# CITY OF REDLANDS
# MUNICIPAL UTILITIES & ENGINEERING DEPARTMENT
# TRIENNIAL PUBLIC HEALTH GOALS (PHGs) REPORT
# JULY 2020

## 1. INTRODUCTION

Provisions of the California Health and Safety Code (Attachment "A") specify that larger (>10,000 service connections) water utilities prepare a special report if their water quality measurements have exceeded any Public Health Goals (PHGs). PHGs are non-enforceable goals established by the Cal-EPA's Office of Environmental Health Hazard Assessment (OEHHA). The law also requires that where OEHHA has not adopted a PHG for a constituent, the water suppliers are to use the MCLGs adopted by USEPA. Only constituents which have a California primary drinking water standard and for which either a PHG or MCLG has been set are to be addressed. Attachment "C" lists of all regulated constituents with the MCLs and PHGs or MCLGs.

There are a few constituents that are routinely detected in water systems at levels usually well below the drinking water standards for which no PHG nor MCLG has yet been adopted by OEHHA or USEPA including Total Trihalomethanes. These will be addressed in a future required report after a PHG has been adopted.

This law specifies what information is to be provided in the report (see Attachment "A").

If a constituent was detected in the City of Redlands water supply between 2017 and 2019 at a level exceeding an applicable PHG or MCLG, this report provides the information required by the law. Included is the numerical public health risk associated with the MCL and the PHG or MCLG, the category or type of risk to health 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 the cost to install that treatment if it is appropriate and feasible.

The purpose of the legislation requiring this report is to provide consumers with information on levels of contaminants even below the enforceable mandatory Maximum Contaminant Levels (MCLs) so consumers are aware of whatever risks might be posed by the presence of these contaminants at levels below the MCLs.

The Association of California Water Agencies (ACWA) formed a workgroup which prepared guidelines for water utilities to use in preparing these newly required reports. ACWA guidelines were used in the preparation of this public health goals report.

## 2. BACKGROUND

- **Public Health Goal (PHG)**
  PHGs are set by the California Office of Environmental Health Hazard Assessment (OEHHA) which is part of Cal-EPA 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 Division of Drinking Water in setting drinking water standards (MCLs) are considered in setting the PHGs. These factors include analytical detection capability, treatment technology available, benefits and costs. The PHGs are not enforceable and are not required to be met by any public water system. MCLGs are the federal equivalent to PHGs.

- **Maximum Contaminant Level Goal (MCLG)**
  The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are non-enforceable public-health goals.

- **Maximum Contaminant Level (MCL)**
  The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards for public water-supply systems.

The U.S. EPA and the California State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) establish MCLs at very conservative levels to provide protection to consumers against all but very low to negligible risk. In other words, MCLs are the regulatory definition of what is "safe." Adopted MCLs are still the criteria for being in compliance, not those proposed or possible in the future, and certainly not MCLGs or PHGs.

MCLGs and PHGs are often set at very low levels depending on the established health risk, and in the case of U.S. EPA, MCLGs are also set at zero for some contaminants. Determination of health risk at these low levels is theoretical based on risk assessments with multiple assumptions and mathematical extrapolations (see Attachment "D"). Many contaminants are considered to be carcinogenic and U.S. EPA's policy is to set the applicable MCLGs at zero because they consider no amount of these contaminants to be without risk. It is understood by all that zero is an unattainable goal and cannot be measured by the practically available analytical methods. Note that by regulation, OEHHA cannot set a PHG at zero and must calculate a numerical level to address risk, even though it may be unattainable or impossible to measure.

PHGs and MCLGs are not enforceable. The Best Available Technology (BAT) to reach such low levels has not been defined and may not realistically be available. Accurate cost estimates are difficult, if not impossible, and are highly speculative and theoretical. Therefore, they have limited value and may not warrant significant investment of agency time and money.

## 3. <u>BEST AVAILABLE TREATMENT TECHNOLOGY AND COST ESTIMATES</u>

Both the USEPA and DDW adopt what are known as BATs or Best Available Technologies which are the best known methods of reducing contaminant levels to the MCL. 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 constituent downward to or near 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 to try and further reduce very low levels of one constituent may have adverse effects on other aspects of water quality.

Costs estimates listed in the tables below for such technologies are based on the ACWA PHG survey of 2012 and internal historical cost models. The estimates are based on $/1000 gallons of treated water which includes annualized capital and O&M costs.

Cost estimate formula =
ACWA estimate ($/1000 gal) x annual historical usage per year / # of service connections

## 4. WATER QUALITY DATA

All of the water quality data collected by our water system between 2017 and 2019 for purposes of determining compliance with drinking water standards was considered. This data was all summarized in our 2017, 2018, and 2019 Consumer Confidence Reports which were mailed to all of our customers in June of each year. For additional information on the City's pervious Consumer Confidence Reports go to https://www.cityofredlands.org/post/water-quality.

## 5. CONSTITUENTS DETECTED THAT EXCEED A PHG OR MCLG

Table 1 identifies the constituents that were detected by the City of Redlands above the PHG or MCLG during the reporting period 2017 – 2019. Over the last three years the City of Redlands drinking water has met all MCLs and safe drinking water standards adopted by USEPA and DDW; however, three contaminates (Perchlorate, Strontium 90 and Uranium) exceeded PHGs, and three (Gross Alpha Particle Activity, Gross Beta Particle Activity and Total Coliform Bacteria) exceeded MCLGs. The following is a discussion of these constituents that were detected in one or more of our drinking water sources. For information related to the numerical health risks associated with each constituents listed see Attachment "D".

**Table 1**

**Constituents detected above the PHG or MCLG (2017 - 2019)**

| Constituent | PHG (MCLG) | MCL |
|---|---|---|
| Total Coliform Bacteria | (0%) | 5% |
| Perchlorate | 1 ug/L | 6 ug/L |
| Gross Alpha Particle Activity (pCi/L) | (0) | 15 (pCi/L) |
| Gross Beta Particle Activity (pCi/L) | (0) | 50 (pCi/L) |
| Strontium-90 (pCi/L) | 0.35 (pCi/L) | 8 (pCi/L) |
| Uranium (pCi/L) | 0.43 (pCi/L) | 20 (pCi/L) |

- **Total Coliform Bacteria**

  The City of Redlands water system is required to sample for a minimum of 80 total coliform samples per month. Each month 80 to 130 samples are collected to monitor for total coliform bacteria. Over the reporting period each year results exceeded the MCLG of 0% however, no MCL violations occurred as a result.

  The MCL for coliform is 5% positive samples of all samples per month and the MCLG is zero. The reason for the coliform drinking water standard is to minimize the possibility of the water containing pathogens which are organisms that cause waterborne disease. Because coliform 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", they indicate that they cannot do so with coliform bacteria.

  Coliform bacteria is 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 follow up sampling performed. It is not at all unusual for a system to have an occasional positive sample. It is difficult, if not impossible, to assure that a system will never get a positive sample.

  The City of Redlands adds chlorine at our sources to assure 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 disinfection byproduct levels. This careful balance of treatment processes is essential to continue supplying our customers with safe drinking water.

  Other equally important measures that we have implemented include: an effective cross-connection control program, maintenance of a disinfectant residual throughout our system, an effective monitoring and surveillance program and maintaining positive pressures in our distribution system. Our system has already taken all of the steps described by DDW as "best available technology" for coliform bacteria in Section 64447, Title 22, CCR (see Attachment “B” Article 12. Best available technologies (BAT)).

**Table 2**

**Months with one or more Total Coliform positive sample(s) (2017 - 2019)**

| 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|
| Month | % Positive | Month | % Positive | Month | % Positive |
| May | 2.5% | October | 2% | January | 1% |
| | | | | March | 1% |
| | | | | April | 1% |

- **Perchlorate**

Perchlorate is an oxidizing chemical used in a variety of industrial processes. Perchlorate can occur in the environment either through industrial contamination or from natural sources. Perchlorate is also an inorganic chemical used in solid rocket propellant, fireworks, explosives, flares, matches, and a variety of industries. It usually gets into drinking water as a result of environmental contamination from historic aerospace or other industrial operations that used or use, store, or dispose of perchlorate and its salts. Perchlorate exposure in the U.S. is ubiquitous, mostly from ingestion of perchlorate in contaminated food or water.

The numerical public health risk associated with Perchlorate is listed in Attachment "D" of this report. Note, the numerical cancer risk at the PHG and MCL are listed N/A = not applicable, cancer risk cannot be calculated.

The City of Redlands currently uses a DDW approved and permitted blending strategy to comply with the regulatory MCL standard. Table 3 lists the source well affected by the perchlorate PHG exceedance. The table lists the treatment strategy used for regulatory compliance and the proposed BAT for additional Perchlorate reductions to meet the PHG target.

The preferred BAT considered for well 38 is Ion Exchange (IX). Staff has evaluated the initial capital and O&M costs based off an existing IX treatment system currently in operation within the City's water system and the ACWA cost references. IX has proven to treat Perchlorate to levels at and below the PHG of 1 ug/L.

**Table 3**

**Perchlorate (2017 - 2019)**

| Source | Perchlorate Concentration (ug/L) | Best Available Technology | * Current Treatment Strategy / (Proposed BAT Treatment) | Estimate Aggregate Annual Cost ($/Year) | Estimate Annual Customer Cost ($/Year) |
|---|---|---|---|---|---|
| Well 38 | 4 | 5, 12 | *Blend / (5) | $ 574,000 | $ 25 |

5 = Ion Exchange
12 = Biological Fluidized Bed Reactor

Perchlorate MCL = 6 ug/L
Perchlorate PHG = 1 ug/L
Detectable Level for the purpose of Reporting (DLR) = 4 ug/L

- **Gross Alpha Particles Activity**

Gross Alpha Particle Activity is a screening test that is performed to measure the overall radioactivity in drinking water. Gross alpha measurements can indicate the presence of a number of alpha emitting radionuclides, such as uranium and radium. Gross alpha particles in water supplies are predominantly from erosion of natural deposits.

The Office of Environmental Health Hazard Assessment (OEHHA) has not established a PHG for gross alpha and the USEPA has set a MCLG of zero pCi/L due to the classification of gross alpha radioactivity as a carcinogenic.

The gross alpha MCL is 15 pCi/L and MCLG is list at zero. The category of health risk for gross alpha particles is carcinogenicity. Carcinogenic risk means capable of producing cancer. The numerical health risk based on USEA's MCLG is zero therefore the cancer risk is zero at the MCLG. OEHHA indicates the numerical public health cancer risk at the MCL of 15 pCi/L to 1 x $10^{-3}$ for a lifetime of exposure. This means one excess case of cancer per 1,000 people exposed for a lifetime

The BAT for Gross Alpha is identified as Reverse Osmosis. Table 4 lists the sources that exceeded the MCLG of zero and costs estimates for reverse osmosis treatment.

**Table 4**

**Gross Alpha Particles (2017 - 2019)**

| Source | Gross Alpha Concentration (pCi/L) | Best Available Technology | * Current Treatment Strategy / (Proposed BAT Treatment) | Estimate Aggregate Annual Cost ($/Year) | Estimate Annual Customer Cost ($/Year) |
|---|---|---|---|---|---|
| Airport 1 | 4 | 7 | (7) | $ 1,451,250 | $ 63 |
| Airport 2 | 8 | 7 | (7) | $ 187,500 | $ 8 |
| East Lugonia 3 | 8 | 7 | (7) | $ 412,500 | $ 18 |
| East Lugonia 6 | 7 | 7 | (7) | $ 243,750 | $ 11 |
| Madeira | 6 | 7 | (7) | $ 1,050,000 | $ 46 |
| Maguet 2 | 7 | 7 | (7) | $ 412,500 | $ 18 |
| Mentone 2 | 12 | 7 | (7) | $ 750,000 | $ 33 |
| N. Orange 2 | 5 | 7 | (7) | $ 1,875,000 | $ 82 |
| Orange Street | 15 | 7 | *Blend / (7) | $ 1,125,000 | $ 49 |
| S.B. Ave Well | 6 | 7 | (7) | $ 562,500 | $ 24 |
| Well 39 | 8 | 7 | (7) | $ 562,500 | $ 24 |
| HWTP | 4 | 7 | *2 / (7) | $ 7,350,000 | $ 320 |
| TWTP | 4 | 7 | *2 / (7) | $ 5,250,000 | $ 228 |

2 = coagulation/filtration
7 = Reverse Osmosis

Gross Alpha MCL = 15 pCi/L
Gross Alpha MCLG = 0 pCi/L
Detectable Level for the purpose of Reporting (DLR) = 3 pCi/L

- **Gross Beta Particle Activity**

Gross beta particle activity is a measure of the total amount of radioactivity in a water sample attributable to the radioactive decay of beta-emitting elements. Gross beta particles in water supplies are predominantly from erosion of natural deposits.

The Office of Environmental Health Hazard Assessment (OEHHA) has not established a PHG for gross beta and the USEPA has set a MCLG of zero pCi/L due to the classification of gross beta radioactivity as a carcinogenic.

The gross beta MCL is 50 pCi/L and MCLG is list at zero. The category of health risk for gross beta particles is carcinogenicity. Carcinogenic risk means capable of producing cancer. The numerical public health cancer risk based on USEA's MCLG is zero therefore the cancer risk is zero at the MCLG. At the MCL of 50 pCi/L the numerical public health cancer risk is at $2x10^{-3}$. This means two excess case of cancer per 1,000 people exposed for a lifetime.

The BAT for gross beta is identified as reverse osmosis (RO) and ion exchange (IX). Table 5 lists all sources which result in an exceedance of the MCLG of zero and cost estimates for IX treatment.

**Table 5**

**Gross Beta Particles (2017 - 2019)**

| Source | Gross Beta Concentration (pCi/L) | Best Available Technology | * Current Treatment Strategy / (Proposed BAT Treatment) | Estimate Aggregate Annual Cost ($/Year) | Estimate Annual Customer Cost ($/Year) |
|---|---|---|---|---|---|
| Airport 1 | 4 | 5, 7 | (5) | $ 464,400 | $ 20 |
| East Lugonia 6 | 5 | 5, 7 | (5) | $ 78,000 | $ 3 |
| Mentone 2 | 13 | 5, 7 | (5) | $ 240,000 | $ 10 |
| N. Orange 1 | 8 | 5, 7 | (5) | $ 858,000 | $ 37 |
| Rees | 5 | 5, 7 | *5 / (5) | $ 360,000 | $ 16 |
| S.B. Ave Well | 10 | 5, 7 | (5) | $ 180,000 | $ 8 |
| Well 38 | 6 | 5, 7 | (5) | $ 576,000 | $ 25 |

7 = Reverse Osmosis
5 = Ion Exchange

Gross Beta MCL = 50 pCi/L
Gross Beta MCLG = 0 pCi/L
Detectable Level for the purpose of Reporting (DLR) = 4 pCi/L

- **Strontium-90**

The radionuclide, strontium-90 (90Sr), is created during the process of nuclear fission, which occurs in a nuclear reactor or an atomic explosion. Although 90Sr does not occur naturally, it is ubiquitous because of the worldwide atmospheric testing of nuclear weapons. These tests, which occurred during the 1950s and 60s, resulted in the deposition of 90Sr onto all continents and water bodies. As such, there is a small amount of 90Sr in most environmental media, including drinking water. 90Sr decays by emitting a beta particle.

The PHG of strontium-90 is 0.35 pCi/ and the MCL is listed at 8 pCi/L. The category of health risk for strontium-90 particles is carcinogenicity. Carcinogenic risk means capable of producing cancer. The numerical public health cancer risk at the PHG is $1\times10^{-6}$ which means one excess case of cancer per 1,000,000 people exposed for a lifetime. At the MCL of 8 pCi/L the numerical public health cancer risk is $2\times10^{-5}$ which means two excess cases of cancer per 100,000 people exposed for a lifetime.

Table 6 lists the source which result in an exceedance of the PHG of .35 pCi/L and cost estimates for IX treatment.

| Table 6<br>Strontium-90<br>(2017 - 2019) | | | | | |
|---|---|---|---|---|---|
| Source | Strontium-90 Concentration (pCi/L) | Best Available Technology | * Current Treatment Strategy / (Proposed BAT Treatment) | Estimate Aggregate Annual Cost ($/Year) | Estimate Annual Customer Cost ($/Year) |
| Airport 1 | 2 | 5, 7 | (5) | $ 464,400 | $ 20 |

5 = Ion Exchange
7 = Reverse Osmosis

Strontium-90 MCL = 8 pCi/L
Strontium-90 PHG = 0.35 pCi/L
Detectable Level for the purpose of Reporting (DLR) = 2 pCi/L

- **Uranium**

Uranium is a naturally occurring radioactive element that is ubiquitous in the earth's crust. Uranium is found in ground and surface waters due to its natural occurrence in geological formations. Uranium particles in water supplies are predominantly from erosion of natural deposits.

The MCL for uranium is 20 pCi/L and the PHG for uranium is 0.43 pCi/L. The category of health risk for uranium particles is carcinogenicity. Carcinogenic risk means capable of producing cancer. The numerical public health cancer risk at the PHG is $1\times10^{-6}$ which means one excess case of cancer per 1,000,000 people exposed for a lifetime. At the MCL of 20 pCi/L the numerical public health cancer risk is $5\times10^{-5}$ which means five excess cases of cancer per 500,000 people exposed for a lifetime.

Table 7 lists the source which result in an exceedance of the PHG of .43 pCi/L and cost estimates for IX and enhances coagulation/filtration treatment.

**Table 7**

**Uranium**

| Source | Uranium Concentration (pCi/L) | Best Available Technology | * Current Treatment Strategy / (Proposed BAT Treatment) | Estimate Aggregate Annual Cost ($/Year) | Estimate Annual Customer Cost ($/Year) |
|---|---|---|---|---|---|
| Airport 1 | 3 | 2, 5, 6, 7 | (5) | $ 464,400 | $ 20 |
| Airport 2 | 4 | 2, 5, 6, 7 | (5) | $ 60,000 | $ 3 |
| East Lugonia 3 | 2 | 2, 5, 6, 7 | (5) | $ 132,000 | $ 6 |
| East Lugonia 6 | 3 | 2, 5, 6, 7 | (5) | $ 78,000 | $ 3 |
| Madeira | 5 | 2, 5, 6, 7 | (5) | $ 336,000 | $ 15 |
| Maguet 2 | 3 | 2, 5, 6, 7 | (5) | $ 132,000 | $ 6 |
| N. Orange 1 | 2 | 2, 5, 6, 7 | (5) | $ 858,000 | $ 37 |
| N. Orange 2 | 4 | 2, 5, 6, 7 | (5) | $ 600,000 | $ 26 |
| Orange Street | 12 | 2, 5, 6, 7 | * Blend / (5) | $ 360,000 | $ 16 |
| Rees | 2 | 2, 5, 6, 7 | (5) | $ 360,000 | $ 16 |
| S.B. Ave Well | 5 | 2, 5, 6, 7 | (5) | $ 180,000 | $ 8 |
| HWTP | 4 | 2, 5, 6, 7 | (2) | $ 1,470,000 | $ 64 |

2 = coagulation/filtration
5 = Ion Exchange
6 = lime softening
7 = Reverse Osmosis

Uranium MCL = 20 pCi/L
Uranium PHG = .43 pCi/L
Detectable Level for the purpose of Reporting (DLR) = 1 pCi/L

## 6. RECOMMENDATIONS FOR FURTHER ACTION

The drinking water quality of the City of Redlands meets all State of California, DDW and USEPA drinking water standards set to protect public health. To further reduce the levels of the constituents 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 would be required. The effectiveness of the treatment processes to provide any significant reductions in constituent 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.

## 7. REFERENCES

- **Attachment “A”** – Excerpt from California Health & Safety Code: Section 116470 (b)
- **Attachment “B”** – Excerpts from California Regulations Related to Drinking Water, Title 22 California Code of Regulations
- **Attachment “C”** – Table of Regulated Constituents with MCLs, PHGs or MCLGs
- **Attachment “D”** – Health Risk Information for Public Health Goal Exceedance Reports

# ATTACHMENT "A"

## Excerpt from California Health & Safety Code Section 116470 (b)

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.

(c) Public water systems required to prepare a report pursuant to subdivision (b) shall hold a public hearing for the purpose of accepting and responding to public comment on the report. Public water systems may hold the public hearing as part of any regularly scheduled meeting.

(d) The department shall not require a public water system to take any action to reduce or eliminate any exceedance of a public health goal.

(e) Enforcement of this section does not require the department to amend a public water system's operating permit.

(f) Pending adoption of a public health goal by the Office of Environmental Health Hazard Assessment pursuant to subdivision (c) of Section 116365, and in lieu thereof, public water systems shall use the national maximum contaminant level goal adopted by the United States Environmental Protection Agency for the corresponding contaminant for purposes of complying with the notice and hearing requirements of this section.

# ATTACHMENT "B"

## Excerpt from California Regulations Related to Drinking Water

## TITLE 22 CODE OF REGULATIONS

**§64400.32. Detected.**
"Detected" means at or above the detection limit for purposes of reporting (DLR).

**§64400.34. Detection Limit for Purposes of Reporting (DLR).**
"Detection limit for purposes of reporting (DLR)" means the designated minimum level at or above which any analytical finding of a contaminant in drinking water resulting from monitoring required under this chapter shall be reported to the State Board.

**§64400.70. MCL.**
"MCL" means maximum contaminant level.

**§64401.80. Total Coliform-positive.**
"Total coliform-positive" means a sample result in which the presence of total coliforms has been demonstrated.

### *Article 12. Best available technologies (BAT)*

**§64447. Best Available Technologies (BAT) – Microbiological Contaminants.**
The technologies identified by the State Board as the best available technology, treatment techniques, or other means available for achieving compliance with the total coliform MCL are as follows:

(a) Protection of wells from coliform contamination by appropriate placement and construction;

(b) Maintenance of a disinfectant residual throughout the distribution system;

(c) Proper maintenance of the distribution system; and

(d) Filtration and/or disinfection of approved surface water, in compliance with Section 64650, or disinfection of groundwater

**§64447.2. Best Available Technologies (BAT) - Inorganic chemicals.**
The technologies listed in table 64447.2-A are the best available technology, treatment techniques, or other means available for achieving compliance with the MCLs in table 64431-A for inorganic chemicals.

**Table 64447.2-A**
**Best Available Technologies (BAT)**
**Inorganic Chemicals**

| *Chemical* | *Best Available Technologies (BATs)* |
|---|---|
| Aluminum | 10 |
| Antimony | 2, 7 |
| Arsenic | 1, 2, 5, 6, 7, 9, 13 |
| Asbestos | 2, 3, 8 |
| Barium | 5, 6, 7, 9 |
| Beryllium | 1, 2, 5, 6, 7 |
| Cadmium | 2, 5, 6, 7 |
| Chromium | 2, 5, 6[a], 7 |
| Cyanide | 5, 7, 11 |
| Fluoride | 1 |
| Mercury | 2[b], 4, 6[b], 7[b] |
| Nickel | 5, 6, 7 |
| Nitrate | 5, 7, 9 |
| Nitrite | 5, 7 |
| Perchlorate | 5,12 |
| Selenium | 1, 2[c], 6, 7, 9 |
| Thallium | 1, 5 |

[a]BAT for chromium III (trivalent chromium) only.
[b]BAT only if influent mercury concentrations <10 ug/L.
[c]BAT for selenium IV only.

Key to BATs in table 64447.2:
1 = Activated Alumina
2 = Coagulation/Filtration (not BAT for systems < 500 service connections)
3 = Direct and Diatomite Filtration
4 = Granular Activated Carbon
5 = Ion Exchange
6 = Lime Softening (not BAT for systems < 500 service connections)
7 = Reverse Osmosis
8 = Corrosion Control
9 = Electrodialysis
10 = Optimizing treatment and reducing aluminum added
11 = Chlorine oxidation
12 = Biological fluidized bed reactor
13 = Oxidation/Filtration

**§64447.3. Best Available Technologies (BAT) - Radionuclides.**

The technologies listed in tables 64447.3-A, B and C are the best available technology, treatment technologies, or other means available for achieving compliance with the MCLs for radionuclides in tables 64442 and 64443.

**Table 64447.3-A**
**Best Available Technologies (BATs)**
**Radionuclides**

| *Radionuclide* | *Best Available Technology* |
|---|---|
| Combined radium-226 and radium-228 | Ion exchange, reverse osmosis, lime softening |
| Uranium | Ion exchange, reverse osmosis, lime softening, coagulation/filtration |
| Gross alpha particle activity | Reverse osmosis |
| Beta particle and photon radioactivity | Ion exchange, reverse osmosis |

**Table 64447.3-B**
**Best Available Technologies (BATs) and Limitations for Small Water Systems**
**Radionuclides**

| *Unit Technologies* | *Limitations (see footnotes)* | *Operator Skill Level Required* | *Raw Water Quality Range and Considerations* |
|---|---|---|---|
| 1. Ion exchange | (a) | Intermediate | All ground waters; competing anion concentrations may affect regeneration frequency |
| 2. Point of use, ion exchange | (b) | Basic | All ground waters; competing anion concentrations may affect regeneration frequency |
| 3. Reverse osmosis | (c) | Advanced | Surface waters usually require pre-filtration |
| 4. Point of use, reverse osmosis | (b) | Basic | Surface waters usually require pre-filtration |
| 5. Lime softening | (d) | Advanced | All waters |
| 6. Green sand filtration | (e) | Basic | All ground waters; competing anion concentrations may affect regeneration frequency |
| 7. Co-precipitation with barium sulfate | (f) | Intermediate to advanced | Ground waters with suitable quality |
| 8. Electrodialysis/electrodialysis reversal | (g) | Basic to intermediate | All ground waters |

| | | | |
|---|---|---|---|
| 9. Pre-formed hydrous manganese oxide filtration | (h) | Intermediate | All ground waters |
| 10. Activated alumina | (a), (i) | Advanced | All ground waters; competing anion concentrations may affect regeneration frequency |
| 11. Enhanced coagulation/filtration | (j) | Advanced | Can treat a wide range of water qualities |

Limitation Footnotes:

[a] The regeneration solution contains high concentrations of the contaminant ions, which could result in disposal issues.

[b] When point of use devices are used for compliance, programs for long-term operation, maintenance, and monitoring shall be provided by systems to ensure proper performance.

[c] Reject water disposal may be an issue.

[d] The combination of variable source water quality and the complexity of the water chemistry involved may make this technology too complex for small systems.

[e] Removal efficiencies can vary depending on water quality.

[f] Since the process requires static mixing, detention basins, and filtration, this technology is most applicable to systems with sufficiently high sulfate levels that already have a suitable filtration treatment train in place.

[g] Applies to ionized radionuclides only.

[h] This technology is most applicable to small systems with filtration already in place.

[i] Chemical handling during regeneration and pH adjustment may be too difficult for small systems without an operator trained in these procedures.

[j] This would involve modification to a coagulation/filtration process already in place.

**Table 64447.3-C**
**Best Available Technologies (BATs) for Small Water Systems by System Size Radionuclides**

| | *Compliance Technologies for System Size Categories Based On Population Served* | | |
|---|---|---|---|
| | *25-500* | *501-3,300* | *3,301 - 10,000* |
| *Contaminant* | *Unit Technologies (Numbers Correspond to Table 64447.3-B)* | | |
| Combined radium-226 and radium-228 | 1, 2 ,3, 4, 5, 6, 7, 8, 9 | 1, 2 ,3, 4, 5, 6, 7, 8, 9 | 1, 2 ,3, 4, 5, 6, 7, 8, 9 |
| Gross alpha particle activity | 3, 4 | 3, 4 | 3, 4 |
| Beta particle activity and photon radioactivity | 1, 2, 3, 4 | 1, 2, 3, 4 | 1, 2, 3, 4 |
| Uranium | 1, 2, 4, 10, 11 | 1, 2, 3, 4, 5, 10, 11 | 1, 2, 3, 4, 5, 10, 11 |

# ATTACHMENT "C"

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

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

**Last Update: March 13, 2019**

This table includes:

California's maximum contaminant levels (MCLs)

Detection limits for purposes of reporting (DLRs)

Public health goals (PHGs) from the Office of Environmental Health Hazard Assessment (OEHHA)

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

For comparison:

Federal MCLs and Maximum Contaminant Level Goals (MCLGs) (US EPA)

| Regulated Contaminant | MCL | DLR | PHG | Date of PHG | MCL | MCLG |
|---|---|---|---|---|---|---|
| ***Chemicals with MCLs in 22 CCR §64431—Inorganic Chemicals*** | | | | | | |
| Aluminum | 1 | 0.05 | 0.6 | 2001 | -- | -- |
| Antimony | 0.006 | 0.006 | 0.001 | 2016 | 0.006 | 0,006 |
| Arsenic | 0.010 | 0.002 | 0.000004 | 2004 | 0.010 | zero |
| Asbestos (MFL = million fibers per liter; for fibers >10 microns long) | 7 MFL | 0.2 MFL | 7 MFL | 2003 | 7 MFL | 7 MFL |
| Barium | 1 | 0.1 | 2 | 2003 | 2 | 2 |
| Beryllium | 0.004 | 0.001 | 0.001 | 2003 | 0.004 | 0.004 |
| Cadmium | 0.005 | 0.001 | 0.00004 | 2006 | 0.005 | 0.005 |
| Chromium, Total - OEHHA withdrew the 0.0025-mg/L PHG | 0.05 | 0.01 | withdrawn Nov. 2001 | 1999 | 0.1 | 0.1 |
| Chromium, Hexavalent - 0.01-mg/L MCL & 0.001-mg/L DLR repealed September 2017 | -- | -- | 0.00002 | 2011 | -- | -- |
| Cyanide | 0.15 | 0.1 | 0.15 | 1997 | 0.2 | 0.2 |
| Fluoride | 2 | 0.1 | 1 | 1997 | 4.0 | 4.0 |
| Mercury (inorganic) | 0.002 | 0.001 | 0.0012 | 1999 (rev2005)* | 0.002 | 0.002 |
| Nickel | 0.1 | 0.01 | 0.012 | 2001 | -- | -- |
| Nitrate (as nitrogen, N) | 10 as N | 0.4 | 45 as NO3 (=10 as N) | 2018 | 10 | 10 |
| Nitrite (as N) | 1 as N | 0.4 | 1 as N | 2018 | 1 | 1 |
| Nitrate + Nitrite (as N) | 10 as N | -- | 10 as N | 2018 | -- | -- |
| Perchlorate | 0.006 | 0.004 | 0.001 | 2015 | -- | -- |
| Selenium | 0.05 | 0.005 | 0.03 | 2010 | 0.05 | 0.05 |
| Thallium | 0.002 | 0.001 | 0.0001 | 1999 (rev2004) | 0.002 | 0.0005 |
| ***Copper and Lead, 22 CCR §64672.3*** | | | | | | |
| *Values referred to as MCLs for lead and copper are not actually MCLs; instead, they are called "Action Levels" under the lead and copper rule* | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Copper | 1.3 | 0.05 | 0.3 | 2008 | 1.3 | 1.3 |
| Lead | 0.015 | 0.005 | 0.0002 | 2009 | 0.015 | zero |
| ***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 - OEHHA concluded in 2003 that a PHG was not practical | 15 | 3 | none | n/a | 15 | zero |
| Gross beta particle activity - OEHHA concluded in 2003 that a PHG was not practical | 4 mrem/yr | 4 | none | n/a | 4 mrem/yr | zero |
| Radium-226 | -- | 1 | 0.05 | 2006 | | |
| Radium-228 | -- | 1 | 0.019 | 2006 | | |
| Radium-226 + Radium-228 | 5 | -- | -- | -- | 5 | zero |
| Strontium-90 | 8 | 2 | 0.35 | 2006 | -- | -- |
| Tritium | 20,000 | 1,000 | 400 | 2006 | -- | -- |
| Uranium | 20 | 1 | 0.43 | 2001 | 30 ug/L | zero |
| ***Chemicals with MCLs in 22 CCR §64444—Organic Chemicals*** | | | | | | |
| ***(a) Volatile Organic Chemicals (VOCs)*** | | | | | | |
| Benzene | 0.001 | 0.0005 | 0.00015 | 2001 | 0.005 | zero |
| Carbon tetrachloride | 0.0005 | 0.0005 | 0.0001 | 2000 | 0.005 | zero |
| 1,2-Dichlorobenzene | 0.6 | 0.0005 | 0.6 | 1997 (rev2009) | 0.6 | 0.6 |
| 1,4-Dichlorobenzene (p-DCB) | 0.005 | 0.0005 | 0.006 | 1997 | 0.075 | 0.075 |
| 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) | 0.005 | zero |
| 1,1-Dichloroethylene (1,1-DCE) | 0.006 | 0.0005 | 0.01 | 1999 | 0.007 | 0.007 |
| cis-1,2-Dichloroethylene | 0.006 | 0.0005 | 0.013 | 2018 | 0.07 | 0.07 |
| trans-1,2-Dichloroethylene | 0.01 | 0.0005 | 0.05 | 2018 | 0.1 | 0.1 |
| Dichloromethane (Methylene chloride) | 0.005 | 0.0005 | 0.004 | 2000 | 0.005 | zero |
| 1,2-Dichloropropane | 0.005 | 0.0005 | 0.0005 | 1999 | 0.005 | zero |
| 1,3-Dichloropropene | 0.0005 | 0.0005 | 0.0002 | 1999 (rev2006) | -- | -- |
| Ethylbenzene | 0.3 | 0.0005 | 0.3 | 1997 | 0.7 | 0.7 |
| Methyl tertiary butyl ether (MTBE) | 0.013 | 0.003 | 0.013 | 1999 | -- | -- |
| Monochlorobenzene | 0.07 | 0.0005 | 0.07 | 2014 | 0.1 | 0.1 |
| Styrene | 0.1 | 0.0005 | 0.0005 | 2010 | 0.1 | 0.1 |
| 1,1,2,2-Tetrachloroethane | 0.001 | 0.0005 | 0.0001 | 2003 | 0.1 | 0.1 |
| Tetrachloroethylene (PCE) | 0.005 | 0.0005 | 0.00006 | 2001 | 0.005 | zero |
| Toluene | 0.15 | 0.0005 | 0.15 | 1999 | 1 | 1 |
| 1,2,4-Trichlorobenzene | 0.005 | 0.0005 | 0.005 | 1999 | 0.07 | 0.07 |
| 1,1,1-Trichloroethane (1,1,1-TCA) | 0.200 | 0.0005 | 1 | 2006 | 0.2 | 0.2 |
| 1,1,2-Trichloroethane (1,1,2-TCA) | 0.005 | 0.0005 | 0.0003 | 2006 | 0.005 | 0.003 |
| Trichloroethylene (TCE) | 0.005 | 0.0005 | 0.0017 | 2009 | 0.005 | zero |
| 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 | 0.002 | zero |
| Xylenes | 1.750 | 0.0005 | 1.8 | 1997 | 10 | 10 |
| ***(b) Non-Volatile Synthetic Organic Chemicals (SOCs)*** | | | | | | |
| Alachlor | 0.002 | 0.001 | 0.004 | 1997 | 0.002 | zero |
| Atrazine | 0.001 | 0.0005 | 0.00015 | 1999 | 0.003 | 0.003 |
| Bentazon | 0.018 | 0.002 | 0.2 | 1999 (rev2009) | -- | -- |
| Benzo(a)pyrene | 0.0002 | 0.0001 | 0.000007 | 2010 | 0.0002 | zero |
| Carbofuran | 0.018 | 0.005 | 0.0007 | 2016 | 0.04 | 0.04 |
| Chlordane | 0.0001 | 0.0001 | 0.00003 | 1997 (rev2006) | 0.002 | zero |
| Dalapon | 0.2 | 0.01 | 0.79 | 1997 (rev2009) | 0.2 | 0.2 |
| 1,2-Dibromo-3-chloropropane (DBCP) | 0.0002 | 0.00001 | 0.0000017 | 1999 | 0.0002 | zero |
| 2,4-Dichlorophenoxyacetic acid (2,4-D) | 0.07 | 0.01 | 0.02 | 2009 | 0.07 | 0.07 |
| Di(2-ethylhexyl)adipate | 0.4 | 0.005 | 0.2 | 2003 | 0.4 | 0.4 |
| Di(2-ethylhexyl)phthalate (DEHP) | 0.004 | 0.003 | 0.012 | 1997 | 0.006 | zero |
| Dinoseb | 0.007 | 0.002 | 0.014 | 1997 (rev2010) | 0.007 | 0.007 |
| Diquat | 0.02 | 0.004 | 0.006 | 2016 | 0.02 | 0.02 |
| Endothal | 0.1 | 0.045 | 0.094 | 2014 | 0.1 | 0.1 |
| Endrin | 0.002 | 0.0001 | 0.0003 | 2016 | 0.002 | 0.002 |
| Ethylene dibromide (EDB) | 0.00005 | 0.00002 | 0.00001 | 2003 | 0.00005 | zero |
| Glyphosate | 0.7 | 0.025 | 0.9 | 2007 | 0.7 | 0.7 |
| Heptachlor | 0.00001 | 0.00001 | 0.000008 | 1999 | 0.0004 | zero |
| Heptachlor epoxide | 0.00001 | 0.00001 | 0.000006 | 1999 | 0.0002 | zero |
| Hexachlorobenzene | 0.001 | 0.0005 | 0.00003 | 2003 | 0.001 | zero |
| Hexachlorocyclopentadiene | 0.05 | 0.001 | 0.002 | 2014 | 0.05 | 0.05 |
| Lindane | 0.0002 | 0.0002 | 0.000032 | 1999 (rev2005) | 0.0002 | 0.0002 |
| Methoxychlor | 0.03 | 0.01 | 0.00009 | 2010 | 0.04 | 0.04 |
| Molinate | 0.02 | 0.002 | 0.001 | 2008 | -- | -- |
| Oxamyl | 0.05 | 0.02 | 0.026 | 2009 | 0.2 | 0.2 |
| Pentachlorophenol | 0.001 | 0.0002 | 0.0003 | 2009 | 0.001 | zero |
| Picloram | 0.5 | 0.001 | 0.166 | 2016 | 0.5 | 0.5 |
| Polychlorinated biphenyls (PCBs) | 0.0005 | 0.0005 | 0.00009 | 2007 | 0.0005 | zero |
| Simazine | 0.004 | 0.001 | 0.004 | 2001 | 0.004 | 0.004 |
| Thiobencarb | 0.07 | 0.001 | 0.042 | 2016 | -- | -- |
| Toxaphene | 0.003 | 0.001 | 0.00003 | 2003 | 0.003 | zero |
| 1,2,3-Trichloropropane | 0.000005 | 0.000005 | 0.0000007 | 2009 | -- | -- |
| 2,3,7,8-TCDD (dioxin) | $3x10^{-8}$ | $5x10^{-9}$ | $5x10^{-11}$ | 2010 | $3x10^{-8}$ | zero |
| 2,4,5-TP (Silvex) | 0.05 | 0.001 | 0.003 | 2014 | 0.05 | 0.05 |
| ***Chemicals with MCLs in 22 CCR §64533—Disinfection Byproducts*** | | | | | | |
| Total Trihalomethanes | 0.080 | -- | -- | -- | 0.080 | -- |
| Bromodichloromethane | -- | 0.0010 | 0.00006 | 2018 draft | -- | zero |

| | | | | | | |
|---|---|---|---|---|---|---|
| Bromoform | -- | 0.0010 | 0.0005 | 2018 draft | -- | zero |
| Chloroform | -- | 0.0010 | 0.0004 | 2018 draft | -- | 0.07 |
| Dibromochloromethane | -- | 0.0010 | 0.0001 | 2018 draft | -- | 0.06 |
| Haloacetic Acids (five) (HAA5) | 0.060 | -- | -- | -- | 0.060 | -- |
| Monochloroacetic Acid | -- | 0.0020 | -- | -- | -- | 0.07 |
| Dichloroacetic Acid | -- | 0.0010 | -- | -- | -- | zero |
| Trichloroacetic Acid | -- | 0.0010 | -- | -- | -- | 0.02 |
| Monobromoacetic Acid | -- | 0.0010 | -- | -- | -- | -- |
| Dibromoacetic Acid | -- | 0.0010 | -- | -- | -- | -- |
| Bromate | 0.010 | 0.0050** | 0.0001 | 2009 | 0.01 | zero |
| Chlorite | 1.0 | 0.020 | 0.05 | 2009 | 1 | 0.8 |
| ***Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking water contaminants.*** | | | | | | |
| N-Nitrosodimethylamine (NDMA) | -- | -- | 0.000003 | 2006 | -- | -- |

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

**The DLR for Bromate is 0.0010 mg/L for analysis performed using EPA Method 317.0 Revision 2.0, 321.8, or 326.0.

# ATTACHMENT “D”

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

# Public Health Goals

## Health Risk Information for Public Health Goal Exceedance Reports

February 2019

Pesticide and Environmental Toxicology Branch
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

# Health Risk Information for Public Health Goal Exceedance Reports

**Prepared by**

**Office of Environmental Health Hazard Assessment**
**California Environmental Protection Agency**

**February 2019**

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 Public Health Goals (PHGs).[1] This document contains health risk information on regulated 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 regulated contaminant in drinking water 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.

**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

[1] Health and Safety Code Section 116470(b)
[2] Health and Safety Code Section 116365

considered to pose no *significant* risk of cancer; this is usually no more than a one-in-one-million excess cancer risk ($1 \times 10^{-6}$) 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 (http://www.oehha.ca.gov). Also, technical fact sheets on most of the chemicals having federal MCLs can be found at http://www.epa.gov/your-drinking-water/table-regulated-drinking-water-contaminants.

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

| Chemical | Health Risk Category[3] | California PHG (mg/L)[4] | Cancer Risk[5] at the PHG | California MCL[6] (mg/L) | Cancer Risk at the California MCL |
|---|---|---|---|---|---|
| Alachlor | carcinogenicity (causes cancer) | 0.004 | NA[7,6] | 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 ($4\times10^{-8}$) | $1\times10^{-6}$ (one per million) | 0.01 | $2.5\times10^{-3}$ (2.5 per thousand) |
| Asbestos | carcinogenicity (causes cancer) | 7 MFL[7] (fibers >10 microns in length) | $1\times10^{-6}$ | 7 MFL (fibers >10 microns in length) | $1\times10^{-6}$ (one per million) |

[3] Based on the OEHHA PHG technical support document unless otherwise specified. The categories are the hazard traits defined by OEHHA for California's Toxics Information Clearinghouse (online at: http://oehha.ca.gov/multimedia/green/pdf/GC_Regtext011912.pdf).
[4] mg/L = milligrams per liter of water or parts per million (ppm)
[5] Cancer Risk = Upper bound estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. $1\times10^{-6}$ means one excess cancer case per million people exposed.
[6] MCL = maximum contaminant level.
[7] NA = not applicable. Cancer risk cannot be calculated.
[8] 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)

| | | | | | |
|---|---|---|---|---|---|
| Atrazine | carcinogenicity (causes cancer) | 0.00015 | $1\times10^{-6}$ | 0.001 | $7\times10^{-6}$ (seven per million) |

| 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[9]) | 0.2 | NA | 0.018 | NA |
| Benzene | carcinogenicity (causes leukemia) | 0.00015 | $1\times10^{-6}$ | 0.001 | $7\times10^{-6}$ (seven per million) |
| Benzo[a]pyrene | carcinogenicity (causes cancer) | 0.000007 ($7\times10^{-6}$) | $1\times10^{-6}$ | 0.0002 | $3\times10^{-5}$ (three per hundred thousand) |
| Beryllium | digestive system toxicity (harms the stomach or intestine) | 0.001 | NA | 0.004 | NA |

[9] 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)

| | | | | | |
|---|---|---|---|---|---|
| Bromate | carcinogenicity (causes cancer) | 0.0001 | $1\times10^{-6}$ | 0.01 | $1\times10^{-4}$ (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 |

| 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 | $1\times10^{-6}$ | 0.0005 | $5\times10^{-6}$ (five per million) |
| Chlordane | carcinogenicity (causes cancer) | 0.00003 | $1\times10^{-6}$ | 0.0001 | $3\times10^{-6}$ (three per million) |
| Chlorite | hematotoxicity (causes anemia) neurotoxicity (causes neurobehavioral effects) | 0.05 | NA | 1 | NA |
| Chromium, hexavalent | carcinogenicity (causes cancer) | 0.00002 | $1\times10^{-6}$ | none | NA |

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

| | | | | | |
|---|---|---|---|---|---|
| Copper | digestive system toxicity<br><br>(causes nausea, vomiting, diarrhea) | 0.3 | NA | 1.3 (AL[10]) | NA |
| Cyanide | neurotoxicity<br><br>(damages nerves) endocrine toxicity<br><br>(affects the thyroid) | 0.15 | NA | 0.15 | NA |
| Dalapon | nephrotoxicity<br><br>(harms the kidney) | 0.79 | NA | 0.2 | NA |
| Di(2-ethylhexyl) adipate (DEHA) | developmental toxicity<br><br>(disrupts development) | 0.2 | NA | 0.4 | NA |
| Diethylhexylphthalate (DEHP) | carcinogenicity (causes cancer) | 0.012 | $1\times10^{-6}$ | 0.004 | $3\times10^{-7}$<br><br>(three per ten million) |

| 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 |
|---|---|---|---|---|---|
| 1,2-Dibromo-3chloropropane (DBCP) | carcinogenicity (causes cancer) | 0.0000017 ($1.7\times10^{-6}$) | $1\times10^{-6}$ | 0.0002 | $1\times10^{-4}$<br><br>(one per ten thousand) |

[10] 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 |
|---|---|---|---|---|---|
| 1,2-Dichlorobenzene (*o*-DCB) | hepatotoxicity (harms the liver) | 0.6 | NA | 0.6 | NA |
| 1,4-Dichlorobenzene (*p*-DCB) | carcinogenicity (causes cancer) | 0.006 | $1\times10^{-6}$ | 0.005 | $8\times10^{-7}$ (eight per ten million) |
| 1,1-Dichloroethane (1,1-DCA) | carcinogenicity (causes cancer) | 0.003 | $1\times10^{-6}$ | 0.005 | $2\times10^{-6}$ (two per million) |
| 1,2-Dichloroethane (1,2-DCA) | carcinogenicity (causes cancer) | 0.0004 | $1\times10^{-6}$ | 0.0005 | $1\times10^{-6}$ (one per million) |
| 1,1-Dichloroethylene (1,1-DCE) | hepatotoxicity (harms the liver) | 0.01 | NA | 0.006 | NA |
| 1,2-Dichloroethylene, cis | nephrotoxicity (harms the kidney) | 0.013 | NA | 0.006 | NA |
| 1,2-Dichloroethylene, trans | immunotoxicity (harms the immune system) | 0.05 | NA | 0.01 | NA |
| Dichloromethane (methylene chloride) | carcinogenicity (causes cancer) | 0.004 | $1\times10^{-6}$ | 0.005 | $1\times10^{-6}$ (one per million) |

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

| | | | | | |
|---|---|---|---|---|---|
| 2,4-Dichlorophenoxyacetic acid (2,4-D) | hepatotoxicity and nephrotoxicity<br><br>(harms the liver and kidney) | 0.02 | NA | 0.07 | NA |
| 1,2-Dichloropropane (propylene dichloride) | carcinogenicity (causes cancer) | 0.0005 | $1\times10^{-6}$ | 0.005 | $1\times10^{-5}$ (one per hundred thousand) |
| 1,3-Dichloropropene (Telone II) | carcinogenicity (causes cancer) | 0.0002 | $1\times10^{-6}$ | 0.0005 | $2\times10^{-6}$<br><br>(two per million) |
| Dinoseb | reproductive toxicity<br><br>(harms the uterus and testis) | 0.014 | NA | 0.007 | NA |
| Diquat | ocular toxicity<br><br>(harms the eye)<br>developmental toxicity<br><br>(causes malformation) | 0.006 | NA | 0.02 | NA |
| Endothall | digestive system toxicity<br><br>(harms the stomach or intestine) | 0.094 | NA | 0.1 | NA |
| Endrin | neurotoxicity<br><br>(causes convulsions)<br>hepatotoxicity<br><br>(harms the liver) | 0.0003 | NA | 0.002 | NA |
| Ethylbenzene (phenylethane) | hepatotoxicity<br><br>(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)

| | | | | | |
|---|---|---|---|---|---|
| Ethylene dibromide (1,2Dibromoethane) | carcinogenicity (causes cancer) | 0.00001 | $1\times10^{-6}$ | 0.00005 | $5\times10^{-6}$ (five per million) |

| 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 |
|---|---|---|---|---|---|
| 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 ($8\times10^{-6}$) | $1\times10^{-6}$ | 0.00001 | $1\times10^{-6}$ (one per million) |
| Heptachlor epoxide | carcinogenicity (causes cancer) | 0.000006 ($6\times10^{-6}$) | $1\times10^{-6}$ | 0.00001 | $2\times10^{-6}$ (two per million) |
| Hexachlorobenzene | carcinogenicity (causes cancer) | 0.00003 | $1\times10^{-6}$ | 0.001 | $3\times10^{-5}$ (three per hundred thousand) |
| Hexachlorocyclopentadiene (HCCPD) | digestive system toxicity (causes stomach lesions) | 0.002 | NA | 0.05 | NA |

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

| | | | | | |
|---|---|---|---|---|---|
| Lead | developmental neurotoxicity (causes neurobehavioral effects in children) cardiovascular toxicity (causes high blood pressure) carcinogenicity (causes cancer) | 0.0002 | $<1\times10^{-6}$ (PHG is not based on this effect) | 0.015 (AL[8]) | $2\times10^{-6}$ (two per million) |
| Lindane (γ-BHC) | carcinogenicity (causes cancer) | 0.000032 | $1\times10^{-6}$ | 0.0002 | $6\times10^{-6}$ (six per million) |
| Mercury (inorganic) | nephrotoxicity (harms the kidney) | 0.0012 | NA | 0.002 | NA |
| **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** |
| Methoxychlor | endocrine toxicity (causes hormone effects) | 0.00009 | NA | 0.03 | NA |
| Methyl tertiarybutyl ether (MTBE) | carcinogenicity (causes cancer) | 0.013 | $1\times10^{-6}$ | 0.013 | $1\times10^{-6}$ (one per million) |
| Molinate | carcinogenicity (causes cancer) | 0.001 | $1\times10^{-6}$ | 0.02 | $2\times10^{-5}$ (two per hundred thousand) |

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

| | | | | | |
|---|---|---|---|---|---|
| Monochlorobenzene (chlorobenzene) | nephrotoxicity<br><br>(harms the kidney) | 0.07 | NA | 0.07 | NA |
| Nickel | developmental toxicity<br><br>(causes increased neonatal deaths) | 0.012 | NA | 0.1 | NA |
| Nitrate | hematotoxicity<br><br>(causes methemoglobinemia) | 45 as nitrate | NA | 10 as nitrogen<br><br>(=45 as nitrate) | NA |
| Nitrite | hematotoxicity<br><br>(causes methemoglobinemia) | 3 as nitrite | NA | 1 as nitrogen (=3 as nitrite) | NA |
| Nitrate and Nitrite | hematotoxicity<br><br>(causes methemoglobinemia) | 10 as nitrogen[11] | NA | 10 as nitrogen | NA |

| 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 |
|---|---|---|---|---|---|
| N-nitrosodimethyl-amine (NDMA) | carcinogenicity (causes cancer) | 0.000003 ($3 \times 10^{-6}$) | $1 \times 10^{-6}$ | none | NA |

[11] 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)

| | | | | | |
|---|---|---|---|---|---|
| Oxamyl | general toxicity (causes body weight effects) | 0.026 | NA | 0.05 | NA |
| Pentachlorophenol (PCP) | carcinogenicity (causes cancer) | 0.0003 | $1\times10^{-6}$ | 0.001 | $3\times10^{-6}$ (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 | $1\times10^{-6}$ | 0.0005 | $6\times10^{-6}$ (six per million) |
| Radium-226 | carcinogenicity (causes cancer) | 0.05 pCi/L | $1\times10^{-6}$ | 5 pCi/L (combined $Ra_{226+228}$) | $1\times10^{-4}$ (one per ten thousand) |
| Radium-228 | carcinogenicity (causes cancer) | 0.019 pCi/L | $1\times10^{-6}$ | 5 pCi/L (combined $Ra_{226+228}$) | $3\times10^{-4}$ (three per ten thousand) |
| Selenium | integumentary toxicity (causes hair loss and nail damage) | 0.03 | 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] | California PHG (mg/L)[2] | Cancer Risk[3] at the PHG | California MCL[4] (mg/L) | Cancer Risk at the California MCL |
|---|---|---|---|---|---|
| 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 | $1\times10^{-6}$ | 8 pCi/L | $2\times10^{-5}$ (two per hundred thousand) |
| Styrene (vinylbenzene) | carcinogenicity (causes cancer) | 0.0005 | $1\times10^{-6}$ | 0.1 | $2\times10^{-4}$ (two per ten thousand) |
| 1,1,2,2Tetrachloroethane | carcinogenicity (causes cancer) | 0.0001 | $1\times10^{-6}$ | 0.001 | $1\times10^{-5}$ (one per hundred thousand) |
| 2,3,7,8-Tetrachlorodibenzo-*p*dioxin (TCDD, or dioxin) | carcinogenicity (causes cancer) | $5\times10^{-11}$ | $1\times10^{-6}$ | $3\times10^{-8}$ | $6\times10^{-4}$ (six per ten thousand) |
| Tetrachloroethylene (perchloroethylene, or PCE) | carcinogenicity (causes cancer) | 0.00006 | $1\times10^{-6}$ | 0.005 | $8\times10^{-5}$ (eight 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] | California PHG (mg/L)[2] | Cancer Risk[3] at the PHG | California MCL[4] (mg/L) | Cancer Risk at the California MCL |
|---|---|---|---|---|---|
| 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 | $1\times10^{-6}$ | 0.003 | $1\times10^{-4}$ (one per ten thousand) |
| 1,2,4-Trichlorobenzene | endocrine toxicity (harms adrenal glands) | 0.005 | NA | 0.005 | NA |
| 1,1,1-Trichloroethane | neurotoxicity (harms the nervous system), reproductive toxicity (causes fewer offspring) hepatotoxicity (harms the liver) hematotoxicity | 1 | NA | 0.2 | NA |

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

| | | | | | |
|---|---|---|---|---|---|
| | (causes blood effects) | | | | |
| 1,1,2-Trichloroethane | carcinogenicity (causes cancer) | 0.0003 | $1x10^{-6}$ | 0.005 | $2\times10^{-5}$ (two per hundred thousand) |
| Trichloroethylene (TCE) | carcinogenicity (causes cancer) | 0.0017 | $1\times10^{-6}$ | 0.005 | $3\times10^{-6}$ (three per million) |

| 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 |
|---|---|---|---|---|---|
| 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 ($7\times10^{-7}$) | $1x10^{-6}$ | 0.000005 ($5\times10^{-6}$) | $7\times10^{-6}$ (seven per million) |
| 1,1,2-Trichloro1,2,2-trifluoroethane (Freon 113) | hepatotoxicity (harms the liver) | 4 | NA | 1.2 | NA |

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

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

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

| Chemical | Health Risk Category[12] | US EPA MCLG[13] (mg/L) | Cancer Risk[14] @ MCLG | California MCL[15] (mg/L) | Cancer Risk @ California MCL |
|---|---|---|---|---|---|
| **Disinfection byproducts (DBPs)** | | | | | |
| Chloramines | acute toxicity (causes irritation) digestive system toxicity (harms the stomach) hematotoxicity (causes anemia) | 4[16,17] | NA[18] | 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)** | | | | | |

[12] Health risk category based on the US EPA MCLG document or California MCL document unless otherwise specified.
[13] MCLG = maximum contaminant level goal established by US EPA.
[14] Cancer Risk = Upper estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. $1\times10^{-6}$ means one excess cancer case per million people exposed.
[15] California MCL = maximum contaminant level established by California.
[16] Maximum Residual Disinfectant Level Goal, or MRDLG.
[17] The federal Maximum Residual Disinfectant Level (MRDL), or highest level of disinfectant allowed in drinking water, is the same value for this chemical.
[18] NA = not available.

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

| | | | | | |
|---|---|---|---|---|---|
| Monochloroacetic acid (MCA) | general toxicity (causes body and organ weight changes[19]) | 0.07 | NA | none | NA |
| Dichloroacetic acid (DCA) | carcinogenicity (causes cancer) | 0 | 0 | none | NA |

| Chemical | Health Risk Category[1] | US EPA MCLG[2] (mg/L) | Cancer Risk[3] @ MCLG | California MCL[4] (mg/L) | Cancer Risk @ California MCL |
|---|---|---|---|---|---|
| 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 |
| **Disinfection byproducts: trihalomethanes (THMs)** | | | | | |
| Bromodichloromethane (BDCM) | carcinogenicity (causes cancer) | 0 | 0 | none | NA |

[19] Body weight effects are an indicator of general toxicity in animal studies.

| | | | | | |
|---|---|---|---|---|---|
| Bromoform | carcinogenicity (causes cancer) | 0 | 0 | none | NA |
| Chloroform | hepatotoxicity and nephrotoxicity<br>(harms the liver and kidney) | 0.07 | NA | none | NA |
| Dibromochloromethane (DBCM) | hepatotoxicity,<br>nephrotoxicity, and neurotoxicity<br>(harms the liver, kidney, and nervous system) | 0.06 | NA | none | NA |
| **Chemical** | **Health Risk Category[1]** | **US EPA MCLG[2] (mg/L)** | **Cancer Risk[3] @ MCLG** | **California MCL[4] (mg/L)** | **Cancer Risk @ California MCL** |
| Total trihalomethanes (sum of BDCM, bromoform, chloroform and<br>DBCM) | carcinogenicity<br>(causes cancer), hepatotoxicity,<br>nephrotoxicity, and neurotoxicity<br>(harms the liver, kidney, and nervous system) | none | NA | 0.08 | NA |
| **Radionuclides** | | | | | |

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

| | | | | | |
|---|---|---|---|---|---|
| Gross alpha particles[20] | carcinogenicity (causes cancer) | 0 ($^{221}$Po included) | 0 | 15 pCi/L[10] (includes $^{226}$Ra but not radon and uranium) | up to 1x10$^{-3}$ (for $^{210}$Po, the most potent alpha emitter |
| 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 2x10$^{-3}$ (for $^{210}$Pb, the most potent betaemitter) |

[20] 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.

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