

# San Jose Water

## Report on Water Quality Relative to Public Health Goals



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## Background

California Health and Safety Code provisions require that water utilities serving more than 10,000 service connections prepare a special report by July 1, every three years if water quality measurements on water supplied to consumers have exceeded any Public Health Goals (PHGs). PHGs are non-enforceable goals established by the California Environmental Protection Agency's (Cal-EPA's) Office of Environmental Health Hazard Assessment (OEHHA). They are developed as goals because they are purely health-based objectives and may not be technically or economically feasible to achieve.

The law also requires that where OEHHA has not adopted a PHG for a constituent, the water suppliers are to use the Maximum Contaminant Level Goals (MCLGs) adopted by United States Environmental Protection Agency (USEPA). MCLGs are also non-enforceable, strictly health-based constituent levels. A Maximum Contaminant Level (MCL) is the legal threshold limit set by the USEPA or the California Division of Drinking Water (DDW) that water systems must comply with. MCLs based on health concerns are referred to as Primary MCLs, and MCLs based on aesthetic concerns are referred to as Secondary MCLs (SMCLs). Only constituents which have a primary MCL and either a PHG or MCLG are to be addressed in this report. Attachment No. 1 is a list of all regulated constituents and their MCLs and PHGs or MCLGs.

If a constituent was detected in SJW's water supply between 2016 and 2018 at a level exceeding an applicable PHG or MCLG, this report provides the legally required information on those constituents.

## What are PHGs?

PHGs are set by the California Office of Environmental Health Hazard Assessment (OEHHA) and are based solely on public health risk considerations. None of the risk-management factors that are considered by the USEPA or the DDW in setting drinking water quality standards are considered in setting the PHGs. These factors include analytical detection capability, treatment technology availability, benefits, and costs. When calculating a PHG, OEHHA identifies the level of that chemical in drinking water that would not cause significant adverse health effects in people who drink two liters of that water every day for 70 years. The PHGs are not enforceable and are not required to be met by any public water system. MCLGs are the federal equivalent to PHGs, but may not be identical.

## Water Quality Data Considered

All of the water quality data collected by SJW for purposes of determining compliance with drinking water standards during the years 2016, 2017, and 2018 was considered for this report. These data were summarized in our 2016, 2017, and 2018 Annual Water Quality Reports. These reports are made available to all of our customers annually. The most recent Annual Water Quality report is posted on our website at <http://www.sjwater.com/ccr>.

Most of the constituents monitored are not listed or reported in the water quality report because they were not detected. This means that either the constituent was below the detection threshold of the laboratory instruments or that it was detected at a level less than the *detection level for purposes of reporting* (DLR). The DLR is the level above which any analytical finding of a contaminant in drinking water resulting from required monitoring must be reported to DDW.

## Guidelines Followed

The Association of California Water Agencies (ACWA) formed a workgroup that prepared guidelines for water utilities to use in preparing these reports. These guidelines were used in the preparation of our report. Health risk information was provided by the OEHHA (Attachment 2). No other guidance was available from state regulatory agencies.

## Best Available Treatment Technology and Cost Estimates

Both the USEPA and the DDW adopt what are known as Best Available Technologies (BATs), which are the best known methods of reducing contaminant levels to the MCL. Costs can be estimated for such technologies, and a table of known costs for instances where BATs have been implemented is included in [Appendix 3](#). Many PHGs and MCLGs are set significantly lower than the MCL. In such cases, BATs may not be feasible to reduce a contaminant's levels down to the PHG or MCLG, many of which are set at zero. Since there is little data available to estimate cost of treatment to achieve absolute zero levels, rough estimates of BATs may be used, but implementation of BATs still may not achieve the PHG or MCLG, and the costs to do so may be prohibitive.

## Constituents Detected that Exceed a PHG or a MCLG

The following is a discussion of constituents that were detected in one or more of SJW's drinking water sources during monitoring for years 2016, 2017, and 2018 compliance at levels above the PHG, or above the MCLG if there is no PHG. Table 1 below summarizes the constituents detected above the PHGs in SJW water samples collected in 2016-2018.

**Table 1.** Constituents detected above PHGs between 2016 and 2018

Contaminant	Sample Date	Unit	MCL/[AL]	PHG/MCLG	Detections
Hexavalent Chromium	2016-2018	mg/L	NA	0.00002	ND-0.0056
Uranium	2018	pCi/L	20	0.43	ND-1.1
Haloacetic Acids	2016-2018	mg/L	0.06	N/A	ND-0.035 <sup>2</sup>
Trihalomethanes	2016-2018	mg/L	0.08	N/A	ND-0.074 <sup>2</sup>
Bromate	2016-2018	mg/L	0.01	0.0001	ND-0.0096
Coliform Bacteria	2016-2018	%	<5% monthly positive samples	0	0-0.5%
E. Coli Bacteria	2018	Count	0	0	1
Copper	2016-2018	mg/L	[1.3]	0.3	0.3-0.46 <sup>1</sup>
1,2,3-Trichloropropane	2018	mg/L	0.000005	0.0000007	ND-0.000012

<sup>1</sup> 90<sup>th</sup> percentile numbers determined by Lead and Copper Rule Monitoring

<sup>2</sup> Locational Running Annual Average Maximums

## Hexavalent Chromium

Chromium is a naturally occurring metal found in soil, rocks, surface water, and groundwater. It is a component of steel products and is used in many industrial processes like metal degreasing and consumer products. In nature, chromium exists in two primary oxidation levels, 6 and 3; Chromium-3 (Cr-3) is an essential nutrient for humans. Chromium-6 (Cr-6) is known as hexavalent chromium, which can form easily in the natural environment from oxidation of Cr-3. Cr-6 is carcinogenic and has been linked to cancer when inhaled or ingested, and skin exposure can lead to rashes.

The BATs suggested by the State of California under Section 64447, Title 22, CCR for dealing with exceedances in hexavalent chromium are intended to reduce the presence of Chromium-3 in the water that could potentially be oxidized to Chromium-6. These technologies include coagulation and filtration of the water, ion exchange, and reverse osmosis.

Chromium-6 in drinking water is primarily found in groundwater wells. California began regulating Cr-6 in July of 2014, and the current PHG for Cr-6 is 0.00002 mg/L. In 2016 and 2017, San Jose Water's groundwater wells produced samples of Cr-6 above the California PHG, but below the previous MCL of 0.01 mg/L. The Chromium-6 MCL was withdrawn by court order on September 11, 2017, but San Jose Water continues to monitor and record Cr-6 levels for informational purposes. In 2018, groundwater and San Francisco Public Utilities Commission (SFPUC) surface water samples tested above the California PHG for Cr-6, but remained below the MCL of 0.01 mg/L. San Jose Water will continue to sample according to DDW recommendations to ensure the level of Cr-6 does not approach the MCL for these wells.

## Radionuclides

Uranium is a naturally occurring radioactive element present in varying amounts in rocks and soil within the earth's crust. Under natural conditions, uranium leaches into groundwater from uranium bearing rocks. In general, surface water is low in uranium; however, deep bedrock aquifers used for drinking water sometimes contain uranium above regulatory standards. Groundwater, which flows through pores in underground layers of rock, dissolves minerals as it flows. If the rock contains significant amounts of uranium, and the groundwater moves at a slow enough rate, the water picks up higher amounts of uranium.

Exposure to uranium over a long period may result in increased risk of diseases such as bone cancer, lymphoma, leukemia, and aplastic anemia. The MCL set for uranium is well below levels at which health effects have been observed, and, hence, is assumed to protect public health. BATs determined by the EPA for removal of radionuclides in drinking water include Ion Exchange, Lime Softening, and Reverse Osmosis.

In 2018, monitoring of all groundwater wells in San Jose Water's distribution system produced one sample of 1.1 pCi/L, which is above the PHG for uranium of 0.43 pCi/L, but well below the current federal MCL of 5 pCi/L. San Jose Water will continue to monitor levels of radioactivity throughout the distribution system according to DDW recommendations.

## Haloacetic Acids

In drinking water, HAA5 are primarily formed during disinfection, and are monitored quarterly by San Jose Water in accordance with water quality regulations. SJW has been in compliance with all state and federal regulations regarding HAA5 through 2016, 2017, and 2018. There is no California PHG for individual Haloacetic Acids, so instead the USEPA MCLGs are used for the purpose of this report. The USEPA MCLG for DCAA is 0 mg/L and for TCAA is 0 mg/L. Both of these compounds were detected in San Jose Water's system at very low levels.

Five chemicals in the Haloacetic Acid family are currently regulated as drinking water contaminants, commonly referred to as HAA5. These include monochloroacetic acid (MCAA), dichloroacetic acid (DCAA), trichloroacetic acid (TCAA), monobromoacetic acid (MBAA, or bromoacetic acid), and dibromoacetic acid (DBAA). Most haloacetic acids in the environment are created as byproducts of chemical reactions or deliberately synthesized for industrial uses. They are used in fruit harvesting, as pesticides, as bacterial control agents, and in the production of chemicals, pharmaceuticals, and medications. They are also a byproduct of the chlorination of water for disinfection. Haloacetic acids are so widely produced, used, and released that they can be found in most surface water and even in rainwater. Haloacetic acids have been linked to cancer and to liver toxicity.

## Trihalomethanes

In drinking water, trihalomethanes (THMs) are a by-product of disinfection and are monitored quarterly by San Jose Water in accordance with water quality regulations. SJW has been in compliance with all state and federal regulations regarding THMs through 2016, 2017, and 2018.

Bromodichloromethane (BDCM), dibromochloromethane (DBCM), bromoform, and chloroform are currently the THMs of public health concern in drinking water. THMs have been linked to cancer and to liver, kidney, and nervous system toxicity. There is no California PHG for individual THMs, so instead the USEPA MCLGs are used for the purposes of this report. The USEPA MCLGs for BDCM and bromoform are 0 mg/L, and for chloroform, the MCLG is 0.07 mg/L. Each of these three chemicals was detected above their USEPA MCLGs in SJW's distribution system.

Dissolved organic matter is linked to formation of both THMs and HAA5 during disinfection. BAT options for minimizing HAA5 and THM during disinfection include treatment with Granular Activated Carbon (GAC) or Powdered Activated Carbon (PAC) to eliminate organic contaminants. SJW is working continuously to minimize the formation of disinfection byproducts through operational adjustments and blending with groundwater, which is low in organic matter.

## Bromate

Bromate is a compound that can be formed during the disinfection of drinking water when chlorine or ozone reacts with naturally occurring bromide ions in the water. Long-term exposure to bromate has been linked to an increased risk of cancer and kidney disease. Natural organic matter, pH, and temperature all affect the amount of bromate formed during the disinfection of drinking water. As bromate is known to be carcinogenic, the USEPA has set the

MCL at 0.01 mg/L, a concentration significantly lower than that at which any known health effects occur.

In 2018, samples from Santa Clara Valley Water District (SCVWD) surface water within San Jose Water's distribution system exceeded the PHG of 0.00001, but were well under the MCL of 0.01 mg/L. The USEPA has identified the BAT for achieving compliance with maximum residual disinfectant levels of bromate and other disinfection byproducts to be through control of treatment processes in order to reduce disinfectant demand and control of disinfection treatment processes to reduce disinfectant levels. San Jose Water attempts to control treatment processes in compliance with these standards and will continue to monitor levels of disinfection byproducts according to DDW recommendations in order to ensure that these levels do not approach the MCL. SJW has complied with all state and federal regulations regarding bromate through 2016, 2017, and 2018.

### Coliform Bacteria

The MCL for Total Coliform (TC) bacteria was >5% positive samples of all samples per month. The Maximum Contaminant Level Goal (MCLG) for *E. coli* is zero. The reason for the coliform drinking water standard is to minimize the possibility of the water containing pathogens, which are organisms that cause waterborne disease. Because coliform bacteria are only a surrogate indicator of the potential presence of pathogens, it is not possible to state a specific numerical health risk. That is, coliforms are sometimes present due to regrowth or sampling errors, and represent little or no risk to public health. A MCLG is virtually the federal equivalent of a PHG. While USEPA normally sets MCLGs "at a level where no known or anticipated adverse effects on persons would occur", they indicate that they cannot do so with coliforms.

During 2016, 2017, and 2018, SJW collected between 300 and 500 samples each month for coliform analysis. A maximum of 0.5% of these samples were positive in any given month, with a mean of 0.29% positive for the years of 2016, 2017, and 2018. For any sample found to be positive for coliform bacteria, the repeat samples were found to be negative.

Coliform bacteria are indicator organisms that are ubiquitous in nature and are not generally considered harmful. They are used as an indicator because of the ease in monitoring and analysis. If a positive sample is found, it indicates a potential problem that needs to be investigated, which always includes follow-up sampling. It is not all that unusual for a system to have an occasional positive sample due to sampling or analytical errors. It is difficult, if not impossible to assure that a system will never get a positive sample. SJW maintains a disinfection residual (chlorine or chloramine) throughout the distribution system to prevent the growth of microbial organisms. Other equally important measures that SJW has implemented to control bacteria include a comprehensive cross-connection control program, a water main flushing program, a monitoring and surveillance program, and maintenance of positive pressures in its distribution system. SJW has already taken all of the steps described by DDW as "best available technology" for coliform bacteria in Section 64447, Title 22, CCR.

### *E. coli* Bacteria

The *E. coli* MCL is based on either an *E. coli* positive repeat sample following a total coliform (TC) positive routine sample or a TC-positive repeat sample following an *E. coli*-

positive routine sample. The Maximum Contaminant Level Goal (MCLG) for E. coli is zero. The reason for the E. coli drinking water standard is to minimize the possibility of the water containing pathogens which are organisms that cause waterborne disease. E. coli bacterial presence indicates that water may be contaminated with human or animal wastes. Human pathogens in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a greater health risk for infants, young children, the elderly, and people with severely-compromised immune systems. Because coliform is only a surrogate indicator of the potential presence of pathogens, it is not possible to state a specific numerical health risk.

During 2016, 2017, and 2018, SJW collected between 300 and 500 samples each month for coliform analysis. During 2018, a single sample returned positive for E. coli bacteria. Follow up samples did not confirm the presence of E. coli and as a result, the single detection did not constitute an MCL violation.

SJW maintains a disinfection residual (chlorine or chloramine) throughout its distribution system to prevent the growth of microbial organisms. Other equally important measures that SJW has implemented to control bacteria include a comprehensive cross-connection control program, a water main flushing program, a monitoring and surveillance program, and maintenance of positive pressures in our distribution system. SJW has already taken all of the steps described by DDW as “best available technology” for coliform bacteria in Section 64447, Title 22, CCR.

## Copper

There is no MCL for lead or copper. Instead, the 90<sup>th</sup> percentile values of all samples from household taps in the distribution system cannot exceed an Action Level of 0.015 mg/l for lead and 1.3 mg/l for copper. The PHG for lead is 0.002 mg/L. The PHG for copper is 0.17 mg/l. All 90<sup>th</sup> percentile values of all lead monitoring since 2016 have been below the DLR, so it requires no further discussion in this report.

The category of health risk for copper is gastrointestinal irritation. Numerical health risk data on lead and copper can be found in the table from OEHHA found in [Appendix 2](#) below.

All SJW source water samples for copper in 2016, 2017, and 2018 were less than the PHG. Below is a summary of data from household taps where copper compliance is determined:

- In 2016, our 90<sup>th</sup> percentile value for copper was 0.46 mg/l
- In 2017, our 90<sup>th</sup> percentile value for copper was 0.37 mg/l
- In 2018, our 90<sup>th</sup> percentile value for copper was 0.30 mg/l

SJW is in compliance with the Federal and State Lead and Copper Rule. Based on our extensive sampling throughout our distribution system, it was determined according to State regulatory requirements that SJW has “optimized corrosion control”. In general, optimizing corrosion control is considered the best available technology to deal with corrosion issues with any lead or copper findings. SJW continues to monitor our water quality parameters that relate to corrosivity, such as the pH, hardness, alkalinity, total dissolved solids, and will take action if necessary to maintain its system in an “optimized corrosion control” condition.



Since SJW is meeting the “optimized corrosion control” requirements, it is not prudent to initiate any additional corrosion control treatment, as it involves the addition of new chemicals, which could present new water quality issues.

### **1,2,3-Trichloropropane (1,2,3-TCP)**

1,2,3-Trichloropropane (1,2,3-TCP) is exclusively a man-made chemical, typically used as an industrial solvent and as a cleaning and degreasing agent. In California, occurrence of 1,2,3-TCP in groundwater is demonstrated to be linked to an impurity resulting from the production of soil fumigants.

Although 1,2,3-TCP is not federally regulated, California implemented in 2018 an MCL of 5 parts per billion (ppb) for the compound. The PHG for 1,2,3-TCP is 0.7 ppb. During the initial monitoring for this compound, every well, and treatment plant entry point to SJW’s distribution system was monitored quarterly. During one quarter of monitoring, a laboratory error returned dozens of spurious TCP results that were subsequently invalidated by the laboratory’s quality control review. Two samples indicating detections of at 9 and 12 ppb were not included in this invalidation. For each the two samples with detections of 1,2,3-TCP, six monthly follow up samples were taken. All follow up samples (12) showed non-detection of 1,2,3-TCP and therefore the original detections did not constitute an MCL violation.

1,2,3-TCP is recognized by the State of California as a human carcinogen. Long-term exposure to TCP may cause liver and kidney damage, reduced body weight and increased incidences of tumors in numerous organs. The BAT for 1,2,3-TCP is Granular Activated Carbon filtration. If the presence of 1,2,3-TCP was confirmed through follow up monitoring, SJW would either implement this BAT, or retire the sources confirmed to have this contaminant. No confirmed levels of 1,2,3-TCP would be acceptable to serve to SJW’s customers. SJW will continue to monitor vigilantly to ensure the absence of this compound in the drinking water served.

### **Conclusions**

The drinking water provided by San Jose Water meets all State of California and USEPA drinking water standards set to protect public health. Additional costly treatment processes would be required to further reduce the levels of the constituents identified in this report. The effectiveness of these treatment processes is uncertain. The health protection benefits of these further hypothetical reductions are not clear and may not be quantifiable. Therefore, no action is proposed. This assessment is consistent with the recommendations of California Division of Drinking Water.

## Appendix 1: MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

### MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

(Units are in milligrams per liter (mg/L), unless otherwise noted.)

Last Update: March 13, 2019

This table includes:

California's maximum contaminant levels (MCLs)

Detection limits for purposes of reporting (DLRs)

[Public health goals \(PHGs\) from the Office of Environmental Health Hazard Assessment \(OEHHA\)](#)

Also, PHGs for NDMA (which is not yet regulated) is included at the bottom of this table.

Regulated Contaminant	MCL	DLR	PHG	Date of PHG
<b>Chemicals with MCLs in 22 CCR §64431—Inorganic Chemicals</b>				
Aluminum	1	0.05	0.6	2001
Antimony	0.006	0.006	0.001	2016
Arsenic	0.010	0.002	0.000004	2004
Asbestos (MFL = million fibers per liter; for fibers >10 microns long)	7 MFL	0.2 MFL	7 MFL	2003
Barium	1	0.1	2	2003
Beryllium	0.004	0.001	0.001	2003
Cadmium	0.005	0.001	0.00004	2006
Chromium, Total - OEHHA withdrew the 0.0025-mg/L PHG	0.05	0.01	withdrawn Nov. 2001	1999
Chromium, Hexavalent – 0.01-mg/L MCL & 0.001-mg/L DLR repealed September 2017	--	--	0.00002	2011
Cyanide	0.15	0.1	0.15	1997
Fluoride	2	0.1	1	1997
Mercury (inorganic)	0.002	0.001	0.0012	1999 (rev2005)*
Nickel	0.1	0.01	0.012	2001
Nitrate (as nitrogen, N)	10 as N	0.4	45 as NO <sub>3</sub> (=10 as N)	2018
Nitrite (as N)	1 as N	0.4	1 as N	2018
Nitrate + Nitrite (as N)	10 as N	--	10 as N	2018
Perchlorate	0.006	0.004	0.001	2015
Selenium	0.05	0.005	0.03	2010
Thallium	0.002	0.001	0.0001	1999 (rev2004)

### Copper and Lead, 22 CCR §64672.3

*Values referred to as MCLs for lead and copper are not actually MCLs; instead, they are called "Action Levels" under the lead and copper rule*

## Appendix 1: MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

Copper	1.3	0.05	0.3	2008
Lead	0.015	0.005	0.0002	2009

<b>Radionuclides with MCLs in 22 CCR §64441 and §64443—Radioactivity</b>				
[units are picocuries per liter (pCi/L), unless otherwise stated; n/a = not applicable]				
Gross alpha particle activity - OEHHA concluded in 2003 that a PHG was not practical	15	3	none	n/a
Gross beta particle activity - OEHHA concluded in 2003 that a PHG was not practical	4 mrem/yr	4	none	n/a
Radium-226	--	1	0.05	2006
Radium-228	--	1	0.019	2006
Radium-226 + Radium-228	5	--	--	--
Strontium-90	8	2	0.35	2006
Tritium	20,000	1,000	400	2006
Uranium	20	1	0.43	2001

<b>Chemicals with MCLs in 22 CCR §64444—Organic Chemicals</b>				
<b>(a) Volatile Organic Chemicals (VOCs)</b>				
Benzene	0.001	0.0005	0.00015	2001
Carbon tetrachloride	0.0005	0.0005	0.0001	2000
1,2-Dichlorobenzene	0.6	0.0005	0.6	1997 (rev2009)
1,4-Dichlorobenzene (p-DCB)	0.005	0.0005	0.006	1997
1,1-Dichloroethane (1,1-DCA)	0.005	0.0005	0.003	2003
1,2-Dichloroethane (1,2-DCA)	0.0005	0.0005	0.0004	1999 (rev2005)
1,1-Dichloroethylene (1,1-DCE)	0.006	0.0005	0.01	1999
cis-1,2-Dichloroethylene	0.006	0.0005	0.013	2018
trans-1,2-Dichloroethylene	0.01	0.0005	0.05	2018
Dichloromethane (Methylene chloride)	0.005	0.0005	0.004	2000
1,2-Dichloropropane	0.005	0.0005	0.0005	1999
1,3-Dichloropropene	0.0005	0.0005	0.0002	1999 (rev2006)
Ethylbenzene	0.3	0.0005	0.3	1997
Methyl tertiary butyl ether (MTBE)	0.013	0.003	0.013	1999
Monochlorobenzene	0.07	0.0005	0.07	2014
Styrene	0.1	0.0005	0.0005	2010
1,1,2,2-Tetrachloroethane	0.001	0.0005	0.0001	2003

## Appendix 1: MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

Tetrachloroethylene (PCE)	0.005	0.0005	0.00006	2001
Toluene	0.15	0.0005	0.15	1999
1,2,4-Trichlorobenzene	0.005	0.0005	0.005	1999
1,1,1-Trichloroethane (1,1,1-TCA)	0.2	0.0005	1	2006
1,1,2-Trichloroethane (1,1,2-TCA)	0.005	0.0005	0.0003	2006
Trichloroethylene (TCE)	0.005	0.0005	0.0017	2009
Trichlorofluoromethane (Freon 11)	0.15	0.005	1.3	2014
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.2	0.01	4	1997 (rev2011)
Vinyl chloride	0.0005	0.0005	0.00005	2000
Xylenes	1.75	0.0005	1.8	1997

<b>(b) Non-Volatile Synthetic Organic Chemicals (SOCs)</b>				
Alachlor	0.002	0.001	0.004	1997
Atrazine	0.001	0.0005	0.00015	1999
Bentazon	0.018	0.002	0.2	1999 (rev2009)
Benzo(a)pyrene	0.0002	0.0001	0.000007	2010
Carbofuran	0.018	0.005	0.0007	2016
Chlordane	0.0001	0.0001	0.00003	1997 (rev2006)
Dalapon	0.2	0.01	0.79	1997 (rev2009)
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.00001	0.0000017	1999
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.07	0.01	0.02	2009
Di(2-ethylhexyl)adipate	0.4	0.005	0.2	2003
Di(2-ethylhexyl)phthalate (DEHP)	0.004	0.003	0.012	1997
Dinoseb	0.007	0.002	0.014	1997 (rev2010)
Diquat	0.02	0.004	0.006	2016
Endrin	0.002	0.0001	0.0003	2016
Endothal	0.1	0.045	0.094	2014
Ethylene dibromide (EDB)	0.00005	0.00002	0.00001	2003
Glyphosate	0.7	0.025	0.9	2007
Heptachlor	0.00001	0.00001	0.000008	1999
Heptachlor epoxide	0.00001	0.00001	0.000006	1999
Hexachlorobenzene	0.001	0.0005	0.00003	2003
Hexachlorocyclopentadiene	0.05	0.001	0.002	2014
Lindane	0.0002	0.0002	0.000032	1999 (rev2005)
Methoxychlor	0.03	0.01	0.00009	2010
Molinate	0.02	0.002	0.001	2008

## Appendix 1: MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants

Oxamyl	0.05	0.02	0.026	2009
Pentachlorophenol	0.001	0.0002	0.0003	2009
Picloram	0.5	0.001	0.166	2016
Polychlorinated biphenyls (PCBs)	0.0005	0.0005	0.00009	2007
Simazine	0.004	0.001	0.004	2001
2,4,5-TP (Silvex)	0.05	0.001	0.003	2014
2,3,7,8-TCDD (dioxin)	3x10 <sup>-8</sup>	5x10 <sup>-9</sup>	5x10 <sup>-11</sup>	2010
Thiobencarb	0.07	0.001	0.042	2016
Toxaphene	0.003	0.001	0.00003	2003
1,2,3-Trichloropropane	0.000005	0.000005	0.0000007	2009
<b>Chemicals with MCLs in 22 CCR §64533—Disinfection Byproducts</b>				
Total Trihalomethanes	0.080	--	--	--
Bromodichloromethane	--	0.0010	0.00006	2018 draft
Bromoform	--	0.0010	0.0005	2018 draft
Chloroform	--	0.0010	0.0004	2018 draft
Dibromochloromethane	--	0.0010	0.0001	2018 draft
Haloacetic Acids (five) (HAA5)	0.060	--	--	--
Monochloroacetic Acid	--	0.0020	--	--
Dichloroacetic Acid	--	0.0010	--	--
Trichloroacetic Acid	--	0.0010	--	--
Monobromoacetic Acid	--	0.0010	--	--
Dibromoacetic Acid	--	0.0010	--	--
Bromate	0.010	0.0050**	0.0001	2009
Chlorite	1.0	0.020	0.05	2009
<b>Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking water contaminants.</b>				
N-Nitrosodimethylamine (NDMA)	--	--	0.000003	2006
*OEHHA's review of this chemical during the year indicated (rev20XX) resulted in no change in the PHG.				
**The DLR for Bromate is 0.0010 mg/L for analysis performed using EPA Method 317.0 Revision 2.0, 321.8, or 326.0.				

## Appendix 2: Health Risk Categories and Cancer Risk Values for Chemicals with PHGs

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<u>Alachlor</u>	carcinogenicity (causes cancer)	0.004	NA <sup>5,6</sup>	0.002	NA
<u>Aluminum</u>	neurotoxicity and immunotoxicity (harms the nervous and immune systems)	0.6	NA	1	NA
<u>Antimony</u>	digestive system toxicity (causes vomiting)	0.02	NA	0.006	NA
<u>Arsenic</u>	carcinogenicity (causes cancer)	0.000004 (4×10 <sup>-6</sup> )	1×10 <sup>-6</sup> (one per million)	0.01	2.5×10 <sup>-3</sup> (2.5 per thousand)
<u>Asbestos</u>	carcinogenicity (causes cancer)	7 MFL <sup>7</sup> (fibers >10 microns in length)	1×10 <sup>-6</sup>	7 MFL (fibers >10 microns in length)	1×10 <sup>-6</sup> (one per million)
<u>Atrazine</u>	carcinogenicity (causes cancer)	0.00015	1×10 <sup>-6</sup>	0.001	7×10 <sup>-6</sup> (seven per million)

<sup>1</sup> Based on the OEHHA PHG technical support document unless otherwise specified. The categories are the hazard traits defined by OEHHA for California's Toxics Information Clearinghouse (online at: [http://oehha.ca.gov/multimedia/green/pdf/GC\\_Regtest011912.pdf](http://oehha.ca.gov/multimedia/green/pdf/GC_Regtest011912.pdf)).

<sup>2</sup> mg/L = milligrams per liter of water or parts per million (ppm).

<sup>3</sup> Cancer risk = Upper estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. 1×10<sup>-6</sup> means one excess cancer case per million people exposed.

<sup>4</sup> MCL = maximum contaminant level.

<sup>5</sup> NA = not applicable. Cancer risk cannot be calculated.

<sup>6</sup> The PHG for alachlor is based on a threshold model of carcinogenesis and is set at a level that is believed to be without any significant cancer risk to individuals exposed to the chemical over a lifetime.

<sup>7</sup> MFL = million fibers per liter of water

Office of Environmental Health Hazard Assessment  
Water Toxicology Section  
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**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>California PHG (mg/L)<sup>2</sup></b>	<b>Cancer Risk<sup>3</sup> at the PHG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk at the California MCL</b>
<u>Barium</u>	cardiovascular toxicity (causes high blood pressure)	2	NA	1	NA
<u>Bentazon</u>	hepatotoxicity and digestive system toxicity (harms the liver, intestine, and causes body weight effects <sup>8</sup> )	0.2	NA	0.018	NA
<u>Benzene</u>	carcinogenicity (causes leukemia)	0.00015	1x10 <sup>-6</sup>	0.001	7x10 <sup>-6</sup> (seven per million)
<u>Benzo[a]pyrene</u>	carcinogenicity (causes cancer)	0.000007 (7x10 <sup>-6</sup> )	1x10 <sup>-6</sup>	0.0002	3x10 <sup>-5</sup> (three per hundred thousand)
<u>Beryllium</u>	digestive system toxicity (harms the stomach or intestine)	0.001	NA	0.004	NA
<u>Bromate</u>	carcinogenicity (causes cancer)	0.0001	1x10 <sup>-6</sup>	0.01	1x10 <sup>-4</sup> (one per ten thousand)
<u>Cadmium</u>	nephrotoxicity (harms the kidney)	0.00004	NA	0.005	NA
<u>Carbofuran</u>	reproductive toxicity (harms the testis)	0.0007	NA	0.018	NA

## Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

<sup>8</sup> Body weight effects are an indicator of general toxicity in animal studies

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<u>Carbon tetrachloride</u>	carcinogenicity (causes cancer)	0.0001	1x10 <sup>-6</sup>	0.0005	5x10 <sup>-6</sup> (five per million)
<u>Chlordane</u>	carcinogenicity (causes cancer)	0.00003	1x10 <sup>-6</sup>	0.0001	3x10 <sup>-6</sup> (three per million)
<u>Chlorite</u>	hematotoxicity (causes anemia) neurotoxicity (causes neurobehavioral effects)	0.05	NA	1	NA
<u>Chromium, hexavalent</u>	carcinogenicity (causes cancer)	0.00002	1x10 <sup>-6</sup>	none	NA
<u>Copper</u>	digestive system toxicity (causes nausea, vomiting, diarrhea)	0.3	NA	1.3 (AL <sup>9</sup> )	NA
<u>Cyanide</u>	neurotoxicity (damages nerves) endocrine toxicity (affects the thyroid)	0.15	NA	0.15	NA
<u>Dalapon</u>	nephrotoxicity (harms the kidney)	0.79	NA	0.2	NA
<u>Di(2-ethylhexyl)adipate (DEHA)</u>	developmental toxicity (disrupts development)	0.2	NA	0.4	NA
<u>Diethylhexylphthalate (DEHP)</u>	carcinogenicity (causes cancer)	0.012	1x10 <sup>-6</sup>	0.004	3x10 <sup>-7</sup> (three per ten million)



## Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

<sup>9</sup> AL = action level. The action levels for copper and lead refer to a concentration measured at the tap. Much of the copper and lead in drinking water is derived from household plumbing (The Lead and Copper Rule, Title 22, California Code of Regulations [CCR] section 64672.3).

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<u>1,2-Dibromo-3chloropropane (DBCP)</u>	carcinogenicity (causes cancer)	0.0000017 (1.7x10 <sup>-6</sup> )	1x10 <sup>-6</sup>	0.0002	1x10 <sup>-4</sup> (one per ten thousand)
<u>1,2-Dichlorobenzene (oDCB)</u>	hepatotoxicity (harms the liver)	0.6	NA	0.6	NA
<u>1,4-Dichlorobenzene (pDCB)</u>	carcinogenicity (causes cancer)	0.006	1x10 <sup>-6</sup>	0.005	8x10 <sup>-7</sup> (eight per ten million)
<u>1,1-Dichloroethane (1,1DCA)</u>	carcinogenicity (causes cancer)	0.003	1x10 <sup>-6</sup>	0.005	2x10 <sup>-6</sup> (two per million)
<u>1,2-Dichloroethane (1,2DCA)</u>	carcinogenicity (causes cancer)	0.0004	1x10 <sup>-6</sup>	0.0005	1x10 <sup>-6</sup> (one per million)
<u>1,1-Dichloroethylene (1,1-DCE)</u>	hepatotoxicity (harms the liver)	0.01	NA	0.006	NA
<u>1,2-Dichloroethylene, cis</u>	nephrotoxicity (harms the kidney)	0.013	NA	0.006	NA
<u>1,2-Dichloroethylene, trans</u>	immunotoxicity (harms the immune system)	0.05	NA	0.01	NA
<u>Dichloromethane (methylene chloride)</u>	carcinogenicity (causes cancer)	0.004	1x10 <sup>-6</sup>	0.005	1x10 <sup>-6</sup> (one per million)

**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<u>2,4-Dichlorophenoxyacetic acid (2,4-D)</u>	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.02	NA	0.07	NA
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<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>California PHG (mg/L)<sup>2</sup></b>	<b>Cancer Risk<sup>3</sup> at the PHG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk at the California MCL</b>
<u>1,2-Dichloropropane (propylene dichloride)</u>	carcinogenicity (causes cancer)	0.0005	1x10 <sup>-6</sup>	0.005	1x10 <sup>-5</sup> (one per hundred thousand)
<u>1,3-Dichloropropene (Telone II£)</u>	carcinogenicity (causes cancer)	0.0002	1x10 <sup>-6</sup>	0.0005	2x10 <sup>-6</sup> (two per million)
<u>Dinoseb</u>	reproductive toxicity (harms the uterus and testis)	0.014	NA	0.007	NA
<u>Diquat</u>	ocular toxicity (harms the eye) developmental toxicity (causes malformation)	0.006	NA	0.02	NA
<u>Endothall</u>	digestive system toxicity (harms the stomach or intestine)	0.094	NA	0.1	NA
<u>Endrin</u>	neurotoxicity (causes convulsions) hepatotoxicity (harms the liver)	0.0003	NA	0.002	NA

**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>California PHG (mg/L)<sup>2</sup></b>	<b>Cancer Risk<sup>3</sup> at the PHG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk at the California MCL</b>
<u>Ethylbenzene (phenylethane)</u>	hepatotoxicity (harms the liver)	0.3	NA	0.3	NA
<u>Ethylene dibromide (1,2-Dibromoethane)</u>	carcinogenicity (causes cancer)	0.00001	1x10 <sup>-6</sup>	0.00005	5x10 <sup>-6</sup> (five per million)
<u>Fluoride</u>	musculoskeletal toxicity (causes tooth mottling)	1	NA	2	NA
<u>Glyphosate</u>	nephrotoxicity (harms the kidney)	0.9	NA	0.7	NA
<u>Heptachlor</u>	carcinogenicity (causes cancer)	0.000008 (8x10 <sup>-6</sup> )	1x10 <sup>-6</sup>	0.00001	1x10 <sup>-6</sup> (one per million)
<u>Heptachlor epoxide</u>	carcinogenicity (causes cancer)	0.00003 (3x10 <sup>-5</sup> )	1x10 <sup>-6</sup>	0.00001	2x10 <sup>-6</sup> (two per million)
<u>Hexachlorobenzene</u>	carcinogenicity (causes cancer)	0.00003	1x10 <sup>-6</sup>	0.001	3x10 <sup>-5</sup> (three per hundred thousand)
<u>Hexachlorocyclopentadiene (HCCPD)</u>	digestive system toxicity (causes stomach lesions)	0.002	NA	0.05	NA

## Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

<u>Lead</u>	developmental neurotoxicity (causes neurobehavioral effects in children) cardiovascular toxicity (causes high blood pressure) carcinogenicity (causes cancer)	0.0002	<1x10 <sup>-6</sup> (PHG is not based on this effect)	0.015 (AL <sup>9</sup> )	2x10 <sup>-6</sup> (two per million)
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Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<u>Lindane (J-BHC)</u>	carcinogenicity (causes cancer)	0.000032	1x10 <sup>-6</sup>	0.0002	6x10 <sup>-6</sup> (six per million)
<u>Mercury (inorganic)</u>	nephrotoxicity (harms the kidney)	0.0012	NA	0.002	NA
<u>Methoxychlor</u>	endocrine toxicity (causes hormone effects)	0.00009	NA	0.03	NA
<u>Methyl tertiarybutyl ether (MTBE)</u>	carcinogenicity (causes cancer)	0.013	1x10 <sup>-6</sup>	0.013	1x10 <sup>-6</sup> (one per million)
<u>Molinate</u>	carcinogenicity (causes cancer)	0.001	1x10 <sup>-6</sup>	0.02	2x10 <sup>-5</sup> (two per hundred thousand)
<u>Monochlorobenzene (chlorobenzene)</u>	nephrotoxicity (harms the kidney)	0.07	NA	0.07	NA
<u>Nickel</u>	developmental toxicity	0.012	NA	0.1	NA

## Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

	(causes increased neonatal deaths)				
<u>Nitrate</u>	hematotoxicity (causes methemoglobinemia)	45 as nitrate	NA	10 as nitrogen (=45 as nitrate)	NA
<u>Nitrite</u>	hematotoxicity (causes methemoglobinemia)	3 as nitrite	NA	1 as nitrogen (=3 as nitrite)	NA

<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>California PHG (mg/L)<sup>2</sup></b>	<b>Cancer Risk<sup>3</sup> at the PHG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk at the California MCL</b>
<u>Nitrate and Nitrite</u>	hematotoxicity (causes methemoglobinemia)	10 as nitrogen <sup>10</sup>	NA	10 as nitrogen	NA
<u>N-nitrosodimethylamine (NDMA)</u>	carcinogenicity (causes cancer)	0.000003 (3x10 <sup>-6</sup> )	1x10 <sup>-6</sup>	none	NA
<u>Oxamyl</u>	general toxicity (causes body weight effects)	0.026	NA	0.05	NA
<u>Pentachlorophenol (PCP)</u>	carcinogenicity (causes cancer)	0.0003	1x10 <sup>-6</sup>	0.001	3x10 <sup>-6</sup> (three per million)
<u>Perchlorate</u>	endocrine toxicity (affects the thyroid) developmental toxicity (causes neurodevelopmental deficits)	0.001	NA	0.006	NA
<u>Picloram</u>	hepatotoxicity (harms the liver)	0.166	NA	0.5	NA

**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<u>Polychlorinated biphenyls (PCBs)</u>	carcinogenicity (causes cancer)	0.00009	1x10 <sup>-6</sup>	0.0005	6x10 <sup>-6</sup> (six per million)
<u>Radium-226</u>	carcinogenicity (causes cancer)	0.05 pCi/L	1x10 <sup>-6</sup>	5 pCi/L (combined Ra <sup>226+228</sup> )	1x10 <sup>-4</sup> (one per ten thousand)
<u>Radium-228</u>	carcinogenicity (causes cancer)	0.019 pCi/L	1x10 <sup>-6</sup>	5 pCi/L (combined Ra <sup>226+228</sup> )	3x10 <sup>-4</sup> (three per ten thousand)

<sup>10</sup> The joint nitrate/nitrite PHG of 10 mg/L (10 ppm, expressed as nitrogen) does not replace the individual values, and the maximum contribution from nitrite should not exceed 1 mg/L nitrite-nitrogen.

<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>California PHG (mg/L)<sup>2</sup></b>	<b>Cancer Risk<sup>3</sup> at the PHG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk at the California MCL</b>
<u>Selenium</u>	integumentary toxicity (causes hair loss and nail damage)	0.03	NA	0.05	NA
<u>Silvex (2,4,5-TP)</u>	hepatotoxicity (harms the liver)	0.003	NA	0.05	NA
<u>Simazine</u>	general toxicity (causes body weight effects)	0.004	NA	0.004	NA
<u>Strontium-90</u>	carcinogenicity (causes cancer)	0.35 pCi/L	1x10 <sup>-6</sup>	8 pCi/L	2x10 <sup>-5</sup> (two per hundred thousand)
<u>Styrene (vinylbenzene)</u>	carcinogenicity (causes cancer)	0.0005	1x10 <sup>-6</sup>	0.1	2x10 <sup>-4</sup> (two per ten thousand)
<u>1,1,2,2-Tetrachloroethane</u>	carcinogenicity (causes cancer)	0.0001	1x10 <sup>-6</sup>	0.001	1x10 <sup>-5</sup> (one per hundred thousand)

**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<u>2,3,7,8-Tetra-chlorodibenzo-<i>p</i>-dioxin (TCDD, or dioxin)</u>	carcinogenicity (causes cancer)	5x10 <sup>-11</sup>	1x10 <sup>-6</sup>	3x10 <sup>-8</sup>	6x10 <sup>-4</sup> (six per ten thousand)
<u>Tetrachloroethylene (perchloroethylene, or PCE)</u>	carcinogenicity (causes cancer)	0.00006	1x10 <sup>-6</sup>	0.005	8x10 <sup>-5</sup> (eight per hundred thousand)
<u>Thallium</u>	integumentary toxicity (causes hair loss)	0.0001	NA	0.002	NA
<u>Thiobencarb</u>	general toxicity (causes body weight effects) hematotoxicity (affects red blood cells)	0.042	NA	0.07	NA

<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>California PHG (mg/L)<sup>2</sup></b>	<b>Cancer Risk<sup>3</sup> at the PHG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk at the California MCL</b>
<u>Toluene (methylbenzene)</u>	hepatotoxicity (harms the liver) endocrine toxicity (harms the thymus)	0.15	NA	0.15	NA
<u>Toxaphene</u>	carcinogenicity (causes cancer)	0.00003	1x10 <sup>-6</sup>	0.003	1x10 <sup>-4</sup> (one per ten thousand)
<u>1,2,4-Trichlorobenzene</u>	endocrine toxicity (harms adrenal glands)	0.005	NA	0.005	NA

**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<u>1,1,1-Trichloroethane</u>	neurotoxicity (harms the nervous system), reproductive toxicity (causes fewer offspring) hepatotoxicity (harms the liver) hematotoxicity (causes blood effects)	1	NA	0.2	NA
<u>1,1,2-Trichloroethane</u>	carcinogenicity (causes cancer)	0.0003	1x10 <sup>-6</sup>	0.005	2x10 <sup>-5</sup> (two per hundred thousand)
<u>Trichloroethylene (TCE)</u>	carcinogenicity (causes cancer)	0.0017	1x10 <sup>-6</sup>	0.005	3x10 <sup>-6</sup> (three per million)
<u>Trichlorofluoromethane (Freon 11)</u>	accelerated mortality (increase in early death)	1.3	NA	0.15	NA

<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>California PHG (mg/L)<sup>2</sup></b>	<b>Cancer Risk<sup>3</sup> at the PHG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk at the California MCL</b>
<u>1,2,3-Trichloropropane (1,2,3-TCP)</u>	carcinogenicity (causes cancer)	0.0000007 (7x10 <sup>-7</sup> )	1x10 <sup>-6</sup>	0.000005 (5x10 <sup>-6</sup> )	7x10 <sup>-6</sup> (seven per million)
<u>1,1,2-Trichloro1,2,2-trifluoroethane (Freon 113)</u>	hepatotoxicity (harms the liver)	4	NA	1.2	NA



**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<u>Tritium</u>	carcinogenicity (causes cancer)	400 pCi/L	$1 \times 10^{-6}$	20,000 pCi/L	$5 \times 10^{-5}$ (five per hundred thousand)
<u>Uranium</u>	carcinogenicity (causes cancer)	0.43 pCi/L	$1 \times 10^{-6}$	20 pCi/L	$5 \times 10^{-5}$ (five per hundred thousand)
<u>Vinyl chloride</u>	carcinogenicity (causes cancer)	0.00005	$1 \times 10^{-6}$	0.0005	$1 \times 10^{-5}$ (one per hundred thousand)
<u>Xylene</u>	neurotoxicity (affects the senses, mood, and motor control)	1.8 (single isomer or sum of isomers)	NA	1.75 (single isomer or sum of isomers)	NA

Chemical	Health Risk Category <sup>1</sup>	U.S. EPA MCLG <sup>2</sup> (mg/L)	Cancer Risk <sup>3</sup> @ MCLG	California MCL <sup>4</sup> (mg/L)	Cancer Risk @ California MCL
<b>Disinfection byproducts (DBPS)</b>					
Chloramines	acute toxicity (causes irritation) digestive system toxicity (harms the stomach) hematotoxicity (causes anemia)	4 <sup>5,6</sup>	NA <sup>7</sup>	none	NA
Chlorine	acute toxicity (causes irritation) digestive system toxicity (harms the stomach)	4 <sup>5,6</sup>	NA	none	NA
Chlorine dioxide	hematotoxicity (causes anemia) neurotoxicity (harms the nervous system)	0.8 <sup>5,6</sup>	NA	none	NA
<b>Disinfection byproducts: haloacetic acids (HAA5)</b>					
Monochloroacetic acid (MCA)	general toxicity (causes body and organ weight changes <sup>8</sup> )	0.07	NA	none	NA

<sup>1</sup> Health risk category based on the U.S. EPA MCLG document or California MCL document unless otherwise specified.

<sup>2</sup> MCLG = maximum contaminant level goal established by U.S. EPA.

<sup>3</sup> Cancer Risk = upper estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero.  $1 \times 10^{-6}$  means one excess cancer case per million people exposed.

<sup>4</sup> California MCL = maximum contaminant level established by California.

<sup>5</sup> Maximum Residual Disinfectant Level Goal, or MRDLG.

<sup>6</sup> The federal Maximum Residual Disinfectant Level (MRDL), or highest level of disinfectant allowed in drinking water, is the same value for this chemical.

<sup>7</sup> NA = not available.

<sup>8</sup> Body weight effects are an indicator of general toxicity in animal studies.

**Health Risk Categories and Cancer Risk Values for Chemicals  
with California Public Health Goals (PHGs)**

<b>Chemical</b>	<b>Health Risk Category<sup>1</sup></b>	<b>U.S. EPA MCLG<sup>2</sup> (mg/L)</b>	<b>Cancer Risk<sup>3</sup> @ MCLG</b>	<b>California MCL<sup>4</sup> (mg/L)</b>	<b>Cancer Risk @ California MCL</b>
Dichloroacetic acid (DCA)	carcinogenicity (causes cancer)	0	0	none	NA
Trichloroacetic acid (TCA)	hepatotoxicity (harms the liver)	0.02	0	none	NA
Monobromoacetic acid (MBA)	NA	none	NA	none	NA
Dibromoacetic acid (DBA)	NA	none	NA	none	NA
Total haloacetic acids (sum of MCA, DCA, TCA, MBA, and DBA)	general toxicity, hepatotoxicity and carcinogenicity (causes body and organ weight changes, harms the liver and causes cancer)	none	NA	0.06	NA
<b>Disinfection byproducts: trihalomethanes (THMs)</b>					
Bromodichloromethane (BDCM)	carcinogenicity (causes cancer)	0	0	none	NA
Bromoform	carcinogenicity (causes cancer)	0	0	none	NA
Chloroform	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.07	NA	none	NA
Dibromochloromethane (DBCM)	hepatotoxicity, nephrotoxicity, and neurotoxicity (harms the liver, kidney, and nervous system)	0.06	NA	none	NA

## Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category <sup>1</sup>	U.S. EPA MCLG <sup>2</sup> (mg/L)	Cancer Risk <sup>3</sup> @ MCLG	California MCL <sup>4</sup> (mg/L)	Cancer Risk @ California MCL
Total trihalomethanes (sum of BDCM, bromoform, chloroform and DBCM)	carcinogenicity (causes cancer), hepatotoxicity, nephrotoxicity, and neurotoxicity (harms the liver, kidney, and nervous system)	none	NA	0.08	NA
<b>Radionuclides</b>					
Gross alpha particles <sup>9</sup>	carcinogenicity (causes cancer)	0 ( <sup>210</sup> Po included)	0	15 pCi/L <sup>10</sup> (includes <sup>226</sup> Ra but not radon and uranium)	up to 1x10 <sup>-3</sup> (for <sup>210</sup> Po, the most potent alpha emitter)
Beta particles and photon emitters <sup>9</sup>	carcinogenicity (causes cancer)	0 ( <sup>210</sup> Pb included)	0	50 pCi/L (judged equiv. to 4 mrem/yr)	up to 2x10 <sup>-3</sup> (for <sup>210</sup> Pb, the most potent beta-emitter)

<sup>9</sup> MCLs for gross alpha and beta particles are screening standards for a group of radionuclides. Corresponding PHGs were not developed for gross alpha and beta particles. See the OEHHA memoranda discussing the cancer risks at these MCLs at <http://oehha.studio-weeren.com/media/downloads/water/chemicals/phg/grossalphahealth.pdf>.

<sup>10</sup> pCi/L = picocuries per liter of water

## Appendix 3: Cost Estimates for Best Available Treatment Technologies

(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

Reference: Updated 2012 ACWA Cost of Treatment Table

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2018* (\$/1,000 gallons treated)
1	Granular Activated Carbon	Reference: Malcolm Pirnie estimate for California Urban Water Agencies, large surface water treatment plants treating water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, 1998	0.63 - 1.19
2	Granular Activated Carbon	Reference: Carollo Engineers, estimate for VOC treatment (PCE), 95% removal of PCE, Oct. 1994, 1900 gpm design capacity	0.29
3	Granular Activated Carbon	Reference: Carollo Engineers, est. for a large No. Calif. surf. water treatment plant ( 90 mgd capacity) treating water from the State Water Project, to reduce THM precursors, ENR construction cost index = 6262 (San Francisco area) - 1992	1.38
4	Granular Activated Carbon	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility for VOC and SOC removal by GAC, 1990	0.54 - 0.78
5	Granular Activated Carbon	Reference: Southern California Water Co. - actual data for "rented" GAC to remove VOCs (1,1-DCE), 1.5 mgd capacity facility, 1998	2.47
6	Granular Activated Carbon	Reference: Southern California Water Co. - actual data for permanent GAC to remove VOCs (TCE), 2.16 mgd plant capacity, 1998	1.60
7	Reverse Osmosis	Reference: Malcolm Pirnie estimate for California Urban Water Agencies, large surface water treatment plants treating water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, 1998	1.85 - 3.55
8	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 1.0 mgd plant operated at 40% of design flow, high brine line cost, May 1991	4.38
9	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 1.0 mgd plant operated at 100% of design flow, high brine line cost, May 1991	2.70
10	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 10.0 mgd plant operated at 40% of design flow, high brine line cost, May 1991	2.92

**COST ESTIMATES FOR TREATMENT TECHNOLOGIES**

<b>No.</b>	<b>Treatment Technology</b>	<b>Source of Information</b>	<b>Estimated 2012 Unit Cost Indexed to 2018* (\$/1,000 gallons treated)</b>
11	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 10.0 mgd plant operated at 100% of design flow, high brine line cost, May 1991	2.26
12	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 1.0 mgd plant operated at 40% of design capacity, Oct. 1991	7.33
13	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 1.0 mgd plant operated at 100% of design capacity, Oct. 1991	4.33
14	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 10.0 mgd plant operated at 40% of design capacity, Oct. 1991	3.24
15	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 10.0 mgd plant operated at 100% of design capacity, Oct. 1991	2.01
16	Reverse Osmosis	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility with RO to remove nitrate, 1990	2.02 - 3.55
17	Packed Tower Aeration	Reference: Analysis of Costs for Radon Removal... (AWWARF publication), Kennedy/Jenks, for a 1.4 mgd facility operating at 40% of design capacity, Oct. 1991	1.16
18	Packed Tower Aeration	Reference: Analysis of Costs for Radon Removal... (AWWARF publication), Kennedy/Jenks, for a 14.0 mgd facility operating at 40% of design capacity, Oct. 1991	0.62
19	Packed Tower Aeration	Reference: Carollo Engineers, estimate for VOC treatment (PCE) by packed tower aeration, without off-gas treatment, O&M costs based on operation during 329 days/year at 10% downtime, 16 hr/day air stripping operation, 1900 gpm design capacity, Oct. 1994	0.31
20	Packed Tower Aeration	Reference: Carollo Engineers, for PCE treatment by Ecolo-Flo Enviro-Tower air stripping, without off-gas treatment, O&M costs based on operation during 329 days/year at 10% downtime, 16 hr/day air stripping operation, 1900 gpm design capacity, Oct. 1994	0.32
21	Packed Tower Aeration	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility - packed tower aeration for VOC and radon removal, 1990	0.50 - 0.82

## COST ESTIMATES FOR TREATMENT TECHNOLOGIES

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2018* (\$/1,000 gallons treated)
22	Advanced Oxidation Processes	Reference: Carollo Engineers, estimate for VOC treatment (PCE) by UV Light, Ozone, Hydrogen Peroxide, O&M costs based on operation during 329 days/year at 10% downtime, 24 hr/day AOP operation, 1900 gpm capacity, Oct. 1994	0.61
23	Ozonation	Reference: Malcolm Pirnie estimate for CUWA, large surface water treatment plants using ozone to treat water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, <i>Cryptosporidium</i> inactivation requirements, 1998	0.14 - 0.29
24	Ion Exchange	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility - ion exchange to remove nitrate, 1990	0.67 - 0.88

\*Costs were adjusted from date of original estimates to present, where appropriate, using the Engineering News Record (ENR) annual average building costs of 2018 and 2012. The adjustment factor was derived from the ratio of 2018 Index/2012 Index, or 1.188. For the indexed 2015 costs, please refer to the ACWA PHG Guidance published in March 2016.