Sweetwater Authority
2022 Public Health Goals Report

1.0 Background

Section 116470(b) of the California Health and Safety Code requires public water systems with greater than 10,000 service connections to prepare a special report by July 1, 2022 if their water quality measurements have exceeded any Public Health Goals (PHGs) or U.S. Environmental Protection Agency (USEPA) Maximum Contaminant Level Goals (MCLGs) for those constituents without a California PHG. PHGs are non-enforceable goals established by the California Environmental Protection Agency's (Cal-EPA) Office of Environmental Health Hazard Assessment (OEHHA). Only constituents that have a California primary drinking water standard and for which either a PHG or MCLG has been set are to be addressed. The purpose of this report is to provide consumers with health risk information for contaminants detected above their respective PHG or MCLG and to estimate the cost of installing treatment to reduce each contaminant to the PHG or MCLG level, regardless of how minimal the risk may be. A list of all regulated constituents with Maximum Contaminant Levels (MCLs) and PHGs or MCLGs is provided in Attachment 1.

1.1 What Are Public Health Goals?

PHGs are set by OEHHA and are based solely on public health risk considerations. As defined in statute, PHGs for noncarcinogenic 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". MCLGs, like PHGs are strictly health based and include a margin of safety; however, MCLGs for carcinogens are set at zero because USEPA assumes there is no absolutely safe level of exposure to them.

None of the practical risk-management factors that are considered by the USEPA or the California State Water Resources Control Board, Division of Drinking Water (State Board) in setting drinking water standards (i.e. MCLs) are considered in setting the PHGs. These factors include analytical detection capability, treatment technology availability, health 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.

1.2 Water Quality Data Considered

All of the water quality data collected by the Sweetwater Authority (Authority) from 2019 through 2021 for purposes of determining compliance with drinking water standards was considered. This data was summarized in our 2019, 2020, and 2021 Consumer Confidence Reports, which have previously been provided to all of our customers.

1.3 Guidelines Followed

The Association of California Water Agencies (ACWA) has prepared guidelines for water utilities to use in preparing the required PHG reports. These guidelines were used in the preparation of this report. In addition, health effects language was obtained from the State Board, OEHHA, and USEPA.

2.0 Executive Summary

The following table provides a summary of contaminants which were detected above their respective PHG or MCLG values over the 2019 – 2021 reporting period. With the exception of chlorite and total coliform bacteria, the main health risk category of the contaminants listed below is carcinogenicity (i.e. causes cancer). The health risks associated with chlorite are anemia and neurobehavioral effects. Although there are no specific health risks associated with total coliform, this family of bacteria is used as a surrogate indicator of the potential presence of water borne pathogens.

It should be emphasized that the USEPA and the State Board have established 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" whereas PHGs and MCLGs are set at levels with virtually no *theoretical* health risk.

Contaminant[1]	Detection Limit[2]	PHG or (MCLG)	MCL[5]	Highest Average[3]	Cancer Risk @ PHG or MCLG
Arsenic (ppb)	2	0.004	10	2.3	1 per million
Gross alpha (pCi/L)	3	(zero)	15	3.9	zero
Gross beta (pCi/L)	4	(zero)	50	8.1	zero
Radium-226 (pCi/L)	1	0.05	5	1.2	1 per million
Radium-228 (pCi/L)	1	0.019	5	1.0	1 per million
Uranium (pCi/L)	1	0.43	20	2.4	1 per million
Chlorite (ppm)	0.02	0.05	1.0	0.3	NA[4]
Total Coliform[6]	NA	(zero)	5.0%	1.1%	NA

[1]Concentration units: ppb = parts per billion; ppm = parts per million; pCi/L = picocuries per liter
[2]State Board detection limit for reporting purposes (DLR); values < DLR are considered to be zero.
[3]Highest annual average (value) of a contaminant that exceeded its PHG or MCLG during the 2019– 2021 reporting period; highest single value used for radium-226 and radium-228.
[4]NA = not applicable
[5]MCL for radium is 5 pCi/L as combined radium-226 + radium-228
[6]For compliance with the total coliform MCL, no more than 5.0% of the monthly samples may be total coliform positive.

The State Board has identified best available technologies (BATs) for achieving compliance with the MCLs for the contaminants listed above. In fact, some State Board recommended BATs, such as coagulation/filtration and reverse osmosis (RO) are currently being used at the Authority's water treatment facilities to remove constituents such as arsenic and uranium from untreated source waters. While it is easy to determine if a given BAT will reduce the concentration of a contaminant below its MCL, it is far more difficult to verify removal down to the PHG or MCLG level, as described below.

Many of the California PHGs and federal MCLGs are set at such low levels that they cannot be measured by available analytical methods. To further reduce the levels of the constituents identified in this report that are already significantly below the health-based MCLs 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 recommended.

Further details regarding levels of detection, health effects, BATs, and costs for contaminants that have exceeded their PHGs or MCLGs are provided in sections 3 and 4 of this report.

3.0 Constituents Detected That Exceeded a PHG or a MCLG

The following contaminants exceeded either a Public Health Goal or Maximum Contaminant Level Goal in the 2019 – 2021 reporting period: arsenic, uranium, chlorite, gross alpha, gross beta, radium-226, radium -228, and total coliform.

The numerical health risk information along with the category of health risk for each contaminant which has exceeded its respective PHG or MCLG is presented in Table 1. The Best Available Technologies and the associated costs of reducing contaminants to below their respective PHGs or MCLGs are presented in Table 2. An explanation of common health effects as well as the efficacy of implementing the best available technologies is provided below for each detected contaminant.

Table 1
Health Risk Categories and Cancer Risk Values
for Detected Contaminants Exceeding PHGs or MCLGs

Contaminant	Health Risk[1] Category	PHG or [MCLG] [2]	Cancer Risk[3] @ PHG or MCLG	California MCL[4]	Cancer Risk @ California MCL
Arsenic	Carcinogenicity (causes cancer)	0.004 ppb[5]	1×10^{-6} (one per million)	10 ppb	2.5×10^{-3} (2.5 per thousand)
Gross alpha[8]	Carcinogenicity (causes cancer)	[zero] (^{210}Po included)	zero	15 pCi/L[9] (includes radium but not radon and uranium)	Up to 1×10^{-3} (one per thousand for ^{210}Po, the most potent alpha emitter)
Gross beta[8]	Carcinogenicity (causes cancer)	[zero] (^{210}Pb included)	zero	50 pCi/L (judged equivalent to 4 mrem/yr)	Up to 2×10^{-3} (two per thousand for ^{210}Pb, the most potent beta emitter)
Radium-226	Carcinogenicity (causes cancer)	0.05 pCi/L	1×10^{-6} (one per million)	5 pCi/L (combined $Ra^{226+228}$)	1×10^{-4} (one per ten thousand)
Radium-228	Carcinogenicity (causes cancer)	0.019 pCi/L	1×10^{-6} (one per million)	5 pCi/L (combined $Ra^{226+228}$)	3×10^{-4} (three per ten thousand)
Uranium	Carcinogenicity (causes cancer)	0.43 pCi/L	1×10^{-6} (one per million)	20 pCi/L	5×10^{-5} (five per hundred thousand)

Table 1 (Continued)
Health Risk Categories and Cancer Risk Values for Detected Contaminants Exceeding PHGs or MCLGs

Contaminant	Health Risk Category	PHG or [MCLG]	Cancer Risk @ PHG or MCLG	California MCL	Cancer Risk @ California MCL
Chlorite	Hematotoxicity (causes anemia) Neurotoxicity (causes neurobehavioral effects)	0.05 ppm	NA[7]	1.0 ppm[6]	NA
Coliform Bacteria	Surrogate indicator of potential waterborne pathogens.	[zero percent] (positive test results per month)	NA	5.0% (positive test results per month)	NA

[1] Health Risk category is based upon the OEHHA PHG technical support document or on the USEPA MCLG document or California MCL document unless otherwise specified.
[2] MCLG = Maximum Contaminant Level Goal, established by USEPA; PHG = Public Health Goal, established by OEHHA.
[3] Cancer Risk = Upper estimate of excess cancer risk from lifetime exposure. Actual cancer risk may be lower or zero. Cancer risk is stated in terms of excess cancer cases per million (or fewer) population, e.g., 1×10^{-6} means one excess cancer case per million people exposed; 5×10^{-5} means five excess cancer cases per 100,000 people exposed.
[4] California MCL = Maximum Contaminant Level established by California.
[5] ppb = parts per billion or micrograms per liter (ug/L) of water
[6] ppm = parts per million or milligrams per liter (mg/L) of water
[7] NA = not applicable. Non-carcinogenic, or a cancer risk cannot be calculated. The PHG is at a level that is believed to be without any significant public health risk to individuals exposed to the chemical over a lifetime.
[8] 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. Refer to the OEHHA memoranda discussing the cancer risks at these MCLs at http://www.oehha.ca.gov/water/reports/grossab.html
[9] pCi/L = picocuries per liter of water.

Table 2
Best Available Technologies (BAT) and Cost Estimates For Treatment Technologies
(Includes Annualized Capital and O&M Costs)

Contaminant	Best Available Technologies[1]	Cost Per 1000 gal of treated water	Cost Per Acre Ft[2]	Total Cost Per Year[3]	Yearly Cost Per Service[4]	Yearly Cost Per Capita[5]
Arsenic, Gross alpha, Gross beta, Uranium, Radium-226, Radium-228	Reverse Osmosis (Current Practice)	$ 3.55 $ 3.55 $ 1.05	$ 1,157 $ 1,157 $ 341	Perdue Plant $10,639,980 NC Wells $ 2,318,169 Reynolds $ 2,264,240	Perdue Plant $ 320 NC Wells $ 70 Reynolds $ 68	Perdue Plant $ 55 NC Wells $ 12 Reynolds $ 12
Arsenic, Uranium, Gross beta, Radium-226, Radium-228	Ion Exchange	$ 2.40 $ 2.40	$ 782 $ 782	Perdue Plant $ 7,193,226 NC Wells $ 1,567,213	Perdue Plant $ 216 NC Wells $ 47	Perdue Plant $ 37 NC Wells $ 8.14
Arsenic and Uranium	Coagulation/Filtration; total ferric chloride[6]. (Current practice)	$ 0.040	$ 13.19	Perdue Plant $ 121,322	Perdue Plant $ 3.65	Perdue Plant $ 0.63
Chlorite	Reduction of chlorite with ferrous chloride. (Current practice)	$ 0.025	$ 8.14	Perdue Plant $ 74,872	Perdue Plant $ 2.25	Perdue Plant $ 0.39

[1] Additional information regarding Best Available Technologies are provided in Title 22 California Code of Regulations, Sections 64447 - 64447.4 and Section 64533 (c).
[2] Cost per acre-ft values for Reverse Osmosis and Ion Exchange were based upon cost estimates provided by ACWA. Cost per acre-ft for ferric chloride and ferrous chloride were based upon the monthly production report for December 2021.
[3] Total costs per year for the Perdue Plant, Reynolds Desalination Facility, and NC Wells are calculated by multiplying the cost per acre-ft x Calendar Year 2021 production totals (acre-ft).
[4] Yearly cost per service = total cost per year / 33,284 service connections.
[5] Yearly cost per capita = total cost per year / 192,480 people
[6] The sum of the cost per acre-ft of ferric chloride and ferrous chloride were used to determine cost of “total” ferric chloride.

3.1 Heavy Metal Contaminants

The following section describes health effects, categories of human risk, and BATs for arsenic.

3.1.1 Arsenic

Arsenic is an element that is found naturally in air, water, soil, rocks and minerals, food, and even in living organisms in low concentrations. Erosion of rocks and minerals is believed to be the primary source of naturally occurring arsenic found in drinking water supplies. Other sources of arsenic in water and soil include urban and farm runoff.

OEHHA has set the PHG for arsenic at 0.004 ppb (parts per billion). Please note it is difficult, using current methodology and instrumentation, to reliably measure down to the arsenic PHG level. The State of California has set the detection limit for reporting purposes (DLR) to 2 parts per billion (ppb), which means any concentration value below 2 ppb is considered zero. The current California MCL for arsenic is 10 ppb.

Some people who drink water containing arsenic in excess of the MCL over many years may experience skin damage or circulatory system problems, and may have an increased risk of getting cancer (lung, bladder, and skin). The numerical health (cancer) risk at the PHG level of 0.004 ppb is 1×10^{-6}, or one excess person in a million. The theoretical (i.e. based upon a statistical confidence level) numerical health (cancer) risk at the California MCL of 10 ppb is 2.5×10^{-3}, which means 2.5 excess cancer cases per 1000 people, based upon a 70-year lifetime.

A summary of arsenic detections during 2019 – 2021 is provided in Table 3.

Table 3
Summary of Arsenic Detections (ppb)

Sample Location	Year Sampled	Range	Average
Raw Aqueduct (Lake Skinner)	2020	2.1	2.1
Raw Aqueduct (Lake Skinner)	2021	2.1	2.1
National City Well #3	2020	ND – 1.5	ND
San Diego Formation Wells 1 - 11	2019	ND – 3.9	1.8
San Diego Formation Wells 1 - 11	2020	ND – 3.4	1.7
San Diego Formation Wells 1 - 11	2021	ND – 5.3	1.9
Sweetwater Lake	2019	ND – 2.0	1.7
Sweetwater Lake	2020	1.9 – 2.7	2.3
Sweetwater Lake	2021	1.6 – 2.3	2.0

The average concentration levels of arsenic detected at the Authority's compliance monitoring points were roughly five times lower than the California arsenic MCL of 10 ppb.

BATs for removing arsenic in drinking water to below MCL levels are provided in Title 22, Section 64447.2. The most appropriate BAT listed in Section 64447.2 for removing arsenic from raw Sweetwater

Lake water or raw aqueduct water is conventional coagulation/filtration with ferric chloride, which is already part of the treatment process at the Authority's Robert A. Perdue Water Treatment Plant.

The effectiveness of using ferric chloride coagulation with filtration is evident as the average arsenic concentration was below the DLR in the finished water from the Perdue Plant during the past three years.

The Richard A. Reynold's Desalination Facility treats brackish ground water from the San Diego Formation Wells using RO technology which effectively lowers the concentration of arsenic in raw source water to below detectable levels in the treated water effluent.

Table 2 also lists RO and Ion Exchange as potential BATs and provides approximate cost estimates for reducing the concentration of arsenic (to as close as possible to the PHG value of 0.004 ppb) at the National City Wells or in the raw water treated at the Perdue Plant. The costs of implementing either the RO ($ 1,157/acre-ft) or Ion exchange ($ 782/acre-ft) BAT options would be significant.

3.2 Radiological Contaminants

This section describes the health effects, categories of human risk, and BATs for the radiological constituents which have exceeded their respective PHG or MCLG in the 2019 - 2021 reporting period.

3.2.1 Uranium

Uranium is a hard, dense, malleable, ductile, silver-white, radioactive metal. Though uranium is radioactive, it is not particularly rare. Uranium can be found naturally in the environment in very small amounts in rocks, soil, water, and air. In ground or surface water, uranium is dissolved as water runs over or through rocks and soil. The amounts of uranium found in drinking water are generally very low. Man-made sources of uranium are derived from erosion of uranium mine tailings, the production of phosphate-based fertilizers, and certain ceramic glazes (now banned).

The primary drinking water standard for uranium is 20 pCi/L, the PHG is 0.43 pCi/L, and the California DLR is 1 pCi/L. Uranium detections in 2019 - 2021 are summarized in Table 4. The average detected concentration levels for uranium were approximately eight to ten times lower than the corresponding MCL.

Table 4
Summary of Uranium Detections (pCi/L)

Sample Location	Year Sampled	Range	Average
Raw Aqueduct (Lake Skinner)	2019	ND – 1.3	ND
Raw Aqueduct (Lake Skinner)	2020	1.4 – 2.6	1.9
San Diego Formation Wells 1 - 11	2017 - 2019	ND – 8.3	2.4
San Diego Formation Wells 1 - 11	2017 - 2021	ND – 8.3	2.4
Sweetwater Lake	2019	2.1	2.1

The health risk category for uranium is carcinogenicity (refer to Table 1). The excess cancer risk at the PHG is one person per million people. The excess cancer risk at the MCL is five people per 100,000 people. No harmful radiation effects of natural levels of uranium have been observed, however some people who drink water containing uranium in excess of the MCL over many years may have an increased risk of getting cancer. Chemical effects may occur after the uptake of large amounts of uranium, which can cause kidney disease.

The BATs and potential costs for removing uranium to levels below the PHG are listed in Table 2 and include ion exchange ($ 782 per acre-ft), RO ($ 1,157 per acre-ft), and coagulation with ferric chloride ($ 13.19 per acre-ft). The Richard A. Reynolds Desalination Plant already incorporates RO technology which effectively removes uranium to below detectable levels. The Robert A. Perdue Treatment Plant currently uses coagulation with ferric chloride and filtration, which effectively reduces uranium to below detectable levels in the finished water.

3.2.2 Gross Alpha

Alpha particles are a type of ionizing radiation ejected by the nuclei of some unstable atoms such as isotopes of radium, radon, polonium, and uranium. Most alpha emitters occur naturally in the environment. For example, alpha particles are given off by uranium-238, radon-222, and radium-226, which are found in nearly all rocks, soil, and water. Alpha particles are short lived, traveling only a few centimeters in air before losing all of their energy. Alpha particles also cannot penetrate most matter they encounter (such as skin or a thin piece of paper).

Table 1 provides health risk information for gross alpha radiation. The health risk category is carcinogenicity (cancer). Most of the health risk from alpha particles is associated with internal exposure. If alpha emitters have been inhaled, ingested (swallowed) or absorbed into the blood stream, sensitive living tissue can be exposed to alpha radiation. The resulting biological damage increases the risk of lung cancer when alpha emitters are inhaled. The greatest exposure to the general population comes through the inhalation of radon gas. The USEPA has set the MCLG for gross alpha to zero and the health risk at the MCLG is also zero. The health risk at the California MCL of 15 pCi/L is one excess cancer case per thousand people for polonium-210, which is the most potent alpha emitter. The DLR for measuring gross alpha is 3 pCi/L. Gross alpha values below 3 pCi/L are considered zero by the State Board.

A summary of gross alpha detections in 2019 - 2021 is provided in Table 5. The highest average source water concentrations detected for gross alpha were approximately four times lower than the MCL.

Table 5
Summary of Gross Alpha Detections (pCi/L)

Sample Location	Year Sampled	Range	Average
Raw Aqueduct (Lake Skinner)	2019	ND – 3.7	ND
Raw Aqueduct (Lake Skinner)	2020	ND – 3.0	ND
San Diego Formation Wells 1 - 11	2017 - 2019	ND – 11	3.9
San Diego Formation Wells 1 - 11	2017 - 2021	ND - 11	3.8

The BAT for removing gross alpha radiation from raw source water is RO (refer to Table 2). Since the MCLG for gross alpha is zero and it is impossible to measure down to zero, it would be virtually impossible to verify that gross alpha radiation would be reduced to a concentration of zero.

The cost for treating raw source water from Sweetwater Lake and/or raw aqueduct water using RO is approximately $ 1,157 per acre-ft. The Richard A. Reynolds Desalination Plant currently utilizes RO technology to effectively remove gross alpha from the San Diego Formation ground water aquifer to below detectable levels in the treated water effluent.

3.2.3 Gross Beta

Beta particles are subatomic particles ejected from the nucleus of radioactive atoms such as tritium, cobalt-60, strontium-90, iodine-129, iodine-131, lead-210, and cesium-137. Beta particles travel several feet and are stopped by solid materials. There are both natural and man-made beta-emitting radio nuclides. For example, potassium-40 and carbon-14 are weak beta emitters that are found naturally in the body. Other beta emitters such as radium-228 occur naturally in soil and rocks. Man-made sources of beta particles would include strontium-90 from atmospheric nuclear testing and iodine-131, which is used in medical imaging and treatment.

The main route of exposure to beta particles is through inhalation or ingestion. Beta radiation can cause both acute (damage to body tissues) and chronic health effects, although chronic health effects are much more common. The category of health risk from chronic exposure (5 to 30 years for example) is carcinogenicity (refer to Table 1). The numerical health risk at the MCLG (zero) is zero. The numerical health risk at the MCL of 50 pCi/L is two excess cancer cases per thousand people for lead-210, which is the most potent beta emitter. The California DLR for gross beta radiation is 4 pCi/L.

Gross beta radiation was detected in the raw aqueduct water, Sweetwater Lake, and San Diego Formation wells at average concentration levels up to approximately one sixth of the MCL of 50 pCi/L (refer to Table 6).

Table 6
Summary of Gross Beta Detections (pCi/L)

Sample Location	Year Sampled	Range	Average
Sweetwater Lake	2016 - 2017[1]	ND – 13	5.5
Sweetwater Lake	2021	4.4 – 9.3	7.5
Raw Aqueduct (Lake Skinner)	2020	ND – 5.5	ND
San Diego Formation Wells 1 - 11	2017 - 2018[1]	ND – 17	8.1

[1]Most recent data available

The BATs and associated costs for reducing gross beta radiation to a level approaching the MCLG of zero are provided in Table 2 and include ion exchange ($ 782 per acre-ft) and RO ($ 1,157 per acre-ft).

Since the MCLG for gross beta radiation is zero and it is impossible to measure down to zero, it would be virtually impossible to verify that gross beta radiation would be reduced to a concentration of zero, no matter what treatment technology is used.

3.2.4 Radium Isotopes

Radium is a naturally occurring radioactive metal which has a silvery-white appearance when freshly cut. Its most common isotopes are radium-224, radium-226, and radium-228. Radium is a radionuclide formed by the decay of uranium and thorium in the environment. Radium is found at low levels in virtually all rock, soil, water, plants, and animals. Radium-224 and radium-226 emit alpha radiation and radium-228 is a beta emitter. Radium decays to form isotopes of radon gas.

Radium and its salts are soluble in water which means it may be leached into ground water from the surrounding bedrock. Since radium is present at low levels in the natural environment, everyone has some minor exposure to it. The concentration of radium in drinking water is generally low. Man-made sources of radium include phosphates, burning coal, and uranium mine tailings.

3.2.4.1 Radium-226

Radium-226 was detected over its PHG level of 0.05 pCi/L. A summary of radium detections in 2017 - 2018 is provided in Table 7. The maximum concentration of radium-226 detected in the San Diego Formation Wells was 1.2 pCi/L, which is far below the California MCL of 5 pCi/L (combined radium-226+228). On average, radium-226 was not detected.

Table 7
Summary of Radium-226 Detections (pCi/L)

Sample Location	Year Sampled	Range	Average
San Diego Formation Wells 1 - 11	2017 - 2018[1]	ND – 1.2	ND

[1]Most recent data available

Table 1 provides specific health risk information pertaining to radium-226 exposure. The category of health risk for radium-226 is carcinogenicity (cancer). Long term exposure to radium increases the risk of developing several diseases such as lymphoma, bone cancer, and diseases that affect the formation of blood such as leukemia and aplastic anemia. The numerical cancer risk at the California PHG (0.05 pCi/L) is one excess cancer case per million people and the excess cancer risk at the California MCL is one person per ten thousand people. The California DLR for radium-226 is 1 pCi/L.

The BATs for removing radium-226 to below PHG levels are Ion Exchange and RO. Refer to the cost estimates provided in Table 2. The Richard A. Reynolds Desalination Plant currently utilizes RO technology to effectively remove radium-226 from the San Diego Formation ground water aquifer to below detectable levels in the treated water effluent.

3.2.4.2 Radium-228

Radium-228 was detected over its PHG level of 0.019 pCi/L in the raw aqueduct water in 2020 (refer to Table 8). The maximum concentration of radium-228 detected in raw aqueduct water was 1.0 pCi/L, which is far below the California MCL of 5 pCi/L (combined radium-226+228). On average, radium-228 was not detected.

Table 8
Summary of Radium-228 Detections (pCi/L)

Sample Location	Year Sampled	Range	Average
Raw Aqueduct (Lake Skinner)	2020	ND – 1.0	ND

The Table 1 provides specific health risk information pertaining to radium-228 exposure. The category of health risk for radium-228 is carcinogenicity (cancer). Long term exposure to radium increases the risk of developing several diseases such as lymphoma, bone cancer, and diseases that affect the formation of blood such as leukemia and aplastic anemia. The numerical cancer risk at the California PHG (0.019 pCi/L) is one excess cancer case per million people and the excess cancer risk at the California MCL is three people per ten thousand people. The California DLR for radium-228 is 1 pCi/L.

The BATs and costs for removing radium-228 to below PHG levels are summarized in Table 2 and include ion exchange ($ 782/acre-ft) and RO ($ 1,157/acre-ft).

3.3 Disinfection By-products

The following section provides public health risk information pertaining to chlorite, which was the only disinfection by-product that was detected at a concentration exceeding its PHG in 2019 - 2021.

3.3.1 Chlorite

Chlorite exists as a soluble anionic species in water and is formed when chlorine dioxide is applied to drinking water as a disinfectant. Chlorine dioxide is a powerful disinfectant which effectively kills pathogenic bacteria and oxidizes iron and manganese in drinking water. As the chlorine dioxide is consumed during water treatment, disinfection by-products are formed which include chlorite and chlorate anions.

The main health risk categories for chlorite are provided in Table 1 and include hematotoxicity (anemia) and neurotoxicity effects in infants and children. Similar effects may occur in fetuses of pregnant women who drink water containing chlorite in excess of the California MCL of 1.0 ppm. Drinking water which contains chlorite below the MCL is associated with little or none of these risks and should be considered safe with respect to chlorite. The California PHG for chlorite ion is 0.05 ppm. The California DLR for chlorite is 0.02 ppm. A summary of chlorite detections in 2019 - 2021 is provided in Table 9.

Table 9 Summary of Chlorite Detections (ppm)			
Sample Location	**Year Sampled**	**Range**	**Average**
SWA Distribution System	2019	ND – 0.4	0.2
SWA Distribution System	2020	0.02 – 0.5	0.3
SWA Distribution System	2021	ND - 0.5	0.2

The BAT for reducing chlorite ion below the PHG is reduction with ferrous iron during the coagulation and flocculation stages of treatment at the Robert A. Perdue Plant. Ferrous chloride is typically fed at the chemical flash mixer at the Perdue Plant in doses ranging from approximately 1.5 ppm to 9.0 ppm, which effectively reduces the chlorite ion concentration below the MCL of 1.0 ppm, but not below the PHG of 0.05 ppm. The total yearly cost associated with reduction of chlorite ion with ferrous chloride is approximately $ 74,872 or $ 8.14 per acre-ft (refer to Table 2). It would be technically and economically unfeasible to reduce chlorite ion to below the PHG of 0.05 ppm. Furthermore, chlorite ion has been shown to be effective in inhibiting the growth of nitrifying bacteria in the distribution system, thus helping to reduce a more immediate health concern.

3.4 Microbiological Contaminants

The only microbiological contaminant which exceeded its PHG or MCLG was total coliform. Health effects data and BATs for coliform bacteria are described below.

3.4.1 Total Coliform

Each week Sweetwater Authority samples for total coliform (an indicator of bacteriological water quality) at 36 monitoring locations throughout the distribution system in Bonita, National City, and Chula Vista as required by the Title 22 Total Coliform Rule (TCR). The weekly coliform data is then compiled and reported to the State Board as a monthly total percentage of coliform bacteria positives.

The Maximum Contaminant Level for coliform is 5% positive samples out of all samples taken per month and the Maximum Contaminant Level Goal is zero under the original TCR. In April 2016, under the Revised TCR (RTCR), the MCLG for total coliform was rescinded by USEPA. However, drinking water systems in California were instructed by the State Board to comply with the provisions of both the TCR and the RTCR until July 1, 2021, when the RTCR was formally adopted into Title 22 regulations. Going forward, total coliform detections will no longer be required in future PHG Reports.

The main impetus for the coliform drinking water standard is to minimize the possibility of waterborne pathogenic organisms (i.e. disease causing) in the distribution system water. Because coliform is only a surrogate indicator of the potential presence of waterborne pathogens, it is not possible to state a specific numerical health risk. While USEPA normally sets Maximum Contaminant Level Goals "at a level where no known or anticipated adverse effects on persons would occur", they indicate that they cannot do so with coliform bacteria.

As mentioned above, coliform bacteria are used as an indicator organism, are found almost everywhere in nature, and can be easily sampled and analyzed. If a positive sample is found, it indicates a potential problem that needs to be investigated and follow up sampling is required. It is not unusual for a public water system to have an occasional positive sample. It is difficult, if not impossible, to assure that a system will never get a positive sample. Table 10 provides a summary of TCR total coliform positive results during 2019 - 2021.

Table 10
Summary of Total Coliform Positive Test Results

TCR Sample Location	Date Sampled	Monthly Percent[1]
I Street and Woodlawn Ave (Chula Vista)	9/16/2019; 9/23/2019	1.1
721 “J” Ave (National City)	5/11/2020	0.7

[1]Monthly percentage of total coliform samples testing positive.

In September 2019 and May 2020, the MCLG of zero percent total coliform positives per month was exceeded. All repeat samples following the total coliform positives listed in Table 10 tested negative for total coliform. The Sweetwater Authority was in complete compliance with both the state and federal primary water quality standard (Maximum Contaminant Level) for total coliform.

Follow-up investigations into the possible reasons for positive total coliform results have produced the following corrective actions and findings:

1. Training for staff collecting distribution system samples has been augmented and refresher training provided.

2. All sample monitoring stations are now disinfected with bleach, alcohol, or by flame prior to sampling to avoid contamination of the water sample from the sample tap.

3. Dedicated alternative sample pedestals (for repeat sampling) have been installed within five service connections upstream and downstream of each distribution system sample location. These alternate sample locations are tested on a regular basis.

4. If a sample pedestal is suspected of being contaminated, even after extensive disinfection and flushing, the pedestal (and lateral connection to the water main) shall be replaced as necessary.

Sweetwater Authority typically disinfects the water leaving the Robert A. Perdue Water Treatment Plant, the National City Wells, and the Richard A. Reynolds Desalinization Facility with chloramines to ensure the water being served to our consumers is microbiologically safe. The chlorine residual levels are carefully controlled at each treatment facility (typically about 3.5 mg/L at the Perdue Plant for example) in order to provide the best health protection without causing the water to have undesirable taste and odor or increasing the disinfection byproduct level. This careful balance of treatment processes is essential to continue supplying the Sweetwater Authority customers with “safe drinking water.”

In addition, Sweetwater Authority operates an effective cross-connection control program and, if necessary, free chlorine may be applied in order clean out any residual bio-growth in the distribution system water mains. An aggressive distribution main replacement and repair program assures that the water mains always maintain adequate operating pressures.

The Sweetwater Authority has implemented a system wide flushing program (except for periods of drought), including dead ends, which should improve the overall water quality and thus minimize the opportunities for coliform re-growth in the distribution system. In addition, the Authority is purchasing a Neutral Output Discharge Elimination System (NO-DES) which allows the distribution system to be flushed without discharging to the storm drain system using a looped flushing protocol through a filter to catch sediment and biofilm. Once received, the NO-DES will allow the Authority to perform system flushing, even under drought conditions (with no negative public perception).

Distribution system tanks are monitored monthly for water quality parameters such as nitrite, ammonia, chlorine residual, and heterotrophic plate counts (HPCs). This monitoring constitutes an early warning system for possible signs of nitrification. Nitrification occurs when ammonia oxidizing bacteria convert free ammonia to nitrite, causing an increase in heterotrophic bacteria and a decrease in chlorine residual levels. Nitrification can potentially cause the re-growth of coliform bacteria in the distribution system. If nitrification is suspected, corrective action is implemented (such as deep cycling or disinfecting the tank).

The Sweetwater Authority complies with procedures described by the California Department of Health Services as “best available technology” for coliform bacteria in Section 64447, Title 22, California Code of Regulations (CCR).

4.0 Recommendations for Further Action

The Authority’s drinking water meets all State Board 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.

The capital expenditures, which would be required for these additional treatment processes, might provide greater public health protection benefits if spent on future treatment upgrades at the Robert A. Perdue Water Treatment Plant, Richard A. Reynolds Desalination Facility, National City Wells, and on on-going watershed protection, enhancement, and compliance monitoring programs.

Attachment 1: California Maximum Contaminant Levels (MCLs), California Public Health Goals (PHGs) and Federal Maximum Contaminant Level Goals (MCLGs)

PARAMETERS/ CONSTITUENTS	Units	STATE MCL	DLR	PHG or (MCLG)
INORGANICS				
ALUMINUM	mg/L	1	0.05	0.6
ANTIMONY	mg/L	0.006	0.006	0.001
ARSENIC	mg/L	0.010	0.002	0.000004
ASBESTOS (MFL = million fibers per liter)	MFL	7 MFL	0.2 MFL	7 MFL
BARIUM	mg/L	1	0.1	2
BERYLLIUM	mg/L	0.004	0.001	0.001
CADMIUM	mg/L	0.005	0.001	0.00004
CHROMIUM	mg/L	0.05	0.01	(0.100)
CHROMIUM, HEXAVALENT (Cr+6)	mg/L	--	--	0.00002
COPPER *(at-the-tap; 90th percentile)*	mg/L	AL=1.3	0.05	0.3
CYANIDE	mg/L	0.15	0.1	0.15
FLUORIDE	mg/L	2.0	0.1	1
LEAD *(at-the-tap; 90th percentile)*	mg/L	AL=0.015	0.005	0.0002
MERCURY (inorganic)	mg/L	0.002	0.001	0.0012
NICKEL	mg/L	0.1	0.01	0.012
NITRATE [as N]	mg/L	10	0.4	10
NITRITE [as N]	mg/L	1	0.4	1
NITRATE + NITRITE [as N]	mg/L	10	--	10
PERCHLORATE	mg/L	0.006	0.004	0.001
SELENIUM	mg/L	0.05	0.005	0.03
THALLIUM	mg/L	0.002	0.001	0.0001
ORGANICS				
ACRYLAMIDE	TT	TT	N/A	(0)
ALACHLOR	mg/L	0.002	0.001	0.004
ATRAZINE	mg/L	0.001	0.0005	0.00015
BENTAZON	mg/L	0.018	0.002	0.2
BENZENE	mg/L	0.001	0.0005	0.00015
BENZO (a) PYRENE	mg/L	0.0002	0.0001	0.000007
CARBOFURAN	mg/L	0.018	0.005	0.0007
CARBON TETRACHLORIDE	mg/L	0.0005	0.0005	0.0001
CHLORDANE	mg/L	0.0001	0.0001	0.00003
CHLOROETHENE [VINYL CHLORIDE]	mg/L	0.0005	0.0005	0.00005
CIS-1,2-DICHLOROETHYLENE	mg/L	0.006	0.0005	0.013
2,4-D	mg/L	0.07	0.01	0.02
DALAPON	mg/L	0.2	0.01	0.79
1,2-DIBROMO-3-CHLOROPROPANE [DBCP]	mg/L	0.0002	0.00001	0.000003
1,2-DICHLOROBENZENE [ORTHO]	mg/L	0.6	0.0005	0.6
1,4-DICHLOROBENZENE [PARA]	mg/L	0.005	0.0005	0.006
1,1-DICHLOROETHANE [1,1-DCA]	mg/L	0.005	0.0005	0.003
1,2-DICHLOROETHANE [1,2-DCA]	mg/L	0.0005	0.0005	0.0004

PARAMETERS/ CONSTITUENTS	Units	STATE MCL	DLR	PHG Or (MCLG)
ORGANICS (CONTINUED)				
1,1-DICHLOROETHENE [1,1-DCE]	mg/L	0.006	0.0005	0.01
DICHLOROMETHANE	mg/L	0.005	0.0005	0.004
1,2-DICHLOROPROPANE	mg/L	0.005	0.0005	0.0005
1,3-DICHLOROPROPENE	mg/L	0.0005	0.0005	0.0002
DI (2-ETHYLHEXYL) ADIPATE	mg/L	0.4	0.005	0.2
DI (2-ETHYLHEXYL) PHTHALATE	mg/L	0.004	0.003	0.012
DINOSEB	mg/L	0.007	0.002	0.014
DIOXIN [2,3,7,8 - TCDD]	mg/L	$3x10^{-8}$	$5x10^{-9}$	$5x10^{-11}$
DIQUAT	mg/L	0.02	0.004	0.006
ENDOTHALL	mg/L	0.1	0.045	0.094
ENDRIN	mg/L	0.002	0.0001	0.0003
EPICHLOROHYDRIN	TT	TT	N/A	(0)
ETHYLBENZENE	mg/L	0.3	0.0005	0.3
ETHYLENE DIBROMIDE [EDB]	mg/L	0.00005	0.00002	0.00001
GLYPHOSATE	mg/L	0.7	0.025	0.9
HEPTACHLOR	mg/L	0.00001	0.00001	0.000008
HEPTACHLOR EPOXIDE	mg/L	0.00001	0.00001	0.000006
HEXACHLOROBENZENE	mg/L	0.001	0.0005	0.00003
HEXACHLOROCYCLOPENTADIENE	mg/L	0.05	0.001	0.002
LINDANE	mg/L	0.0002	0.0002	0.000032
METHOXYCHLOR	mg/L	0.03	0.01	0.00009
METHYL TERTIARY BUTYL ETHER (MTBE)	mg/l	0.013	0.003	0.013
MOLINATE	mg/L	0.02	0.002	0.001
MONOCHLOROBENZENE	mg/L	0.07	0.0005	0.07
OXAMYL	mg/L	0.05	0.02	0.026
PENTACHLOROPHENOL	mg/L	0.001	0.0002	0.0003
PICLORAM	mg/L	0.5	0.001	0.166
POLYCHLORINATED BIPHENYLS [PCBs]	mg/L	0.0005	0.0005	0.00009
SILVEX [2,4,5-TP]	mg/L	0.05	0.001	0.003
SIMAZINE	mg/L	0.004	0.001	0.004
STYRENE	mg/L	0.1	0.0005	0.0005
1,1,2,2-TETRACHLOROETHANE	mg/L	0.001	0.0005	0.0001
TETRACHLOROETHYLENE [PCE]	mg/L	0.005	0.0005	0.00006
THIOBENCARB	mg/L	0.07	0.001	0.042
TOLUENE	mg/L	0.15	0.0005	0.15
TOXAPHENE	mg/L	0.003	0.001	0.00003
TRANS-1,2-DICHLOROETHYLENE	mg/L	0.01	0.0005	0.05
1,2,3-TRICHLOROPROPANE	mg/L	0.000005	0.000005	0.0000007
1,2,4-TRICHLOROBENZENE	mg/L	0.005	0.0005	0.005
1,1,1-TRICHLOROETHANE [1,1,1-TCA]	mg/L	0.2	0.0005	1.0
1,1,2-TRICHLOROETHANE [1,1,2-TCA]	mg/L	0.005	0.0005	0.0003
TRICHLOROETHYLENE [TCE]	mg/L	0.005	0.0005	0.0017
TRICHLOROFLUOROMETHANE (FREON 11)	mg/L	0.15	0.005	1.3
TRICHLOROTRIFUOROETHANE (FREON 113)	mg/L	1.2	0.01	4
XYLENES [SUM OF ISOMERS]	mg/L	1.75	0.0005	1.8

PARAMETERS/ CONSTITUENTS	Units	STATE MCL	DLR	PHG Or (MCLG)
DISINFECTION BYPRODUCTS				
TRIHALOMETHANES, TOTAL [TTHMs]	mg/L	0.08	N/A	N/A
BROMODICHLOROMETHANE	mg/L	N/A	0.0010	0.00006
BROMOFORM	mg/L	N/A	0.0010	0.0005
CHLOROFORM	mg/L	N/A	0.0010	0.0004
DIBROMOCHLOROMETHANE	mg/L	N/A	0.0010	0.0001
HALOACETIC ACIDS (five) [HAA5]	mg/L	0.06	N/A	N/A
MONOCHLOROACETIC ACID	mg/L	N/A	0.0020	(0.07)
DICHLOROACETIC ACID	mg/L	N/A	0.0010	(zero)
TRICHLOROACETIC ACID	mg/L	N/A	0.0010	(0.02)
MONOBROMOACETIC ACID	mg/L	N/A	0.0010	N/A
DIBROMOACETIC ACID	mg/L	N/A	0.0010	N/A
BROMATE	mg/L	0.01	0.0050	0.0001
CHLORITE	mg/L	1.0	0.020	0.05
MICROBIOLOGICAL				
COLIFORM % POSITIVE SAMPLES	%	5	N/A	(zero)
CRYPTOSPORIDIUM*	N/A	TT	N/A	(zero)
GIARDIA LAMBLIA	N/A	TT	N/A	(zero)
LEGIONELLA	N/A	TT	N/A	(zero)
VIRUSES	N/A	TT	N/A	(zero)
RADIOLOGICAL				
ALPHA ACTIVITY, GROSS	pCi/L	15	3	(zero)
BETA ACTIVITY, GROSS	pCi/L	50	4	(zero)
RADIUM-226	pCi/L	N/A	1	0.05
RADIUM-228	pCi/L	N/A	1	0.019
RADIUM-226 + RADIUM-228	pCi/L	5	N/A	(zero)
STRONTIUM-90	pCi/L	8	2	0.35
TRITIUM	pCi/L	20000	1000	400
URANIUM	pCi/L	20	1	0.43
SPECIAL CHEMICALS WITH PHGs				
N-NITROSODIMETHYLAMINE (NDMA)	mg/L	N/A	N/A	0.000003

MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
*Surface Water Systems Only
N/A = Not Applicable

PHG = Public Health Goal
DLR = Detection Limit for Reporting purposes; set by CDPH
TT = Treatment Technique