

Report on Water Quality Relative to Public Health Goals

June 2022

CITY OF STOCKTON



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CITY OF STOCKTON WATER SYSTEM REPORT ON WATER QUALITY RELATIVE TO PUBLIC HEALTH GOALS June 2022

BACKGROUND

Provisions of California Health and Safety Code Section 116470(b) require that public water systems serving more than 10,000 service connections prepare a brief, written report by July 1, 2022 that provides information on water quality levels from the three previous years that exceeded any Public Health Goals (PHGs), published by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA). The law also requires that where OEHHA has not adopted a PHG for a contaminant, water suppliers are to use the Maximum Contaminant Level Goals (MCLGs) set by the United States Environmental Protection Agency (USEPA). Only contaminants in a water system which have a level exceeding a PHG or MCLG are addressed in this report.

This report provides the following information as specified in the California Health and Safety Code Section 116470(b) for any contaminant detected in the City's water supply between 2019 and 2021 at a level exceeding a PHG or MCLG:

- Numerical public health risk associated with the Maximum Contaminant Level (MCL), and the PHG or MCLG,
- Category or type of risk to health that could be associated with each contaminant level,
- Best Available Treatment Technology that could be used to reduce the contaminant level, and
- Estimate of the cost to install that treatment.

PUBLIC HEALTH GOALS

PHGs are set by the California OEHHA and are based solely on public health risk considerations. None of the practical risk management factors that are considered by the USEPA or the California State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) in setting drinking water standards are considered in setting the PHGs. These factors include analytical detection capability, treatment technology available, benefits, and costs. PHGs are not enforceable and are not required to be met by any public water system. MCLGs are the federal equivalent to PHGs. Appendix A lists the regulated contaminants for which PHGs and MCLGs have been set.

CITY OF STOCKTON WATER SOURCES

Most of the City's drinking water is treated surface water produced through the Delta Water Treatment Plant (DWTP) or purchased from the Stockton East Water District (SEWD). Water is diverted from the Sacramento-San Joaquin Delta, and Mokelumne River water is purchased from Woodbridge Irrigation District for treatment at the City's DWTP. SEWD imports surface water from New Melones and New Hogan Reservoirs for treatment and delivery to the City. The City of Stockton's water supply also consists of groundwater sources.

WATER QUALITY DATA CONSIDERED

All water quality data collected from the City's treated surface water and groundwater between 2019 and 2021 for purposes of determining compliance with drinking water standards were considered for this report. In addition, water quality data from SEWD is also considered for this report. This data is summarized in the 2019, 2020, and 2021 annual Drinking Water Quality Reports (i.e., Consumer Confidence Reports) which are available on the City's website. Copies of these reports may be viewed at the following location: <http://www.stocktonca.gov/files/ccr.pdf>

GUIDELINES FOLLOWED

Suggested Guidelines for Preparation of Required Reports on Public Health Goals (PHGs) to satisfy requirements of California Health and Safety Code Section 116470(b) by the Association of California Water Agencies was used in the preparation of this report.

PHGs, MCLGs and DLRs

PHGs are based solely on public health risk considerations. They represent the level of a contaminant in drinking water below which there is no known or expected significant risk to health. None of the practical risk-management factors that are considered by the DDW or USEPA in setting drinking water MCLs are considered in setting PHGs. These factors include analytical detection capability, available treatment technologies, and benefits and costs of operating the treatment. MCLGs are the federal equivalent to PHGs, however, in cases where a contaminant is a known or suspected carcinogen, the MCLG is set to zero. PHGs and MCLGs are not enforceable and are not required to be met by any public water systems. A constituent's DLR (Detection Limits for Purposes of Reporting) is the designated minimum level at or above which any analytical result for drinking water must be reported to DDW. PHG report guidance recommends considering results that are above their PHG or MCLG and less than their DLR to be zero. A list published by DDW of regulated constituents with the MCLs, DLRs and PHGs for Regulated Drinking Water Contaminants is included as Attachment 2.

BEST AVAILABLE TREATMENT TECHNOLOGY AND COST ESTIMATES

Both the USEPA and SWRCB adopt Best Available Technologies (BATs) which are the best-known methods of reducing contaminant levels to the MCL. Costs can be estimated for such technologies. However, since many PHGs and all MCLGs are set much lower than the MCL, it is not always possible, nor feasible, to determine what treatment is needed to further reduce a contaminant to or near the PHG or MCLG, many of which are set at zero. Estimating the costs to reduce a contaminant to zero is difficult, if not impossible and costly. In some cases, installing

treatment to try and further reduce to very low levels of one contaminant may have adverse effects on other aspects of water quality.¹

CONTAMINANTS DETECTED THAT EXCEEDED A PUBLIC HEALTH GOALS OR MAXIMUM CONTAMINANT LEVEL GOALS

The following is a discussion of contaminants that were detected in one or more of our drinking water sources at levels above the PHG, or if no PHG, above the MCLG. This report only provides information on contaminants that were found in the City's drinking water system to have exceeded established PHG or MCLG. **The City of Stockton consistently delivers safe water at the lowest possible cost to our customers. The levels of these contaminants were well below the MCLs, so this does not constitute a violation of drinking water regulations or indicate the water was unsafe to drink.** These results could be considered typical for a California water agency. The health risk information for regulated contaminants with PHGs are provided in Appendix B.

Arsenic

The PHG for arsenic is 0.004 µg/L, and United States Environmental Protection Agency and State of California MCL is 10 µg/L. Arsenic is a naturally occurring element and is widely present in the environment. In certain geographical areas, natural mineral deposits may contain large quantities of arsenic and this may result in higher levels of arsenic in water. The main commercial use of arsenic in the United States is pesticides and in wood preservatives.

In humans, while ingestion of larger doses of arsenic may be lethal, lower levels of exposure may cause a variety of systemic effects including irritation of the digestive tract, nausea, vomiting, and diarrhea. In addition, arsenic ingestion can increase the risk of cancer in the digestive system, lungs, heart, and skin. The duration of arsenic exposure appears to be a key factor in determining the extent of the toxic effects.

The City of Stockton is required to monitor each of its drinking water wells for arsenic at least once every three years. In sampling conducted in 2019, 2020 and 2021, nine (9) samples were collected from a total of nine (9) active well sites. Arsenic values ranged from 0 µg/L to a maximum of 6.7 µg/L, with an average concentration of 4.3 µg/L over the three-year span. The MCL is 10 µg/L on a quarterly running average.

Three (3) samples were collected from the SEWD treated surface water and there were no detections of arsenic.

Health Risk Category

The health risk category for arsenic is carcinogenicity. People who drink water containing arsenic above the MCL throughout their lifetime could experience an increased risk of getting cancer.

Numerical Health Risk at MCLG

The numerical health risk for arsenic based on the PHG is 1×10^{-6} . This means one excess

¹ The estimated service connection costs were derived from adjusting the 2019 Public Health Goals Report's estimated service connection costs with respects to the Updated 2012 ACWA Cost of Treatment Table (Attachment A, Table 3).

cancer case per million people exposed.

Best Available Technologies and Treatment Costs

The BAT to lower the level of arsenic below the MCL is the addition of ion exchange treatment units. The estimated annual cost to install and operate ion exchange treatment units at 9 of the City's wells to reduce arsenic levels to below the PHG would be approximately \$0.73 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$221 per service connection per year for the life of the treatment system.

Bromate

The PHG for bromate is 1 µg/L and MCL is 10 µg/L calculated on a quarterly running average. Bromate is formed when naturally occurring bromide reacts with ozone in the surface water treatment process. The City uses ozone in the treatment process at the Delta Water Supply Treatment Plant.

In sampling conducted at the DWTP from 2019 to 2021, a total of thirty five (35) samples were collected and bromate was detected in seven of those samples. Bromate values ranged from 0 µg/L to 28 µg/L with an average of 2.8 µg/L over the three-year span. The City is complying of the MCL, as the quarterly running average is below 10 µg/L.

Health Risk Category

The health risk category for bromate is carcinogenicity. People who drink water containing bromate above the MCL throughout their lifetime could experience an increased risk of getting cancer.

Numerical Health Risk at MCLG

The numerical health risk for bromate based on the PHG is 1×10^{-6} . This means one excess cancer case per million people exposed.

Best Available Technologies and Treatment Costs

The BAT to lower the level of bromate below the MCL is the addition of granular activated carbon treatment units. The estimated annual cost to install and operate a granular activated carbon treatment unit at the Delta Water Supply Treatment Plant to reduce bromate levels to below the PHG would be approximately \$0.69 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$156 per service connection per year for the life of the treatment system, assuming the treatment plant operates 365 days of the year.

Radionuclides

Many naturally occurring substances and a few man-made ones have the potential to emit ionizing radiation, and therefore, are referred to as radioactive. Of the radionuclides that have been observed in drinking water, most are naturally occurring. The naturally occurring contaminant of greatest concern in drinking water is uranium. Most of the naturally occurring radionuclides are alpha particle emitters.

Contamination by man-made nuclear materials can also occur. The man-made radionuclides, which are primarily beta and photon emitters, are produced by several activities that involve the use of concentrated radioactive materials. These include production of electricity; nuclear medicines used in therapy and diagnosis; and various commercial products such as, televisions and smoke detectors. The City of Stockton is only required to monitor its groundwater and surface water supplies for naturally occurring radionuclides.

Exposure to radionuclides from drinking water results in an increased risk of cancer. In addition to cancer, exposure to uranium has the potential to cause kidney damage. In California, the radionuclides currently regulated in drinking water are gross alpha particle activity, radium 226, radium 228, uranium, and beta and photon emitters. The City detected Gross Alpha Particles, Radium-228, and Uranium above the PHG or MCLG but well under the MCL.

Gross Alpha Particles

Radionuclides such as gross alpha particles in water supplies are predominantly from erosion of natural deposits. The term radionuclide refers to naturally occurring elemental radium, radon, uranium, and thorium with unstable atomic nuclei that spontaneously decay, producing ionizing radiation. Gross alpha is defined as the sum total of these radionuclides. The MCL for gross alpha is 15 picocuries per liter of water (pCi/L) and the MCLG is 0 pCi/L.

The City collected and analyzed samples for gross alpha particles during 2019-2021, with values that ranged from non-detect (ND) to 7.11 pCi/L, with an average value of 4.51 pCi/L, all sample results were below the MCL.

Health Risk Category

The category of health risk for gross alpha particles is carcinogenicity chronic toxicity. Carcinogenic risk means capable of producing cancer. Chronic toxicity means that adverse effects may develop gradually from low levels of exposure over a long period of time.

Numerical Health Risk at MCLG

The numerical health risk based on USEA's MCLG is zero therefore the cancer risk is zero.

Best Available Technologies and Treatment Costs

The best available technology (BAT) to lower the level of these compounds below the PHG is reverse osmosis. Since the levels are already below the MCL, reverse osmosis would be required to attempt to lower the levels to below the PHG. Please note that accurate cost estimates are difficult, if not impossible, and are highly speculative and theoretical. The estimated annual cost to install and operate reverse osmosis system at 13 of the City's wells to reduce uranium levels to below the PHG would be approximately \$4.75 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$1351 per service connection per year for the life of the treatment system.

Radium-228

Radium-228 is a naturally occurring radioactive element present in geological formations and the earth's crust. It is introduced into groundwater and surface water through erosion. The MCL for Radium-228 is a combined total of Radium-226 + Radium-228 is 5 pCi/L and the PHG for

Radium-228 is 0.019 pCi/L.

The City collected and analyzed samples for Radium-228 during 2019-2021, with values that ranged from ND to 1.71 pCi/L, with an average result of 0.60 pCi/L, with all samples below the MCL.

Health Risk Category

The category of health risk for uranium is carcinogenicity chronic toxicity (kidneys). Carcinogenic risk means capable of producing cancer. Chronic toxicity means that adverse effects may develop gradually from low levels of exposure over a long period of time.

Numerical Health Risk at MCLG

The numerical health risk for Radium-228 based on the PHG is 1×10^{-6} . This means one excess cancer case per million people exposed.

Best Available Technologies and Treatment Costs

The best available technology (BAT) to lower the level of these compounds below the PHG is reverse osmosis. Since the levels are already below the MCL, reverse osmosis would be required to attempt to lower the levels to below the PHG. Please note that accurate cost estimates are difficult, if not impossible, and are highly speculative and theoretical. The estimated annual cost to install and operate reverse osmosis system at 2 of the City's wells to reduce uranium levels to below the PHG would be approximately \$4.75 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$208 per service connection per year for the life of the treatment system.

Uranium

Uranium is a naturally occurring radioactive element present in geological formations and the earth's crust. It is introduced into groundwater and surface water through erosion. The MCL for uranium is 20 pCi/L and the PHG for uranium is 0.43 pCi/L.

The City collected and analyzed samples for uranium during 2019-2021, with values that ranged from ND to 5.80 pCi/L, there were 4 detections above the PHG with an average of 3.71 pCi/L, with all samples below the MCL.

Health Risk Category

The category of health risk for uranium is carcinogenicity chronic toxicity (kidneys). Carcinogenic risk means capable of producing cancer. Chronic toxicity means that adverse effects may develop gradually from low levels of exposure over a long period of time.

Numerical Health Risk at MCLG

The numerical health risk for uranium based on the PHG is 1×10^{-6} . This means one excess cancer case per million people exposed.

Best Available Technologies and Treatment Costs

The best available technology (BAT) to lower the level of these compounds below the PHG is reverse osmosis. Since the levels are already below the MCL, reverse osmosis would be

required to attempt to lower the levels to below the PHG. Please note that accurate cost estimates are difficult, if not impossible, and are highly speculative and theoretical. The estimated annual cost to install and operate reverse osmosis system at 4 of the City's wells to reduce uranium levels to below the PHG would be approximately \$4.75 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$416 per service connection per year for the life of the treatment system.

Total Coliform Bacteria

Total coliform bacteria are tested at sampling sites throughout the City's water distribution system. No more than 5% of all samples collected in a month can be positive for total coliforms in order to comply with the MCL. Although there is no PHG for total coliform bacteria, the MCLG is 0% positive samples. The reason for the total coliform drinking water standard is to minimize the possibility of the water containing pathogens, which are organisms that cause waterborne diseases. Because total coliform analysis is only a surrogate indicator of the potential presence of pathogens, it is not possible to state a specific numerical health risk. While USEPA normally sets MCLGs "at a level where no known or anticipated adverse effects on persons would occur," the USEPA indicates that this is not possible with total coliforms.

Coliform bacteria are an indicator organism that are ubiquitous in nature and are not generally considered harmful. They are used because of the ease in monitoring and analysis. If a positive sample is found, it indicates a potential problem that needs to be investigated and additional sampling is warranted. It is not at all unusual for a system to have an occasional positive coliform bacteria sample. It is difficult, if not impossible; to assure that a system will never get a positive sample.

During 2019, 2020 and 2021, between 145 and 186 samples were collected each month for coliform analyses. Occasionally, a sample(s) is found to be positive for coliform bacteria. Repeat samples for sites having positive coliform bacteria were taken as a follow-up, and in every case, the repeat samples were negative.

The City provides chlorine disinfection to ensure that the water served is microbiologically safe. The chlorine residual levels are carefully controlled to provide the best health protection without causing the water to have undesirable taste and odor or increasing the level of certain compounds. This careful balance of treatment processes is essential to supplying our customers with safe drinking water.

Other equally important measures that we have implemented include: an effective cross-connection and backflow control programs; an effective monitoring and surveillance program; and maintaining positive pressures in our distribution system. The system has already taken all the steps described by DDW as "Best Available Technology" for coliform bacteria, which is regulated in Title 22, CCR, Section 64447.

RECOMMENDATIONS FOR FURTHER ACTION

The City of Stockton's drinking water quality for the contaminants discussed in this 2022 Public Health Goals Report meet all State Water Resources Control Board and USEPA drinking water standards set to protect public health. To further reduce the levels of the contaminants identified in this report that are already significantly below the health-based maximum contaminant levels established to provide "safe drinking water", additional costly treatment processes at City water wells and DWTP would be required. The effectiveness of the treatment processes to provide any significant reductions in contaminant levels at these already low values is uncertain. The health protection benefits of these further hypothetical reductions are not at all clear and may not be quantifiable. Therefore, no action is proposed at this time.

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APPENDIX A
MCLs, DLRs and PHGs for Regulated Drinking Water Contaminants

ATTACHMENT NO. 1

2022 PHG Triennial Report: Calendar Years 2019-2020-2021

MCLs, DLRs, and PHGs for Regulated Drinking Water Contaminants
(Units are in milligrams per liter (mg/L), unless otherwise noted.)

Last Update: September 14, 2021

(Reference last update 9/14/2021:

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/mclreview/mcls_dlr_phgs.pdf)

This table includes:

- DDW's maximum contaminant levels (MCLs)
- DDW's detection limits for purposes of reporting (DLRs)
- [Public health goals \(PHGs\) from the Office of Environmental Health Hazard Assessment \(OEHHA\)](#)
- PHGs for NDMA and 1,2,3-Trichloropropane (both are unregulated) are at the bottom of this table
- The federal MCLG for chemicals without a PHG, microbial contaminants, and the DLR for 1,2,3-TCP

Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
Chemicals with MCLs in 22 CCR §64431 —Inorganic Chemicals				
Aluminum	1	0.05	0.6	2001
Antimony	0.006	0.006	0.02	1997
Antimony	--	--	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 1999 0.0025 mg/L PHG in Nov 2001	0.05	0.01	(0.100)	1999
Chromium, Hexavalent (Chromium-6)	0.04	0.004	0.00002	2014
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 N)	10 as N	0.4	45 as NO ₃ (=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	0.002	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				
<i>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</i>				
Copper	1.3	0.05	0.3	2008
Lead	0.015	0.005	0.0002	2009

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Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
Radionuclides with MCLs in 22 CCR §64441 and §64443 — Radioactivity				
[units are picocuries per liter (pCi/L), unless otherwise stated; n/a = not applicable]				
Gross alpha particle activity - OEHA concluded in 2003 that a PHG was not practical	15	3	none	n/a
Gross beta particle activity - OEHA 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
Chemicals with MCLs in 22 CCR §64444 — Organic Chemicals				
(a) Volatile Organic Chemicals (VOCs)				
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-Dichloropropane	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
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)	0.200	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

ATTACHMENT NO. 1

Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
(b) Non-Volatile Synthetic Organic Chemicals (SOCs)				
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	0.0017	2000
Carbofuran	--	--	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	0.000003	2020
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	0.015	2000
Diquat	--	--	0.006	2016
Endrin	0.002	0.0001	0.0018	1999 (rev2008)
Endrin	--	--	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
Oxamyl	0.05	0.02	0.026	2009
Pentachlorophenol	0.001	0.0002	0.0003	2009
Picloram	0.5	0.001	0.5	1997
Picloram	--	--	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 ⁻⁸	5x10 ⁻⁹	5x10 ⁻¹¹	2010
Thiobencarb	0.07	0.001	0.07	2000
Thiobencarb	--	--	0.042	2016
Toxaphene	0.003	0.001	0.00003	2003

ATTACHMENT NO. 1

Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
Chemicals with MCLs in 22 CCR §64533 —Disinfection Byproducts				
Total Trihalomethanes	0.080	--		
Total Trihalomethanes	--	--	0.0008	2010 draft
Bromodichloromethane	--	0.0010	0.00006	2020
Bromoform	--	0.0010	0.0005	2020
Chloroform	--	0.0010	0.0004	2020
Dibromochloromethane	--	0.0010	0.0001	2020
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 or 0.0010 ^a	0.0001	2009
Chlorite	1.0	0.020	0.05	2009
Microbiological Contaminants (TT = Treatment Technique)				
Coliform % positive samples	%	5	(zero)	
<i>Cryptosporidium</i> **		TT	(zero)	
<i>Giardia lamblia</i> **		TT	(zero)	
<i>Legionella</i> **		TT	(zero)	
Viruses**		TT	(zero)	
Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking water contaminants.				
N-Nitrosodimethylamine (NDMA)	--	--	0.000003	2006
1,2,3-Trichloropropane	--	0.000005	0.000007	2009

Notes:

^a DDW will maintain a 0.0050 mg/L DLR for bromate to accommodate laboratories that are using EPA Method 300.1. However, laboratories using EPA Methods 317.0 Revision 2.0, 321.8, or 326.0 must meet a 0.0010 mg/L MRL for bromate and should report results with a DLR of 0.0010 mg/L per Federal requirements.

*OEHHA's review of this chemical during the year indicated (rev20XX) resulted in no change in the PHG

** Surface water treatment = TT

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APPENDIX B
Health Risk Information for Public Health Goal Exceedance Reports

Health Risk Information for Public Health Goal Exceedance Reports

Prepared by

Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

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NEW for the 2022 Report: New in this document are an updated Public Health Goal (PHG) for 1,2-dibromo-3-chloropropane (DBCP) and newly established PHGs for the trihalomethanes bromodichloromethane, bromoform, chloroform, and dibromochloromethane.

Background: Under the Calderon-Sher Safe Drinking Water Act of 1996 (the Act), public water systems with more than 10,000 service connections are required to prepare a report every three years for contaminants that exceed their respective PHGs.¹ This document contains health risk information on drinking water contaminants to assist public water systems in preparing these reports. A PHG is the concentration of a contaminant in drinking water that poses no significant health risk if consumed for a lifetime. PHGs are developed and published by the Office of Environmental Health Hazard Assessment (OEHHA) using current risk assessment principles, practices and methods.²

The water system's report is required to identify the health risk category (e.g., carcinogenicity or neurotoxicity) associated with exposure to each contaminant in drinking water that has a PHG and to include a brief, plainly worded description of these risks. The report is also required to disclose the numerical public health risk, if available, associated with the California Maximum Contaminant Level (MCL) and with the PHG for each contaminant. This health risk information document is prepared by OEHHA every three years to assist the water systems in providing the required information in their reports.

¹ Health and Safety Code Section 116470(b)

² Health and Safety Code Section 116365

Numerical health risks: Table 1 presents health risk categories and cancer risk values for chemical contaminants in drinking water that have PHGs.

The Act requires that OEHHA publish PHGs based on health risk assessments using the most current scientific methods. As defined in statute, PHGs for non-carcinogenic chemicals in drinking water are set at a concentration “at which no known or anticipated adverse health effects will occur, with an adequate margin of safety.” For carcinogens, PHGs are set at a concentration that “does not pose any significant risk to health.” PHGs provide one basis for revising MCLs, along with cost and technological feasibility. OEHHA has been publishing PHGs since 1997 and the entire list published to date is shown in Table 1.

Table 2 presents health risk information for contaminants that do not have PHGs but have state or federal regulatory standards. The Act requires that, for chemical contaminants with California MCLs that do not yet have PHGs, water utilities use the federal Maximum Contaminant Level Goal (MCLG) for the purpose of complying with the requirement of public notification. MCLGs, like PHGs, are strictly health based and include a margin of safety. One difference, however, is that the MCLGs for carcinogens are set at zero because the US Environmental Protection Agency (US EPA) assumes there is no absolutely safe level of exposure to such chemicals. PHGs, on the other hand, are set at a level considered to pose no *significant* risk of cancer; this is usually no more than a one-in-one-million excess cancer risk (1×10^{-6}) level for a lifetime of exposure. In Table 2, the cancer risks shown are based on the US EPA’s evaluations.

For more information on health risks: The adverse health effects for each chemical with a PHG are summarized in a PHG technical support document. These documents are available on the OEHHA website (<https://oehha.ca.gov/water/public-health-goals-phgs>).

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

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

¹ 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: <https://oehha.ca.gov/media/downloads/risk-assessment/gcregtext011912.pdf>).

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

³ Cancer Risk = Upper bound estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. 1×10⁻⁶ means one excess cancer case per million people exposed.

⁴ MCL = maximum contaminant level.

⁵ NA = not applicable. Cancer risk cannot be calculated.

⁶ 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.

⁷ MFL = million fibers per liter of water.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Barium	cardiovascular toxicity (causes high blood pressure)	2	NA	1	NA
Bentazon	hepatotoxicity and digestive system toxicity (harms the liver, intestine, and causes body weight effects ⁸)	0.2	NA	0.018	NA
Benzene	carcinogenicity (causes leukemia)	0.00015	1×10^{-6}	0.001	7×10^{-6} (seven per million)
Benzo[a]pyrene	carcinogenicity (causes cancer)	0.000007 (7×10^{-6})	1×10^{-6}	0.0002	3×10^{-5} (three per hundred thousand)
Beryllium	digestive system toxicity (harms the stomach or intestine)	0.001	NA	0.004	NA
Bromate	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.01	1×10^{-4} (one per ten thousand)
Cadmium	nephrotoxicity (harms the kidney)	0.00004	NA	0.005	NA
Carbofuran	reproductive toxicity (harms the testis)	0.0007	NA	0.018	NA

⁸ Body weight effects are an indicator of general toxicity in animal studies.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Carbon tetrachloride	carcinogenicity (causes cancer)	0.0001	1×10 ⁻⁶	0.0005	5×10 ⁻⁶ (five per million)
Chlordane	carcinogenicity (causes cancer)	0.00003	1×10 ⁻⁶	0.0001	3×10 ⁻⁶ (three per million)
Chlorite	hematotoxicity (causes anemia) neurotoxicity (causes neurobehavioral effects)	0.05	NA	1	NA
Chromium, hexavalent	carcinogenicity (causes cancer)	0.00002	1×10 ⁻⁶	none	NA
Copper	digestive system toxicity (causes nausea, vomiting, diarrhea)	0.3	NA	1.3 (AL ⁹)	NA
Cyanide	neurotoxicity (damages nerves) endocrine toxicity (affects the thyroid)	0.15	NA	0.15	NA
Dalapon	nephrotoxicity (harms the kidney)	0.79	NA	0.2	NA
Di(2-ethylhexyl) adipate (DEHA)	developmental toxicity (disrupts development)	0.2	NA	0.4	NA

⁹ 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).

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Di(2-ethylhexyl) phthalate (DEHP)	carcinogenicity (causes cancer)	0.012	1×10^{-6}	0.004	3×10^{-7} (three per ten million)
1,2-Dibromo-3-chloropropane (DBCP)	carcinogenicity (causes cancer)	0.000003 (3×10^{-6})	1×10^{-6}	0.0002	7×10^{-5} (seven per hundred thousand)
1,2-Dichloro-benzene (o-DCB)	hepatotoxicity (harms the liver)	0.6	NA	0.6	NA
1,4-Dichloro-benzene (p-DCB)	carcinogenicity (causes cancer)	0.006	1×10^{-6}	0.005	8×10^{-7} (eight per ten million)
1,1-Dichloro-ethane (1,1-DCA)	carcinogenicity (causes cancer)	0.003	1×10^{-6}	0.005	2×10^{-6} (two per million)
1,2-Dichloro-ethane (1,2-DCA)	carcinogenicity (causes cancer)	0.0004	1×10^{-6}	0.0005	1×10^{-6} (one per million)
1,1-Dichloro-ethylene (1,1-DCE)	hepatotoxicity (harms the liver)	0.01	NA	0.006	NA
1,2-Dichloro-ethylene, cis	nephrotoxicity (harms the kidney)	0.013	NA	0.006	NA
1,2-Dichloro-ethylene, trans	immunotoxicity (harms the immune system)	0.05	NA	0.01	NA

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Dichloromethane (methylene chloride)	carcinogenicity (causes cancer)	0.004	1×10 ⁻⁶	0.005	1×10 ⁻⁶ (one per million)
2,4-Dichlorophenoxyacetic acid (2,4-D)	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.02	NA	0.07	NA
1,2-Dichloropropane (propylene dichloride)	carcinogenicity (causes cancer)	0.0005	1×10 ⁻⁶	0.005	1×10 ⁻⁵ (one per hundred thousand)
1,3-Dichloropropene (Telone II®)	carcinogenicity (causes cancer)	0.0002	1×10 ⁻⁶	0.0005	2×10 ⁻⁶ (two per million)
Dinoseb	reproductive toxicity (harms the uterus and testis)	0.014	NA	0.007	NA
Diquat	ocular toxicity (harms the eye) developmental toxicity (causes malformation)	0.006	NA	0.02	NA
Endothall	digestive system toxicity (harms the stomach or intestine)	0.094	NA	0.1	NA
Endrin	neurotoxicity (causes convulsions) hepatotoxicity (harms the liver)	0.0003	NA	0.002	NA
Ethylbenzene (phenylethane)	hepatotoxicity (harms the liver)	0.3	NA	0.3	NA

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Ethylene dibromide (1,2-Dibromoethane)	carcinogenicity (causes cancer)	0.00001	1×10^{-6}	0.00005	5×10^{-6} (five per million)
Fluoride	musculoskeletal toxicity (causes tooth mottling)	1	NA	2	NA
Glyphosate	nephrotoxicity (harms the kidney)	0.9	NA	0.7	NA
Heptachlor	carcinogenicity (causes cancer)	0.000008 (8×10^{-6})	1×10^{-6}	0.00001	1×10^{-6} (one per million)
Heptachlor epoxide	carcinogenicity (causes cancer)	0.000006 (6×10^{-6})	1×10^{-6}	0.00001	2×10^{-6} (two per million)
Hexachlorobenzene	carcinogenicity (causes cancer)	0.00003	1×10^{-6}	0.001	3×10^{-5} (three per hundred thousand)
Hexachlorocyclopentadiene (HCCPD)	digestive system toxicity (causes stomach lesions)	0.002	NA	0.05	NA
Lead	developmental neurotoxicity (causes neurobehavioral effects in children) cardiovascular toxicity (causes high blood pressure) carcinogenicity (causes cancer)	0.0002	$< 1 \times 10^{-6}$ (PHG is not based on this effect)	0.015 (AL ⁹)	2×10^{-6} (two per million)

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Lindane (γ-BHC)	carcinogenicity (causes cancer)	0.000032	1×10 ⁻⁶	0.0002	6×10 ⁻⁶ (six per million)
Mercury (inorganic)	nephrotoxicity (harms the kidney)	0.0012	NA	0.002	NA
Methoxychlor	endocrine toxicity (causes hormone effects)	0.00009	NA	0.03	NA
Methyl tertiary-butyl ether (MTBE)	carcinogenicity (causes cancer)	0.013	1×10 ⁻⁶	0.013	1×10 ⁻⁶ (one per million)
Molinate	carcinogenicity (causes cancer)	0.001	1×10 ⁻⁶	0.02	2×10 ⁻⁵ (two per hundred thousand)
Monochlorobenzene (chlorobenzene)	nephrotoxicity (harms the kidney)	0.07	NA	0.07	NA
Nickel	developmental toxicity (causes increased neonatal deaths)	0.012	NA	0.1	NA
Nitrate	hematotoxicity (causes methemoglobinemia)	45 as nitrate	NA	10 as nitrogen (=45 as nitrate)	NA
Nitrite	hematotoxicity (causes methemoglobinemia)	3 as nitrite	NA	1 as nitrogen (=3 as nitrite)	NA

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Nitrate and Nitrite	hematotoxicity (causes methemoglobinemia)	10 as nitrogen ¹⁰	NA	10 as nitrogen	NA
N-nitroso-dimethyl-amine (NDMA)	carcinogenicity (causes cancer)	0.000003 (3×10 ⁻⁶)	1×10 ⁻⁶	none	NA
Oxamyl	general toxicity (causes body weight effects)	0.026	NA	0.05	NA
Pentachlorophenol (PCP)	carcinogenicity (causes cancer)	0.0003	1×10 ⁻⁶	0.001	3×10 ⁻⁶ (three per million)
Perchlorate	endocrine toxicity (affects the thyroid) developmental toxicity (causes neurodevelopmental deficits)	0.001	NA	0.006	NA
Picloram	hepatotoxicity (harms the liver)	0.166	NA	0.5	NA
Polychlorinated biphenyls (PCBs)	carcinogenicity (causes cancer)	0.00009	1×10 ⁻⁶	0.0005	6×10 ⁻⁶ (six per million)
Radium-226	carcinogenicity (causes cancer)	0.05 pCi/L	1×10 ⁻⁶	5 pCi/L (combined Ra ²²⁶⁺²²⁸)	1×10 ⁻⁴ (one per ten thousand)

¹⁰ 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.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Radium-228	carcinogenicity (causes cancer)	0.019 pCi/L	1×10^{-6}	5 pCi/L (combined Ra ²²⁶⁺²²⁸)	3×10^{-4} (three per ten thousand)
Selenium	integumentary toxicity (causes hair loss and nail damage)	0.03	NA	0.05	NA
Silvex (2,4,5-TP)	hepatotoxicity (harms the liver)	0.003	NA	0.05	NA
Simazine	general toxicity (causes body weight effects)	0.004	NA	0.004	NA
Strontium-90	carcinogenicity (causes cancer)	0.35 pCi/L	1×10^{-6}	8 pCi/L	2×10^{-5} (two per hundred thousand)
Styrene (vinylbenzene)	carcinogenicity (causes cancer)	0.0005	1×10^{-6}	0.1	2×10^{-4} (two per ten thousand)
1,1,2,2-Tetrachloroethane	carcinogenicity (causes cancer)	0.0001	1×10^{-6}	0.001	1×10^{-5} (one per hundred thousand)
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD, or dioxin)	carcinogenicity (causes cancer)	5×10^{-11}	1×10^{-6}	3×10^{-8}	6×10^{-4} (six per ten thousand)

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Tetrachloro-ethylene (perchloro-ethylene, or PCE)	carcinogenicity (causes cancer)	0.00006	1×10 ⁻⁶	0.005	8×10 ⁻⁵ (eight per hundred thousand)
Thallium	integumentary toxicity (causes hair loss)	0.0001	NA	0.002	NA
Thiobencarb	general toxicity (causes body weight effects) hematotoxicity (affects red blood cells)	0.042	NA	0.07	NA
Toluene (methylbenzene)	hepatotoxicity (harms the liver) endocrine toxicity (harms the thymus)	0.15	NA	0.15	NA
Toxaphene	carcinogenicity (causes cancer)	0.00003	1×10 ⁻⁶	0.003	1×10 ⁻⁴ (one per ten thousand)
1,2,4-Trichloro-benzene	endocrine toxicity (harms adrenal glands)	0.005	NA	0.005	NA
1,1,1-Trichloro-ethane	neurotoxicity (harms the nervous system), reproductive toxicity (causes fewer offspring) hepatotoxicity (harms the liver) hematotoxicity (causes blood effects)	1	NA	0.2	NA

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
1,1,2-Trichloroethane	carcinogenicity (causes cancer)	0.0003	1x10 ⁻⁶	0.005	2x10 ⁻⁵ (two per hundred thousand)
Trichloroethylene (TCE)	carcinogenicity (causes cancer)	0.0017	1x10 ⁻⁶	0.005	3x10 ⁻⁶ (three per million)
Trichlorofluoromethane (Freon 11)	accelerated mortality (increase in early death)	1.3	NA	0.15	NA
1,2,3-Trichloropropane (1,2,3-TCP)	carcinogenicity (causes cancer)	0.0000007 (7x10 ⁻⁷)	1x10 ⁻⁶	0.000005 (5x10 ⁻⁶)	7x10 ⁻⁶ (seven per million)
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	hepatotoxicity (harms the liver)	4	NA	1.2	NA
Trihalomethanes: Bromodichloromethane	carcinogenicity (causes cancer)	0.00006	1x10 ⁻⁶	0.080*	1.3x10 ⁻³ (1.3 per thousand) ¹¹
Trihalomethanes: Bromoform	carcinogenicity (causes cancer)	0.0005	1x10 ⁻⁶	0.080*	2x10 ⁻⁴ (two per ten thousand) ¹²

* For total trihalomethanes (the sum of bromodichloromethane, bromoform, chloroform, and dibromochloromethane). There are no MCLs for individual trihalomethanes.

¹¹ Based on 0.080 mg/L bromodichloromethane; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.

¹² Based on 0.080 mg/L bromoform; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.

Table 1: Health Risk Categories and Cancer Risk Values for Chemicals with California Public Health Goals (PHGs)

Chemical	Health Risk Category ¹	California PHG (mg/L) ²	Cancer Risk ³ at the PHG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Trihalomethanes: Chloroform	carcinogenicity (causes cancer)	0.0004	1x10 ⁻⁶	0.080*	2x10 ⁻⁴ (two per ten thousand) ¹³
Trihalomethanes: Dibromochloromethane	carcinogenicity (causes cancer)	0.0001	1x10 ⁻⁶	0.080*	8x10 ⁻⁴ (eight per ten thousand) ¹⁴
Tritium	carcinogenicity (causes cancer)	400 pCi/L	1x10 ⁻⁶	20,000 pCi/L	5x10 ⁻⁵ (five per hundred thousand)
Uranium	carcinogenicity (causes cancer)	0.43 pCi/L	1x10 ⁻⁶	20 pCi/L	5x10 ⁻⁵ (five per hundred thousand)
Vinyl chloride	carcinogenicity (causes cancer)	0.00005	1x10 ⁻⁶	0.0005	1x10 ⁻⁵ (one per hundred thousand)
Xylene	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

* For total trihalomethanes (the sum of bromodichloromethane, bromoform, chloroform, and dibromochloromethane). There are no MCLs for individual trihalomethanes.

¹³ Based on 0.080 mg/L chloroform; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.

¹⁴ Based on 0.080 mg/L dibromochloromethane; the risk will vary with different combinations and ratios of the other trihalomethanes in a particular sample.

Table 2: Health Risk Categories and Cancer Risk Values for Chemicals without California Public Health Goals

Chemical	Health Risk Category ¹	US EPA MCLG ² (mg/L)	Cancer Risk ³ at the MCLG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Disinfection byproducts (DBPs)					
Chloramines	acute toxicity (causes irritation) digestive system toxicity (harms the stomach) hematotoxicity (causes anemia)	4 ^{5,6}	NA ⁷	none	NA
Chlorine	acute toxicity (causes irritation) digestive system toxicity (harms the stomach)	4 ^{5,6}	NA	none	NA
Chlorine dioxide	hematotoxicity (causes anemia) neurotoxicity (harms the nervous system)	0.8 ^{5,6}	NA	none	NA
Disinfection byproducts: haloacetic acids (HAA5)					
Monochloroacetic acid (MCA)	general toxicity (causes body and organ weight changes ⁸)	0.07	NA	none	NA

¹ Health risk category based on the US EPA MCLG document or California MCL document unless otherwise specified.

² MCLG = maximum contaminant level goal established by US EPA.

³ Cancer Risk = Upper estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. 1×10^{-6} means one excess cancer case per million people exposed.

⁴ California MCL = maximum contaminant level established by California.

⁵ Maximum Residual Disinfectant Level Goal, or MRDLG.

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

⁷ NA = not available.

⁸ Body weight effects are an indicator of general toxicity in animal studies.

Table 2: Health Risk Categories and Cancer Risk Values for Chemicals without California Public Health Goals

Chemical	Health Risk Category ¹	US EPA MCLG ² (mg/L)	Cancer Risk ³ at the MCLG	California MCL ⁴ (mg/L)	Cancer Risk at the California MCL
Dichloroacetic acid (DCA)	Carcinogenicity (causes cancer)	0	0	none	NA
Trichloroacetic acid (TCA)	hepatotoxicity (harms the liver)	0.02	NA	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
Radionuclides					
Gross alpha particles ⁹	carcinogenicity (causes cancer)	0 (²¹⁰ Po included)	0	15 pCi/L ¹⁰ (includes radium but not radon and uranium)	up to 1x10 ⁻³ (for ²¹⁰ Po, the most potent alpha emitter)

⁹ 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://www.oehha.ca.gov/water/reports/grossab.html>.

¹⁰ pCi/L = picocuries per liter of water.

Chemical	Health Risk Category¹	US EPA MCLG² (mg/L)	Cancer Risk³ at the MCLG	California MCL⁴ (mg/L)	Cancer Risk at the California MCL
Beta particles and photon emitters ⁹	carcinogenicity (causes cancer)	0 (²¹⁰ Pb included)	0	50 pCi/L (judged equiv. to 4 mrem/yr)	up to 2×10^{-3} (for ²¹⁰ Pb, the most potent beta-emitter)

APPENDIX C

Cost Estimates for Treatment for Treatment Technologies

Source – Association of California Water Agencies – Suggested Guidelines for Preparation of
Required Reports dated April 2022

ATTACHMENT NO. 3

Table 3

Reference: Updated 2012 ACWA Cost of Treatment Table

COST ESTIMATES FOR TREATMENT TECHNOLOGIES

(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2021* (\$/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	0.69 - 1.31
2	Granular Activated Carbon	Reference: Carollo Engineers, estimate for VOC treatment (PCE), 95% removal of PCE, Oct. 1994, 1900 gpm design capacity	0.32
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	1.51
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	0.59 - 0.86
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	2.71
6	Granular Activated Carbon	Reference: Southern California Water Co. - actual data for permanent GAC to remove VOCs (TCE), 2.16 mgd plant capacity, 1998	1.75
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	2.036 – 3.89
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	4.80
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	2.96
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	3.20

COST ESTIMATES FOR TREATMENT TECHNOLOGIES
(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2021* (\$/1,000 gallons treated)
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	2.48
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	8.04
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	4.75
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	3.55
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	2.20
16	Reverse Osmosis	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility with RO to remove nitrate, 1990	2.22 - 3.89
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	1.27
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	0.68
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	0.34
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	0.35
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	0.55 - 0.90

COST ESTIMATES FOR TREATMENT TECHNOLOGIES
(INCLUDES ANNUALIZED CAPITAL AND O&M COSTS)

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2021* (\$/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	0.67
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	0.15 - 0.32
24	Ion Exchange	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility - ion exchange to remove nitrate, 1990	0.73 - 0.97

* Costs were adjusted from date of original estimates to present, where appropriate, using the Engineering News Record (ENR) annual average Construction Cost Index of 12,133 for 2021.