CITY OF WESTMINSTER WATER DIVISION

2022 Report On Water Quality Relative to Public Health Goals

Prepared by Westminster Water Division
May 2022

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List of Abbreviations

ACWA	Association of California Water Agencies
AL	Action Level, a regulatory action level is the concentration of a contaminant, which if exceeded, triggers treatment or other requirements a water system must follow.
Cal-EPA	California Environmental Protection Agency
CDPH	California Department of Public Health
EPA	Environmental Protection Agency
MCL	Maximum Contaminant Level, the highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the public health goals as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.
MCLG	Maximum Contaminant Level Goal, the level of contaminant in drinking water below which there is no known or expected risk to health. Maximum Contaminant Levels are set by the U.S. Environmental Protection Agency.
mg/L	Milligrams per liter of water or parts per million (ppm). PHG's are often expressed in mg/L for consistency with the typical unit used for MCLs and MCLGs. Comparable to 3 drops in 42 gallons.
OEHHA	The California State Office of Environmental Health Hazard Assessment, which is part of the California Environmental Protection Agency.
PHG	Public Health Goal, the level of a contaminant in drinking water below which there is no known or expected risk to health. Public health goals are set by the California Environmental Protection Agency.
pCi/L	A pCi/L is a measure of radiation defined as an emission of radiation from some element as a result of the spontaneous disintegration of the nuclei of the atoms of the element. A Pico Curie represents a quantity of radioactive material with an activity equal to one millionth of one millionth of a curie (i.e. 10 the negative 12^{th} power) per liter.
ppm	Parts per million or mg/L of water. Comparable to 3 drops in 42 gallons.
ug/L	Parts per billion of water. Comparable to 1 drop in 14,000 gallons
USEPA	United States Environmental Protection Agency

Executive Summary:

The City Of Westminster meets or exceeds all United States Environmental Protection Agency (USEPA) and State of California Department of Public Health (CDPH) drinking water standards. These two agencies govern the water quality of public drinking water systems.

For the purposes of this report, the amounts of contaminants in drinking water fall into two categories. One category involves "Maximum Contaminant Levels" (MCL), which is the regulatory definition of what is "safe" and the criteria used to determine a water system's compliance. The other is "Public Health Goals", (PHGs). Unlike MCLs that demand corrective procedures, PHGs are non-enforceable drinking water quality goals set by the California Office of Environmental Health Hazard Assessment (OEHHA), and are not required to be met by any public water system. Maximum Contaminant Level Goals (MCLG) are the federal equivalent to state PHGs.

This report emphasizes the following three important realities of drinking water safety:

1. Westminster's water is in full compliance with existing drinking water quality standards.

2. There can be significant costs per resident and technology limitations associated with water treatment to reduce constituents to meet PHG or MCLG levels.

3. No public water supply can meet <u>all</u> PHGs and MCLGs.

The Westminster Water Division routinely monitors its water supplies for over 250 constituents and contaminants, of which 115 have enforceable standards. For calendar years 2019 through 2021 only 6 of the 250 contaminants were detected above PHG or MCLG levels in the City's major water supply. Each is at levels far below enforceable drinking water standards.

<u>Constituents Detected Above PHG or MCLG</u>

Contaminants that were "detected" at a level that "exceeds" the PHG or, where there is no PHG, the Federal MCLG, are required to be included in this report.

The six constituents that were detected above the PHG or MCLG for calendar years 2019 through 2021 were Arsenic, Hexavalent Chromium, Perchlorate and Uranium (which includes Total Radium 228, Natural Uranium and Gross Alpha Excluding Uranium). These constituents are naturally occurring inorganics and radionuclides which are found in the earth's crust and are naturally present in the environment.

The health risks to humans of a lifetime exposure to levels of these constituents above the MCL (or drinking water standard) could increase the risk of getting cancer.

Cost Estimates Summary

The USEPA and DHS have adopted the Best Available Treatment Technologies (BAT), which are the best known methods of reducing contaminant levels to the MCL. While costs can be estimated for such technologies, it is not always possible or feasible to determine what further treatment is needed, or to reduce a constituent to meet the PHG or MCLG, many of which are set to zero. In some cases, installing treatment systems to try and further reduce very low levels of one constituent may have adverse effects on other aspects of water quality.

The BAT to lower the levels of Arsenic, Perchlorate and Uranium in the City's wells below the PHG is reverse osmosis. The BATs to lower the levels of Hexavalent Chromium is Reduction-Coagulation-Filtration and IX-Weak Base Anion Resin, of which the latter is the less expensive option. According to the Association of California Water Agencies the estimated costs for removing Arsenic, Perchlorate, Uranium and Hexavalent Chromium from Westminster's water system using reverse osmosis and IX-Weak Base Anion Resin methods are estimated at 38 million dollars per year (9 of the 10 well sites will require both forms of treatment as determined by the sampling results from 2019 - 2021). This extrapolates out annually to approximately $1828 per Westminster service connection (21,000 total service connections) and approximately $305 more per billing period to be passed on to each Westminster residential and business customer. These are only treatment costs and do not include the initial investment of capital for real estate and storage facilities.

Recommendations for Further Action

The quality of drinking water for the City of Westminster meets all State of California Department of Public Health and the USEPA drinking water standards set to protect public health. To further reduce the levels of the constituents identified in this report, which are already significantly below the health-based Maximum Contaminant Levels established to provide "safe drinking water", would require additional costly treatment processes. The effectiveness of the treatment processes to provide any significant reductions in constituent levels at these already low levels is uncertain. The health protection benefits of these further hypothetical reductions are not clear and may not be quantifiable. **Therefore, no action is recommended.**

Background:

Under the Calderon-Sher Safe Drinking Water Act of 1996, (California Health and Safety Code, Section 116470(2)[b]), public water systems serving more than 10,000 connections must prepare a brief, written report in plain language every three years and hold a public hearing that gives information on the detection of any contaminants above the Public Health Goals (PHGs) published by the State Office of Environmental Health Hazard Assessment (OEHHA). The report must also list the detection of any contaminant above the Maximum Contaminant Level Goals (MCLGs) set by USEPA (United States Environment Protection Agency) for all contaminants for which a PHG has not yet been established by OEHHA.

This report provides information required by law on constituents detected in the water supply for three calendar years, 2019 through 2021, that exceeded an applicable PHG or MCLG. Included in this report is the numerical cancer risk value associated with the PHG and the MCLG or MCL, if available or applicable, the category or health risk that could be associated with each constituent, the best treatment technology available that could be used to reduce the constituent level, and an estimate of costs to install that treatment if it is appropriate and feasible.

What are PHGs?

PHGs are set by the California Office of Environmental Health Hazard Assessment, which is part of Cal-EPA, and are solely based on public health risk considerations. Practical risk-management factors that are considered by the USEPA, or the California Department of Public Health (CDPH), in setting drinking water standards (MCLs) are *not* considered in setting the PHGs. These practical risk-management factors include: analytical detection capability, the treatment technology available, and cost / benefit analysis**. The PHGs are not enforceable and are not required to be met by any public water system.** MCLGs are the federal equivalent to PHGs.

Water Quality Data Considered:

Water quality data collected by the Westminster Water Division for years 2019 through 2021 to determine compliance with drinking water standards was considered. This data was summarized in Westminster's 2021 Annual Water Quality Report, which is posted on the City's website and made available for mailing to residents in June 2022.

The Association of California Water Agencies (ACWA) formed a workgroup, which prepared guidelines for water utilities to use in preparing these required PHG reports. This report follows those guidelines.

Best Available Treatment Technology and Cost Estimates:

Both the USEPA and CDPH adopt what are known as BAT's or Best Available Technologies, 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 or feasible to determine what further treatment is needed or possible to reduce a constituent to meet the PHG or MCLG, many of which are set at zero. Estimating the costs to reduce a constituent to zero is difficult, if not impossible, because it is not possible to verify by analytical means that the level has been lowered to zero. In some cases, installing treatment systems to try and further reduce very low levels of one constituent may have adverse effects on other aspects of water quality.

The following is a discussion of constituents that were detected at levels above the PHG, or if no PHG, above the MCLG. Arsenic, Perchlorate, Uranium and Hexavalent Chromium were detected above the PHG or MCLG levels.

Constituents Detected That Exceed a PHG or a MCLG

Arsenic

Arsenic is a naturally occurring metalloid element found in the earth's crust. It is widely distributed and commonly associated with ores of metals like copper, lead, and gold. Arsenic is present in all sources of water. It has generally been assumed that surface waters, including the sea, are "self-purifying" with respect to arsenic, i.e., that the arsenic is removed from solution by deposition with sediments.

The PHG for Arsenic is 0.004 ug/L (parts per billion). The drinking water standard or MCL for Arsenic is 10 ug/L. While all Westminster wells were sampled during calendar years 2019 through 2021, Arsenic was detected above the PHG at one of them (Well 6). The levels of Arsenic ranged from 5.4 to 5.6 ug/L, with an average of 5.5 ug/L. <u>The amount of Arsenic measured in this well is below the MCL (10 ug/L).</u>

The category of health risk associated with Arsenic is carcinogenicity, capable of producing cancer. Arsenic is a known human carcinogen, based on increased risk of lung cancer in workers exposed to airborne arsenic, bladder cancer studies, and dose- dependent increases in skin cancer risk in Taiwan. The numerical health risk for this PHG is 1 x 10^{-6} (1 per million). The numerical health risk for this MCL is 2.5 x 10^{-3} (2.5 per thousand).

The Best Available Treatment Technology for Arsenic removal would be reverse osmosis. Since this is also the BAT for Uranium, Radium and Percolate it will be discussed later.

Uranium

Uranium in the aquifer, in which Westminster and other Orange County cities draw on for their drinking water, comes from the outwash of granitic material from local mountains in the watershed. It is naturally occurring in the materials that make up sands and gravels in the aquifer. The PHG for Uranium is 0.43 pCi/L and the Federal EPA MCLG is 0. The drinking water standard or MCL for Uranium is 20 pCi/L.

During Calendar Years 2019 through 2021, Uranium measurements were made at all 10 of Westminster's active wells. Detections of Uranium ranged from 2.72 to 9.3 pCi/L at all ten of the well sites and is below the MCL (20 pCi/L).

The category of health risk associated with Uranium is carcinogenicity and chronic toxicity. People who drink water containing Uranium above the MCL throughout their lifetime could increase their risk of getting cancer. Exposure to elevated Uranium levels in drinking water has been associated with changes in kidney function. The numerical health risk for this PHG is 1×10^{-6} (one per million). The numerical health risk for this MCL is 5×10^{-5} (5 in 100,000).

The Best Available Treatment Technology for Uranium removal would be reverse osmosis. Since this is also the BAT for Arsenic, Radium and Percolate it will be discussed at the end of these descriptions.

Hexavalent Chromium

Hexavalent Chromium, also known as Chromium 6, is a heavy metal that is commonly found at low levels in drinking water. It can occur naturally but can also enter drinking water sources by historic leaks from industrial plants' hazardous waste sites. Various other sources also contribute to the amount of hexavalent chromium in groundwater. Chromium 6 is known to be a potent carcinogen when inhaled. It was recently found to also cause cancer in laboratory mice and rats that were exposed through drinking water. The Best Available Treatment methods considered for removing Hexavalent Chromium are the Reduction-Coagulation-Filtration method and the IX-Weak Base Anion Resin method, of which the latter is the cheaper.

The PHG for hexavalent chromium is 0.02 ug/L (parts per billion). The drinking water standard was set by the EPA at 10 ug/L for hexavalent chromium. All Westminster wells were sampled during calendar years 2019 through 2021 and Hexavalent Chromium was detected above the PHG at 9 of them. The levels of Hexavalent Chromium ranged from 0.2 to 1.89ug/L, with an average of 1.1 ug/L. The amount of Hexavalent Chromium measured in these wells is below the MCL (10 ug/L).

The category of health risk associated with hexavalent chromium is carcinogenicity, capable of producing cancer. Consuming water containing levels of hexavalent chromium above the MCL throughout a lifetime could result in an increased risk of getting cancer.

The numerical health risk for this PHG is 1×10^{-6}. The numerical health risk for this MCL is up to 5×10^{-4} (five per ten thousand).

Total Radium 228 and **Gross Alpha Excluding Uranium**

Radium is naturally occurring and depends, in part, on the solubility of the parents and decay products ahead of it in its decay series. Radium can adsorb to particulate surfaces. In ground waters, high total dissolved solids offer other ions, particularly divalent cations like calcium and barium, competing for sorption sites that keep radium in solution. Deep wells have limited sorption sites, therefore are more likely to have radium in solution than shallow wells. Radionuclides are detected more frequently in ground water than in surface water. Radium detections in surface water are related to discharges from ground waters or from man-made activities.
The PHG for Radium 228 is 0.019 pCi/L (picocuries). The drinking water standard or MCL for Radium 228 is 5 pCi/L. All Westminster wells were sampled during calendar years 2019 through 2021, and Radium 228 was detected above the PHG at 1 of them (Well 11). The level of Radium 228 is at 1.16 pCi/L.
The PHG for Gross Alpha Excluding Uranium is ZERO pCi/L. and the drinking water standard or MCL for Gross Alpha Excluding Uranium is 15 pCi/L. All Westminster wells were sampled during calendar years 2019 through 2021, and Gross Alpha Excluding Uranium was detected above the PHG at 1 of them (Well 107a). The level of Gross Alpha Excluding Uranium at this well site was 3.94 pCi/L.

The category of health risk associated with Total Radium 228 and Gross Alpha Excluding Uranium is carcinogenicity, capable of producing cancer. Consuming water containing levels of Total Radium 228 and Gross Alpha Excluding Uranium above the MCL throughout a lifetime could result in an increased risk of getting cancer.
The Best Available Treatment Technology for both Total Radium 228 and Gross Alpha Excluding Uranium removal would be ion exchange and reverse osmosis.

Perchlorate

Perchlorate (ClO4-) is a naturally occurring and man-made chemical and a strong oxidizing anion. It is most commonly associated with the salts of ammonium, potassium and sodium, with ammonium the most common. The most common use in the US is as a primary ingredient in solid rocket propellants. Other related uses are explosives, military munitions, mortars, grenades and flairs. 90 percent of production is for military and aerospace use. It is also used in fireworks, matches, batteries and automobile air bags. It is manufactured or used in 44 of 50 states. Wastes from the manufacture and improper disposal are increasingly being discovered in soil and water. It occurs naturally in highly arid environments, and has been found in nitrate fertilizer deposits in Chile and fertilizers derived from those deposits.

The PHG for Perchlorate is 1 ug/L. The drinking water standard or MCL for Perchlorate is 6 ug/L. All Westminster wells were sampled during calendar years 2019 through 2021, and Perchlorate was detected above the PHG at 4 of them. The levels of Perchlorate at the four well sites range from <2.0 to 3.9 ug/L.

The Best Available Treatment Technology for Perchlorate removal would be reverse osmosis.

Best Available Treatment Technology and Cost Estimates Breakdown and Chart per Site

The Best Available Technology (BAT) to lower the level of naturally occurring Uranium, Perchlorate and Arsenic in the City's water is Reverse Osmosis (RO), and as described above, for Hexavalent Chromium the Reduction-Coagulation-Filtration method and the IX-Weak Base Anion Resin method. While the Reverse Osmosis may not be the ultimate best treatment technology for Total Radium 228 and Gross Alpha Excluding Uranium, it is somewhat effective and the costs associated with using Reverse Osmosis will be lower than adding a third removal system to a well site which already must use the Reverse Osmosis for the Uranium, Perchlorate and Arsenic, and the IX-Weak Base Anion Resin for the Hexavalent Chromium.

According to the ACWA Guidance Document provided to water utilities to assist in the preparation of PHG reports, cost estimates to reduce these constituents to a loosely defined theoretical zero in Westminster's wells would be approximately $38 million annually.

Total annual capital costs for land, housing, piping, storage tanks, etc have not been factored into the estimated costs for this report. Operation and maintenance equipment, process equipment, preliminary testing, permits, and training were calculated in aggregate with annual O & M costs which include membrane replacement and disposal, waste residuals disposal or treatment, chemical use, repair and maintenance, power and labor. This annual aggregate cost is approximately $3.55 per 1,000 gallons of treated water for all sites for Uranium, Arsenic and Perchlorate and $8.19 per 1,000 gallons of treated water at nine of the well sites with Hexavalent Chromium in addition to the Reverse Osmosis.

The following table shows the approximate unit cost per 1,000 gallons of water to lower levels of Uranium, Arsenic and Hexavalent Chromium to a theoretical zero for Westminster's water system. These numbers are only capital and O & M costs and do not include the initial costs of securing property and construction of buildings, etc.

Cost for Reverse Osmosis Treatment of Uranium, Arsenic and Cost for IX-Weak Base Anion Resin treatment Hexavalent Chromium based on 2021 Water Demands and Costs by site, Aggregate

Site	Acre-Feet	1000 Gals / Year	Treatment + O & M Cost / 1000 Gallons	Cost / Site / Annually	Cost / Connection	Cost / Connection / Bill
3	601.8	196,097	$11.74	$2,302,180	$109.63	$18.27
4	1046.5	341,003	$11.74	$4,003,376	$190.64	$31.77
6	745.6	242,955	$11.74	$2,852,286	$135.82	$22.64
11	1059.7	345,304	$11.74	$2,828,042	$193.04	$32.17
75a	1454.9	474,081	$11.74	$5,565,706	$265.03	$44.17
107	1708.3	556,651	$11.74	$6,535,086	$311.19	$51.87
R1	1488.2	484,931	$11.74	$5,693,095	$271.10	$45.18
R2	1136.7	370,395	$11.74	$4,348,435	$207.07	$34.51
125	1170.3	381,343	$3.55	$1,353,769	$64.47	$10.74
SC4	441.7	143,928	$11.74	$1,689,719	$80.46	$13.41
TO	**10853**	**3,536,689**		**$38,397,526**	**$1,828.45**	**$304.74**

Source: State Water Resources Control Board / ACWA Guidance Document, 2018 cost estimates adjusted by CPI for 2021.

For 21,000 service connections, costs to lower levels of naturally occurring Uranium, Arsenic, Perchlorate and Hexavalent Chromium in the City's water would be passed on to residential and business water customers at approximately $1,828.45 per service connection, or $304.74 per bi-monthly water bill.

Determining accurate cost estimates are difficult, if not impossible, and are highly speculative and theoretical. Since there is little data readily available to estimate the cost of treatment to achieve absolute zero, installation of treatment may not necessarily achieve the MCLG and the costs may be significantly higher than originally estimated.

Appendix A

Law: Section 116470 (b)

On or before July 1, 1998, and every three years thereafter, public water systems serving more than 10,000 service connections that detect one or more contaminants in drinking water that exceed the applicable public health goal, shall prepare a brief written report in plain language that does all of the following:

(1) Identifies each contaminant detected in drinking water that exceeds the applicable public health goal.

(2) Discloses the numerical public health risk, determined by the office, associated with the maximum contaminant level for each contaminant identified in paragraph (1) and the numerical public health risk determined by the office associated with the public health goal for that contaminant.

(3) Identifies the category of risk to public health, including, but not limited to, carcinogenic, mutagenic, teratogenic, and acute toxicity, associated with exposure to the contaminant in drinking water, and includes a brief plainly worded description of these terms.

(4) Describes the best available technology, if any is then available on a commercial basis, to remove the contaminant or reduce the concentration of the contaminant. The public water system may, solely at its own discretion, briefly describe actions that have been taken on its own, or by other entities, to prevent the introduction of the contaminant into drinking water supplies.

(5) Estimates the aggregate cost and the cost per customer of utilizing the technology described in paragraph (4), if any, to reduce the concentration of that contaminant in drinking water to a level at or below the public health goal.

(6) Briefly describes what action, if any, the local water purveyor intends to take to reduce the concentration of the contaminant in public drinking water supplies and the basis for that decision.

Appendix B

Attachment No. 2

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

Chemical	Health Risk Category[1] (more specific information in parentheses)	California PHG (mg/L)[2]	Cancer Risk[3] @ PHG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Alachlor	cancer	0.004[5]	NA[6]	0.002	NA
Aluminum	chronic toxicity (increased serum aluminum level) (human data)	0.6	NA	1	NA
Antimony	chronic toxicity (shortened lifespan)	0.02	NA	0.006	NA
Arsenic	cancer	0.000004 ($4x10^{-6}$)	1×10^{-6} (one per million)	0.01	2.5×10^{-3} (2.5 per thousand)
Asbestos	cancer	7 MFL (fibers >10 microns in length)	1×10^{-6}	7 MFL[7] (fibers >10 microns in length)	1×10^{-6} (one per million)
Atrazine	cancer	0.00015	1×10^{-6}	0.001	7×10^{-6} (seven per million)
Barium	chronic toxicity (hypertension)	2	NA	1	NA
Bentazon	chronic toxicity (clinical, body weight, liver and intestinal effects)	0.2	NA	0.018	NA
Benzene	cancer (leukemia)	0.00015	1×10^{-6}	0.001	7×10^{-6} (seven per million)

[1] Health risk category based on experimental animal testing data evaluated in the OEHHA PHG technical support document unless otherwise specified.
[2] mg/L = milligrams per liter of water or parts per million (ppm) (PHGs are expressed here in milligrams per liter for consistency with the typical unit used for MCLs and MCLGs.)
[3] Cancer Risk = theoretical 70-year lifetime excess cancer risk at the statistical upper confidence limit. Actual cancer risk may be lower or zero. Cancer risk is stated in terms of excess cancer cases per million (or fewer) population exposed for a lifetime.
[4] MCL = maximum contaminant level.
[5] Non-linear approach used for alachlor risk assessment, no cancer risk assumed at the PHG level.
[6] NA = not applicable. Noncarcinogenic, or a cancer risk cannot be calculated. The PHG for these chemicals is set at a level that is believed to be without any significant public health risk to individuals exposed to that chemical over a lifetime.
[7] MFL = million fibers per liter.

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Chemical	Health Risk Category[1] (more specific information in parentheses)	California PHG (mg/L)[2]	Cancer Risk[3] @ PHG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Benzo[a]pyrene	cancer	0.000004	1×10^{-6}	0.0002	5×10^{-5} (five per hundred thousand)
Beryllium	chronic toxicity (gastrointestinal lesions)	0.001	NA	0.004	NA
Bromate	cancer	0.0001	1×10^{-6}	0.01	1×10^{-4} (one per ten thousand)
Cadmium	chronic toxicity (kidney effects, human data)	0.00004	NA	0.005	NA
Carbofuran	chronic toxicity (enzyme inhibition, blood chemistry and testis effects)	0.0017	NA	0.018	NA
Carbon tetrachloride	cancer	0.0001	1×10^{-6}	0.0005	5×10^{-6} (five per million)
Chlordane	cancer	0.00003	1×10^{-6}	0.0001	3×10^{-6} (three per million)
Chlorite	chronic toxicity (anemia) and neurotoxicity (infants and children, human data)	0.05	NA	1	NA
Copper	acute toxicity (gastrointestinal effects in children, human data)	0.3	NA	1.3 (AL)[8]	NA
Cyanide	chronic toxicity[9] (no clinical and histopathological effects observed)	0.15	NA	0.15	NA
Dalapon	chronic toxicity (kidney effects)	0.79	NA	0.2	NA

[8] AL = action level.

[9] Cyanide: Acute toxicity of concern is respiratory arrest. Long-term exposure allows for detoxification.

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1,2-Dibromo-3-chloropropane (DBCP)	cancer	0.0000017 (1.7×10^{-6})	1×10^{-6}	0.0002	1×10^{-4} (one per ten thousand)
1,2-Dichloro-benzene (o-DCB)	chronic toxicity (liver effects)	0.6	NA	0.6	NA
1,4-Dichloro-benzene (p-DCB)	cancer	0.006	1×10^{-6}	0.005	8×10^{-7} (eight per ten million)
1,1-Dichloroethane (1,1-DCA)	cancer	0.003	1×10^{-6}	0.005	2×10^{-6} (two per million)
1,2-Dichloroethane (1,2-DCA)	cancer	0.0004	1×10^{-6}	0.0005	1×10^{-6} (one per million)
1,1-Dichloro-ethylene (1,1-DCE)	chronic toxicity (liver effects)	0.01	NA	0.006	NA
1,2-Dichloro-ethylene, cis	Subchronic toxicity (kidney effects)	0.1	NA	0.006	NA
1,2-Dichloro-ethylene, trans	Subchronic toxicity (liver effects)	0.06	NA	0.01	NA
Dichloromethane (methylene chloride)	cancer	0.004	1×10^{-6}	0.005	1×10^{-6} (one per million)
2,4-Dichloro-phenoxyacetic acid (2,4-D)	chronic toxicity (liver and kidney effects)	0.02	NA	0.07	NA
1,2-Dichloro-propane (propylene dichloride)	cancer	0.0005	1×10^{-6}	0.005	1×10^{-5} (one per hundred thousand)
1,3-Dichloro-propene (Telone II®)	cancer	0.0002	1×10^{-6}	0.0005	2×10^{-6} (two per million)
Di(2-ethylhexyl) adipate (DEHA)	developmental toxicity (disrupted development)	0.2	NA	0.4	NA

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Diethylhexyl-phthalate (DEHP)	cancer	0.012	1×10^{-6}	0.004	3×10^{-7} (three per ten million)
Dinoseb	reproductive toxicity (uterus and testis effects)	0.014	NA	0.007	NA
Diquat	chronic toxicity (eye effects) and developmental toxicity (malformation)	0.015	NA	0.02	NA
Endothall	chronic toxicity (stomach effects)	0.58	NA	0.1	NA
Endrin	chronic toxicity (liver effects) and neurotoxicity (convulsions)	0.0018	NA	0.002	NA
Ethylbenzene (phenylethane)	chronic toxicity (liver effects)	0.3	NA	0.3	NA
Ethylene dibromide	cancer	0.00001	1×10^{-6}	0.00005	5×10^{-6} (five per million)
Fluoride	chronic toxicity (tooth mottling, human data)	1	NA	2	NA
Glyphosate	chronic toxicity (kidney effects)	0.9	NA	0.7	NA
Heptachlor	cancer	0.000008	1×10^{-6}	0.00001	1×10^{-6} (one per million)
Heptachlor epoxide	cancer	0.000006	1×10^{-6}	0.00001	2×10^{-6} (two per million)
Hexachloroben-zene	cancer	0.00003	1×10^{-6}	0.001	3×10^{-5} (three per hundred thousand)
Hexachlorocyclo-pentadiene (HEX)	chronic toxicity (stomach lesions)	0.05	NA	0.05	NA

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Lead	chronic toxicity (neurobehavioral effects in children, hypertension in adults) and cancer	0.0002	3×10^{-8} (PHG is not based on this effect)	0.015 (AL)	2×10^{-6} (two per million)
Lindane (γ-BHC)	cancer	0.000032	1×10^{-6}	0.0002	6×10^{-6} (six per million)
Mercury (inorganic)	chronic toxicity (kidney effects)	0.0012	NA	0.002	NA
Methoxychlor	reproductive toxicity (vagina, ovary, uterus and hormonal effects)	0.03	NA	0.03	NA
Methyl tertiary-butyl ether (MTBE)	cancer	0.013	1×10^{-6}	0.013	1×10^{-6} (one per million)
Molinate	cancer	0.001	1×10^{-6}	0.02	2×10^{-5} (two per hundred thousand)
Monochloroben-zene (chlorobenzene)	subchronic toxicity (liver damage)	0.2	NA	0.07	NA
Nickel	developmental toxicity (increased neonatal deaths) and possible cancer risk	0.012	NA	0.1	NA
Nitrate	acute toxicity (methemoglobinemia, human data)	45 as NO_3	NA	45 as NO_3	NA
Nitrite	acute toxicity (methemoglobinemia, human data)	1 as nitrite-nitrogen	NA	1 as nitrite-nitrogen	NA
Nitrate and Nitrite	acute toxicity (methemoglobinemia, human data)	10 as nitrogen	NA	10 as nitrogen	NA
N-nitrosodimethyl-amine (NDMA)	cancer	0.000003	$1x10^{-6}$	---	---
Oxamyl	chronic toxicity (body weight effects)	0.026	NA	0.05	NA

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

Chemical	Health Risk Category[1] (more specific information in parentheses)	California PHG (mg/L)[2]	Cancer Risk[3] @ PHG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Pentachloro-phenol (PCP)	cancer	0.0003	1×10^{-6}	0.001	3×10^{-6} (three per million)
Perchlorate	subchronic toxicity (thyroid and reproductive effects)	0.006	NA	0.006	NA
Picloram	chronic toxicity (liver effects)	0.5	NA	0.5	NA
Polychlorinated biphenyls (PCBs)	cancer	0.00009	1×10^{-6}	0.0005	6×10^{-6} (six per million)
Radium-226	cancer	0.05 pCi/L	1×10^{-6}	5 pCi/L	1×10^{-4} (one per ten thousand)
Radium-228	cancer	0.019 pCi/L	1×10^{-6}	5 pCi/L (combined $Ra^{226+228}$)	3×10^{-4} (three per ten thousand)
Silvex (2,4,5-TP)	chronic toxicity (liver effects)	0.025	NA	0.05	NA
Simazine	chronic toxicity (reduced body weight)	0.004	NA	0.004	NA
Strontium-90	cancer	0.35 pCi/L	$1x10^{-6}$	8 pCi/L	$2x10^{-5}$ (two per hundred thousand)
1,1,2,2-Tetrachloroethane	cancer	0.0001	1×10^{-6}	0.001	1×10^{-5} (one per hundred thousand)
Tetrachloro-ethylene (perchloro-ethylene, or PCE)	cancer	0.00006	1×10^{-6}	0.005	8×10^{-5} (eight per hundred thousand)
Thallium	subchronic toxicity (hair loss)	0.0001	NA	0.002	NA

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

Attachment No. 2

Chemical	Health Risk Category[1] (more specific information in parentheses)	California PHG (mg/L)[2]	Cancer Risk[3] @ PHG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Thiobencarb	chronic toxicity (body weight, food efficiency and enzyme activity effects)	0.07	NA	0.07	NA
Toluene (methylbenzene)	chronic toxicity (liver and thymus effects)	0.15	NA	0.15	NA
Toxaphene	cancer	0.00003	1×10^{-6}	0.003	1×10^{-4} (one per ten thousand)
1,2,4-Trichloro-benzene (Unsym-TCB)	chronic toxicity (effects on adrenal glands)	0.005	NA	0.005	NA
1,1,1-Trichloro-ethane	neurotoxicity (structural changes), reproductive toxicity (fewer offspring), chronic toxicity (liver and blood effects)	1	NA	0.2	NA
1,1,2-Trichloro-ethane	cancer	0.0003	$1x10^{-6}$	0.005	$2x10^{-5}$ (two per hundred thousand)
1,1,2-Trichloro-ethylene (TCE)	cancer	0.0017	1×10^{-6}	0.005	3×10^{-6} (three per million)
Trichlorofluoro-methane (Freon 11)	chronic toxicity (liver effects)	0.7	NA	0.15	NA
1,2,3-Trichloro-propane	cancer	0.0000007	1×10^{-6}	---	---
1,1,2-Trichloro-1,2,2-trifluoro-ethane (Freon 113)	chronic toxicity (liver effects)	4	NA	1.2	NA
Tritium	cancer	400 pCi/L	$1x10^{-6}$	20,000 pCi/L	$5x10^{-5}$ (five per hundred thousand)
Uranium	cancer	0.43 pCi/L	1×10^{-6}	20 pCi/L	5×10^{-5} (five per hundred thousand)

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

Chemical	Health Risk Category[1] (more specific information in parentheses)	California PHG (mg/L)[2]	Cancer Risk[3] @ PHG	California MCL[4] (mg/L)	Cancer Risk @ California MCL
Vinyl chloride	cancer	0.00005	1×10^{-6}	0.0005	1×10^{-5} (one per hundred thousand)
Xylenes	neurotoxicity (effects on senses, mood and motor control, human data)	1.8 (single isomer or sum of isomers)	NA	1.75 (single isomer or sum of isomers)	NA

Appendix C

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

Chemical	Health Risk Category[10] (more specific information in parentheses)	U.S. EPA MCLG[11] (mg/L)	Cancer Risk[12] @ MCLG	California MCL[13] (mg/L)	Cancer Risk @ California MCL
Chromium (total)	chronic toxicity (stomach, liver effects), immunotoxicity (allergic dermatitis)	0.1	NA	0.05	NA
Dioxin (2,3,7,8-TCDD)	cancer and reproductive effects	0	0	0.00000003	1×10^{-5} (one per hundred thousand)

[10] Health risk category based on experimental animal testing data evaluated in the U.S. EPA MCLG document or California MCL document unless otherwise specified.
[11] MCLG = maximum contaminant level goal established by U.S. EPA.
[12] Cancer Risk = theoretical 70-year lifetime excess cancer risk at the statistical confidence limit. Actual cancer risk may be lower or zero. Cancer risk is stated in terms of excess cancer cases per million (or fewer) population, e.g., 1×10^{-6} means one excess cancer case per million people; 5×10^{-5} means five excess cancer cases per 100,000 people.
[13] California MCL = maximum contaminant level established by California.

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

Chemical	Health Risk Category[10] (more specific information in parentheses)	U.S. EPA MCLG[11] (mg/L)	Cancer Risk[12] @ MCLG	California MCL[13] (mg/L)	Cancer Risk @ California MCL
Selenium	chronic toxicity (hair and nail changes, skin lesions, blood effects; human data) and neurotoxicity	0.05	NA	0.05	NA
Styrene (vinylbenzene)	chronic toxicity (liver, kidney and blood effects)	0.1	NA	0.1	NA
Disinfection byproducts (DBPS)					
Chloramines	acute toxicity (irritation) and chronic toxicity (stomach effects, anemia)	4[14]	NA	none	NA
Chlorine	acute toxicity (irritation) and chronic toxicity (stomach effects)	4[5]	NA	none	NA
Chlorine dioxide	chronic toxicity (anemia) and neurotoxicity (infants and young children, human data)	0.8[5]	NA	none	NA
Disinfection byproducts: haloacetic acids (HAA5)					
Chloroacetic acid	chronic toxicity (body and organ weight changes)	0.07	NA	none	NA
Dichloroacetic acid	cancer	0	0	none	NA
Trichloroacetic acid	chronic toxicity (liver effects)	0.02	0	none	NA
Bromoacetic acid	NA	none	NA	none	NA
Dibromoacetic acid	NA	none	NA	none	NA
Total haloacetic acids	cancer	none	NA	0.06	NA
Disinfection byproducts: trihalomethanes (THMs)					
Bromodichloro-methane (BDCM)	cancer	0	0	none	NA
Bromoform	cancer	0	0	none	NA
Chloroform	chronic toxicity (liver and kidney effects)	0.07	NA	none	NA
Dibromo-chloromethane (DBCM)	chronic toxicity (liver and kidney effects) and neurotoxicity	0.06	NA	none	NA

[14] Maximum Residual Disinfectant Level Goal, or MRDLG

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

Chemical	Health Risk Category[10] (more specific information in parentheses)	U.S. EPA MCLG[11] (mg/L)	Cancer Risk[12] @ MCLG	California MCL[13] (mg/L)	Cancer Risk @ California MCL
Total (sum of BDCM, bromoform, chloroform and DBCM)	cancer, chronic toxicity (liver and kidney effects), and neurotoxicity	none	NA	0.08	NA
Radionuclides					
Gross alpha particles[15]	cancer	0 (^{210}Po included)	0	15 pCi/L[16] (includes ^{226}Ra but not radon and uranium)	up to $1x10^{-3}$ (one per thousand for ^{210}Po, the most potent alpha emitter)
Beta particles and photon emitters[6]	cancer	0 (^{210}Pb included)	0	50 pCi/L (judged equiv. to 4 mrem/yr)	up to $2x10^{-3}$ (two per thousand for ^{210}Pb, the most potent beta-emitter)

[6] MCLs for gross alpha and beta are screening standards for a group of radionuclides. A corresponding PHG was considered inappropriate because risks vary for the individual radionuclides covered by the screening level; see OEHHA memoranda discussing the cancer risks at these MCLs at http://www.oehha.ca.gov/water/phg/index.html.

[16] pCi/L = picocuries per liter of water.