

# Report on Water Quality Relative to Public Health Goals

June 2016



INTENTIONALLY LEFT BLANK

## TABLE OF CONTENTS

<b>SECTION</b>	<b>PAGE</b>
BACKGROUND.....	3
PUBLIC HEALTH GOALS .....	3
CITY OF STOCKTON WATER SOURCES.....	4
WATER QUALITY DATA CONSIDERED.....	4
GUIDELINES FOLLOWED.....	4
BEST AVAILABLE TREATMENT TECHNOLOGY AND COST ESTIMATES .....	4
CONTAMINANTS DETECTED THAT EXCEED A PUBLIC HEALTH GOALS OR MAXIMUM CONTAMINANT LEVEL GOALS.....	4
Total Coliform Bacteria.....	5
Radionuclides.....	6
Gross Alpha Particle Activity .....	6
Uranium.....	7
Arsenic .....	7
Hexavalent Chromium .....	8
Bromate.....	9
RECOMMENDATIONS FOR FURTHER ACTION .....	10

### APPENDICES

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

APPENDIX B - Health Risk Information for Public Health Goal Exceedance Reports

APPENDIX C - Cost Estimates for Treatment for Treatment Technologies

**CITY OF STOCKTON WATER SYSTEM  
REPORT ON WATER QUALITY  
RELATIVE TO PUBLIC HEALTH GOALS  
June 2016**

**BACKGROUND**

Provisions of California Health and Safety Code Section 116470(b) require that public water systems serving more than 10,000 service connections prepare a brief, written report by July 1, 2016 that provides information on water quality levels from the three previous years that exceeded any Public Health Goals (PHGs), published by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA). The law also requires that where OEHHA has not adopted a PHG for a contaminant, water suppliers are to use the Maximum Contaminant Level Goals (MCLGs) set by the United States Environmental Protection Agency (USEPA). Only contaminants in a water system which have a level exceeding a PHG or MCLG are addressed in this report.

This report provides the following information as specified in the California Health and Safety Code Section 116470(b) for any contaminant detected in the City's water supply between 2013 and 2015 at a level exceeding a PHG or MCLG:

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

**PUBLIC HEALTH GOALS**

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

### CITY OF STOCKTON WATER SOURCES

The majority of City's drinking water is treated surface water produced through the Delta Water Supply Treatment Plant (DWSTP) or purchased from the Stockton East Water District (SEWD). Water is diverted from the Sacramento-San Joaquin Delta, and Mokelumne River water is purchased from Woodbridge Irrigation District for treatment at the City's DWSTP. SEWD imports surface water from New Melones and New Hogan Reservoirs for treatment and delivery to the City. The City of Stockton's water supply also consists of groundwater sources. Approximately, 21 percent of the water supplied to our customers originates from wells owned by the City.

### WATER QUALITY DATA CONSIDERED

All of the water quality data collected from the City's treated surface water and groundwater between 2013 and 2015 for purposes of determining compliance with drinking water standards were considered for this report. In addition, water quality data from SEWD is also considered for this report. This data is summarized in the 2013, 2014, and 2015 annual Drinking Water Quality Reports (i.e., Consumer Confidence Reports) which are available on the City's website. Copies of these reports may be viewed at [www.stocktongov.com/mud](http://www.stocktongov.com/mud).

### GUIDELINES FOLLOWED

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

### BEST AVAILABLE TREATMENT TECHNOLOGY AND COST ESTIMATES

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

### CONTAMINANTS DETECTED THAT EXCEED A PUBLIC HEALTH GOALS OR MAXIMUM CONTAMINANT LEVEL GOALS

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

agency. The health risk information for regulated contaminants with PHGs are provided in Appendix B.

### Total Coliform Bacteria

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

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

During 2013, 2014 and 2015, between 146 and 185 samples were collected each month for coliform analyses. Occasionally, a sample(s) is found to be positive for coliform bacteria. During the three-year span, the maximum percentage of positive coliform bacteria samples was in the month of August of 2014 with 2.53% out of 158 samples. Repeat samples for sites having positive coliform bacteria were taken as a follow-up, and in every case, the repeat samples were negative.

The City 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 level of certain compounds. This careful balance of treatment processes is essential to supplying our customers with safe drinking water.

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

## Radionuclides

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

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

Exposure to radionuclides from drinking water results in an increased risk of cancer. In addition to cancer, exposure to uranium has the potential to cause kidney damage. In California, the radionuclides currently regulated in drinking water are gross alpha particle activity, radium 226, radium 228, uranium, and beta and photon emitters.

### *Gross Alpha Particle Activity*

There is no PHG for gross alpha particle activity as OEHHA concluded in 2003 that a PHG was not practical. The United States Environmental Protection Agency and State of California MCL, or drinking water standard is 15 picocuries per liter (pCi/L).

The City of Stockton is required to monitor each of its drinking water wells for gross alpha particle activity at least once every six to nine years. During the three-year period (2013-2015) covered by this report, a total of 15 samples were taken from 15 drinking water wells for gross alpha particle activity. The detected gross alpha particle activity detected in all of those samples ranged from 0 pCi/L to 9.71 pCi/L, with an average of 5.84 pCi/L over the three year period. The levels detected were below the MCL at all times.

### *Health Risk Category*

The category of health risk associated with gross alpha particle activity is carcinogenicity. People who drink water containing gross alpha particle activity above the California MCL of 15 pCi/L throughout their lifetime could experience an increased risk of getting cancer.

### *Numerical Health Risk at MCLG*

The numerical health risk for a MCLG is zero.

### *Best Available Technologies and Treatment Costs*

The BAT to lower the level of alpha particles below the MCL is reverse osmosis, although it is not known if the technology is feasible of achieving the MCLG level of zero pCi/L.

The estimated annual cost to install and operate reverse osmosis systems at 20 of the City's wells to reduce gross alpha particle activity would be approximately \$3.00 per 1,000 gallons of water treated, which includes annualized construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$1,313.00 per service connection per year for the life of the treatment system.

Since there is little data readily available to estimate cost of treatment to achieve absolute zero, installation of reverse osmosis treatment may not necessarily achieve the MCLG and the costs may be significantly higher to do so.

### *Uranium*

The PHG for uranium is 0.43 pCi/L and MCL for the State of California is 20 pCi/L. During calendar year 2013, 2014 and 2015, eight (8) uranium samples were taken from eight (8) wells. The level of uranium detected ranged from 3.65 pCi/L to 12.90 pCi/L, and averaged 6.55 pCi/L. The amount of uranium measured in these wells is below the MCL.

#### *Health Risk Category*

The category of health risk associated with uranium is carcinogenicity. People who drink water containing uranium above the MCL throughout their lifetime could experience an increased risk of getting kidney problems and cancer.

#### *Numerical Health Risk at MCLG*

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

#### *Best Available Technologies and Treatment Costs*

The BAT to lower the level of uranium below the MCL is reverse osmosis, although it is not known if the technology is feasible of achieving the PHG level of 0.43 pCi/L.

The estimated annual cost to install and operate reverse osmosis systems at 20 of the City's wells to reduce uranium below the PHG would be approximately \$3.00 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$1,313.00 per service connection per year for the life of the treatment system.

### Arsenic

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

In humans, while ingestion of larger doses of arsenic may be lethal, lower levels of exposure may cause a variety of systemic effects including irritation of the digestive tract, nausea,

vomiting, and diarrhea. In addition, arsenic ingestion can increase the risk of cancer in the digestive system, lungs, heart, and skin. The duration of arsenic exposure appears to be a key factor in determining the extent of the toxic effects.

The City of Stockton is required to monitor each of its drinking water wells for arsenic at least once every three years. In sampling conducted in 2013, 2014 and 2015, twenty-two (22) samples were collected from a total of twenty-two (22) well sites. Arsenic values ranged from 0 µg/L to a maximum of 9.0 µg/L, with an average concentration of 4.0 µg/L over the three year span. The MCL is 10 µg/L on a quarterly running average.

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

#### *Health Risk Category*

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

#### *Numerical Health Risk at MCLG*

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

#### *Best Available Technologies and Treatment Costs*

The BAT to lower the level of arsenic below the MCL is the addition of ion exchange treatment units. The estimated annual cost to install and operate ion exchange treatment units at 20 of the City's wells to reduce arsenic levels to below the PHG would be approximately \$0.61 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$267 per service connection per year for the life of the treatment system.

### Hexavalent Chromium

The PHG for hexavalent chromium is 0.02 µg/L and MCL for the State of California is 10 µg/L. Hexavalent chromium occurs naturally in the environment from the erosion of natural chromium deposits. It can also be produced by industrial process. There are demonstrated instances of chromium being released to the environment by leakage, poor storage or inadequate industrial waste disposal practices.

In sampling conducted in 2013, 2014 and 2015, thirty-one (31) samples were collected in the distribution system and the DWSTP collected twenty-four (24) locations. Hexavalent chromium was detected above the PHG in twenty-three (23) samples. The values ranged from 0 µg/L up to a maximum of 7.5 µg/L, and average 3.0 µg/L. None of the hexavalent chromium samples exceeded the State of California MCL of 10.0 µg/L.

*Health Risk Category*

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

*Numerical Health Risk at MCLG*

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

*Best Available Technologies and Treatment Costs*

The BAT to lower the level of hexavalent chromium below the MCL is the addition of ion exchange treatment units. The estimated annual cost to install and operate ion exchange treatment units on 20 of the City's wells to reduce hexavalent chromium levels to below the PHG would be approximately \$0.61 per 1,000 gallons of water treated, which includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$267 per service connection per year for the life of the treatment system. Since the hexavalent chromium results for the DWSTP was 0 µg/L, a treatment cost was only prepared for groundwater sources and not for the surface water treatment plant.

Bromate

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

In sampling conducted at the DWSTP from 2013 to 2015, a total of thirty (30) samples were collected, and bromate was detected in seven of those samples. Bromate values ranged from 0 µg/L to 36 µg/L with an average of 3.0 µg/L over the three year span. The City is in compliance with the MCL, as the quarterly running average is below 10 µg/L.

*Health Risk Category*

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

*Numerical Health Risk at MCLG*

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

*Best Available Technologies and Treatment Costs*

The BAT to lower the level of bromate below the MCL is the addition of granular activated carbon treatment units. The estimated annual cost to install and operate a granular activated carbon treatment units at the Delta Water Supply Treatment Plant to reduce bromate levels to below the PHG would be approximately \$0.57 per 1,000 gallons of water treated, which

includes annualized cost of construction, plus operation and maintenance costs. This translates into an additional annual cost of approximately \$129 per service connection per year for the life of the treatment system, assuming the treatment plant operates 365 days of the year.

#### RECOMMENDATIONS FOR FURTHER ACTION

The City of Stockton's drinking water quality for the contaminants discussed in this 2016 Public Health Goals Report meet all State Water Resources Control Board and USEPA drinking water standards set to protect public health. To further reduce the levels of the contaminants identified in this report that are already significantly below the health-based maximum contaminant levels established to provide "safe drinking water", additional costly treatment processes at City water wells and DWSTP would be required. The effectiveness of the treatment processes to provide any significant reductions in contaminant levels at these already low values is uncertain. The health protection benefits of these further hypothetical reductions are not at all clear and may not be quantifiable. Therefore, no action is proposed at this time.

INTENTIONALLY LEFT BLANK

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

## ATTACHMENT NO. 1

## 2016 PHG Triennial Report: Calendar Years 2013-2014-2015

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

**Last Update: December 29, 2015**

(Reference last update 9/23/2015: [http://www.waterboards.ca.gov/drinking\\_water/certlic/drinkingwater/MCLsandPHGs.shtml](http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLsandPHGs.shtml))

This table includes:

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

Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
<b>Chemicals with MCLs in 22 CCR §64431—Inorganic Chemicals</b>				
Aluminum	1	0.05	0.6	2001
Antimony	0.006	0.006	0.02	1997
Antimony	--	--	0.0007	2009 draft
Arsenic	0.010	0.002	0.000004	2004
Asbestos (MFL = million fibers per liter; for fibers >10 microns long)	7 MFL	0.2 MFL	7 MFL	2003
Barium	1	0.1	2	2003
Beryllium	0.004	0.001	0.001	2003
Cadmium	0.005	0.001	0.00004	2006
Chromium, Total - OEHHA withdrew the 1999 0.0025 mg/L PHG in Nov 2001	0.05	0.01	(0.100)	
Chromium, Hexavalent (Chromium-6)	0.01	0.001	0.00002	2011
Cyanide	0.15	0.1	0.15	1997
Fluoride	2	0.1	1	1997
Mercury (inorganic)	0.002	0.001	0.0012	1999 (rev2005)*
Nickel	0.1	0.01	0.012	2001
Nitrate (as N)	10 as N	0.4	45 as NO <sub>3</sub> (=10 as N)	1997
Nitrite (as N)	1 as N	0.4	1 as N	1997
Nitrate + Nitrite (as N)	10 as N	0.4	10 as N	1997
Perchlorate	0.006	0.004	0.001	2015
Selenium	0.05	0.005	0.03	2010
Thallium	0.002	0.001	0.0001	1999 (rev2004)
<b>Copper and Lead, 22 CCR §64672.3</b>				
<i>Values referred to as MCLs for lead and copper are not actually MCLs; instead, they are called "Action Levels" under the lead and copper rule</i>				
Copper	1.3	0.05	0.3	2008
Lead	0.015	0.005	0.0002	2009

## ATTACHMENT NO. 1

Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
<b>Radionuclides with MCLs in 22 CCR §64441 and §64443—Radioactivity</b>				
[units are picocuries per liter (pCi/L), unless otherwise stated; n/a = not applicable]				
Gross alpha particle activity - OEHHA concluded in 2003 that a PHG was not practical	15	3	(zero)	n/a
Gross beta particle activity - OEHHA concluded in 2003 that a PHG was not practical	4 mrem/yr	4	(zero)	n/a
Radium-226	--	1	0.05	2006
Radium-228	--	1	0.019	2006
Radium-226 + Radium-228	5	--	(zero)	--
Strontium-90	8	2	0.35	2006
Tritium	20,000	1,000	400	2006
Uranium	20	1	0.43	2001
<b>Chemicals with MCLs in 22 CCR §64444—Organic Chemicals</b>				
<b>(a) Volatile Organic Chemicals (VOCs)</b>				
Benzene	0.001	0.0005	0.00015	2001
Carbon tetrachloride	0.0005	0.0005	0.0001	2000
1,2-Dichlorobenzene	0.6	0.0005	0.6	1997 (rev2009)
1,4-Dichlorobenzene (p-DCB)	0.005	0.0005	0.006	1997
1,1-Dichloroethane (1,1-DCA)	0.005	0.0005	0.003	2003
1,2-Dichloroethane (1,2-DCA)	0.0005	0.0005	0.0004	1999 (rev2005)
1,1-Dichloroethylene (1,1-DCE)	0.006	0.0005	0.01	1999
cis-1,2-Dichloroethylene	0.006	0.0005	0.1	2006
trans-1,2-Dichloroethylene	0.01	0.0005	0.06	2006
Dichloromethane (Methylene chloride)	0.005	0.0005	0.004	2000
1,2-Dichloropropane	0.005	0.0005	0.0005	1999
1,3-Dichloropropane	0.0005	0.0005	0.0002	1999 (rev2006)
Ethylbenzene	0.3	0.0005	0.3	1997
Methyl tertiary butyl ether (MTBE)	0.013	0.003	0.013	1999
Monochlorobenzene	0.07	0.0005	0.07	2014
Styrene	0.1	0.0005	0.0005	2010
1,1,2,2-Tetrachloroethane	0.001	0.0005	0.0001	2003
Tetrachloroethylene (PCE)	0.005	0.0005	0.00006	2001
Toluene	0.15	0.0005	0.15	1999
1,2,4-Trichlorobenzene	0.005	0.0005	0.005	1999
1,1,1-Trichloroethane (1,1,1-TCA)	0.2	0.0005	1	2006
1,1,2-Trichloroethane (1,1,2-TCA)	0.005	0.0005	0.0003	2006
Trichloroethylene (TCE)	0.005	0.0005	0.0017	2009
Trichlorofluoromethane (Freon 11)	0.15	0.005	1.3	2014
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1.2	0.01	4	1997 (rev2011)
Vinyl chloride	0.0005	0.0005	0.00005	2000
Xylenes	1.75	0.0005	1.8	1997

## ATTACHMENT NO. 1

Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
<b>(b) Non-Volatile Synthetic Organic Chemicals (SOCs)</b>				
Alachlor	0.002	0.001	0.004	1997
Atrazine	0.001	0.0005	0.00015	1999
Bentazon	0.018	0.002	0.2	1999 (rev2009)
Benzo(a)pyrene	0.0002	0.0001	0.000007	2010
Carbofuran	0.018	0.005	0.0017	2000
Carbofuran	--	--	0.0007	2015 draft
Chlordane	0.0001	0.0001	0.00003	1997 (rev2006)
Dalapon	0.2	0.01	0.79	1997 (rev2009)
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.00001	0.0000017	1999
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.07	0.01	0.02	2009
Di(2-ethylhexyl)adipate	0.4	0.005	0.2	2003
Di(2-ethylhexyl)phthalate (DEHP)	0.004	0.003	0.012	1997
Dinoseb	0.007	0.002	0.014	1997 (rev2010)
Diquat	0.02	0.004	0.015	2000
Diquat	--	--	0.006	2015 draft
Endrin	0.002	0.0001	0.0018	1999 (rev2008)
Endrin	--	--	0.0003	2015 draft
Endothal	0.1	0.045	0.094	2014
Ethylene dibromide (EDB)	0.00005	0.00002	0.00001	2003
Glyphosate	0.7	0.025	0.9	2007
Heptachlor	0.00001	0.00001	0.000008	1999
Heptachlor epoxide	0.00001	0.00001	0.000006	1999
Hexachlorobenzene	0.001	0.0005	0.00003	2003
Hexachlorocyclopentadiene	0.05	0.001	0.002	2014
Lindane	0.0002	0.0002	0.000032	1999 (rev2005)
Methoxychlor	0.03	0.01	0.00009	2010
Molinate	0.02	0.002	0.001	2008
Oxamyl	0.05	0.02	0.026	2009
Pentachlorophenol	0.001	0.0002	0.0003	2009
Picloram	0.5	0.001	0.5	1997
Picloram	--	--	0.166	2015 draft
Polychlorinated biphenyls (PCBs)	0.0005	0.0005	0.00009	2007
Simazine	0.004	0.001	0.004	2001
2,4,5-TP (Silvex)	0.05	0.001	0.003	2014
2,3,7,8-TCDD (dioxin)	$3 \times 10^{-8}$	$5 \times 10^{-9}$	$5 \times 10^{-11}$	2010
Thiobencarb	0.07	0.001	0.07	2000
Thiobencarb	--	--	0.042	2015 draft
Toxaphene	0.003	0.001	0.00003	2003

## ATTACHMENT NO. 1

Constituent	MCL	DLR	PHG or (MCLG)	Date of PHG
<b>Chemicals with MCLs in 22 CCR §64533—Disinfection Byproducts</b>				
Total Trihalomethanes	0.080	--		
Total Trihalomethanes	--	--	0.0008	2010 draft
Bromodichloromethane	--	0.0010	(zero)	--
Bromoform	--	0.0010	(zero)	--
Chloroform	--	0.0010	(0.07)	--
Dibromochloromethane	--	0.0010	(0.06)	--
Haloacetic Acids (five) (HAA5)	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 or 0.0010 <sup>a</sup>	0.0001	2009
Chlorite	1.0	0.020	0.05	2009
<b>Microbiological Contaminants (TT = Treatment Technique)</b>				
Coliform % positive samples	%	5	(zero)	
<i>Cryptosporidium</i> **		TT	(zero)	
<i>Giardia lamblia</i> **		TT	(zero)	
<i>Legionella</i> **		TT	(zero)	
Viruses**		TT	(zero)	
<b>Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking water contaminants.</b>				
N-Nitrosodimethylamine (NDMA)	--	--	0.000003	2006
1,2,3-Trichloropropane	--	0.000005	0.0000007	2009

**Notes:**

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

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

\*\* Surface water treatment = TT

INTENTIONALLY LEFT BLANK

APPENDIX B  
Health Risk Information for Public Health Goal Exceedance Reports

# Health Risk Information for Public Health Goal Exceedance Reports

Prepared by

Office of Environmental Health Hazard Assessment  
California Environmental Protection Agency

February 2016

Under the Calderon-Sher Safe Drinking Water Act of 1996 (the Act), water utilities are required to prepare a report every three years for contaminants that exceed public health goals (PHGs) (Health and Safety Code Section 116470 (b)(2)). The numerical health risk for a contaminant is to be presented with the category of health risk, along with a plainly worded description of these terms. The cancer health risk is to be calculated at the PHG and at the California maximum contaminant level (MCL). This report is prepared by the Office of Environmental Health Hazard Assessment (OEHHA) to assist the water utilities in meeting their requirements.

PHGs are concentrations of contaminants in drinking water that pose no significant health risk if consumed for a lifetime. PHGs are developed and published by OEHHA (Health and Safety Code Section 116365) using current risk assessment principles, practices and methods.

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

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

Table 2 presents health risk information for contaminants that do not have PHGs but have state or federal regulatory standards. The Act requires that, for chemical contaminants with California MCLs that do not yet have PHGs, water utilities use the federal maximum contaminant level goal (MCLG) for the purpose of complying with the requirement of public notification. MCLGs, like PHGs, are strictly health based and include a margin of safety. One difference, however, is that the MCLGs for carcinogens are set at zero because the US Environmental Protection Agency (US EPA) assumes there is no absolutely safe level of exposure to such chemicals. PHGs, on the other hand, are set at a level considered to pose no *significant* risk of cancer; this is usually a no more than 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 Web site (<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 <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">Alachlor</a>	carcinogenicity (causes cancer)	0.004	NA <sup>5</sup>	0.002	NA
<a href="#">Aluminum</a>	neurotoxicity and immunotoxicity (harms the nervous and immune systems)	0.6	NA	1	NA
<a href="#">Antimony</a>	digestive system toxicity (causes vomiting)	0.02	NA	0.006	NA
<a href="#">Arsenic</a>	carcinogenicity (causes cancer)	0.000004 (4×10 <sup>-6</sup> )	1×10 <sup>-6</sup> (one per million)	0.01	2.5×10 <sup>-3</sup> (2.5 per thousand)
<a href="#">Asbestos</a>	carcinogenicity (causes cancer)	7 MFL <sup>6</sup> (fibers >10 microns in length)	1×10 <sup>-6</sup>	7 MFL (fibers >10 microns in length)	1×10 <sup>-6</sup> (one per million)
<a href="#">Atrazine</a>	carcinogenicity (causes cancer)	0.00015	1×10 <sup>-6</sup>	0.001	7×10 <sup>-6</sup> (seven per million)

<sup>1</sup> Based on the OEHHA PHG technical support document unless otherwise specified. The categories are the hazard traits defined by OEHHA for California's Toxics Information Clearinghouse (online at: [http://oehha.ca.gov/multimedia/green/pdf/GC\\_Regtext011912.pdf](http://oehha.ca.gov/multimedia/green/pdf/GC_Regtext011912.pdf)).

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

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

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

<sup>5</sup> NA = not applicable. Risk cannot be calculated. The PHG is set at a level that is believed to be without any significant public health risk to individuals exposed to the chemical over a lifetime.

<sup>6</sup> MFL = million fibers per liter of water.

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">Barium</a>	cardiovascular toxicity (causes high blood pressure)	2	NA	1	NA
<a href="#">Bentazon</a>	hepatotoxicity and digestive system toxicity (harms the liver, intestine, and causes body weight effects <sup>7</sup> )	0.2	NA	0.018	NA
<a href="#">Benzene</a>	carcinogenicity (causes leukemia)	0.00015	$1 \times 10^{-6}$	0.001	$7 \times 10^{-6}$ (seven per million)
<a href="#">Benzo[a]pyrene</a>	carcinogenicity (causes cancer)	0.000007 ( $7 \times 10^{-6}$ )	$1 \times 10^{-6}$	0.0002	$3 \times 10^{-5}$ (three per hundred thousand)
<a href="#">Beryllium</a>	digestive system toxicity (harms the stomach or intestine)	0.001	NA	0.004	NA
<a href="#">Bromate</a>	carcinogenicity (causes cancer)	0.0001	$1 \times 10^{-6}$	0.01	$1 \times 10^{-4}$ (one per ten thousand)
<a href="#">Cadmium</a>	nephrotoxicity (harms the kidney)	0.00004	NA	0.005	NA
<a href="#">Carbofuran</a>	reproductive toxicity (harms the testis)	0.0017	NA	0.018	NA

<sup>7</sup> Body weight effects are an indicator of general toxicity in animal studies.

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">Carbon tetrachloride</a>	carcinogenicity (causes cancer)	0.0001	$1 \times 10^{-6}$	0.0005	$5 \times 10^{-6}$ (five per million)
<a href="#">Chlordane</a>	carcinogenicity (causes cancer)	0.00003	$1 \times 10^{-6}$	0.0001	$3 \times 10^{-6}$ (three per million)
<a href="#">Chlorite</a>	hematotoxicity (causes anemia) neurotoxicity (causes neurobehavioral effects)	0.05	NA	1	NA
<a href="#">Chromium, hexavalent</a>	carcinogenicity (causes cancer)	0.00002	$1 \times 10^{-6}$	0.01	$5 \times 10^{-4}$ (five per ten thousand)
<a href="#">Copper</a>	digestive system toxicity (causes nausea, vomiting, diarrhea)	0.3	NA	1.3 (AL <sup>8</sup> )	NA
<a href="#">Cyanide</a>	neurotoxicity (damages nerves) endocrine toxicity (affects the thyroid)	0.15	NA	0.15	NA
<a href="#">Dalapon</a>	nephrotoxicity (harms the kidney)	0.79	NA	0.2	NA

<sup>8</sup> AL = action level. The action levels for copper and lead refer to a concentration measured at the tap. Much of the copper and lead in drinking water is derived from household plumbing (The Lead and Copper Rule, Title 22, California Code of Regulations [CCR] section 64672.3).

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">1,2-Dibromo-3-chloropropane (DBCP)</a>	carcinogenicity (causes cancer)	0.0000017 (1.7×10 <sup>-6</sup> )	1×10 <sup>-6</sup>	0.0002	1×10 <sup>-4</sup> (one per ten thousand)
<a href="#">1,2-Dichlorobenzene (o-DCB)</a>	hepatotoxicity (harms the liver)	0.6	NA	0.6	NA
<a href="#">1,4-Dichlorobenzene (p-DCB)</a>	carcinogenicity (causes cancer)	0.006	1×10 <sup>-6</sup>	0.005	8×10 <sup>-7</sup> (eight per ten million)
<a href="#">1,1-Dichloroethane (1,1-DCA)</a>	carcinogenicity (causes cancer)	0.003	1×10 <sup>-6</sup>	0.005	2×10 <sup>-6</sup> (two per million)
<a href="#">1,2-Dichloroethane (1,2-DCA)</a>	carcinogenicity (causes cancer)	0.0004	1×10 <sup>-6</sup>	0.0005	1×10 <sup>-6</sup> (one per million)
<a href="#">1,1-Dichloroethylene (1,1-DCE)</a>	hepatotoxicity (harms the liver)	0.01	NA	0.006	NA
<a href="#">1,2-Dichloroethylene, cis</a>	nephrotoxicity (harms the kidney)	0.1	NA	0.006	NA
<a href="#">1,2-Dichloroethylene, trans</a>	hepatotoxicity (harms the liver)	0.06	NA	0.01	NA
<a href="#">Dichloromethane (methylene chloride)</a>	carcinogenicity (causes cancer)	0.004	1×10 <sup>-6</sup>	0.005	1×10 <sup>-6</sup> (one per million)
<a href="#">2,4-Dichlorophenoxyacetic acid (2,4-D)</a>	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.02	NA	0.07	NA

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">1,2-Dichloro-propane (propylene dichloride)</a>	carcinogenicity (causes cancer)	0.0005	$1 \times 10^{-6}$	0.005	$1 \times 10^{-5}$ (one per hundred thousand)
<a href="#">1,3-Dichloro-propene (Telone II®)</a>	carcinogenicity (causes cancer)	0.0002	$1 \times 10^{-6}$	0.0005	$2 \times 10^{-6}$ (two per million)
<a href="#">Di(2-ethylhexyl) adipate (DEHA)</a>	developmental toxicity (disrupts development)	0.2	NA	0.4	NA
<a href="#">Diethylhexyl-phthalate (DEHP)</a>	carcinogenicity (causes cancer)	0.012	$1 \times 10^{-6}$	0.004	$3 \times 10^{-7}$ (three per ten million)
<a href="#">Dinoseb</a>	reproductive toxicity (harms the uterus and testis)	0.014	NA	0.007	NA
<a href="#">Dioxin (2,3,7,8-TCDD)</a>	carcinogenicity (causes cancer)	$5 \times 10^{-11}$	$1 \times 10^{-6}$	$3 \times 10^{-8}$	$6 \times 10^{-4}$ (six per ten thousand)
<a href="#">Diquat</a>	ocular toxicity (harms the eye) developmental toxicity (causes malformation)	0.015	NA	0.02	NA
<a href="#">Endothall</a>	digestive system toxicity (harms the stomach or intestine)	0.094	NA	0.1	NA
<a href="#">Endrin</a>	hepatotoxicity (harms the liver) neurotoxicity (causes convulsions)	0.0018	NA	0.002	NA

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">Ethylbenzene (phenylethane)</a>	hepatotoxicity (harms the liver)	0.3	NA	0.3	NA
<a href="#">Ethylene dibromide</a>	carcinogenicity (causes cancer)	0.00001	$1 \times 10^{-6}$	0.00005	$5 \times 10^{-6}$ (five per million)
<a href="#">Fluoride</a>	musculoskeletal toxicity (causes tooth mottling)	1	NA	2	NA
<a href="#">Glyphosate</a>	nephrotoxicity (harms the kidney)	0.9	NA	0.7	NA
<a href="#">Heptachlor</a>	carcinogenicity (causes cancer)	0.000008 ( $8 \times 10^{-6}$ )	$1 \times 10^{-6}$	0.00001	$1 \times 10^{-6}$ (one per million)
<a href="#">Heptachlor epoxide</a>	carcinogenicity (causes cancer)	0.000006 ( $6 \times 10^{-6}$ )	$1 \times 10^{-6}$	0.00001	$2 \times 10^{-6}$ (two per million)
<a href="#">Hexachlorobenzene</a>	carcinogenicity (causes cancer)	0.00003	$1 \times 10^{-6}$	0.001	$3 \times 10^{-5}$ (three per hundred thousand)
<a href="#">Hexachloro-cyclopentadiene (HCCPD)</a>	digestive system toxicity (causes stomach lesions)	0.002	NA	0.05	NA
<a href="#">Lead</a>	developmental neurotoxicity (causes neurobehavioral effects in children) cardiovascular toxicity (causes high blood pressure) carcinogenicity (causes cancer)	0.0002	$<1 \times 10^{-6}$ (PHG is not based on this effect)	0.015 (AL <sup>8</sup> )	$2 \times 10^{-6}$ (two per million)

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

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

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">Nitrate and Nitrite</a>	hematotoxicity (causes methemoglobinemia)	10 as nitrogen	NA	10 as nitrogen	NA
<a href="#">N-nitroso-dimethyl-amine (NDMA)</a>	carcinogenicity (causes cancer)	0.000003 ( $3 \times 10^{-6}$ )	$1 \times 10^{-6}$	none	NA
<a href="#">Oxamyl</a>	general toxicity (causes body weight effects)	0.026	NA	0.05	NA
<a href="#">Pentachloro-phenol (PCP)</a>	carcinogenicity (causes cancer)	0.0003	$1 \times 10^{-6}$	0.001	$3 \times 10^{-6}$ (three per million)
<a href="#">Perchlorate</a>	endocrine toxicity (affects the thyroid) developmental toxicity (causes neurodevelopmental deficits)	0.001	NA	0.006	NA
<a href="#">Picloram</a>	hepatotoxicity (harms the liver)	0.5	NA	0.5	NA
<a href="#">Polychlorinated biphenyls (PCBs)</a>	carcinogenicity (causes cancer)	0.00009	$1 \times 10^{-6}$	0.0005	$6 \times 10^{-6}$ (six per million)
<a href="#">Radium-226</a>	carcinogenicity (causes cancer)	0.05 pCi/L	$1 \times 10^{-6}$	5 pCi/L (combined Ra <sup>226+228</sup> )	$1 \times 10^{-4}$ (one per ten thousand)
<a href="#">Radium-228</a>	carcinogenicity (causes cancer)	0.019 pCi/L	$1 \times 10^{-6}$	5 pCi/L (combined Ra <sup>226+228</sup> )	$3 \times 10^{-4}$ (three per ten thousand)

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">Selenium</a>	integumentary toxicity (causes hair loss and nail damage)	0.03	NA	0.05	NA
<a href="#">Silvex (2,4,5-TP)</a>	hepatotoxicity (harms the liver)	0.003	NA	0.05	NA
<a href="#">Simazine</a>	general toxicity (causes body weight effects)	0.004	NA	0.004	NA
<a href="#">Strontium-90</a>	carcinogenicity (causes cancer)	0.35 pCi/L	$1 \times 10^{-6}$	8 pCi/L	$2 \times 10^{-5}$ (two per hundred thousand)
<a href="#">Styrene (vinylbenzene)</a>	carcinogenicity (causes cancer)	0.0005	$1 \times 10^{-6}$	0.1	$2 \times 10^{-4}$ (two per ten thousand)
<a href="#">1,1,2,2-Tetrachloroethane</a>	carcinogenicity (causes cancer)	0.0001	$1 \times 10^{-6}$	0.001	$1 \times 10^{-5}$ (one per hundred thousand)
<a href="#">Tetrachloroethylene (perchloroethylene, or PCE)</a>	carcinogenicity (causes cancer)	0.00006	$1 \times 10^{-6}$	0.005	$8 \times 10^{-5}$ (eight per hundred thousand)
<a href="#">Thallium</a>	integumentary toxicity (causes hair loss)	0.0001	NA	0.002	NA
<a href="#">Thiobencarb</a>	general toxicity (causes body weight effects) hematotoxicity (affects red blood cells)	0.07	NA	0.07	NA

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">Toluene (methylbenzene)</a>	hepatotoxicity (harms the liver) endocrine toxicity (harms the thymus)	0.15	NA	0.15	NA
<a href="#">Toxaphene</a>	carcinogenicity (causes cancer)	0.00003	$1 \times 10^{-6}$	0.003	$1 \times 10^{-4}$ (one per ten thousand)
<a href="#">1,2,4-Trichlorobenzene</a>	endocrine toxicity (harms adrenal glands)	0.005	NA	0.005	NA
<a href="#">1,1,1-Trichloroethane</a>	neurotoxicity (harms the nervous system), reproductive toxicity (causes fewer offspring) hepatotoxicity (harms the liver) hematotoxicity (causes blood effects)	1	NA	0.2	NA
<a href="#">1,1,2-Trichloroethane</a>	carcinogenicity (causes cancer)	0.0003	$1 \times 10^{-6}$	0.005	$2 \times 10^{-5}$ (two per hundred thousand)
<a href="#">Trichloroethylene (TCE)</a>	carcinogenicity (causes cancer)	0.0017	$1 \times 10^{-6}$	0.005	$3 \times 10^{-6}$ (three per million)
<a href="#">Trichlorofluoromethane (Freon 11)</a>	accelerated mortality (increase in early death)	1.3	NA	0.15	NA

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

Chemical	Health Risk Category <sup>1</sup>	California PHG (mg/L) <sup>2</sup>	Cancer Risk <sup>3</sup> at the PHG	California MCL <sup>4</sup> (mg/L)	Cancer Risk at the California MCL
<a href="#">1,2,3-Trichloro-propane</a> (1,2,3-TCP)	carcinogenicity (causes cancer)	0.0000007 ( $7 \times 10^{-7}$ )	$1 \times 10^{-6}$	none	NA
<a href="#">1,1,2-Trichloro-1,2,2-trifluoro-ethane</a> (Freon 113)	hepatotoxicity (harms the liver)	4	NA	1.2	NA
<a href="#">Tritium</a>	carcinogenicity (causes cancer)	400 pCi/L	$1 \times 10^{-6}$	20,000 pCi/L	$5 \times 10^{-5}$ (five per hundred thousand)
<a href="#">Uranium</a>	carcinogenicity (causes cancer)	0.43 pCi/L	$1 \times 10^{-6}$	20 pCi/L	$5 \times 10^{-5}$ (five per hundred thousand)
<a href="#">Vinyl chloride</a>	carcinogenicity (causes cancer)	0.00005	$1 \times 10^{-6}$	0.0005	$1 \times 10^{-5}$ (one per hundred thousand)
<a href="#">Xylene</a>	neurotoxicity (affects the senses, mood, and motor control)	1.8 (single isomer or sum of isomers)	NA	1.75 (single isomer or sum of isomers)	NA

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

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

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

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

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

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

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

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

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

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

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

Chemical	Health Risk Category <sup>1</sup>	U.S. EPA MCLG <sup>2</sup> (mg/L)	Cancer Risk <sup>3</sup> @ MCLG	California MCL <sup>4</sup> (mg/L)	Cancer Risk @ California MCL
Dichloroacetic acid	carcinogenicity (causes cancer)	0	0	none	NA
Trichloroacetic acid	hepatotoxicity (harms the liver)	0.02	0	none	NA
Bromoacetic acid	NA	none	NA	none	NA
Dibromoacetic acid	NA	none	NA	none	NA
Total haloacetic acids	carcinogenicity (causes cancer)	none	NA	0.06	NA
<b>Disinfection byproducts: trihalomethanes (THMs)</b>					
Bromodichloromethane (BDCM)	carcinogenicity (causes cancer)	0	0	none	NA
Bromoform	carcinogenicity (causes cancer)	0	0	none	NA
Chloroform	hepatotoxicity and nephrotoxicity (harms the liver and kidney)	0.07	NA	none	NA
Dibromochloromethane (DBCM)	hepatotoxicity, nephrotoxicity, and neurotoxicity (harms the liver, kidney, and nervous system)	0.06	NA	none	NA
Total trihalomethanes (sum of BDCM, bromoform, chloroform and DBCM)	carcinogenicity (causes cancer), hepatotoxicity, nephrotoxicity, and neurotoxicity (harms the liver, kidney, and nervous system)	none	NA	0.08	NA

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

Chemical	Health Risk Category <sup>1</sup>	U.S. EPA MCLG <sup>2</sup> (mg/L)	Cancer Risk <sup>3</sup> @ MCLG	California MCL <sup>4</sup> (mg/L)	Cancer Risk @ California MCL
<b>Radionuclides</b>					
Gross alpha particles <sup>9</sup>	carcinogenicity (causes cancer)	0 ( <sup>210</sup> Po included)	0	15 pCi/L <sup>10</sup> (includes <sup>226</sup> Ra but not radon and uranium)	up to $1 \times 10^{-3}$ (for <sup>210</sup> Po, the most potent alpha emitter)
Beta particles and photon emitters <sup>9</sup>	carcinogenicity (causes cancer)	0 ( <sup>210</sup> Pb included)	0	50 pCi/L (judged equiv. to 4 mrem/yr)	up to $2 \times 10^{-3}$ (for <sup>210</sup> Pb, the most potent beta-emitter)

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

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

APPENDIX C

Cost Estimates for Treatment for Treatment Technologies

Source – Association of California Water Agencies – Suggested Guidelines for Preparation of  
Required Reports dated February 2013

## ATTACHMENT NO. 3

Table 3

Reference: Updated 2012 ACWA Cost of Treatment Table

## COST ESTIMATES FOR TREATMENT TECHNOLOGIES

(INCLUDES ANNUALIZED CAPITAL AND O&amp;M COSTS)

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2015* (\$/1,000 gallons treated)
1	Granular Activated Carbon	Reference: Malcolm Pirnie estimate for California Urban Water Agencies, large surface water treatment plants treating water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, 1998	0.57-1.08
2	Granular Activated Carbon	Reference: Carollo Engineers, estimate for VOC treatment (PCE), 95% removal of PCE, Oct. 1994, 1900 gpm design capacity	0.26
3	Granular Activated Carbon	Reference: Carollo Engineers, est. for a large No. Calif. surf. water treatment plant ( 90 mgd capacity) treating water from the State Water Project, to reduce THM precursors, ENR construction cost index = 6262 (San Francisco area) - 1992	1.25
4	Granular Activated Carbon	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility for VOC and SOC removal by GAC, 1990	0.49-0.71
5	Granular Activated Carbon	Reference: Southern California Water Co. - actual data for "rented" GAC to remove VOCs (1,1-DCE), 1.5 mgd capacity facility, 1998	2.24
6	Granular Activated Carbon	Reference: Southern California Water Co. - actual data for permanent GAC to remove VOCs (TCE), 2.16 mgd plant capacity, 1998	1.46
7	Reverse Osmosis	Reference: Malcolm Pirnie estimate for California Urban Water Agencies, large surface water treatment plants treating water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, 1998	1.68-3.22
8	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 1.0 mgd plant operated at 40% of design flow, high brine line cost, May 1991	3.98
9	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 1.0 mgd plant operated at 100% of design flow, high brine line cost, May 1991	2.45
10	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 10.0 mgd plant operated at 40% of design flow, high brine line cost, May 1991	2.65
11	Reverse Osmosis	Reference: Boyle Engineering, RO cost to reduce 1000 ppm TDS in brackish groundwater in So. Calif., 10.0 mgd plant operated at 100% of design flow, high brine line cost, May 1991	2.05
12	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 1.0 mgd plant operated at 40% of design capacity, Oct. 1991	6.65

**COST ESTIMATES FOR TREATMENT TECHNOLOGIES**

(INCLUDES ANNUALIZED CAPITAL AND O&amp;M COSTS)

No.	Treatment Technology	Source of Information	Estimated 2012 Unit Cost Indexed to 2015* (\$/1,000 gallons treated)
13	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 1.0 mgd plant operated at 100% of design capacity, Oct. 1991	3.92
14	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 10.0 mgd plant operated at 40% of design capacity, Oct. 1991	2.94
15	Reverse Osmosis	Reference: Arsenic Removal Study, City of Scottsdale, AZ - CH2M Hill, for a 10.0 mgd plant operated at 100% of design capacity, Oct. 1991	1.82
16	Reverse Osmosis	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility with RO to remove nitrate, 1990	1.83-3.22
17	Packed Tower Aeration	Reference: Analysis of Costs for Radon Removal... (AWWARF publication), Kennedy/Jenks, for a 1.4 mgd facility operating at 40% of design capacity, Oct. 1991	1.06
18	Packed Tower Aeration	Reference: Analysis of Costs for Radon Removal... (AWWARF publication), Kennedy/Jenks, for a 14.0 mgd facility operating at 40% of design capacity, Oct. 1991	0.56
19	Packed Tower Aeration	Reference: Carollo Engineers, estimate for VOC treatment (PCE) by packed tower aeration, without off-gas treatment, O&M costs based on operation during 329 days/year at 10% downtime, 16 hr/day air stripping operation, 1900 gpm design capacity, Oct. 1994	0.28
20	Packed Tower Aeration	Reference: Carollo Engineers, for PCE treatment by Ecolo-Flo Enviro-Tower air stripping, without off-gas treatment, O&M costs based on operation during 329 days/year at 10% downtime, 16 hr/day air stripping operation, 1900 gpm design capacity, Oct. 1994	0.29
21	Packed Tower Aeration	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility - packed tower aeration for VOC and radon removal, 1990	0.45-0.74
22	Advanced Oxidation Processes	Reference: Carollo Engineers, estimate for VOC treatment (PCE) by UV Light, Ozone, Hydrogen Peroxide, O&M costs based on operation during 329 days/year at 10% downtime, 24 hr/day AOP operation, 1900 gpm capacity, Oct. 1994	0.55
23	Ozonation	Reference: Malcolm Pirnie estimate for CUWA, large surface water treatment plants using ozone to treat water from the State Water Project to meet Stage 2 D/DBP and bromate regulation, <i>Cryptosporidium</i> inactivation requirements, 1998	0.13-0.26
24	Ion Exchange	Reference: CH2M Hill study on San Gabriel Basin, for 135 mgd central treatment facility - ion exchange to remove nitrate, 1990	0.61-0.80

\*Costs were adjusted from date of original estimates to present, where appropriate, using the Engineering News Record (ENR) annual average building costs of 2015 and 2012. The adjustment factor was derived from the ratio of 2015 Index/2012 Index.