Singapore Area Coordinator Drinking Water Annual Consumer Confidence Report

The U.S. Navy applies the regulations of the U.S. Safe Drinking Water Act (SDWA) to all U.S. Navy installations overseas. Per the U.S. Department of the Navy regulations, Singapore Area Coordinator (SAC) issues a report annually describing the quality of SAC's drinking water. This report reflects annual water quality monitoring data collected through December 31, 2018.

SAC is pleased to report that in calendar year 2018 SAC's drinking water met all U.S. and Singapore standards for water quality.

Drinking Water Standards
To ensure water is safe to drink, the U.S. Navy ensures compliance with water quality standards set forth by the U.S. Environmental Protection Agency (EPA). Per Navy guidance, SAC is required to regularly test the installation's drinking water for contaminants and report the results on an annual basis.

Last year, as in years past, SAC's drinking water met all EPA and Singapore National Environmental Agency (NEA) standards for drinking water quality. SAC's water also met the standards established by the Department of Defense (DoD) Overseas Environmental Baseline Guidance Document (OEBGD) and CNICINST 5090.1A U.S. Drinking Water Standards for U.S. Navy Installations Overseas.

In the latest compliance monitoring period, SAC conducted tests for over 120 contaminants which have the potential to be present in drinking water. Table 1-1 identifies all contaminants detected in our water and their levels of concentration. All drinking water, to include bottled water, is reasonably expected to contain at least small amounts of some contaminants. The presence of contaminants in water does not necessarily indicate a health risk; rather, the important fact is that none of the contaminant levels found in SAC's water exceed the governing water quality standards, known as maximum contaminant levels (MCL).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. Any such individuals should seek advice from their health care providers about drinking water.

Water Provider
Singapore has built a robust, diversified, and sustainable water supply from four water sources known as the Four National Taps – Water from Local Catchment, Imported Water, Reclaimed water (known as NEWater) and Desalinated Water. The Public Utilities Board (PUB) is the agency in Singapore responsible for the treatment and distribution of drinking water throughout the island. Water provided by the PUB arrives at SAC fully compliant with U.S. standards. No additional treatment of the water is provided by SAC. The SAC Public Works Department (PWD) routinely tests the water to ensure it meets water quality standards.

Additional information on the Four National Taps can be found on the PUB website: https://www.pub.gov.sg/.

Water Treatment
Raw water from various sources in Singapore is conveyed by pipelines to local waterworks where it is chemically treated, filtered and disinfected. Treatment removes contaminants and improves water clarity and taste.

Most treatment plants use chemical coagulation to remove larger particles (i.e., dirt or debris) suspended in the raw water. Aluminum sulfate is the main coagulant, and hydrated lime and polyelectrolyte are used as coagulant aids. These chemicals cause the suspended matter to settle more readily, thus facilitating removal of large particles. Rapid gravity filtration is used to remove finer particles of suspended matter.

Chlorine, and sometimes ozone (trioxygen), is then added to the filtered water to disinfect and remove all harmful bacteria and viruses. Ammonia is added to combine with the free chlorine to form stable chlorine residual. Activated carbon is also used to remove any bad taste and odor from the water.

Sodium silicofluoride is added to the water as it progresses from the filters to the clear water tank. Fluoridation is required by the Singapore Ministry of Health, and has been a standard water treatment practice since 1957 to prevent tooth decay (cavities). The water is then pumped into the distribution system, ready for consumption.

Water Quality Monitoring
Singapore PUB and SAC routinely monitor for contaminants using certified laboratories and approved methods per DoD and U.S. Navy regulations. The following contaminants are monitored:

- Monthly – Total Coliform, pH, Chlorine Residual, Bromate, Nitrate/Nitrite & Total Nitrate/Nitrite.
- Quarterly – Disinfection by-products [Total Trihalomethanes (TTHM) and Haloacetic Acids (HAA5), Volatile Organic Chemicals & Synthetic Organic Chemicals.
- Annually – Lead, Copper, Inorganic Chemicals, Pesticides, Herbicides & PCBs
- Once every 3 years – Radionuclides
- Once every 9 years – Asbestos

Table 1-1 lists contaminants detected during 2018, or last applicable, sampling period. The samples were collected directly from water fixtures at selected locations throughout the water distribution system in the housing and industrial areas of the installation. Only contaminants detected during testing are listed in the tables. As noted previously, all contaminant levels were within the applicable standards.

Substances Expected in Drinking Water
Drinking water sources include rivers, lakes, streams, reservoirs, wells, and the ocean. As water travels over the land's surface or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from animals or human activity.

Contaminants which may be present in Singapore source water (listed alphabetically)

Arsenic – Arsenic occurs in inorganic and organic forms. Inorganic arsenic compounds (such as those found in water) are highly toxic while organic arsenic compounds (such as those found in seafood) are less harmful to health. Additional information on arsenic in drinking water is available from the EPA http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/index.cfm.

Inorganic contaminants, such as salts and metals, which can be naturally occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

Lead can come primarily from materials and components associated with service lines and home plumbing. Singapore ended the practice of using lead-containing materials in water systems over 20 years ago, though it is possible plumbing components over 20 years old may still contain lead. If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children.

When water in a pipe has been sitting for several hours, one can minimize the potential for lead exposure by running the tap for 30 seconds to 2 minutes before using water for drinking or cooking. Additional information on lead in drinking water is available from the EPA: https://www.epa.gov/your-drinking-water/basic- information-about-lead-drinking-water.

Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Nitrate is an inorganic chemical that is naturally present in soil, water and food. Major sources of nitrate in drinking water include fertilizers, sewage and animal manure. Nitrates themselves are relatively nontoxic; however, when swallowed, they are converted to nitrites which can react with hemoglobin in the blood, creating methemoglobin. Infants convert approximately double, or 10 present, of ingested nitrates to nitrites compared to 5 percent conversion in older children and adults and can lead to blue baby symptoms. High enough concentrations of nitrate in drinking water can result in a temporary blood disorder in infants called methemoglobinemia, commonly called "blue baby syndrome." In severe, untreated cases, brain damage and eventually death can result from suffocation due to lack of oxygen. Additional information on Nitrate in drinking water is available from the EPA: http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm.

Organic chemical contaminants, including synthetic and volatile organic chemicals, are by-products of industrial processes and petroleum production, as well as gas stations, urban storm water runoff, and septic systems.

Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban storm water runoff, and residential uses.

Radioactive contaminants – which can be naturally occurring or the result of oil and gas production and mining activities.

Water Quality Data Table
The following table lists contaminants for which the SAC PWD routinely tests. The presence of a contaminant does not necessarily indicate a health risk. Please note that the PWD monitors many contaminants, in addition to the ones listed below, per the OEBGD and CNICINST 5090.1A. Only those contaminants detected during laboratory analysis are listed below. The water samples were collected from our installation and analyzed by Marchwood Laboratory Services Pte. Ltd. an ISO / IEC 17025, 2005 Certified Laboratory contracted by the Singapore Base Operation Services Contractor.

How to Read the Data Tables:
SAC conducts extensive monitoring to ensure that your water meets all water quality standards. The results of our monitoring are reported in the tables on the following pages.

Starting with a **Substance**, read across. **Year Sampled** is usually 2018 or a year prior. **MCL** shows the highest level of substance (contaminant) allowed in drinking water. **MCLG** is the goal level for that substance (this may be lower than what is allowed). A "**No**" under **Violation** means the amount of the substance met government requirements. **Possible Source of Contamination** tells where the substance usually originates.

Unregulated substances are measured, but maximum allowed contaminant levels have not been established by the U.S.

Table Definitions and Abbreviations

AL (Action Level): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

MCL (Maximum Contaminant Level): The highest level of a contaminant allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

MCLG (Maximum Contaminant Level Goal): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

MRDL (Maximum Residual Disinfectant Level): The highest level of drinking water disinfectant routinely allowed in drinking water. Addition of a disinfectant is necessary for the control of microbial contamination.

MRDLG (Maximum Residual Disinfectant Level Goal): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contamination.

N/A: Not applicable

ND: Not detected

mg/L (milligrams per liter): one part substance per million parts water (parts per million).

ng/L (nanograms per liter): one part substance per trillion parts water (parts per trillion)

µg/L (micrograms per liter): one part substance per billion parts water (parts per billion)

pCi/L (picocuries per liter): Measurement of the natural rate of disintegration of radioactive contaminants in water (also beta particles).

MFL (million fibres per liter) Measurement of the presence of asbestos fibres that are longer than 10 micrometers.

TT (Treatment Technique): A required process intended to reduce the level of a contaminant in drinking water.

<: less than

Additional Sources of Information:
U.S. EPA Office of Water (www.epa.gov/safewater) and the Center for Disease Control and Prevention (www.cdc.gov) websites provide a substantial amount of information on many issues relating to water resources, water conservation, and public health.

Concerns/Additional Copies:
For questions, information, and /or additional copies, please contact Singapore Area Coordinator, Public Works Department, Environmental Division at (+65) 6750-2052 or William.C.Davis@fe.navy.mil.

Table 1-1 Drinking Water Constituents Detected

Substance	Unit of Measurement	Level Detected		Regulated Levels (OEBGD and CNICINST 5090.1)	Violation	Possible Sources of Contamination
		Low	High		Yes / No	
Inorganic Contaminants						
Arsenic	**mg/L**	<0.0025	0.0031	MCL = 0.01 MCLG = 0.0	No	Erosion of natural deposits; runoff from orchards, runoff from glass and electronics production wastes
Asbestos	**MFL**	<0.2	-	MCL = 7.0 MCLG = 7.0	No	Runoff from asbestos containing minerals, runoff from asbestos roofing and pipes and industrial wastes
Barium	**mg/L**	0.033	0.038	MCL = 2 .0 MCLG = 2.0	No	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Fluoride	**mg/L**	0.42	0.57	MCL = 4.0 MCLG = 4.0	No	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
Nitrate (as Nitrogen)	**mg/L**	0.430	1.010	MCL = 10.0 MCLG = 10.0	No	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits
Nitrite (as Nitrogen)	**mg/L**	0.020	0.069	MCL = 1.0 MCLG = 1.0	No	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits
Total Nitrite & Nitrate (as Nitrogen)	**mg/L**	0.490	1.030	MCL = 10 MCLG = 10	No	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits
Sodium[1]	**mg/L**	2.6	4.45	MCL = N/A MCLG = N/A	No	Erosion of natural deposits
Disinfectant/Disinfection Byproducts						
Haloacetic Acids	**mg/L**	0.0066	.048	MCL = .06 MCLG = N/A	No	Byproduct of drinking water disinfection
Trihalomethanes (Total)	**mg/L**	0.021	.062	MCL = .08 MCLG = N/A	No	Byproduct of drinking water disinfection
Chloramine (As Total Chlorine)	**mg/L**	0.600	1.80	MRDL = 4.0 MRDL = 4.0	No	Water additive used to control microbes

Notes: 1) Sodium has no established MCL per OEGBD. Monitoring is required so concentration levels can be made available on request.

Table 1-1 Continued, Drinking Water Constituents Detected

Substance	Unit of Measurement	Level Detected		Regulated Levels (OEBGD and CNICINST 5090.1)	Violation	Possible Sources of Contamination
		Low	High		Yes / No	
Radionuclides[2]						
Gross Alpha	**pCi/L**	1.35	1.35	MCL =15 MCLG = 0.0	No	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Gross Beta	**pCi/L**	1.35	1.35	MCL = 50.0 MCLG = 0.0	No	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as photons and beta radiation
Combined Radium-226 and -228	**pCi/L**	1	1	MCL = 5 MCLG = 0.0	No	Erosion of natural deposits
Microorganisms						
Total Coliform	**positive samples per month**	0	0	MCL = 0 MCLG = 0	No	Coliforms are naturally present in the environment; as well as feces; fecal coliforms and E. coli only come from human and animal fecal waste
Lead & Copper						
Copper	**mg/L**	0.009	0.079	AL = 1.3 MCLG = 0	No	Corrosion of household plumbing systems: erosion of natural deposits
Lead	**mg/L**	0.005	0.005	AL =0.015 MCLG = 0.0	No	Corrosion of household plumbing systems: erosion of natural deposits

Notes: 2) Radionuclides last tested in 2017. Required frequency of sampling & testing for is once every 3 years.