.S. EPA, 2001) **Analytical Methods:** U.S. EPA Method 1623 PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.		

References:

Federal Register. January 14, 2002. Environmental Protection Agency. Parts 9, 141 and 142. National Primary Drinking Water Regulations: Long Term 1 Enhanced Surface Water Treatment Rule. Final Rule. (67 FR 1811).

U.S. Environmental Protection Agency (U.S. EPA). November 1999. *Giardia*: Drinking Water Health Advisory. EPA-822-R-99-008. Office of Science and Technology. Office of Water.

U.S. Environmental Protection Agency (U.S. EPA). April 2001. Method 1623: *Cryptosporidium* and *Giardia* in Water by Filtration/IMS/FA. EPA-821-R-01-025. Office of Water.

U.S. Environmental Protection Agency (U.S. EPA). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

GLYPHOSATE	CASRN: 1071836	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.7 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL is based on the MCLG of 0.7 mg/L.

Basis for Criteria: The MCLG is derived using the RfD presented below and assuming that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 1×10^{-1} mg/kg/day

UF: 100 (10 = interspecies; 10 = intraspecies)
MF: 1 **Confidence in RfD:** High

Critical Effects: Acute exposure to glyphosate for relatively short periods of time at levels above the MCL could result in congestion of the lungs and an increased breathing rate. Chronic lifetime exposure to concentrations above the MCL may produce kidney damage and reproductive effects. In a three-generation rat feeding study, at dose levels of 0, 3, 10 or 30 mg/kg/day, the only compound-related effect noted was tubular dilation of the kidneys in third generation males at the highest dose. A NOAEL of 10 mg/kg/day was identified in this study (55 FR 30370; 7-25-90).

Cancer Assessment: There is some evidence that glyphosate may have the potential to cause cancer from a lifetime exposure at levels above the MCL.

Class: Pesticide

Analytical Information:

PQL: 0.4 µg/L (57 FR 31776: 7-17-92)

Analytical Methods: U.S. EPA Method 547
Standard Method 6651

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

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Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Supporting Documentation for Drinking Water Standards and Guidelines

GROSS ALPHA RADIATION	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = 15 pCi/L. ORS has adopted the MCL published by the U.S. EPA (65 FR 76708).

Federal Regulatory Limit: The MCL is equal to an adjusted gross alpha concentration of 15 pCi/L, calculated by excluding radon and uranium, but including radium 226.

There is no MCLG for alpha emitters since MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act.

Basis for Criteria: U.S. EPA has retained the MCL proposed in 1991 based on the newly estimated risk levels associated with this MCL. U.S. EPA used updated information on risk coefficients contained in U.S. EPA's Federal Guidance Report-13. The risk coefficients in this report were calculated using state-of-the art methods and models and are a significant improvement over the information used to support the 1991 radionuclides proposal. Concentrations of alpha emitters, assuming consumption of 2 L/day of drinking water each correspond to an excess lifetime cancer risk (ELCR) of 10^{-4}. These concentrations are presented in Appendix C of 56 FR 33050.

Critical Effects: All alpha radiation is considered to have the potential to cause cancer as a result of its interaction with genetic material. A number of human epidemiological studies indicate increasing risks of various types of cancer associated with increasing doses of ionizing radiation. The cancers produced by radiation cover the full range of carcinomas and sarcomas. Every form of cancer has been shown to be induced by radiation (56 FR 33050).

Cancer Assessment: A

Alpha emitters release ionizing radiation during alpha decay. U.S. EPA has classified ionizing radiation as a Group A human carcinogen. There are also data on individual alpha emitters that indicate they are carcinogenic.

Class: Radionuclide

Analytical Information:

PQL: 3 pCi/L

Analytical Methods: U.S. EPA 00-02
SM 7110 C

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may

be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. December 7, 2000. Part II. Environmental Protection Agency. Parts 9, 141, and 142. National Primary Drinking Water Regulations; Radionuclides; Final Rule. (65 FR 76708).

Federal Register. April 21, 2000. Part IV. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Radionuclides; Notice of Data Availability; Proposed Rule. (65 FR 21576).

Federal Register. July 18, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Radionuclides; Proposed Rule. (56 FR 33050).

U.S. Environmental Protection Agency. September 1999. Cancer Risk Coefficients for Environmental Exposure to Radionuclides. Federal Guidance Report No. 13. Air and Radiation. U.S. EPA-402-R-99-001.

Supporting Documentation for Drinking Water Standards and Guidelines

HALOACETIC ACIDS (HAA5)	CASRN: N/A	Update: May 2004

Current Massachusetts Regulatory Limit: For **chlorinated** supplies only, the haloacetic acids **MMCL = 0.060 mg/L** and is the sum of the concentrations of mono-, di-, and trichloroacetic acids and mono-and dibromoacetic acids.

Federal Regulatory Limit: Under its Disinfectants and Disinfection Byproducts Rule (Federal Register, December 16, 1998 – Volume 63, Number 241), U.S. EPA set the MCL for haloacetic acids at 0.060 mg/L. U.S. EPA did not set a Maximum Contaminant Level Goal (MCLG) for the group of haloacetic acids although there are MCLGs for some of the individual constituents, including dichloroacetic acid (zero) and trichloroacetic acid (0.3 mg/L). Monochloroacetic acid, bromoacetic acid, and dibromoacetic acid are regulated with this group but have no MCLGs.

Basis for Criteria: The five haloacetic acids (HAA5) are byproducts of the disinfection process. The MCL of 0.06 mg/L was set based on the potential for an increased risk of cancer (U.S. EPA, 1998a). U.S. EPA believes that by meeting MCLs for HAA5 and total trihalomethanes (TTHM) (other disinfection byproducts), water suppliers will also control the formation of other disinfection byproducts not currently regulated that may also adversely affect human health (U.S. EPA, 2002).

Critical Effects: Results from toxicology studies indicate that several disinfection byproducts (including the HAA5 chemicals dichloroacetic acid and trichloroacetic acid) may be carcinogenic in laboratory animals. Exposure to other disinfection byproducts, including several HAA5 has also been associated with adverse reproductive or developmental effects in laboratory animals (U.S. EPA, 1998b).

Cancer Assessment: U.S. EPA has not conducted a cancer assessment for the HAA5s. However, several of the individual HAA5 constituents have been evaluated and qualitative descriptors of their carcinogenicity are provided below.

- Information for monochloroacetic acid is inadequate for assessment of human carcinogenic potential.
- Dichloroacetic acid is likely to be a carcinogen to humans.
- There is suggestive evidence that trichloroacetic acid is carcinogenic. (U.S. EPA, 2004)

Class: Disinfection Byproducts

Supporting Documentation for Drinking Water Standards and Guidelines

Analytical Information:

PQL: See specific method. (57 FR 31776: 7-17-92)

Analytical Methods: U.S. EPA Method 552.1; 552.2; Standard Method 6251 B (U.S. EPA, 1998)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

Please note that there are individual RfDs and Health Advisories for some of the individual constituents of the HAA5s.

References:

U.S. EPA (U.S. Environmental Protection Agency). December 16, 1998a. National Primary Drinking Water Regulations. Disinfectants and Disinfection Byproducts. Final Rule. Fed. Reg. 63:241:69406.

U.S. EPA (U.S. Environmental Protection Agency). December 1998b. Stage 1 Disinfectants and Disinfection Byproducts Rule. U.S. EPA 815-F-98-010.

U.S. EPA (U.S. Environmental Protection Agency). July 2002. List of Contaminants and Their MCLs. U.S. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

U.S. EPA (U.S. Environmental Protection Agency). Winter 2004. 2004 Edition of the Drinking Water Standards and Health Advisories.

Supporting Documentation for Drinking Water Standards and Guidelines

HEPTACHLOR	CASRN: 76448	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.0004 mg/L (56 FR 3526; 1-30-91)

Federal Regulatory Limit: The MCL for heptachlor is based on its detection limit of 0.0004 mg/L. The MCLG is equal to zero.

Basis for Criteria: An MCLG of zero is assigned for heptachlor based on the evidence for carcinogenic potential. The MCL is based on the heptachlor PQL.

Critical Effects: Symptoms of acute heptachlor intoxication include central nervous system effects such as tremors, convulsions, paralysis and hypothermia. Lower doses result in microsomal enzyme induction, hyperplasia, hepatic vein thrombosis and cirrhosis in mice (50 FR 46936; 11-13-85).

Cancer Assessment: B2

The U.S. EPA has classified heptachlor as a Group B2 carcinogen based upon a significant increase in hepatocellular carcinomas in male mice as well as a highly significant dose-related trend in hepatocellular carcinomas between high and low dose female mice.

The MCL of 0.0004 mg/L is associated with a maximum individual risk* of 5×10^{-5} (56 FR 3526; 1-30-91).

Class: Chlorinated pesticide

Analytical Information:

PQL: 0.0004 mg/L

Analytical Methods: 505; microextraction GC
508; GC/ECD
525; GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

NCI. National Cancer Institute. 1977. Bioassay of Heptachlor for Possible Carcinogenicity. NCI carcinogenesis Tech. Report. Sec. No 9.

Velsicol Chemical Company. 1955. MRID No. 00062599. Available from U.S. EPA.

*This information on risk is extrapolated from information provided in the January 30, 1991 Federal Register that a 1 x 10^{-4} Excess Lifetime Cancer Risk (ELCR) is associated with a concentration of 0.0008 mg/L.

Supporting Documentation for Drinking Water Standards and Guidelines

HEPTACHLOR EPOXIDE	CASRN: 1024573	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.0002 mg/L (56 FR 3526; 1-30-91).

Federal Regulatory Limit: The MCL for heptachlor epoxide is based on its detection limit of 0.0002 mg/L. The MCLG is equal to zero.

Basis for Criteria: The MCL of 0.0002 mg/L is set at the PQL of 0.0002 mg/L for heptachlor epoxide. The MCLG is set to zero based on the evidence for carcinogenic potential.

Critical Effects: Heptachlor epoxide is the major metabolite of heptachlor. Symptoms of acute heptachlor intoxication include central nervous system effects such as tremors, convulsions, paralysis and hypothermia. Lower doses result in microsomal enzyme induction, hyperplasia, hepatic vein thrombosis and cirrhosis in mice (50 FR 46936; 11-13-85).

Cancer Assessment: B2

The U.S. EPA has classified heptachlor epoxide as a Group B2 carcinogen based upon a study conducted with heptachlor, the parent compound, which indicated a significant increase in hepatocellular carcinomas in male mice as well as a highly significant dose-related trend in hepatocellular carcinomas between high and low dose female mice.

The MCL of 0.0002 mg/L is associated with a maximum individual risk* of 5×10^{-5} (56 FR 3526; 1-30-91).

Class: Chlorinated Pesticide

Analytical Information:

PQL: 0.0002 mg/L

Analytical Methods: 505; microextraction GC
508; GC/ECD
525; GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Dow Chemical Company. 1958. MRID No. 00061912. Available from U.S. EPA.

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

*This information on risk is extrapolated from information provided in the January 30, 1991 Federal Register that a 1 x 10^{-4} Excess Lifetime Cancer Risk (ELCR) is associated with a concentration of 0.0004 mg/L.

Supporting Documentation for Drinking Water Standards and Guidelines

HETEROTROPHIC PLATE COUNT	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. (Refer to 310 CMR 22.20.) ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for heterotrophic plate count is a Treatment Technique. Under U.S. EPA's Surface Water Treatment Rule, systems using surface water or groundwater under the direct influence of surface water must achieve a heterotrophic plate count (HPC) no greater than 500 bacterial colonies per milliliter (67 FR 1811; U.S. EPA, 2002).

Basis for Criteria: The MCL for Heterotrophic plate count is based on a Treatment Technique as described above.

Critical Effects: Heterotrophic plate count is not an indicator of health effects and is not associated with disease. It is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is (67 FR 1811; U.S. EPA, 2002).

Cancer Assessment: NA

Class: Biological Pathogen

Analytical Information:

PQL: See CMR 22.20

Analytical Methods: Standard Method 9215 B. See 310 CMR 22.20A(5).

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

References:

Federal Register. January 14, 2002. Environmental Protection Agency. Parts 9, 141 and 142. National Primary Drinking Water Regulations: Long Term 1 Enhanced Surface Water Treatment Rule. Final Rule. (67 FR 1811).

U.S. Environmental Protection Agency (U.S. EPA). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

HEXACHLOROBENZENE	CASRN: 118741	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.001 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL for hexachlorobenzene is based on its detection limit of 0.001 mg/L. The MCLG is equal to zero.

Basis for Criteria: The MCL of 0.001 mg/L is set at the PQL for hexachlorobenzene of 0.001 mg/L. The MCLG is set to zero based on the evidence for carcinogenic potential.

Critical Effects: Acute exposure to hexachlorobenzene for relatively short periods of time at levels above the MCL could result in skin lesions and nerve and liver damage. Chronic lifetime exposure to concentrations above the MCL may produce damage to the liver and kidneys, reproductive effects, benign tumors of the endocrine glands and cancer.

Cancer Assessment: Hepatocellular carcinomas were produced in Sprague-Dawley female rats exposed to hexachlorobenzene in the diet.

U.S. EPA has classified hexachlorobenzene as a B2 probable human carcinogen. The MCL of 0.001 mg/L is associated with a maximum individual risk* of 5×10^{-5} (57 FR 31776).

Class: Chlorinated Organic

Analytical Information:

PQL: 0.001 mg/L

Analytical Methods: U.S. EPA Methods 505; 508; 508.1; 525.2.

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

*This information on risk is extrapolated from information provided in the July 17, 1992 Federal Register that a 1 x 10^{-4} Excess Lifetime Cancer Risk (ELCR) is associated with a concentration of 0.002 mg/L.

Supporting Documentation for Drinking Water Standards and Guidelines

HEXACHLOROCYCLOPENTADIENE	CASRN: 77474	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.05 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL of 0.05 mg/kg/day is equal to its MCLG.

Basis for Criteria: The MCLG is derived based on the RfD of 0.007 mg/kg/day presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 7×10^{-3} mg/kg/day (55 FR 30370; 7-25-90)

Exposure adjustment: multiplied by 5/7 to adjust the NOAEL from a 5-day to a 7-day exposure

UF: 1000 (10 = subchronic to chronic; 10 = interspecies; 10 = intraspecies)

MF: 1 **Confidence in RfD:** Low

Critical Effects: Acute exposure to hexachlorocyclopentadiene for relatively short periods of time at levels above the MCL could result in gastrointestinal distress, and damage to liver, kidneys and heart. Chronic lifetime exposure to concentrations above the MCL may produce damage to the stomach and kidneys.

In a subchronic oral toxicity study, hexachlorocyclopentadiene was administered in corn oil by gavage to rats at doses of 0, 10, 19, 38, 75 or 150 mg/kg/day The only effect noted was a slight depression of body weight at 10 mg/kg. A NOAEL of 10 mg/kg/day was identified from this study.

Cancer Assessment: There is no evidence that hexachlorocyclopentadiene has the potential to cause cancer from a lifetime exposure in drinking water.

Class: Chlorinated Organic

Analytical Information:

PQL: 0.001 mg/L (57 FR 31776: 7-17-92)

Analytical Methods: U.S. EPA Methods 505; 508; 508.1; 525.2.

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be

found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Supporting Documentation for Drinking Water Standards and Guidelines

LEAD	CASRN: 7439921	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. Action Level = 0.015 mg/L. (ORS has adopted the Action Level published by the U.S. EPA.) (FR 6/7/91, 56 FR32112; 7-15-91)

The Treatment Technique for lead requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the lead Action Level of 0.015 mg/L, water systems must take additional steps (U.S. EPA, 2002).

Federal Regulatory Limit: The action level is not a health-based value. Instead, exceeding the action level triggers a series of treatment techniques including:
(1) replacement of lead-lined service pipes,
(2) corrosion control
(3) source water reduction
(4) public education

The U.S. EPA has decided that setting an MCL for lead is not feasible and the approach outlined in the regulations (56 FR 32112) will achieve the public health goals of the Safe Drinking Water Act.

Basis for Criteria: The MCLG for lead is zero based on (1) the occurrence of low level effects and difficulty in identifying clear threshold levels, (2) the goal of reducing the overall exposure to lead and (3) the classification of lead as a group B-2 carcinogen. The Action Level is based on treatment technique.

Critical Effects: The toxicology of lead is complicated. High blood lead concentrations (Hb-Pb) have been associated with mental retardation in children, neurological and nephrological adverse health effects in adults and children and high blood pressure in adults. A threshold for effects has not been established.

Cancer Assessment: Likely to be Carcinogenic To Humans/B2
Lead is currently classified as a B2 carcinogen by U.S. EPA. There is sufficient animal evidence. Ten rat bioassays and one mouse bioassay have shown statistically significant increase in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Human evidence is inadequate (see IRIS for more details).

Class: naturally occurring heavy metal

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Analytical Information:

PQL: Method dependent

Analytical Methods: 200.8; ICP/MS
200.9; AA/furnace

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. Friday, June 7, 1991. Vol. 56, No. 110. Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper; Final Rule.

U.S. Environmental Protection Agency (U.S. EPA). July 2002. List of Contaminants and Their MCLs. U.S. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

Legionella	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. (Refer to 310 CMR 22.20.) ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for *Legionella* is a Treatment Technique. Under U.S. EPA's Surface Water Treatment Rule, systems using surface water or groundwater under the direct influence of surface water must control *Legionella* (U.S. EPA, 2002). Although there is no limit for *Legionella*, U.S. EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled. The MCLG for *Legionella* is zero.

Basis for Criteria: The MCL for *Legionella* is based on a Treatment Technique as described above.

Critical Effects: *Legionella* is a naturally occurring genus of bacteria. Some species of *Legionella* have been known to multiply in heating systems and cause Legionnaire's Disease, a type of pneumonia (U.S. EPA, 2002).

Cancer Assessment: NA

Class: Biological Pathogen

Analytical Information:

PQL: See 310 CMR 22.20

Analytical Methods: See 310 CMR 22.20

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

References:

Federal Register. January 14, 2002. Environmental Protection Agency. Parts 9, 141 and 142. National Primary Drinking Water Regulations: Long Term 1 Enhanced Surface Water Treatment Rule. Final Rule. (67 FR 1811).

U.S. Environmental Protection Agency (U.S. EPA). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

LINDANE	CASRN: 58899	August 1991

Current Massachusetts Regulatory Limit: MMCL = 0.0002 mg/L. ORS has adopted the MCL that the U.S. EPA promulgated as part of the Phase II rule (56 FR 3526: 1-30-91); (56 FR 30266; 7-1-91).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.0002 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. The MCLG incorporates a relative source contribution factor of 20% and a ten-fold uncertainty factor of 10 to account for potential carcinogenicity.

RfD: 0.0003 mg/kg/day

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = subchronic to chronic)

Critical Effects: The liver and kidney are the primary target organs for lindane toxicity. Acute exposure of animals to lindane results in neurological and behavioral effects. Subchronic and chronic studies have shown a variety of effects, including liver hypertrophy, kidney tubular degeneration and interstitial nephritis.

In a feeding study, rats were fed lindane in the diet at concentrations of 0, 0.2, 0.8, 4, 20 and 100 ppm for 84 days. Liver, kidney, tubular degeneration, interstitial nephritis and other effects were noted at the two highest doses. A NOAEL of 4 ppm (0.33 mg/kg/day) was identified from this study (U.S. EPA, 1987).

Cancer Assessment: C

There is inadequate evidence to determine whether or not lindane has the potential to cause cancer from lifetime exposures in drinking water. Under the U.S. EPA 1986 Carcinogen Risk Assessment Guidelines, lindane is classified as a Group C (possible) human carcinogen. This classification indicates that there is limited evidence of carcinogenicity of lindane in animals in the absence of human data.

Class: Pesticide

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Analytical Information:

PQL: 0.00002 mg/L

Analytical Methods: U.S. EPA Methods 505; 508; 508.1; 525.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

U.S. EPA. March 31, 1987. Lindane Health Advisory. Office of Drinking Water.

Supporting Documentation for Drinking Water Standards and Guidelines

Current Regulatory Limit: Manganese

MANGANESE:
CASRN: 7439-96-5

DATE: July 2014

Current Massachusetts Regulatory Limit
Office of Research and Standards Guideline (ORSG):

Target Population	Exposure Period	ORSG, mg/L (ppm)
General population	Lifetime	0.3
General population	10-day	1.0
Infants/children less than 1 year of age	< 10 days (Address within 10 days or sooner if possible)	0.3

Federal Regulatory Limit
The US EPA has not published a Maximum Contaminant Level (MCL) for manganese (Mn). It does have a Secondary MCL (SMCL) (http://water.epa.gov/drink/contaminants/index.cfm) and Health Advisory values for Mn (US EPA 2004). (http://water.epa.gov/action/advisories/drinking/upload/dwstandards2012.pdf).

Basis for Criteria
Manganese is an essential element and part of a healthy diet, but it can be harmful if consumed in excess. The US EPA's and MassDEP's Mn drinking water guidance values are intended to minimize excess intake of Mn from drinking water. EPA's general population water concentration exposure limits of 0.3 and 1.0 mg/L for lifetime and short-term exposures respectively have been set based upon typical daily dietary manganese intake levels not known to be associated with adverse health effects. This does not imply that intakes above these levels will necessarily cause health problems. Individual requirements for, as well as adverse effects from Mn can be highly variable.

The US EPA ten-day HA of 1 mg/L for the general population is based on Mn intake data for children from 7 months to 3 years of age and was conservatively applied to older individuals. Because no suitable data were available in the literature to determine a one-day HA, they used the ten-day value for a one-day HA as a default.

The following issues have been identified with regard to potential Mn toxicity from drinking water exposures:

1) infants and younger children may be particularly susceptible to Mn toxicity;
2) intakes of water on a weight basis are higher for infants and younger children;
3) infant formulas have contained variable (and sometimes high) levels of Mn; and
4) infants may absorb more Mn and excrete less than older individuals,

In view of this information, the US EPA advises that infants younger than 6 months who are formula-fed should not be given water containing more than 0.3 mg Mn/L for longer than ten days.

MassDEP therefore adopts as ORSGs the following guidance for manganese in drinking water:

- For the general population, MassDEP adopts the US EPA lifetime and 10-day Health Advisory values of 0.3 mg/L and 1 mg/L.
- Because of a lack of information on very short-term exposures ORS also concludes that EPA's one-day HA value is not supported.
- ORS further recommends limiting drinking water exposures (including through both formula and direct ingestion of water) for infants under one year of age[1] to less than a total of 10 days when Mn levels are in excess of 0.3 mg/L, if possible. This ten day limit isn't a critical bright line but is used to underscore the need to minimize high exposures to infants.

Analytical Methods
Mn in drinking water should be analyzed using one of the USEPA-recommended methods for Secondary Drinking Water Contaminants listed at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods. The current list includes the following methods for Mn: USEPA Methods 200.5, 200.7, and 200.8 and Standard Methods 3111B, 3113B, and 3120B.

Class
Inorganic, heavy metal

Reference
US EPA (2004). Drinking Water Health Advisory for Manganese. EPA-822-R-04-003. Washington, DC, US Environmental Protection Agency, Office of Water, Health and Ecological Criteria Division.

[1] One year of age was selected as a cutoff because intake of formula by older children is unlikely.

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http://www.epa.gov/ogwdw000/ccl/pdfs/reg_determine1/support_cc1_magnese_dwreport.pdf.

MERCURY (inorganic)	CASRN: 7439976	Update: May 2004
Current Massachusetts Regulatory Limit: MMCL = 0.002 mg/L. ORS has adopted the MCL promulgated by the U.S. EPA.		
Federal Regulatory Limit: The MCL for mercury is equal to the MCLG of 0.002 mg/L.		
Basis for Criteria: The MCLG is calculated based on the oral RfD for mercuric chloride, an inorganic form of mercury (presented below) and assuming that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value. **RfD:** 0.0003 mg/k/day (U.S. EPA, 1995a) **UF:** 1000 (10 = LOAEL to NOAEL; 10 = subchronic to chronic; 10 = inter- and intra-species conversion **MF:** 1		
Critical Effects: In 1987, U.S. EPA convened a panel of mercury experts who met at a Peer Review Workshop on Mercury Issues. A number of recommendations came out of this meeting. The most sensitive adverse effect for mercury risk assessment was identified as formation of mercuric-mercury-induced autoimmune glomerulonephritis. The Brown Norway rat was identified as a good surrogate for the study of mercury-induced kidney damage in sensitive humans. Information from three studies (Druet *et al*., 1978, Andres, P., 1984, Bernaudin *et al*., 1981) using the Brown Norway rat was selected as the basis for the panel's recommendation of 0.010 mg/L as the DWEL for inorganic mercury. However, the recommended DWEL of 0.010 mg/L was derived as the product of an intensive review and workshop discussions of the entire inorganic mercury database. The oral RfD of 0.0003 mg/kg/day was back calculated from the DWEL (U.S. EPA, 1995a).		

Cancer Assessment: C (by the old U.S. EPA classification system). Under the new, proposed guidelines (U.S. EPA, 1999), this classification would correspond to the descriptor "suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential".

There are no human data and only limited evidence of carcinogenicity in rats and mice. In a 1993 NTP study in which male rats were gavaged for two years with mercuric chloride, observed cancer included focal papillary hyperplasia and squamous cell papillomas in the forestomach, as well as thyroid follicular cell adenomas and carcinomas. However, NTP questioned the relevance of these tumors to humans based on the fact that there is no evidence that the forestomach papillomas progress to malignancy and the thyroid tumors are secondary to hyperplasia. The authors reported that the doses exceeded the Maximum Tolerated Dose (MTD) for male rats. Two other studies had equivocal results (NTP, 1993). A second study indicated equivocal evidence in male mice of renal tubular adenomas and adenocarcinomas, which is a rare tumor type in mice. However, the increased incidence of this tumor was statistically significant compared to historic controls. A similar increasing trend for renal tubular cell tumors was observed in several mouse studies involving chronic dietary exposure to methylmercury chloride (Hirano *et al*., 1986; Mitsumori *et al*., 1981, 1990). In these studies, increases in renal tubular tumors were seen at doses at which substantial nephrotoxicity was observed. Mercuric chloride produced mixed results in a series of genotoxicity tests (U.S. EPA, 1995b).

Class: Heavy metal

Analytical Information:

PQL: 0.0005 mg/l

Analytical Methods: 200.7; ICP/AA
245.1; manual cold vapor
245.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U. S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Andres, P. 1984. IgA-IgG disease in the intestine of Brown Norway rats ingesting mercuric chloride. Clin. Immunol. Immunopathol. 30: 488-494.

Bernaudin, J.F., Druet, E., Druet, P. and Masse, R.. 1981. Inhalation or ingestion of organic or inorganic mercurials produces auto-immune disease in rats. Clin. Immunol. Immunopathol. 20: 129-135.

Druet, P., Druet E., Potdevin, F. and Sapin, C. 1978. Immune type glomerulonephritis induced by HgCl2 in the Brown Norway rat. Ann. Immunol. 129C: 777-792.

Hirano, M., K. Mitsumori, K. Maita and Y. Shiraso. 1986. Further carcinogenicity study on methylmercury chloride in ICR mice. Jap. J. Vet. Sci. 48(1): 127-135.

Mitsumori, K., Maita, K., Saito, T. Tsuda, S. and Shirasu, Y. 1981. Carcinogenicity of methylmercury chloride in ICR mice: Preliminary note on renal carcinogenesis. Cancer Lett. 12: 305-310.

Mitsumori, K., Hirano, M., Ueda, H., Maita, K. and Shirasu, Y. 1990. Chronic toxicity and carcinogenicity of methylmercury chloride in B6C3F1 mice. Fund. Appl. Toxicol. 14: 179-190.

NTP (National Toxicology Program). 1993. Toxicology and carcinogenesis studies of mercuric chloride (CAS No. 7487-94-7) in F344 rats and B3C3F1 mice (gavage studies).

NTP Technical Report Series No. 408. National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, Research Triangle Park, NC.

U.S. EPA (U.S. Environmental Protection Agency). May 1, 1995a. Integrated Risk Information System (IRIS). Sec I.A. – Reference dose for chronic oral exposure. U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

U.S. EPA (U.S. Environmental Protection Agency). June 1, 1995b. Integrated Risk Information System (IRIS). Sec II.A. – Evidence for human carcinogenicity. U.S.

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Environmental Protection Agency. Washington, D.C.
http://cfpub.epa.gov/ncea/iris/index.cfm.

U. S. EPA (U.S. Environmental Protection Agency). July 1999. Guidelines for Carcinogen Risk Assessment. Review Draft. NCEA-F-0644. Risk Assessment Forum.

METHOXYCHLOR	CASRN: 72435	Update: August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.04 mg/L (56 FR 3526: 1-30-91)

Federal Regulatory Limit: The MCL for methoxychlor is equal to the MCLG of 0.04 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 0.005 mg/kg/day

UF: 1000 (10 = inter-species; 10 = intra-species; 10 = steep dose-response curve and incompleteness of the database). **MF:** 1

Confidence in RfD: low

Critical Effects: Methoxychlor has produced effects in many organ systems when administered to animals at high doses, including the central nervous system, the kidney, the liver and the male reproductive system.

In a teratology study, female rabbits were dosed with 5.01, 35.5 or 251.1 mg/kg/day of methoxychlor during days 7 through 19 of gestation. Maternal toxicity was manifested as excessive loss of litters (abortions) and decreases in weight gain at the two highest doses. A NOAEL of 5.01 mg/kg/day was identified from this study (Kincaid Enterprises, Inc. 1986).

Cancer Assessment: D

The U.S. EPA has classified methoxychlor in U.S. EPA's Group D based upon a lack of human studies and inconclusive results in animal studies.

Class: insecticide

Analytical Information:

PQL: 0.01 mg/L

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Analytical Methods: 505; microextraction GC
508; GC/ECD
525; GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Kincaid Enterprises, Inc. 1986. MRID NO. 00139929. Available from U.S. EPA.

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METHYL ETHYL KETONE	CASRN: 78933	Update: May 2004

Current Massachusetts Regulatory Limit: ORSGL = 4.0 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for methyl ethyl ketone.

Basis for Criteria: The ORSGL is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 6×10^{-1} mg/kg/day (U.S. EPA, 2003)

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = database deficiency

MF: 1

Critical Effects: There is limited toxicological data available for methyl ethyl ketone (also known as 2-butanone), although there is sufficient data for its metabolic precursor, 2-butanol. The available pharmacokinetic and toxicological data support the use of 2-butanol as a surrogate for methyl ethyl ketone. Thus, the identification of the critical effect for methyl ethyl ketone is based on toxicological data for 2-butanol. The RfD is based on a multigenerational developmental and reproductive toxicity study in which rats were administered 2-butanol in drinking water. The results of the Cox *et al*. (1975) study demonstrate that the administration of 2-butanol in drinking water to rats at a concentration of 3% produced maternal toxicity accompanied by developmental effects, but did not affect reproductive performance (with the possible exception of effects on male rat copulatory success) (U.S. EPA, 2003). The critical effect was a decreased pup body weight. A NOAEL of 594 mg/kg/day was identified from this study. The lower 95% confidence limit on the effective dose associated with a 5% decrease in first generation pup (F1) body weight on postnatal day 21 (LED_{05}), a value of 639 mg/L was selected as the point of departure for the RfD (Cox, 1975).

Cancer Assessment: D

Data are inadequate for assessment of human carcinogenic potential.

Methyl ethyl ketone has yielded little or no evidence of mutagenicity. Structure Activity Relationship (SAR) analysis suggests that MEK is unlikely to be carcinogenic based on the absence of any structural characteristics indicative of carcinogenicity (U.S. EPA, 2003).

Class: VOC

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Analytical Information:

PQL: 10 µg/L

Analytical Methods: 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Cox, G.E., Bailey, DE and Morgareidge, K.. 1975. Toxicity studies in rats with 2-butanol including growth, reproduction and teratologic observation. Food and Drug Research Lab, Inc. Waverly, N.Y. Report No. 91MR1R1673.

U.S. EPA (U.S. Environmental Protection Agency). September 26, 2003. Integrated Risk Information System. Washington, D.C.. http://cfpub.epa.gov/ncea/iris/index.cfm.

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METHYL ISOBUTYL KETONE	CASRN: 108101	Update: February 1996

Current Massachusetts Regulatory Limit: ORSGL = 0.35 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for methyl isobutyl ketone. Listed in the January 1991 Drinking Water Priority List (Fed Reg, 1991).

Basis for Criteria: The ORSGL is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 5×10^{-2} mg/kg/day (U.S. EPA, 1988; U.S. EPA, 1991)

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = subchronic to chronic)

The reference dose has been withdrawn from IRIS.

Critical Effects: A NOAEL of 50 mg/kg/day was identified from a subchronic gavage study in rats (U.S. EPA, 1986). Critical effects of exposure to methyl isobutyl ketone include the liver and kidneys.

Cancer Assessment:

Under U.S. EPA's draft revised cancer guidelines (U.S. EPA, 1999), the data for methyl isobutyl ether are inadequate for an assessment of human carcinogenic potential. Both in vivo and in vitro genotoxicity studies of MIBK are overwhelmingly negative.

Class: VOC

Analytical Information:

PQL: 0.01 mg/L

Analytical Methods: 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 14, 1991. Drinking Water Priority List. (56 FR 1470).

U.S. EPA (U.S. Environmental Protection Agency). 1986. Subchronic toxicity of methyl isobutyl ketone in Sprague-Dawley rats. Office of Solid Waste. Washington, D.C..

U.S. EPA (U.S. Environmental Protection Agency). March 1988. Integrated Risk Information System (IRIS). Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm.

U.S. EPA (U.S. Environmental Protection Agency). January 1991. HEAST (Health Effects Assessment Summary Table). Office of Research and Development. Office of Emergency and Remedial Response.

U.S. EPA (U.S. Environmental Protection Agency). July 1999. Guidelines for Carcinogen Risk Assessment. Review Draft. NCEA-F-0644. Risk Assessment Forum.

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METHYL TERTIARY BUTYL ETHER	CASRN: 1634044	Update: October 1992

Current Massachusetts Regulatory Limit: ORSGL = 0.07 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for methyl tertiary butyl ether.

Basis for Criteria: The ORSGL is based on the RfD derived below and assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity are incorporated into the final value.

RfD: 0.1 mg/kg/day

UF: 1000 (10 = interspecies, 10= intraspecies; 10 = subchronic to chronic)

Critical Effects: Robinson *et al*. (1990) conducted an oral toxicity study in which Sprague-Dawley rats were exposed via gavage to MTBE. This study included fourteen-day (subacute) and ninety day (subchronic) components, which were well done, included controls, a sufficient numbers of animals of both sexes and an adequate number of endpoints. The authors of the study concluded that there were no significant pathophysiological changes observed at doses below those inducing anesthesia (1200 mg/kg). This observation would result in the identification of a NOAEL of 900 mg/kg. ORS chose the next lowest dose as the NOAEL (100 mg/kg) for two primary reasons: 1) a previous inhalation study done by Greenough *et al.* indicates that effects may be observed at lower doses and, 2) the study by Robinson *et al.* is the only available oral study.

Cancer Assessment: C (tentative)

Although ORS believes there is suggestive evidence that MTBE may be a possible human carcinogen, there is much uncertainty over the strength of the available data. ORS has therefore tentatively classified MTBE as a possible human carcinogen.

Class: Volatile Organic Compound

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Analytical Information:

PQL: 10 µg/L

Analytical Methods: 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Greenough, R.J., P. McDonald, P. Robinson *et al*. 1980. Methyl tertiary-butyl ether (Driveron) three-month inhalation toxicity in rats (unpublished material). Prepared for Chemische Werke Huls AG, West Germany, by Inversek Research International. TSCATS/303353. EPA/OTS No. 86-870000172.

Robinson *et al*. 1990. Fourteen and Ninety-Day Oral Toxicity Studies of Methyl Tertiary Butyl Ether in Sprague-Dawley Rats. J. Amer. Coll. Toxicol. 9:525-539.

Supporting Documentation for Drinking Water Standards and Guidelines

METOLACHLOR	CASRN: 51218452	Update: August 1993

Current Massachusetts Regulatory Limit: ORSGL = 0.1 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for metolachlor. Listed in the January 1991 Drinking Water Priority List (Fed Reg., 1991).

Basis for Criteria: The ORSGL is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. The ORSGL incorporates a relative source contribution of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity.

RfD: 1.5×10^{-1} mg/kg/day

UF: 100 (10 = intraspecies; 10 = interspecies) **MF:** 1

(U.S. EPA, 1993)

Critical Effects: In a 2-year study, Albino CD rats were fed 0, 30, 300 or 3,000 ppm (0, 1.5, 15 or 150 mg/kg/day) metolachlor. Effects noted included decreased body weight gain at the highest dose tested. A NOEL of 15 mg/kg/day was identified from this study. In a 2-generation reproductive study with Charles CD rats fed 1, 30, 300 or 1,000 ppm (0, 1.5, 15 or 50 mg/kg/day), a NOEL of 15 mg/kg/day was also identified based on reduced pup weight and reduced parental food consumption at the highest dose (Ciba Geigy Corporation, 1981; 1983).

Cancer Assessment: C

Metolachlor is currently classified as a class C Carcinogen. This classification is based on the appearance of liver lesions (combined neoplastic nodules and carcinomas) in female mice. No oral slope value is available (IBI, 1979).

Class: Pesticide

Analytical Information:

PQL: 0.001 mg/L

Analytical Methods: 597; gas chromatography

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Ciba Geigy Corporation. 1983. MRID No. 00063398, 00084005, 00129377, 00144364, 00158924. Available from U.S. EPA.

Ciba Geigy Corporation. 1981. MRID No. 00080897. Available from U.S. EPA.

Federal Register. January 14, 1991. Drinking Water Priority List (56 FR 1470).

IBI. Industrial Biotest Laboratories. 1979. Two year chronic oncogenicity oral toxicity study with metolachlor in albino rats. Cited in U.S. EPA 1993.

U.S. EPA (U.S. Environmental Protection Agency). 1993. Integrated Risk Information System (IRIS). Washington, D.C.. http://cfpub.epa.gov/ncea/iris/index.cfm.

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NAPHTHALENE	CASRN: 91203	Spring 2000

Current Massachusetts Regulatory Limit: ORSGL = 0.14 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for naphthalene.

Basis for Criteria: The ORSGL is based on an updated oral reference dose for naphthalene. The ORSGL is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution of 20% is incorporated into the final value.

RfD: 2×10^{-2} mg/kg/day

UF: 3000 (10 = intraspecies; 10 = interspecies; 10 = subchronic to chronic; 3 = database deficiencies including the lack of chronic oral exposure studies and 2-generation reproductive toxicity studies) **MF:** 1

(U.S. EPA, 1998)

Critical Effects: Noncancer effects produced in laboratory animals orally exposed to high doses of naphthalene for acute or subchronic periods of time include hemolytic anemia (in dogs) and cataracts (in rats and rabbits). Effects noted at lower doses included decreased body weight, central nervous system depression and organ weight changes. In developmental studies in which pregnant female rats were exposed via gavage, maternal toxicity was produced in the absence of fetal developmental toxicity (U.S. EPA, 2000).

In a 3-week study, Fischer 344 rats were exposed at dose levels of 0, 25, 50, 100 200 or 400 mg/kg for 5 days/week for 13 weeks. Decreased body weight was the most sensitive effect noted in this study. A NOAEL identified from this study (for a greater than 10% decrease in body weight) is 100 mg/kg/day (duration adjusted for 5/7 days to 71 mg/kg/day). This NOAEL for this critical effect was used for development of the RfD referenced above (U.S. EPA, 1998).

Cancer Assessment: The U.S. EPA has classified naphthalene as a C carcinogen (possible human carcinogen) under the 1986 Carcinogen Risk Assessment Guidelines, based on the inadequate data of carcinogenicity in humans exposed to naphthalene via the oral and inhalation routes, and the limited evidence of carcinogenicity in animals via the inhalation route (U.S. EPA, 2000). Benign respiratory tumors and one carcinoma were observed in female mice only exposed to naphthalene by inhalation (NTP, 1992). The fact that exposure to 1-methylnaphthalene produced an increase in respiratory tumors provides supportive evidence of carcinogenicity (U.S. EPA, 2000). Although the mechanism of carcinogenicity has not currently been fully determined, based on the many negative results obtained in mutagenicity tests, a genotoxic mechanism of action is probably not likely (U.S. EPA, 2000).

Class: Polycyclic Aromatic Hydrocarbon

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Analytical Information:

Analytical Methods: U.S. EPA Methods 502.2; 524.2; 550; 550.1; 610

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

U.S. EPA (U.S. Environmental Protection Agency). August 1998. Toxicological Review of Naphthalene (CAS No. 91-20-3) in Support of Summary Information on the Integrated Risk Information System (IRIS).

U.S. EPA (U.S. Environmental Protection Agency). 2000. Integrated Risk Information System (IRIS). Washington, D.C.. http://cfpub.epa.gov/ncea/iris/index.cfm.

NTP (National Toxicology Program). 1992. Technical Report on the Toxicology and Carcinogenesis Studies of Naphthalene (CAS No. 91-20-3) in B6C3F1 Mice. (Inhalation Studies). DHHS, PHS, NIH, Rockville, MD.

Supporting Documentation for Drinking Water Standards and Guidelines

NICKEL (soluble salts)	CASRN:	Update: March 1996

Current Massachusetts Regulatory Limit: ORSGL = 0.1 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for nickel.

Basis for Criteria: The ORSGL is derived assuming that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 0.02 mg/kg/day

UF: 300 (10 = interspecies; 10 = intraspecies; 3 = inadequacies in reproductive studies)
MF: 1 **Confidence in RfD:** Medium

(U.S. EPA, 1996)

Critical Effects: In a 2-year feeding study of rats exposed to nickel at 0, 100, 1000 or 2,500 ppm (0, 5, 50, and 125 mg Ni/kg bw), body weights in the high-dose male and female rats were significantly decreased compared with controls. A reduction in body weight was also noted at 50 mg/kg/day. This reduction was significant for females at week 6 and from weeks 26 through 104, and for males starting at 52 weeks. In addition, groups of females had significantly higher liver-to-body weight ratios at the 50 and 125 mg/kg/day dose levels. A NOAEL of 5 mg/kg/day was identified based on a lack of these effects at this dose level (Ambrose *et al*., 1976).

Cancer Assessment: D

The U.S. EPA has not evaluated soluble salts of nickel as a class of compounds for potential human carcinogenicity.

Class: Inorganic, heavy metal

Analytical Information:

PQL: 0.05 mg/L

Analytical Methods: 200.7 - Inductively coupled plasma
200.8 - ICP - MS
249.2 - Atomic absorption

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Ambrose, A.M.; D. S. Larson, J.R. Borzelleca; and G.R. Hennigan, Jr. 1976. Long-term toxicological assessment of nickel in rats and dogs. J. Food Sci. Tech. 13:181-187.

U.S. EPA (U.S. Environmental Protection Agency). 1996. Integrated Risk Information System (IRIS). Washington, D.C.. http://cfpub.epa.gov/ncea/iris/index.cfm.

Supporting Documentation for Drinking Water Standards and Guidelines

NITRATE (as N)	CASRN: 14797558	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL: 10 mg/L. ORS has adopted the MCL adopted by the U.S. EPA. Final - 1/30/91 (56 FR 3256: 1-30-91)

Federal Regulatory Limit: The MCL for nitrate is equal to the MCLG of 10 mg/L.

Basis for Criteria: Infants and small children are most susceptible to the effects of nitrate and nitrite. The MCLG is protective of infants and small children. The MCLG was derived based on the RfD presented below and assumes that a 4 kg infant ingests 0.64 L of formula per day (54 FR 22062).

RfD: 1.6 mg/kg/day

UF: 1 **MF:** 1

Chronic toxicity, developmental and reproductive toxicity were considered.

Critical Effects: Methemoglobinemia in infants.

Nitrate in the human body is reduced to nitrite. Nitrite binds to hemoglobin and is responsible for the formation of methemoglobin which decreases the oxygen carrying capacity of the blood.

The RfD is based on information described by Walton (1951) from a survey conducted by the American Public Health Association (APHA) to identify clinical cases of infantile methemoglobinemia that were associated with ingestion of nitrate-contaminated water. Of a total of 214 cases of methemoglobinemia for which data were available on nitrate levels in water, none occurred in infants consuming water containing <10 mg nitrate-nitrogen/L (1.6 mg nitrate-nitrogen/kg/day).

Cancer Assessment: U.S. EPA has classified nitrate as a Group D carcinogen based upon inadequate data in animals and humans. A risk assessment is underway for nitrate by the U.S. EPA.

Class: Inorganic

Supporting Documentation for Drinking Water Standards and Guidelines

Analytical Information:

PQL: 0.4 mg/L

Analytical Methods: U.S. EPA 353.3 Manual Cadmium reduction
U.S. EPA 353.1 Hydrazine Reduction
U.S. EPA 300 Ion Selective electrode

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Walton, G. 1951. Survey of literature relating to infant methemoglobinemia due to nitrate contaminated water. Am. J. Public Health. 41:986-996.

Supporting Documentation for Drinking Water Standards and Guidelines

NITRATE/NITRITE (total)	CASRN: N/A	Update: August 1992

Current Massachusetts Regulatory Limit: MMCL = 10 mg/L as the sum of nitrate and nitrite. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for nitrate/nitrite is equal to the MCLG of 10 mg/L.

Basis for Criteria: The MCLG for nitrate/nitrite is based on the potential for exposure to nitrate and nitrite greater than the MCLGs for the individual constituents to result in adverse health effects, in particular, methemoglobinemia. The value for the sum of nitrate and nitrite is established to be protective of infants and children.

Since both nitrate and nitrite result in methemoglobin toxicity, the toxicity of nitrate and nitrite may be additive. The joint standard was proposed to account for the possible additive toxicity of these two chemicals and also to protect against the deterioration of drinking water quality since the presence of nitrite in water is indicative of water contaminated with sewage. The combined standard does not replace the individual standards for nitrate and nitrite.

The individual MCLGs for nitrate and nitrite as well as the joint nitrate/nitrite MCLG were all derived based on the RfD presented below. Both the MCLGs for nitrate and nitrite were derived based on the RfD presented below and assuming that a 4 kg infant ingests 0.64 L of formula per day. Since the toxicity database for nitrite is much smaller than the toxicity database for nitrate and due to the demonstrated direct toxicity of this chemical, U.S. EPA applied an uncertainty factor of 10 to derive the nitrite MCLG (54 FR 22062). The joint standard is based on the consideration of data for the individual constituents.

RfD: 1.6 mg/kg/day

UF: 1 **MF:** 1

Chronic toxicity, developmental and reproductive toxicity were considered.

Critical Effects: Methemoglobinemia, especially in infants.

Nitrate in the human body is reduced to nitrite. Nitrite binds to hemoglobin and is responsible for the formation of methemoglobin, which decreases the oxygen carrying capacity of the blood.

The RfD is based on information described by Walton (1951) from a survey conducted by the American Public Health Association (APHA) to identify clinical cases of infantile methemoglobinemia that were associated with ingestion of nitrate-contaminated water. Of a total of 214 cases of methemoglobinemia for which data were available on nitrate levels in water, none occurred in infants consuming water containing <10 mg nitrate-

nitrogen/L (1.6 mg nitrate-nitrogen/kg/day).

Cancer Assessment: U.S. EPA has classified nitrate and nitrite as Group D carcinogens based upon inadequate data in animals and humans. A risk assessment is underway for these substances by the U.S. EPA.

Class: Inorganic

Analytical Information:

PQL: 0.4 mg/L

Analytical Methods:

300	ion selective electrode
353.1	automated hydrazine reduction
353.3	manual cadmium reduction

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Walton, G. 1951. Survey of literature relating to infant methemoglobinemia due to nitrate contaminated water. Am. J. Public Health. 41:986-996.

Supporting Documentation for Drinking Water Standards and Guidelines

NITRITE (as N)	CASRN: 14797650	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 1 mg/L (56 FR 3526: 1-30-91). ORS has adopted the MCL promulgated by the U.S. EPA.

Federal Regulatory Limit: Final. The MCL for nitrite is equal to the MCLG of 1 mg/L.

Basis for Criteria: Infants and small children are most susceptible to the effects of nitrate and nitrite. The MCLG is protective of infants and small children. The MCLG was derived based on the RfD developed for nitrate presented below and assumes that a 4 kg infant ingests 0.64 L of formula per day. Because the toxicity database for nitrite is much smaller than the toxicity database for nitrate and due to the demonstrated direct toxicity of this chemical, U.S. EPA is applying an uncertainty factor of 10 to derive an MCLG for nitrite of 1 mg/L (54 FR 22062).

RfD (for nitrate): 1.6 mg/kg/day

UF: 1 **MF:** 10

Chronic toxicity, developmental and reproductive toxicity were considered.

Critical Effects: Methemoglobinemia, especially in infants.

Nitrate in the human body is reduced to nitrite. Nitrite binds to hemoglobin and is responsible for the formation of methemoglobin which decreases the oxygen carrying capacity of the blood.

The RfD is based on information described by Walton (1951) from a survey conducted by the American Public Health Association (APHA) to identify clinical cases of infantile methemoglobinemia that were associated with ingestion of nitrate-contaminated water. Of a total of 214 cases of methemoglobinemia for which data were available on nitrate levels in water, none occurred in infants consuming water containing <10 mg nitrate-nitrogen/L (1.6 mg nitrate-nitrogen/kg/day).

Cancer Assessment: U.S. EPA has classified nitrite as a Group D carcinogen based upon inadequate data in animals and humans. A risk assessment is underway for nitrite by the U.S. EPA.

Class: Inorganic

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Analytical Information:

PQL: 0.4 mg/L

Analytical Methods: U.S. EPA 300 Ion chromatography
U.S. EPA 359.1 Spectrophotometric

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Walton, G. 1951. Survey of literature relating to infant methemoglobinemia due to nitrate contaminated water. Am. J. Public Health. 41:986-996.

Supporting Documentation for Drinking Water Standards and Guidelines

n-NITROSODIMETHYLAMINE (NDMA)	CASRN: 62759	Update: May 2004

Current Massachusetts Regulatory Limit: ORSGL = 0.00001 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for n-Nitrosodimethylamine (NDMA).

Basis for Criteria: The ORSGL is based on the analytical practical quantitation limit (PQL) for this chemical in water. This PQL has been identified by the state of California as the concentration of NDMA that most analytical laboratories are capable of detecting in drinking water.

Critical Effects: NDMA has been found to be carcinogenic in all experimental animals tested. NDMA produces liver tumors after oral administration in rats and tumors in lung, liver and kidney after inhalation exposures in rats and mice. It is a transplacental carcinogen when administered via various routes to pregnant mice, rats and hamsters. It is also mutagenic and is structurally related to known carcinogens. Since this chemical has consistently been found to be a potent carcinogen, and it is expected that this endpoint is the most sensitive effect, the focus of animal studies has been carcinogenicity. As a result, other non-cancer endpoints have not been well studied and available data are considered inadequate as a basis for their characterization (WHO, 2002). Non-cancer effects observed in these studies include liver toxicity, kidney effects, internal bleeding and death especially associated with acute exposures to high doses but also associated with longer-term exposure to low doses (WHO, 2002; ATSDR, 1989).

Cancer Assessment: B2 (by the old U.S. EPA carcinogen classification system). Under U.S. EPA's Proposed Guidelines for Carcinogen Risk Assessment (U.S. EPA, 1999), this classification would correspond to the descriptor "likely to be carcinogenic to humans".

Class: Organic

Analytical Information:

PQL: 0.00001 mg/L

Analytical Methods: Gas chromatographic/mass spectrometric methods offer the most sensitive and definitive measurement systems for analysis of NDMA in the low ng/L range. High-resolution electron impact mass spectrometry, and low-resolution chemical ionization (using ammonia, methanol, etc.) or other mass spectrometric techniques with equivalent sensitivity are acceptable (CDHS, 2003).

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may

be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

ATSDR (Agency for Toxic Substances and Disease Registry). December 1989. Toxicological Profile for N-Nitrosodimethylamine. U.S. Public Health Service (in collaboration with U.S. Environmental Protection Agency).

CDHS (California Department of Health Services). May 16, 2003 (Last Update). NDMA Laboratory Analyses. General Considerations, Acceptable Analytical Approaches, Laboratories Capable of Low-Level analyses for NDMA. Available on the Internet at http://www.dhs.ca.gov/ps/ddwem/chemicals/NDMA/NDMAlabs.htm.

U.S. EPA (U.S. Environmental Protection Agency). July 1999. Guidelines for Carcinogen Risk Assessment. Review Draft. NCEA-F-0644. Risk Assessment Forum.

WHO (World Health Organization). 2002. Concise International Chemical Assessment Document 38: N-Nitrosodimethylamine. (first draft: R.G. Liteplo and M.E. Meek, Health Canada, Ottawa, Canada and W. Windle, Environment Canada, Ottawa, Canada.) Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals. Geneva.

Supporting Documentation for Drinking Water Standards and Guidelines

OXAMYL (Vydate)	CASRN: 23135220	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.2 mg/L. ORS adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for oxamyl (vydate) is equal to the MCLG of 0.2 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into this value.

RfD: 0.025 mg/kg/day

UF: 100 (10 = interspecies; 10 = intraspecies) **MF:** 1
Confidence in RfD: Medium

Critical Effects: Oxamyl is a cholinesterase inhibitor. Clinical signs of acute poisoning include tremors, salivation and lacrimation. The principal adverse effect noted in animal studies is a decrease in body weight.

Groups of 36 weanling rats of each sex were given doses of 0, 2.5, 5.0 and 7.5 mg/kg in the diet daily for two years. Significant decreases in body weight occurred in both males and females at the two highest doses. A NOAEL of 2.5 mg/kg/day was identified from this study (55 FR 30370).

Cancer Assessment: E

The U.S. EPA does not consider oxamyl to be carcinogenic based on evidence from two available studies with rats and mice. U.S. EPA has classified oxamyl in Group E (i.e., no evidence of carcinogenicity).

Class: Pesticide

Analytical Information:

PQL: 0.02 mg/L

Analytical Methods: U.S. EPA 531.1 Derivitization/gas chromatography

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370).

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

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PENTACHLOROPHENOL	CASRN: 87865	Update: March 1993

Current Massachusetts Regulatory Limit: MMCL = 0.001 mg/L. ORS has adopted the MCL published by the U.S. EPA (50 FR 46936; 56 FR 3526).

Federal Regulatory Limit: The MCL for pentachlorophenol is set at the PQL of 0.0005 mg/L. The MCLG is equal to zero.

Basis for Criteria: An MCLG of zero has been established for pentachlorophenol based on its designation as a B2 carcinogen. The MCL is based on the pentachlorophenol PQL.

Critical Effects: The U.S. EPA currently classifies pentachlorophenol as a class B2 carcinogen. The MCLGs for B2 carcinogens are set at zero and the MCL is set as close to the MCLG as is feasible or at the 1×10^{-6} excess lifetime cancer risk. For pentachlorophenol, the PQL is the limiting factor and thus the MCL is set at the PQL of 0.001 mg/L.

Cancer Assessment: The cancer classification is based on limited evidence of increased incidence of biologically significant tumor types (hepatocellular adenomas, and carcinomas, adrenal medulla pheochromocytomas and malignant pheochromocytomas, hemangiosarcomas and hemangiomas) in mice. There was also a high incidence of two unusual tumor types, hemangiomas/hemangiosarcomas and adrenal medulla pheochromocytomas. There are mutagenicity data to support the cancer classification.

The MCL of 0.001 mg/L is associated with an individual excess lifetime cancer risk* of 3.3 in one million (56 FR 3526).

Class: Semivolatile; Chlorine substituted phenol

Analytical Information:

PQL: 0.001 mg/L

Analytical Methods: U.S. EPA 515.1 Electron Capture GC
U.S. EPA 525 GC/MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Schwetz, B.A., J.F. Quast, P.A. Keelev, C.G. Humiston and R.J. Kociba. 1978. Results of 2-year toxicity and reproduction studies on pentachlorophenol in rats. In: Pentachlorophenol: Chemistry, Pharmacology and Environmental Toxicology, K.R. Rao, Ed. Plenum Pub. NY. P. 301.

*This information on risk is extrapolated from information provided in the July 7, 1992 Federal Register that a 1 x 10^{-4} Excess Lifetime Cancer Risk (ELCR) is associated with a concentration of 0.03 mg/L.

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PERCHLORATE	CASRN: Various CASRN numbers for different chemical species	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = 0.002 mg/L. The ORS MMCL for perchlorate is directed at the sensitive subgroups of pregnant women, infants, children up to the age of 12, and individuals with hypothyroidism. They should not consume drinking water containing concentrations of perchlorate exceeding 0.002 mg/L. It is recommended that no one consume water containing perchlorate concentration greater than 18 mg/L.

Federal Regulatory Limit: The U.S. EPA has not published an MCL for perchlorate.

Basis for Criteria: ORS developed a health-based ORS MMCLG (Massachusetts Maximum Contaminant Level Goal) for perchlorate of 0.49 mg/L based on the RfD derived by ORS of 0.00007 mg/kg/day. The RfD was based on iodide uptake inhibition in healthy, iodine-sufficient adult subjects. The calculation assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 0.00007 mg/kg/day (MassDEP, 2004)

UF: 300 **MF:** 1

AN MMCL of 0.002 mg/L was identified based on feasibility and cost considerations. Perchlorate has been found to be a byproduct of the drinking water disinfection process and thus may be present in treated waters at low concentration. As is typically done with drinking water contaminants that are present in water a result of treatment to address pathogens, comparative risks were considered in establishing the MMCL of 0.002 mg/L. Other considerations included the analytical feasibility of detecting low levels and the cost considerations of cleanup.

Critical Effects: Perchlorate disrupts normal function of the thyroid gland. It interferes with iodide transport into the thyroid gland, decreasing the availability of iodide needed for the synthesis of thyroid hormones, which are essential for metabolism and normal growth and development. The effects caused by perchlorate are expected to be similar to those caused by iodine deficiency in humans, including impairment in physical development, behavior, movement, speech, hearing, vision and intelligence. Other possible symptoms include hypothyroidism, enlargement of the thyroid gland, and impaired brain development and lower IQ in children. The greatest impacts of perchlorate exposure are on pregnant women, developing fetuses, infants, children and individuals with low levels of thyroid hormones. Rats and mice chronically exposed to high concentrations of perchlorate produced thyroid tumors (Pajer and Kalisnik, 1991; Kessler and Kruskemper, 1966; Argus Research Laboratories, Inc., 1999). A number of genotoxicity assays have indicated that perchlorate is not mutagenic, suggesting a non-genotoxic mechanism of carcinogenesis.

Cancer Assessment: The U.S. EPA has not classified perchlorate under either the old U.S. EPA carcinogen classification system or under their Proposed Guidelines for Carcinogen Risk Assessment (U.S. EPA, 1999a). Using the 1999 proposed guidelines, ORS would tentatively classify perchlorate as having suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential.

Class: Inorganic

Analytical Information:

PQL: Less than 0.001 mg/L

Analytical Methods: U.S. EPA Method 314.0, revision 1.0 (U.S. EPA, 1999b)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Argus Research Laboratories, Inc. 1999. Oral (drinking water) two-generation (one litter per generation) reproduction study of ammonium perchlorate in rats. Protocol no. 1416-001. Argus Research Laboratories, Inc., Horsham, PA.

Greer MA, Goodman G, Pleus RC, and Greer SE. 2002. Health effects assessment for environmental perchlorate contamination: The dose-response for inhibition of thyroidal radioiodine uptake in humans. Environ Health Perspect. 110:927-37.

Kessler, F.J., Kruskemper, H.J. 1966. Experimentelle Schilddrusentumoren durch mehrjahrige Zufuhr von Kaliumperchlorat. [Experimental thyroid tumors caused by long-term administration of potassium perchlorate.] Klin Wochenschr. 44:1154-1156.

MassDEP (Massachusetts Department of Environmental Protection). May 2004. Perchlorate Toxicological Profile and Health Assessment. Office of Research and Standards. Boston, MA.

Pajer, Z., Kalisnik, M. 1991. The effect of sodium perchlorate and ionizing radiation on the thyroid parenchymal and pituitary thyrotropic cells. Oncology. 48:317-320.

U.S. EPA (U.S. Environmental Protection Agency). July 1999a. Guidelines for Carcinogen Risk Assessment. Review Draft. NCEA-F-0644. Risk Assessment Forum.

U.S. EPA (U.S. Environmental Protection Agency). November 1999b. Method 314.0, Determination of Perchlorate in Drinking Water Using Ion Chromatography.

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PETROLEUM HYDROCARBONS	CASRN: Various CASRN numbers for different chemical species	Update: May 2004

Current Massachusetts Regulatory Limit: Carbon number fraction-specific ORSGLs are presented below:

Aliphatics (mg/L)		Aromatics (mg/L)	
C5-C8	0.3	**C9-C10**	0.2
C9-C12	0.7	**C11-C22**	0.2
C9-C18	0.7		
C19-C36	14.0		

Federal Regulatory Limit: The U.S. EPA has not published an MCL for petroleum hydrocarbon as a class.

Basis for Criteria: The ORSGLs for petroleum hydrocarbons were originally based on the approach described in the Interim Final Petroleum Report: Development of Health-Based Alternative to the Total Petroleum Hydrocarbon Parameter (MassDEP, 1994). This approach essentially grouped the list of component chemicals in petroleum by carbon number (i.e., carbon number fraction) and designated a "reference compound" for each range of compounds usually chosen because its toxicity is relatively well characterized. For each reference compound, a U.S. EPA oral Reference Dose (RfD) was identified or, for reference compounds without U.S. EPA published values, an oral dose-response value was developed from available toxicity information.

An update to the toxicity values was published in November 2003 (MassDEP, 2003). The updated values were used to derive the current ORSGLs. The updated derivation uses toxicity studies on mixtures corresponding to these fractions to develop these fraction-specific values.

The toxicity values are used together with standard drinking water assumptions (a 70-kg adult drinks 2 liters of water per day) to back-calculate fraction-specific drinking water guidelines.

Critical Effects: Petroleum is composed of a large number of constituents, each of which is characterized by a separate toxicology. In general, acute exposure to hydrocarbons at high concentrations affect the central nervous system and with such symptoms as lethargy, confusion, headache, dizziness and nausea. Information on chronic exposures and effects is limited for many constituents, although a number of petroleum constituents have been well-studied. Chronic effects noted among a range of constituents include effects on the liver, kidney, blood, nervous system and testis.

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Cancer Assessment: U.S. EPA has identified cancer slope factors for only two compounds, including benzene and benzo(a)pyrene (B(a)P), although U.S. EPA considers a number of other compounds to be carcinogenic as well. For additional information on the carcinogenicity of petroleum hydrocarbons, please consult ORS.

Class: petroleum hydrocarbons

Analytical Information:

Please refer to MassDEP (2004a, 2004b) for information regarding the analysis of petroleum hydrocarbon fractions.

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

References:

MassDEP (Massachusetts Department of Environmental Protection). August 1994. Interim final petroleum report: development of health-based alternative to the total petroleum hydrocarbon (TPH) parameter. Office of Research and Standards and ABB Environmental Services. Boston, MA.

MassDEP (Massachusetts Department of Environmental Protection). 2003. Updated petroleum hydrocarbon fraction toxicity values for the VPH/EPH/APH methodology. Final report. Office of Research and Standards. Boston, MA.

MassDEP (Massachusetts Department of Environmental Protection). 2004a. Method for the Determination of Volatile Petroleum Hydrocarbons (VPH). Rev 1.1. Bureau of Waste Site Cleanup. Massachusetts Department of Environmental Protection. Boston, MA.

MassDEP (Massachusetts Department of Environmental Protection). 2004b. Method for the Determination of Extractable Petroleum Hydrocarbons (EPH). Rev 1.1. Bureau of Waste Site Cleanup. Massachusetts Department of Environmental Protection. Boston, MA.

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PICLORAM	CASRN: 1918021	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.5 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL for picloram is equal to the MCLG of 0.5 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 7×10^{-2} mg/kg/day

UF: 100 (10 = interspecies; 10 = intraspecies)
MF: 1 **Confidence in RfD:** Medium

Critical Effects: Acute exposure to picloram for relatively short periods of time at levels above the MCL could result in damage to the central nervous system, weakness, diarrhea and weight loss. Chronic lifetime exposure to concentrations above the MCL may produce liver damage.

Reduced food consumption and reduced body weight were observed at 175 mg/kg/day in a dog study in which male and female dogs (6/sex/group) were fed diets containing 0, 7, 35, or 175 mg/kg/day of picloram. Increased absolute and relative liver weights were also noted at 35 mg/kg/day in males and 175 mg/kg/day in males and females. Elevated serum alkaline phosphatase was also noted at 175 mg/kg/day. The RfD was based on a NOEL of 7 mg/kg/day (U.S. EPA, 1992).

Cancer Assessment: D

There is inadequate evidence to state whether or not picloram has the potential to cause cancer from a lifetime exposure in drinking water.

Class: Chlorinated organic

Analytical Information:

PQL: 0.001 mg/L

Analytical Methods: U.S. EPA Methods 515.1; 515.2; 555

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

U.S. EPA (U.S. Environmental Protection Agency). May 1, 1992. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. Washington, D.C. http://cfpub.epa.gov.ncea/iris/index.cfm.

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POLYCHLORINATED BIPHENYLS (PCBs)	CASRN: 1336363	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.0005 mg/L. ORS has adopted the MCL published by the U.S. EPA (56 FR 3256: 1/30/91).

Federal Regulatory Limit: Final. The MCL for polychlorinated biphenyls (PCBs) is set at the PQL of 0.0005 mg/L. The MCLG is set at zero based on carcinogenic effects.

Basis for Criteria: An MCLG of zero is assigned for PCBs based on the evidence for carcinogenic potential. The MCL is based on the PCB PQL.

Critical Effects: The U.S. EPA currently classifies PCBs as a group B2 carcinogen. There are 209 PCB isomers but they are regulated as a group. As a group B2 carcinogen, the MCLG for PCBs is set at zero. The MCL for group B2 carcinogens is set at a level as close to zero or at an extra risk level of 1×10^{-6} as is feasible. The MCL is based on the PQL for PCBs.

Cancer Assessment: B2

Rats and mice fed PCBs (Arochlor 1260) in their diets for two years developed neoplastic nodules and hepatocellular carcinomas. Based on positive results in rats and mice, U.S. EPA has classified PCBs as Group B2 carcinogen (i.e., sufficient animal evidence and inadequate human evidence).

The MCL of 0.0005 mg/L is associated with an individual excess lifetime cancer risk of one in ten thousand (1×10^{-4}).

Analytical Information:

PQL: 0.0005 mg/L

Analytical Methods: U.S. EPA 505 microextraction/GC
U.S. EPA 508 electron capture/GC
U.S. EPA 508A perchlorination/GC

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

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Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

Class: Synthetic Organic Chemicals

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

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RADIUM 226 and 228	CASRN: 7440144	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = 5 pCi/L. ORS has adopted the MCL published by the U.S. EPA (65 FR 76708).

Federal Regulatory Limit: The MCL for radium 226 and 228 is 5 pCi/L.

There is no MCLG for Radium 226 and 228 since MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act.

Basis for Criteria: U.S. EPA has retained the MCL of 5 pCi/L proposed when the radionuclides rule was first promulgated in 1976. In 1991, new, higher MCLs were proposed for these isotopes. However, a more current risk analysis, conducted based on new data contained in the U.S. EPA Federal Guidance Report-13, indicated that the risks associated with these higher proposed MCLs were well above the U.S. EPA target excess lifetime risk (ELCR) range of 10^{-6} – 10^{-4}. Thus, the MCL for both radium isotopes together is finalized as 5 pCi/L, which brings the risk associated with this MCL within U.S. EPA's target ELCR range for carcinogens.

Critical Effects: Radium 226 and 228 emit alpha radiation. All alpha radiation is considered to have the potential to cause cancer as a result of its interaction with genetic material. A number of human epidemiological studies indicate increasing risks of various types of cancer associated with increasing doses of ionizing radiation. The cancers produced by radiation cover the full range of carcinomas and sarcomas. Every form of cancer has been shown to be induced by radiation (56 FR 33050).

Cancer Assessment: Group A

Bone sarcomas and head carcinomas were seen in workers (e.g., radium dial painters) occupationally exposed via ingestion to paints containing radium-226. Similar findings were seen with radium-228 exposures, although head carcinomas are not believed to be associated with ingestion of radium-228. Supporting studies for these findings include a number of other studies, in which humans or animals injected with various radium isotopes had an increased incidence of cancer.

Class: Radionuclide

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Analytical Information:

PQL: (radium-226) 1 pCi/L
(radium-228) 1 pCi/L

Analytical Methods: U.S. EPA 903.0; radiochemical
U.S. EPA 904.0; radiochemical
U.S. EPA 903.1; radon emanation

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. December 7, 2000. Part II. Environmental Protection Agency. Parts 9, 141, and 142. National Primary Drinking Water Regulations; Radionuclides; Final Rule. (65 FR 76708).

Federal Register. April 21, 2000. Part IV. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Radionuclides; Notice of Data Availability; Proposed Rule. (65 FR 21576).

Federal Register. July 18, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Radionuclides; Proposed Rule. (56 FR 33050).

U.S. Environmental Protection Agency. September 1999. Cancer Risk Coefficients for Environmental Exposure to Radionuclides. Federal Guidance Report No. 13. Air and Radiation. U.S. EPA-402-R-99-001.

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RADON-222	CASRN: 14859677	Update: March 2007

Current Massachusetts Regulatory Limit: ORSGL = 10,000 pCi/L.

The ORSGL is actually an "Action Limit". When concentrations of Rn-222 in water equal or exceed the Action Limit of 10,000 pCi/l, indoor air should be tested (see paper written by K. Martin and C.R. West; March, 1987).

Federal Regulatory Limit: The U.S. EPA has not published a final MCL for radon-222. The U.S. EPA proposed an MCL of 300 pCi/l on 7/18/91 [56 FR 33050]. This value is equal to the practical quantitation limit and is associated with an ELCR of 2×10^{-4}. In 1994, the U.S. EPA provided a report to Congress on the multimedia risks from exposure to radon. It then withdrew the proposed MCL in 1997. In 1999 (64 FR59246) the U.S. EPA proposed a multimedia approach for reducing radon risk in indoor air while protecting public health from the highest levels of radon in drinking water. A 4000 pCi/L option was proposed for states where multimedia radon mitigation programs were implemented; otherwise a 300 pCi/L limit was to apply. This proposal has not been finalized as of 2007.

Basis for Criteria: Review of exposure studies of radon in water indicates that for a given concentration of radon in water, the dose to the lung outweighs the dose to the stomach by three to twelve times. Lung cancer is the main health effect attributed to radon and its progeny. The action level of 10,000 pCi/L is based on considerations of the distribution of background radon concentrations in the U.S. A waterborne radon concentration of 10,000 pCi/L would not be expected to contribute to an indoor air radon progeny level in excess of normal background levels (Martin and West, 1987).

Critical Effects: Radon 222 is a naturally occurring element. Upon nuclear decay, alpha particles are emitted from the decaying nucleus. Alpha particles are considered carcinogenic and therefore human exposures should be limited.

Cancer Assessment: The cancer assessment for radon has been withdrawn.

Class: Radionuclide

Analytical Information:

PQL: 300 pCi/L

Analytical Methods: U.S. EPA 913; liquid scintillation

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 18, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Radionuclides; Proposed Rule. (56 FR 33050).

Martin, K.A. and West, C.R.. March 1987. Interim action limit for radon in drinking water. Office of Research and Standards. Massachusetts Department of Environmental Protection.

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SELENIUM	CASRN: 7782492	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL: 0.05 mg/L. ORS has adopted the MCL published by the U.S. EPA (56 FR 3256 (1/30/91).

Federal Regulatory Limit: The MCL of 0.05 mg/L is equal to the MCLG of 0.05 mg/L.

Basis for Criteria: The MCLG is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of about 40% (estimated from human intake data as described below) is incorporated into the final value.

RfD: 3×10^{-3} mg/kg/day*

UF: 15 **MF:** 1

Since selenium is an essential element, U.S. EPA feels that applying an uncertainty factor of 100 or greater to the LOAEL cannot be justified as it would result in a value below that considered safe and adequate by the National Academy of Science (NAS) (i.e., 0.05 mg/day) and thus may not protect against adverse effects resulting from selenium deficiency. The factor of 15 is judged to provide a balance between the potential deficiency and toxicity effects of selenium (54 FR 22062).

Based on the above RfD, a total acceptable selenium intake per day for a 70 kg adult may be calculated as 0.003 mg/kg/day x 70 kg, or approximately 0.210 mg/day. As discussed below, dietary selenium intake is 0.125 mg/day. Since it is assumed that exposure to selenium via inhalation is zero, by subtraction, 0.210 mg/day – 0.125 mg/day leaves about 0.085 mg/day. The ratio 0.85 mg/day/0.210 mg/day is approximately equal to 40%.

Critical Effects: Selenium is toxic at high doses and is an essential element in the low dose range. In animals, a level of 0.1 mg selenium per kg food has been considered to be the general level of dietary requirement (56 FR 3526). The NAS (1989) has determined a recommended daily allowance for selenium of 55 and 70 mg/day for North American females and males, respectively. Dietary intake of selenium in the United States is approximately 0.125 mg/person/day.

Signs of selenium toxicity (selenosis) include liver dysfunction, hair and nail loss.

A human study examined selenium toxicity and deficiency effects in an area of China with unusually high environmental concentrations of selenium. The minimum daily intake in an area of chronic selenosis was 3.2 mg. This level was identified as the LOAEL of this study (Yang *et al*., 1983). In a subsequent study also conducted in China, the same investigators also propose that 0.400 mg selenium per person per day is a maximal daily intake of selenium (Yang *et al*., 1989).

Cancer Assessment: D

Data are currently inadequate in both animals and humans for the classification of selenium as a carcinogen.

Class: Inorganic, heavy metal

Analytical Information:

PQL: 0.01 mg/L

Analytical Methods: U.S. EPA 270.2; Atomic absorption spectrophotometry

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

NAS (National Academy of Sciences). 1989. Recommended Dietary Allowances, 10th ed. National Academy Press, Washington, DC. p. 217-224.

Yang, G., *et al*., 1983. Endemic Selenium Intoxication of Humans in China. American Journal of Clinical Nutrition. 37:872-881.

Yang, G., S. Yin, R. Zhou, et. al. 1989. Studies of safe maximal daily dietary Se-intake in a seleniferous area in China II. Relation between Se-intake and the manifestation of clinical signs and certain biochemical alterations in blood and urine. J. Trace Elem. Electrolytes Health Disc. 3(2):123-130.

*This RfD was derived from the information used to derived the Adjusted Acceptable Daily Intake (AADI) value of 0.106 mg/L. In the first step of this derivation, a LOAEL of 3.2 mg/kg/day was divided by an uncertainty factor of 15 to get an allowable dose in mg/day. To express this dose in mg/kg/day (thus analogous to the definition of an RfD), this value was divided by a default body weight of 70 kg.

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SIMAZINE	CASRN: 122349	August 1993

Current Massachusetts Regulatory Limit: MMCL = 0.004 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V Rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: The MCL is equal to the MCLG of 0.004 mg/L.

Basis for Criteria: The MCLG is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. The MCLG incorporates a relative source contribution factor of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity (55 FR 30370).

RfD: 5×10^{-3} mg/kg/day

UF: 100 (10 = interspecies; 10 = intraspecies)

MF: 1 **Confidence in RfD:** High

Critical Effects: Acute exposure to simazine for relatively short periods of time at levels above the MCL could result in weight loss and changes in blood. Chronic lifetime exposure to concentrations above the MCL may result in tremors; damage to testes, kidneys, liver and thyroid; gene mutations; and cancer.

A NOAEL of 0.5 mg/kg/day was identified from a two-year chronic feeding study in which rats were given 0, 10, 100 or 1000 ppm (corresponding to 0, 0.4, 4.2 or 45.8 mg/kg/day for males and 0, 0.05, 5.3 or 63.1 mg/kg/day for females) simazine in the diet. Significant reductions in body weight gain and hematology parameters were observed in females at 100 ppm. This NOAEL is supported by a one-year feeding study in which dogs were fed 0, 20 100 or 1250 ppm in the diet. A NOAEL of 20 ppm (corresponding to a dose of 0.7 mg/kg/day) was identified from this study. The NOAEL of 0.5 mg/kg/day from the rat study was used as the basis for the RfD above.

Cancer Assessment: C

U.S. EPA has classified simazine as a Group C carcinogen based on the presence of limited or equivocal evidence of carcinogenicity in animals in the absence of human data. Simazine has been found to produce mammary tumors in female rats. This classification is supported by the fact that both atrazine and propazine, two similar compounds also cause mammary tumors in the rat (55 FR 30370).

A carcinogenic potency for simazine of 1.2×10^{-1} was developed based on the incidence of mammary gland tumors in female Sprague Dawley rats. The MCLG of 0.004 mg/L corresponds to the theoretical cancer risk level of 1×10^{-5} (57 FR31776).

Class: Pesticide

Analytical Information:

PQL: 0.001 mg/L

Analytical Methods: U.S. EPA Methods 505; 507; 508.1; 525.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

McCormick, GC, Arthur, AT and Green, JD. Ciba-Geigy Corporation. 1988. Simazine-technical: 104-week oral chronic toxicity and carcinogenicity study in rats. MRID Number: 406144-05. Study Number 2-0011-09. Testing Facility: Pharmaceuticals Division , Summit, NJ.

McCormick, GC and Green, JD. Ciba-Geigy Corporation. 1988b. Simazine-technical: A 52-week oral feeding study in dogs. MRID Number: 406144-02. Study Number: 87122. Testing Facility: Pharmaceuticals Division, Summit, NJ.

Supporting Documentation for Drinking Water Standards and Guidelines

SODIUM	CASRN: 7440235	Update: March 1994

Current Massachusetts Regulatory Limit: ORSGL = 20 mg/L

Federal Regulatory Limit: The U.S. EPA has not published an MCL for sodium.

Basis for Criteria: The ORSGL is not a health-based concentration. The origin of this number comes from the US FDA's approach for labeling bottled waters for their sodium content, which uses 5 mg or less per 8 oz serving to indicate that water is virtually sodium free; 35mg or less per serving or 197 mg/L is considered to be very low sodium; and 140 mg of sodium per serving or 789 mg/L is considered to be low sodium.

The 5 mg mass limit can be expressed on the basis of different water serving sizes to give two different concentrations:

- 5 mg of sodium per 6 oz serving yields 28 mg/L.
- 5 mg of sodium per 8 oz serving yields 20 mg/L.

The Massachusetts sodium guideline is based on an 8 oz serving size (MassDEP, 1992).

Critical Effects: Hypertension at very high concentrations

Cancer Assessment: N/A

Class: Metal

Analytical Information:

PQL: See specific method as listed below.

Analytical Methods: U.S. EPA Method 200.7 (inductively coupled plasma)
SM Method 3111B (atomic absorption (direct aspiration))
(U.S. EPA, 1994)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Supporting Documentation for Drinking Water Standards and Guidelines

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

MassDEP (Massachusetts Department of Environmental Protection). 1992. Review of the Current Sodium Standard. Memorandum dated July 30, 1992 from Nick Anastas, ORS to Julie Smith, DWS. Office of Research and Standards.

U.S. EPA. (U.S. Environmental Protection Agency). May 1994. Methods for the determination of metals in environmental samples-supplement. EPA/600/R-94/111.

Supporting Documentation for Drinking Water Standards and Guidelines

STYRENE	CASRN: 100425	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL: 0.1 mg/L. ORS has adopted the MCL published by the U.S. EPA 56 FR 3526 (1/30/91).

Federal Regulatory Limit: The MCL for styrene is equal to its MCLG of 0.1 mg/L. A secondary MCL of 0.01 mg/L has been proposed (45 FR 22062; 56 FR 3526).

Basis for Criteria: The MCLG is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. The MCLG incorporates a relative source contribution factor of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity.

RfD: 2×10^{-1} mg/kg/day

UF: 1000 (10 intraspecies; 10 interspecies; 10 subchronic to chronic) **MF:** 1

Critical Effects: The RfD for styrene is based on a subchronic study by Quast *et al*., (1979) where beagle dogs were exposed to styrene by gavage at 0, 200, 400 or 600 mg/kg/d in peanut oil 7 days per week for up to 561 days. The effects included red blood cell and liver effects. A NOAEL of 200 mg/kg/d was determined from this study.

Cancer Assessment:

The current cancer status of styrene is currently under review by U.S. EPA and the Scientific Advisory Board (SAB). For more information - refer to discussion in May 1989 Fed. Reg. Vol. 54, No. 97 and January 30, 1991 Fed. Reg. Vol. 56, No. 20.

U.S. EPA presented arguments to the SAB that styrene should be designated a B2 carcinogen whereas the SAB maintained that the weight of evidence for styrene only supports a group C classification under the U.S. EPA's classification system. The evidence for styrene is based on upon several positive animal studies via inhalation that are limited due to poor survival of the animals. There is currently no adequately conducted drinking water study for styrene.

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA Methods 503.1, 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may

be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Quast, J.F., C. A. Humiston, R.Y. Kalmins, et. al. 1979. Results of a toxicity study of monomeric styrene administered to beagle dogs by oral intubation for 19 months. Toxicology Research Laboratory, Health and Environmental Sciences, Dow Chemical Co., Midland, MI. Final Report.

Supporting Documentation for Drinking Water Standards and Guidelines

TERTIARY BUTYL ALCOHOL (TBA)	CASRN: 75650	Update: April 2006

Current Massachusetts Regulatory Limit: ORSGL = 0.12 mg/L.

Federal Regulatory Limit: No MCL available

Basis for Criteria: The ORS guideline for TBA was derived based on the RfD (presented below) derived by ORS for this chemical and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity are incorporated into the final value.

RfD: 0.175 mg/kg/day (MassDEP, 2006)

UF: 1000 (10 = LOAEL to NOAEL; 10 = interspecies; 10 = intraspecies) **MF:** 1

Critical Effects: Inhalation of high concentrations of TBA at prolonged exposures may produce transient effects on the central nervous system, as well as eye and mucous membrane irritation. Subchronic exposure studies have indicated that the urinary tract is the primary target system of TBA. Chronic exposure studies have also indicated adverse effects on the kidney, urinary bladder and thyroid gland.

In a 2-year chronic drinking water study conducted by NTP (NTP, 1995; Cirvello *et al*., 1995), TBA was administered to rats and mice using 60 animals per dose at doses of 0, 1250, 2500 or 5000 ppm (male rats); 0, 2500, 5000 or 10,000 ppm (female rats); and 1, 5000, 10,000, or 20,000 ppm (male and female mice). In female rats, the lowest concentration of 2500 ppm produced nephropathy and is a LOAEL for this effect. The concentration of 2500 ppm results in a dose of approximately 175 mg/kg/day (Cirvello *et al*., 1995). All exposure doses produced nephropathy in a dose-dependent manner in the female rat (MassDEP, 2006).

Cancer Assessment: The U.S. EPA has not classified TBA under either the old U.S. EPA carcinogen classification system or under their Proposed Guidelines for Carcinogen Risk Assessment (U.S. EPA, 1999a). Using the 1999 proposed guidelines, ORS would tentatively classify TBA as having suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential.

Class: Volatile Organic Compound

Supporting Documentation for Drinking Water Standards and Guidelines

Analytical Information:

PQL: 50 µg/L

Analytical Methods: U.S. EPA Method 8260 and 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Cirvello, J. D.; Radovsky, A.; Heath, J. E.; Farnell, D. R., and Lindamood, C. 3rd. Toxicity and carcinogenicity of t-butyl alcohol in rats and mice following chronic exposure in drinking water. Toxicol Ind Health. 1995 Mar-1995 Apr 30; 11(2):151-65.

NTP (National Toxicology Program). May 1995. NTP Toxicology and Carcinogenesis Studies of t -Butyl Alcohol (CAS No. 75-65-0) in F344/N Rats and B6C3F1 Mice (Drinking Water Studies).

Massachusetts Department of Environmental Protection (MassDEP). March 27, 2006. Drinking Water Guideline for Tertiary Butyl Alcohol (TBA). Office of Research and Standards (ORS).

U.S. EPA (U.S. Environmental Protection Agency). July 1999a. Guidelines for Carcinogen Risk Assessment. Review Draft. NCEA-F-0644. Risk Assessment Forum.

Supporting Documentation for Drinking Water Standards and Guidelines

TERTIARY-AMYL METHYL ETHER (TAME)	CASRN: 994058	Update: April 2006

Current Massachusetts Regulatory Limit: ORSGL = 0.09 mg/L.

Federal Regulatory Limit: No MCL available

Basis for Criteria: The ORS guideline for TAME was derived based on the RfD (presented below) derived by ORS for this chemical and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% and a relative source contribution factor to account for potential carcinogenicity are incorporated into the final value.

RfD: 0.125 mg/kg/day (MassDEP, 2006)

UF: 1000 (10 = subchronic to chronic; 10 = interspecies; 10 = intraspecies) **MF:** 1

Critical Effects: Exposure to high concentrations of TAME has produced effects on the central nervous system, liver and kidney. In a 28-day subchronic oral study, 10 Sprague-Dawley rats per group were administered 125, 500 or 1000 mg/kg/day of TAME via gavage 7 days per week for 28 days. Dose-related, statistically significant increases in adrenal and kidney weights were seen at the 500 and 1000 mg/kg/day doses in male rats. ORS identified a NOAEL of 125 mg/kg/day from this study (MassDEP, 2006).

Cancer Assessment: The U.S. EPA has not classified TAME under either the old U.S. EPA carcinogen classification system or under their Proposed Guidelines for Carcinogen Risk Assessment (U.S. EPA, 1999a). Using the 1999 proposed guidelines, ORS would tentatively classify TAME as having suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential.

Class: Volatile Organic Compound

Analytical Information:

PQL: 5 µg/L

Analytical Methods: U.S. EPA Method 8260 and 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Massachusetts Department of Environmental Protection (MassDEP). March 27, 2006. Drinking Water Guideline for Tertiary-Amyl Methyl Ether (TAME). Office of Research and Standards (ORS).

U.S. EPA (U.S. Environmental Protection Agency). July 1999a. Guidelines for Carcinogen Risk Assessment. Review Draft. NCEA-F-0644. Risk Assessment Forum.

Supporting Documentation for Drinking Water Standards and Guidelines

TETRACHLOROETHYLENE	CASRN: 127184	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL of 0.005 mg/L is set at the PQL for tetrachloroethylene of 0.005 mg/L. The MCLG is set to zero.

Basis for Criteria: An MCLG of zero is assigned for tetrachloroethylene based on the evidence for carcinogenic potential. The MCL is based on the tetrachloroethylene PQL.

Critical Effects: Acute or chronic exposure to tetrachloroethylene may produce adverse liver, kidney and central nervous system effects. Tetrachloroethylene has also produced increases in the incidence of mouse liver tumors and male rat kidney tumors, and peroxisome proliferation.

Cancer Assessment: B2

U.S. EPA has classified this chemical as a B2 carcinogen based on several factors including increases in the incidence of mouse liver tumors and male rat kidney tumors, as well as peroxisome proliferation.

The cancer risk assessment is currently under review by U.S. EPA.

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA 502.1 P/T/GC
U.S. EPA 503.1 P/T/GC
U.S. EPA 524.2 P/T/GC-MS

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Supporting Documentation for Drinking Water Standards and Guidelines

TETRAHYDROFURAN	CASRN: 109999	May 2014
Current Massachusetts Regulatory Limit: ORSGL = 0.6 mg/L		
Federal Regulatory Limit: The U.S. EPA has not published an MCL for tetrahydrofuran.		
Basis for Criteria: The ORSGL is based on an EPA IRIS RfD developed based on the two-generation reproductive study by Hellwig *et al.*, (2002) presented below. The ORSGL assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% and a 10-fold uncertainty factor to account for potential carcinogenicity are incorporated into the final value. **RfD:** 0.9 mg/kg/day (U.S. EPA, 2012) **UF:** 1000 (10 = interspecies; 10 = intraspecies; 10 = database variability) **MF:** 1		
Critical Effects: Tetrahydrofuran may cause irritation to the gastrointestinal tract with symptoms including nausea, vomiting and diarrhea, sore throat and abdominal pain. Liver or kidney injury may also occur. In a 2-generation reproductive study in which rats were exposed to tetrahydrofuran in drinking water, dose-related decreases in body weight gain were consistently observed in both F1 and F2 generations pups and were accompanied by other developmental delays (i.e., delayed eye opening and increased incidence of sloped incisors) in the absence of significant maternal body weight changes or overt signs of toxicity (Hellwig *et al*., 2002). This study was used as the basis for the ORSGL. A benchmark dose[2] of 928 mg/kg/day identified by IRIS is the basis of the ingestion RfD as described above.		

[2] The benchmark dose corresponds to the 95% lower confidence limit on the maximum likelihood estimate of the dose corresponding to a one standard deviation change from the control mean. A one standard deviation change corresponds to 10% of an exposed population having larger decreases in body weight gain than the lowest 1% of the control group when the data follow a normal distribution.

Cancer Assessment: In a two-year inhalation study, the National Toxicology Program (NTP, 1998) reported an increased incidence of renal tubule adenomas and carcinomas (statistically significant exposure-response trend) in male F344/N rats and an increased incidence of hepatocellular adenomas and carcinomas in female $B6C3F_1$ mice (statistically significant trend). No evidence of carcinogenicity was observed in female rats or male mice. No other treatment-related increases in tumor incidence were observed. NTP concluded that the data provided some evidence of carcinogenicity in male rats and clear evidence of carcinogenicity in female mice. Based on this information and a lack of information via the oral or dermal routes to suggest that absorption does not occur via these routes, the U.S, EPA assumes that an internal dose of tetrahydrofuran will be achieved regardless of the route of exposure and thus designates tetrahydrofuran as having "suggestive evidence of carcinogenic potential".

Class: Organic

Analytical Information:

PQL: See method.

Analytical Methods: U.S. EPA Method 524.2

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, References Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories – The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at http://www.epa/gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Chhabra, R.S., Elwell, M.R., Chou, B., Miller, R.A., and Renne, R.A. (1990). Subchronic toxicity of tetrahydrofuran vapors in rats and mice. Fund. Appl. Toxicol. 14: 338-345.

Hellwig, J; Gembardt, C; Jasti, S. (2002) Tetrahydrofuran: two-generation reproduction toxicity in Wistar rats by continuous administration in the drinking water. Food Chem Toxicol 40(10):1515–1523.

Komsta, E., Chu, I., Secours, V.E., Valli, V.E. and Villeneuve, D.C.. 1988. Results of a Short-Term Toxicity Study for Three Organic Chemicals Found in Niagara River Drinking Water. Bull. Environ. Contam. Toxicol. 41:515-522.

NTP (National Toxicology Program). June 1998. NTP Technical Report on the Toxicology and Carcinogenesis Studies of Tetrahydrofuran (CAS No. 109-99-9) in F344/N Rats and B6C3F1 Mice (Inhalation Studies). TR-475. NIH Publication No. 98-3965. Public Health Service. National Institutes of Health (NIH).

U.S. EPA (U.S. Environmental Protection Agency). 2012. Integrated Risk Information System (IRIS). Washington, D.C. http://cfpub.epa.gov/ncea/iris/index.cfm (date accessed: May 2012).

Supporting Documentation for Drinking Water Standards and Guidelines

THALLIUM	CASRN: 7446-18-6	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.002 mg/L. ORS has adopted the MCL published by the U.S. EPA as part of the Phase V Rule (57 FR 31776: 7-17-92).

Federal Regulatory Limit: Though the MCLG for thallium is 0.0005 mg/L, the U.S. EPA has set the MCL at 0.002 mg/L. The U.S. EPA usually bases such a decision on either the detection capability for the chemical or the technical feasibility of being able to achieve compliance with the MCL given the available treatment techniques.

Basis for Criteria: The MCLG is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 6.7×10^{-5} mg/kg/day*

UF: 3000 (10 = subchronic to chronic; 10 = interspecies; 10 = intraspecies; 3 = lack of adequate reproductive studies) **MF:** 1

Critical Effects: Toxic effects of thallium in test animals include degenerative changes in mitochondria of the kidneys, liver, brain and intestines. The MCLG is based on a NOAEL of 0.2 mg/kg/day identified from a thirteen-week dietary study in which rats were given approximately 0.008 to 0.20 mg thallium/kg /day. Significant increases in blood levels of glutamic-oxaloacetic transaminase (SGOT), lactic dehydrogenase (LDH), and sodium levels were reported. No histopathologic changes were seen (with light microscopic or gross pathologic evaluation of organs and tissues) that would reveal a significant treatment-related effect. Alopecia was noted although light microscopic evaluation did not indicate changes in hair follicles. Uncertainty remains as to whether any effects would be found at the electron microscope level (Stoltz *et al*., 1983).

Cancer Assessment: D

The U.S. EPA has classified thallium in Group D based on inadequate evidence of carcinogenicity in humans or animals

Class: Inorganic; Heavy metal

Supporting Documentation for Drinking Water Standards and Guidelines

Analytical Information:

PQL: 0.001 mg/L

Analytical Methods: Standard Methods 3113 (atomic absorption; furnace)
U.S. EPA Method 279.2 (atomic absorption; furnace)
U.S. EPA Method 200.9 (atomic absorption, platform)
200.8 (ICP-Mass Spectrometry)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. July 25, 1990. Part II. Environmental Protection Agency. 40 CFR Part 141 *et al*. National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule. (55 FR 30370)

Federal Register. July 17, 1992. Part III. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule. (57 FR 31776).

Stoltz, ML. Stedman, MA, Brown, LK, Laber, L. El-hawari, AM, 1986. Midwest Research Institute. Final Report. Subchronic (90-day) Toxicity of Thallium (I) Sulfate (CAS No. 7446-18-6) in Sprague-Dawley Rats. Project No. 8702-L. November 21, 1986.

*This RfD was determined from information used by the U.S. EPA to derive the Drinking Water Equivalent Level (DWEL) for this chemical for the Phase V Rule.

Supporting Documentation for Drinking Water Standards and Guidelines

TOLUENE	CASRN: 108883	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 1 mg/L. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for toluene is equal to the MCLG of 1 mg/L.

Basis for Criteria: The MCLG is derived based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of drinking water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 2×10^{-1} mg/kg/day

UF: 1000 (10 = interspecies; 10 = intraspecies; 10 = limited reproductive/development data)

MF: 1

The confidence in the RfD is medium.

Critical Effects: Acute exposure to toluene has produced central nervous system depression, and effects on the lung, liver and kidneys. Chronic exposure has produced similar effects, although mostly in the liver and lungs (if exposure is via inhalation) (50 FR 46936: November 13, 1985). The MCL for toluene is based on a 1989 NTP study in which rats were exposed to toluene via gavage in corn oil, five days per week for thirteen weeks, at dose levels of 0, 312, 625, 1,250, 2,500 or 5,000 mg/kg. Liver-to-brain ratio was increased significantly in males exposed to the 625 mg/kg dose. A NOAEL of 312 mg/kg/d (adjusted to 223 mg/kg/d for 5 days/week exposure) was established (NTP, 1989).

Cancer Assessment: D

Toluene is currently classified as a Group D carcinogen based on negative results in an animal study and inadequate data on ingestion exposure.

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA 502.2; gas chromatography
U.S. EPA 503.1; gas chromatography
U.S. EPA 524.2; gas chromatography-mass spectrometry

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56

FR 3526).

NTP. 1989. Toxicology and carcinogenesis studies of toluene in F344/n rats and B6C3F1 Mice. Technical Report Series No. 271. Research Triangle Park, N.C.

Supporting Documentation for Drinking Water Standards and Guidelines

TOTAL COLIFORM BACTERIA (including fecal coliform and E. coli)	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = no more than 5.0% samples total coliform-positive in a month. ORS has adopted the MCL published by the U.S. EPA. Refer to CMR 22.05 for additional regulatory information.

Federal Regulatory Limit: The MCL for total coliform is no more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample must be analyzed for either fecal coliforms or *E. coli* if two consecutive total coliform positive samples are found. If one is also positive for *E. coli* fecal coliforms, the system has an acute MCL violation (U.S. EPA, 2002). The MCLG for Total Coliform Bacteria is zero.

Basis for Criteria: The MCL for total coliform was set as an indicator for the potential presence of sewage in the water supply.

Critical Effects: Total coliforms include fecal coliforms and *Escherichia coli (E. coli)*. Fecal coliform bacteria are typically found in the intestines of animals and humans. *E. coli* is one type of fecal coliform bacteria. The presence of *E. coli* or other fecal coliform in water is an indicator that the water may be contaminated with human sewage or animal waste. While most indicator coliform bacteria are harmless, sewage may contain many disease-causing organisms (U.S. EPA, 2002).

Cancer Assessment: NA

Class: Biological Pathogen

Analytical Information:

PQL: See CMR 22.20

Analytical Methods: See CMR 22.05

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

References:

Federal Register. January 14, 2002. Environmental Protection Agency. Parts 9, 141 and 142. National Primary Drinking Water Regulations: Long Term 1 Enhanced Surface Water Treatment Rule. Final Rule. (67 FR 1811).

U.S. Environmental Protection Agency (U.S. EPA). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

TOTAL TRIHALOMETHANES (TTHMs)	CASRN: N/A	Update: May 2004

Current Massachusetts Regulatory Limit: For **chlorinated** supplies only, the total trihalomethanes (TTHM) MMCL = 0.080 mg/L and is the sum of the concentrations of bromodichloromethane, bromoform, dibromochloromethane and chloroform.

Federal Regulatory Limit: The four trihalomethanes are byproducts of the disinfection process. Under its Disinfectants and Disinfection Byproducts Rule (63 FR 69390: December 16, 1998), U.S. EPA set the MCL for TTHMs at 0.080 mg/L. U.S. EPA did not set a Maximum Contaminant Level Goal (MCLG) for the group of TTHMs although there are MCLGs for some of the individual constituents, including bromodichloromethane (zero), bromoform (zero), and dibromochloromethane (0.06 mg/L). Chloroform is regulated with this group but has no MCLG.

Basis for Criteria: The four trihalomethanes (TTHMs) are byproducts of the disinfection process. The MCL of 0.080 mg/L was set based on the potential for an increased risk of cancer and other health effects (U.S. EPA, 1998a). The U.S. EPA considers that the MCL for TTHMs is feasible and achievable for a chlorinated drinking water supply. U.S. EPA also believes that by meeting MCLs for TTHMs and haloacetic acids (HAA5) (other disinfection byproducts), water suppliers will also control the formation of other disinfection byproducts not currently regulated that may also adversely affect human health (U.S. EPA, 2002).

Critical Effects: Potential health effects from ingestion of TTHMs in water include liver, kidney and central nervous system problems, as well as an increased risk of cancer. The MCL of 0.08 mg/L was set based on the potential for an increased risk of these health effects (U.S. EPA, 1998).

Cancer Assessment: U.S. EPA has not conducted a cancer assessment for the TTHMs. However, the individual TTHM constituents have been evaluated and qualitative descriptors of their carcinogenicity are provided below.

- Bromodichloromethane is likely to be carcinogenic to humans by all routes of exposure.
- Bromoform is likely to be carcinogenic to humans by all routes of exposure.
- There is suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential for dibromochloromethane.
- Chloroform is likely to be carcinogenic to humans by all routes of exposure under high-dose conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues. Chloroform is not likely to be carcinogenic to humans by all routes of exposures at a dose level that does not cause cytotoxicity and cell regeneration (U.S. EPA, 2004).

Class: Disinfection Byproducts

Analytical Information:

PQL: See specific method

Analytical Methods: U.S. EPA Methods 502.1; 524.2; 551.1 (U.S. EPA, 1998)

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

There are individual RfDs and Health Advisories for some of the individual constituents of the TTHMs. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. December 16, 1998. National Primary Drinking Water Regulations. Disinfectants and Disinfection Byproducts. Final Rule. Federal Register. (63 FR 69390).

U.S. EPA (U.S. Environmental Protection Agency). July 2002. List of Contaminants and Their MCLs. U.S. EPA 816-F-02-013.

U.S. EPA (U.S. Environmental Protection Agency). Winter 2004. 2004 Edition of the Drinking Water Standards and Health Advisories.

Supporting Documentation for Drinking Water Standards and Guidelines

TOXAPHENE	CASRN: 8001352	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.003 mg/L. ORS has adopted the MCL published by the U.S. EPA (56 FR 3526: 1/30/91).

Federal Regulatory Limit: The MCL for toxaphene is based on its detection limit of 0.003 mg/L. The MCLG is equal to zero.

Basis for Criteria: An MCLG of zero is assigned for toxaphene based on the evidence for carcinogenic potential. The MCLs for group B2 carcinogens are set as close to zero as feasible. The MCL is based on the toxaphene PQL of 0.003 mg/L.

Critical Effects: Acute exposure to toxaphene produces effects on the central nervous system, liver and kidney. The critical target organ, upon subchronic and chronic exposure, is the liver. The critical effect from exposure to toxaphene is a potential increase in the incidence of cancer. The excess lifetime cancer risk at the MCL of 0.003 mg/L is approximately 1 in ten thousand.

Cancer Assessment: B2

The cancer assessment is based on hepatocellular carcinomas and neoplastic nodules in male mice (Litton Bionetics 1978). The oral slope factor is 1.1 $(mg/kg/day)^{-1}$.

Class: Chlorinated Pesticide

Analytical Information:

PQL: 0.003 mg/L

Analytical Methods: U.S. EPA 505; Microextraction/Gas Chromatography

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. November 13, 1985. Part IV. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations: Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms; Proposed Rule. (50 FR 46936).

Federal Register. May 22, 1989. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary and Secondary Drinking Water Regulations; Proposed Rule. (54 FR 22062).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Litton Bionetics. 1978. Carcinogenic evaluation in mice. Toxaphene. Final Report. Prepared by Litton Bionetics, Inc., Kensington, MD for Hercules, Jr. Wilmington DE. LBI Project No. 20602.

Supporting Documentation for Drinking Water Standards and Guidelines

TRICHLOROETHYLENE	CASRN: 79016	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.005 mg/L. ORS has adopted the MCL published by the U.S. EPA (52 FR 25690 (7/8/87) and 56 FR 3526 (1/30/91)).

Federal Regulatory Limit: The MCL of 0.005 mg/L for trichloroethylene (TCE) is equal to its PQL of 0.005 mg/L. The MCLG is equal to zero.

Basis for Criteria: The MCLG is set at zero based on the evidence for carcinogenic potential of a B2 carcinogen. The MCL is set at the trichloroethylene PQL.

Critical Effects: The critical health effect from exposure to trichloroethylene is a potential increase in the incidence of cancer. In addition, long-term exposure to trichloroethylene may damage the liver and kidneys and may produce effects on the CNS and depression in myocardial contractility.

Cancer Assessment: B2

A carcinogen assessment summary for trichloroethylene has been withdrawn. A new carcinogen summary is in preparation by the CRAVE workgroup. Significant increases in the incidence of liver tumors have been reported in mice. Malignant lymphoma and adenocarcinoma were also reported in mice.

Class: VOC

Analytical Methods:

PQL: 0.005 mg/L

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Analytical Methods: U.S. EPA 502.1; gas chromatography
U.S. EPA 503.1; gas chromatography
U.S. EPA 524.2; gas chromatography-mass spectrometry

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. June 12, 1984. Part V. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Volatile Synthetic Organic Chemicals; Proposed Rulemaking. (49 FR 24329).

Federal Register. July 8, 1987. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25689).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Supporting Documentation for Drinking Water Standards and Guidelines

TURBIDITY	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. Refer to 310 CMR 22.20. ORS has adopted the MCL published by the U.S. EPA.

Federal Regulatory Limit: Under U.S. EPA's Surface Water Treatment Rule, systems using surface water or groundwater under the direct influence of surface water must control turbidity (cloudiness of water). At no time can turbidity go above 5 nephelometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002 for systems serving greater than 10,000 and (under the Long Term 1 Enhanced Surface Water Treatment Rule) January 14, 2005, for systems serving less than 10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month (U.S. EPA, 2002).

Basis for Criteria: The MCL for turbidity is based on a Treatment Technique as described above.

Critical Effects: Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches (U.S. EPA, 2002).

Cancer Assessment: NA

Class: Biological Pathogens

Analytical Information:

PQL: See CMR 22.20

Analytical Methods: See 310 CMR 22.20

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

References:

Federal Register. January 14, 2002. Environmental Protection Agency. Parts 9, 141 and 142. National Primary Drinking Water Regulations: Long Term 1 Enhanced Surface Water Treatment Rule. Final Rule. (67 FR 1811).

U.S. Environmental Protection Agency (U.S. EPA). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

URANIUM	CASRN: 7440611	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = 0.030 mg/L. On June 27, 2002, the Massachusetts DEP Safe Drinking Water Act Advisory Committee decided to adopt the MCL published by the U.S. EPA.

Federal Regulatory Limit: The MCL for uranium is 0.030 mg/L. The MCLG is equal to zero.

Basis for Criteria: The U.S. EPA established an MCL of 0.030 mg/L for uranium in its Radionuclides Final Rule, published in the December 7, 2000 Federal Register (Volume 65, Number 236). This standard became effective on December 8, 2003. Since uranium is radioactive and U.S. EPA uses a non-threshold linear risk model for ionizing radiation, U.S. EPA has set the MCLG for uranium at zero (Fed Reg, 2000). In 1991, U.S. EPA set an MCL for uranium of 0.020 mg/L that was determined to be as close as feasible to the MCLG of zero. In its Final Rule, U.S. EPA did a cost benefit analysis and concluded that the benefits of an MCL of 0.020 mg/L do not justify the costs. U.S. EPA concluded that the MCL of 0.030 mg/L is more appropriate since it maximizes the net benefits (benefits minus costs), while being protective of kidney toxicity and carcinogenicity with an adequate margin of safety (65 FR 76708).

Critical Effects: Uranium has been shown to be nephrotoxic in humans and animals. It interferes with readsorption of proteins in the proximal renal tubules of the kidney, resulting in proteinuria. It is not known whether manifestation of this effect is indicative of an incipient adverse effect or if it is a reversible effect that does not typically result in kidney effects (65 FR 76708).

Cancer Assessment: A

Radionuclides emit ionizing radiation, a known human carcinogen, when they radioactively decay. Long-term exposure to radionuclides in drinking water may cause cancer (U.S. EPA, 11/26/02). As with other forms of ionizing radiation, U.S. EPA assumes that uranium has no threshold for carcinogenicity.

Class: Radionuclide

Supporting Documentation for Drinking Water Standards and Guidelines

Analytical Information:

PQL: 5 pCi/L

Analytical Methods: U.S. EPA 908.0 (radiochemical);
908.1 (fluorometric)

For additional methods, see the Radionuclides Final Rule (65 FR 76708).

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. December 7, 2000. Part II. Environmental Protection Agency. Parts 9, 141, and 142. National Primary Drinking Water Regulations; Radionuclides; Final Rule. (65 FR 76708).

U.S. EPA (U.S. Environmental Protection Agency). October 1, 1989. Integrated Risk Information System (IRIS). Washington, D.C.. http://cfpub.epa.gov/ncea/iris/index.cfm.

U.S. EPA (U.S. Environmental Protection Agency). Last updated November 26, 2002. Radionuclides in Drinking Water. http://www.epa.gov/safewater/standard/pp/radnucpp.html (web page).

Supporting Documentation for Drinking Water Standards and Guidelines

U. S. EPA (U.S. Environmental Protection Agency). Winter 2004. 2004 Edition of the Drinking Water Standards and Health Advisories.

Supporting Documentation for Drinking Water Standards and Guidelines

VINYL CHLORIDE	CASRN: 7440611	Update: March 1996

Current Massachusetts Regulatory Limit: MMCL = 0.002 mg/L. ORS has adopted the MCL published by the U.S.EPA (52 FR 25690 (7/8/87) and 56 FR 3526 (1/30/91)).

Federal Regulatory Limit: The MCL for vinyl chloride is based on its detection limit of 0.002 mg/L. The MCLG is equal to zero.

Basis for Criteria: The MCLG is set as zero based on the evidence for carcinogenic potential of a group A carcinogen. The MCL is set as close to zero as is feasible. In the case of vinyl chloride, the PQL is the limiting factor, so the MCL is set at the PQL.

Critical Effects: The critical effect from exposure to vinyl chloride is a potential increase in the incidence of cancer. In addition, high-dose exposures to vinyl chloride have produced congestion and edema of the lungs and hyperemia of the kidney and liver. Other non-cancer effects noted in acute and chronic toxicity studies include disturbances of the central nervous system, pulmonary insufficiency, cardiovascular manifestations, gastrointestinal symptoms and acroosteolysis (49 FR 24329).

Cancer Assessment: A

The U.S. EPA has classified vinyl chloride as a group A carcinogen (human) by the oral route based on the availability of sufficient evidence to support the causal association between exposure to this chemical and cancer.

Class: VOC

Analytical Methods:

PQL: 0.002 mg/L

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Analytical Methods: U.S. EPA 502.1; gas chromatography
U.S. EPA 503.1; gas chromatography
U.S. EPA 524.2; gas chromatography-mass spectrometry

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. June 12, 1984. Part V. Environmental Protection Agency. 40 CFR Part 141. National Primary Drinking Water Regulations; Volatile Synthetic Organic Chemicals; Proposed Rulemaking. (49 FR 24329).

Federal Register. July 8, 1987. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations; Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25689).

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Supporting Documentation for Drinking Water Standards and Guidelines

VIRUSES (ENTERIC)	CASRN: NA	Update: May 2004

Current Massachusetts Regulatory Limit: MMCL = Treatment Technique. Refer to 310 CMR 22.20. ORS has adopted the MCL published by the U.S EPA.

Federal Regulatory Limit: Under U.S. EPA's Surface Water Treatment Rule, systems using surface water or groundwater under the direct influence of surface water must achieve a 99.9% removal/inactivation of viruses (U.S. EPA, 2002). The MCLG for viruses is zero.

Basis for Criteria: The MCL for viruses is based on a Treatment Technique as described above.

Critical Effects: Enteroviruses, including polioviruses, coxsackieviruses [groups A and B], echoviruses, and hepatitis A virus), rotaviruses and other reoviruses , adenoviruses and Norwalk-type agents, comprising more than 100 serological types, constitute the major enteric viruses of human origin. Although viruses are only viable when they infect a living cell, multiply, and then direct processes in that cell, viruses in sewage can reach 10,000-100,000/L and they can survive for months in water and soil. Infection with as little as a single infectious unit can theoretically lead to infection in a susceptible human. A number of outbreaks of hepatitis A have been waterborne. A large number of reported gastroenteritis outbreaks of nonbacterial etiology have probably also been associated with waterborne viruses.
Such cases of contamination have been frequently documented over the years, even in the apparent absence of indicator bacteria (U.S. EPA, 1984).

Cancer Assessment: NA

Class: Biological Pathogen

Analytical Information:

PQL: See 310 CMR 22.20

Analytical Methods: See 310 CMR 22.20

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

References:

Federal Register. January 14, 2002. Environmental Protection Agency. Parts 9, 141 and 142. National Primary Drinking Water Regulations: Long Term 1 Enhanced Surface Water Treatment Rule. Final Rule. (67 FR 1811).

U.S. EPA (U.S. Environmental Protection Agency). February 1984. Manual of Methods for Virology. EPA/600/4-84/013.

U.S. EPA (U.S. Environmental Protection Agency). July 2002. List of Contaminants and Their MCLs. EPA 816-F-02-013.

Supporting Documentation for Drinking Water Standards and Guidelines

XYLENES	CASRN: 1330207	Update: March 1994

Current Massachusetts Regulatory Limit: MMCL = 10 mg/L. ORS has adopted the MCL published by the U.S. EPA (56 FR 3526: 1/30/91 and 56 FR 30266: 7/1/91).

Federal Regulatory Limit: The MCL for xylenes is equal to its MCLG of 10 mg/L.

Basis for Criteria: The MCLG is based on the RfD presented below and assumes that a 70 kg adult ingests 2 L/day of water. A relative source contribution factor of 20% is incorporated into the final value.

RfD: 2.0 mg/kg/day

UF: 100 (10 intraspecies; 10 interspecies) **MF: 1** **CONFIDENCE:** medium

Critical Effects: The RfD is based on a 103-week rat gavage study (NTP 1986) that identified a NOAEL of 250 mg/kg/day. Hyperactivity, decreased body weight gain and increased mortality were observed at higher doses.

Cancer Assessment: D; not classifiable as to human carcinogenicity

The U.S. EPA currently classifies xylenes as a group D carcinogen (insufficient evidence of carcinogenicity).

Class: VOC

Analytical Information:

PQL: 0.005 mg/L

Analytical Methods: U.S. EPA 502.2; gas chromatography
U.S. EPA 503.1; gas chromatography
U.S. EPA 524.2; gas chromatography-mass spectrometry

PQLs and analytical methods may have been updated since this guidance value was last revised. Updated analytical methods for drinking water and their associated PQLs may be found at https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods.

Other Regulatory Data:

Any Health Advisories, Reference Doses (RfDs), cancer assessments or Cancer Potency Factors (CPFs) referenced in this document pertain to the derivation of the current guidance value. Updated information may be obtained from the following sources:

Health Advisories - The U.S. EPA provides guidance for shorter-term exposures for chemicals based on their non-cancer effects. Current health advisories may be more current than those used to derive MCLs and may be found at https://www.epa.gov/sdwa/drinking-water-health-advisories-has.

RfDs, cancer assessments and CPFs – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs and CPFs as well as cancer assessments for specific chemicals may be found in the U.S. EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris/. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

References:

Federal Register. January 30, 1991. Part II. Environmental Protection Agency. 40 CFR Parts 141, 142, and 143. National Primary Drinking Water Regulations; Final Rule. (56 FR 3526).

Federal Register. July 8, 1987. Part II. Environmental Protection Agency. 40 CFR Parts 141 and 142. National Primary Drinking Water Regulations-Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants; Final Rule. (52 FR 25690).

NTP (National Toxicology Program) 1986. NTP Technical Report on the Toxicology and Carcinogenesis of xylenes (mixed) [60.2% m-xylenes, 13.640 p-xylene, 17.0% ethylbenzene and 9.1% o-xylene] (CAS No. 1330-20-7) in F344/N rats and B6C3F1 mice (gavage studies). US-DHHS, PHS, NIH, RIP, Research Triangle Park, NC. NTP TR. 327. NIH. publ. No. 86-2583.

Supporting Documentation for Drinking Water Standards and Guidelines

Documentation for Massachusetts Maximum Contaminant Level (MMCL) for Six Per- and Polyfluoroalkyl Substances (PFAS6) in Drinking Water

PFAS included[1]:	CASRN:	**Update: October 2020**
Perfluorooctane Sulfonic Acid (PFOS)	1763-23-1	
Perfluorooctanoic Acid (PFOA)	335-67-1	
Perfluorohexane Sulfonic Acid (PFHxS)	355-46-4	
Perfluorononanoic Acid (PFNA)	375-95-1	
Perfluoroheptanoic Acid (PFHpA)	375-85-9	
Perfluorodecanoic Acid (PFDA)	335-76-2	

[1]The compounds and associated CAS registry numbers (CASRN) listed refer to the acid form of these PFAS compounds. The information presented in this document and the MMCL are also applicable to the respective anionic forms of these compounds. These anions may form salts with any of a number of cations resulting in a variety of possible chemical species, each having a unique CASRN.

MMCL: 0.000020 mg/L (20 ppt). When all or some of the listed compounds occur together in drinking water, the detected concentrations for these PFAS should be summed and compared to 0.000020 mg/L. This value is also applicable to the individual compounds.

To be protective of shorter-term effects associated with these compounds, particularly developmental effects, the PFAS6 MMCL is violated when the average of three months of PFAS6 concentrations exceeds 20 ppt within the same quarter (for instance, Quarter 2 includes April, May and June) or if PFAS6 concentrations from one or two months would cause the quarterly average to exceed 20 ppt.

Federal Regulatory Limit: The United States Environmental Protection Agency (US EPA) has not published a Federal Maximum Contaminant Level (MCL) for any PFAS.

Basis for Criteria - Non-Cancer Health Risk:

In January 2020, the Massachusetts Department of Environmental Protection (MassDEP) updated its PFAS6 Office of Research and Standards (ORS) Guideline (ORSG) and in October 2020 promulgated a MMCL for these compounds. This MMCL is based on an extensive assessment of the available data by MassDEP ORS. The ORS assessment reflects technical input from the MassDEP Health Effects Advisory Committee. Detailed supporting information can be found in the Technical Support Document Per- and Polyfluoroalkyl Substances (PFAS): An Updated Subgroup Approach to Groundwater and Drinking Water Values (the TSD) (https://www.mass.gov/info-details/per-and-polyfluoroalkyl-substances-pfas#massachusetts-drinking-water-standard-and-health-information-).

In summary, MassDEP ORS concluded that the Reference Dose (RfD), the toxicity value for non-cancer effects, for compounds in this subgroup of longer-chain PFAS should be adjusted

downward from that used in the 2018 ORSG derivation, to 5 x 10^{-6} milligrams per kilogram body weight per day (mg/kg-day). The revised MassDEP RfD value results from the application of an additional uncertainty factor (UF) of $10^{1/2}$ in the RfD derivations for PFOA and PFOS as detailed in the TSD. This was done to account for considerable and convincing evidence associating exposures to these compounds with adverse responses in laboratory animals at levels of exposure lower than those used to derive the previous RfD. ORS also concluded that one additional compound, PFDA, should be included in the subgroup, based on structural and toxicological similarity. As discussed in the TSD, the revised MassDEP ORS RfD is applied to the noted subgroup of six closely-related PFAS. Based on their similarities MassDEP ORS also concluded that it is appropriate to treat these six compounds additively.

Application of the revised RfD, using the same water ingestion rate and body weight parameters for a lactating woman (i.e., a water ingestion rate of 54 mL/kg-day) and relative source contribution factor of 0.2 previously applied, results in a drinking value of 20 ppt.

Cancer Risk:

MassDEP ORS also considered the potential carcinogenicity of these compounds. A study of people exposed to PFOA and other PFAS concluded that the data supported a probable link between exposure and cancers of the kidney and testes (Barry et al. 2013). No potency estimates were derived. Animal bioassay data from the National Toxicology Program (NTP 2019c) reported elevated pancreatic and liver tumor rates following high dose exposures to PFOA. Although NTP had issued summary data tables for this study, a final report had not been issued during preparation of the TSD. The cancer data is concerning to MassDEP and ORS is closely following the developing science on this topic to better understand the level of cancer risk posed by these compounds.

ORS is assessing this data as part of three-year review required under the MassDEP PFAS6 MMCL, to determine if revisions to the drinking water values are needed.

Analytical Information:

Analytical Methods: US EPA Method 537 (US EPA, 2009)
US EPA Method 537.1 (US EPA, 2018)

Laboratories should achieve a Minimum Reporting Level (MRL) of 2.0 ppt.

Updated analytical methods for drinking water may be found at https://www.epa.gov/measurements-modeling/collection-methods#2
Note US EPA Method 533 (https://www.epa.gov/sites/production/files/2019-12/documents/method-533-815b19020.pdf) was issued too late to be included as an approved method under the MassDEP PFAS6 MMCL.

Other Information:

Information and data referenced in this document pertain to the derivation of the current MassDEP PFAS6 drinking water values may not reflect the most current information regarding

these compounds or other PFAS. Additional relevant information may be available from the following sources:

HAs – The US EPA provides guidance for exposures for chemicals based on their non-cancer effects. More current HAs may be found at https://www.epa.gov/sites/production/files/2018-03/documents/dwtable2018.pdf.

Toxicity values and assessments – For specific information pertaining to derivation of drinking water criteria, consult the Federal Register notice that announces the availability of the most current guidance for that chemical. In addition, information on other current RfDs, as well as cancer assessments for specific chemicals, may be found in the US EPA Integrated Risk Information System (IRIS) at https://www.epa.gov/iris. Please note that the information in IRIS may differ from that used in the derivation process as published in the Federal Register notice.

Class: Organic

References:

MassDEP (2019). Massachusetts Department of Environmental Protection (MassDEP). Technical Support Document - Per- and Polyfluoroalkyl Substances (PFAS): An Updated Subgroup Approach to Groundwater and Drinking Water Values. Office of Research and Standards.

US EPA (2009). United States Environmental Protection Agency. Method 537, Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS) Version 1. US EPA, Office of Research and Development, National Exposure Research Laboratory. EPA/600/R-08/092.

US EPA. (2016a). United States Environmental Protection Agency. Drinking Water Health Advisory for Perfluorooctaanoic Acid (PFOA) and Health Effects Support Document for Perfluorooctaanoic Acid (PFOA). US EPA Office of Water. EPA 822-R-16-005

US EPA. (2016b). United States Environmental Protection Agency. Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS) and Health Effects Support Document for Perfluorooctane Sulfonate (PFOS). US EPA Office of Water. EPA 822-R-16-004.