



Singapore Area Coordinator

Annual Overseas Drinking Water System

Consumer Confidence Report

In order to ensure that tap water is safe to drink, the U.S. Navy applies the regulations of the U.S. Safe Drinking Water Act (SDWA) to all U.S. Navy installations overseas. These regulations limit the amount of certain contaminants in water provided by public water systems. To comply with U.S. and Department of the Navy regulations, Navy Region Center Singapore (NRCS) issues a report annually describing the quality of our drinking water. It includes details about where our water comes from and what it contains.

Based on the most recent sanitary survey (December-2014), it is determined that our drinking water meets or exceeds U.S. standards. Ours is a potable water system, meaning it is fit for human consumption. This report reflects the annual monitoring data collected up to December 31, 2015.

Water Provider

Our water comes from surface water treatment systems owned and operated by Singapore Public Utilities board (PUB). Water provided by PUB arrives at NRCS fully compliant to U.S. standards. No additional treatment of the water is provided by NRCS, only additional surveillance. Public Works Environmental Division and the COMLOG-WESTPAC Medical Aid Station take routine samples and test the water to ensure the water quality meets U.S. standards.

Water Treatment

Raw water from various sources is conveyed by pipelines to local waterworks where it is chemically treated, filtered and disinfected. Treatment frees the water of harmful contaminants, makes it clear, sparkling, odourless, colourless, and safe for consumption.

Most treatment plants use chemical coagulation to remove the larger particles of matter suspended in the raw water. Aluminum sulphate is the main coagulant. Hydrated lime and polyelectrolyte are used as coagulant aids. This causes the suspended matter to settle more readily and then be removed. Then rapid gravity filtration is used to remove the finer particles of suspended matter.

Chlorine, and sometime ozone, is then added to the filtered water to disinfect and to get rid of all harmful

bacteria and viruses. Ammonia is then added to combine with the free chlorine to form stable chlorine residual. Activated carbon is also used to remove any bad taste and odor.

Sodium silicofluoride is also added to the water on its way from the filters to the clear water tank. Fluoridation is a requirement by the Ministry of Health (Singapore) and has been a practice since 1957. It helps in the prevention of dental caries. The water is then pumped into the distribution system, ready for consumption.

Drinking Water Standards

Last year, as in years past, our drinking water met all U.S., Singapore Public Utility Board, and World Health Organization Guidelines for Drinking Water Quality and parameters on contaminants regulated by the U.S. Overseas Environmental Baseline Guidance Document and CNICINST 5090.1 series. In accordance with Navy guidance, we are required to test our water for contaminants on a regular basis, making sure it is safe to drink, and to report our results accordingly.

To ensure that our water is safe to drink, EPA and the World Health Organization prescribes limits to which the water standards must meet.

In the latest compliance monitoring period, we conducted tests for over 120 contaminants that have



potential for being found in our drinking water. Table 1-1 identifies all contaminants detected in our water and their levels of concentration. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk.

Cryptosporidium Information for Navy Region Center Singapore

Cryptosporidium is a microbial pathogen sometimes found in surface water. Although filtration removes *Cryptosporidium*, the most commonly used filtration methods cannot guarantee 100 percent removal. PUB consistently maintains its filtration process in accordance with regulatory guidelines to maximize removal efficiency. Monitoring has indicated their occasional presence in the source water.

Cryptosporidium may cause abdominal infection. Symptoms of infection include nausea, diarrhea and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immuno-compromised people, infants and small children, and the elderly are at greater risk of developing life-threatening illness.

Cryptosporidium must be ingested in order to cause disease. It may be spread through other means than drinking water, such as other people, animals, water, swimming pools, fresh food, soils and any surface that has not been sanitized after exposure to feces.

Under the EPA Long Term 2 Enhanced Surface Water Treatment Rule, an average *Cryptosporidium* concentration of 0.075 oocysts/Litre would have triggered additional treatment measures. PUB water's *Cryptosporidium* concentrations consistently remain below this threshold.

Substances Expected to be in Drinking Water

The source of drinking water comes from surface water includes rivers, lakes, streams, ponds and reservoirs. As water travels over the surface of the land or through the ground it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

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

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.

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

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

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

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, and no known lead-containing materials are present in our system, and results are consistently well below established thresholds. If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. When water has been sitting for several hours, one can minimize the potential for lead exposure by running the tap for 30 seconds to two minutes before using water for drinking or cooking. Additional information on lead in drinking water can be found at:

<https://www.epa.gov/your-drinking-water/basic-information-about-lead-drinking-water>

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 that can react with haemoglobin in the blood, creating methemoglobin. Infants convert approximately double, or 10 percent 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 can be found at:

<http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm>

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 can be found at:

<http://water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/index.cfm>

How is our drinking water monitored?

PUB and NRCS routinely monitor for 120 contaminants using certified laboratories and approved methods in accordance with OEBGD and U.S. Navy regulations. The following constituents are monitored at these frequencies:

- Monthly – Total Coliform, pH, Chlorine Residual.
- Quarterly – Disinfection byproducts [Total Trihalomethanes (TTHM) and Haloacetic Acids (HAA5), Volatile Organic Chemicals.
- Annually – Lead, Copper, Inorganic Chemicals, Pesticides, Herbicides & PCBs
- Once every 4 years – Radionuclides
- Once every 9 years – Asbestos

Table 1-1 lists contaminants detected during the 2015, or last applicable, sampling period.. The samples were collected directly from water fixtures at selected locations for the water distribution system on installation. Only contaminants that were detected

during testing are listed in the tables, all were within health based standards.

How to Read the Data Tables:

NRCS 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 in 2015 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 government.

Table Definitions and Abbreviations

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

MCL (Maximum Contaminant Level): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs allow for a margin of safety.

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 (MRDLG): 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 contaminants.

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).

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 Navy Region Center Singapore, Public Works Department, Environmental Division at (+65) 6750-2052/2911 or William.C.Davis@fe.navy.mil.

Water Quality Data Table

The following table lists contaminants that PWD/ENV routinely test. Please note that NRCS monitors many constituents, in addition to the ones listed below, in accordance with the OEBGD and CNICINST 5090.1. Only those constituents that were detected during laboratory analysis are listed below. The water samples were collected from our installation and analysed by the Laboratory Sciences

Division, USA Public Health Command Region-Pacific. The presence of contaminants does not necessarily indicate that the water poses a health risk.

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	0.00016	0.00032	MCL = 0.01 MCLG = 0.0	No	Erosion of natural deposits; runoff from orchards, runoff from glass and electronics production wastes
Barium	mg/L	0.034	0.034	MCL = 2.0 MCLG = 2.0	No	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Fluoride	mg/L	0.42	0.42	MCL = 4.0 MCLG = 4.0	No	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminium factories
Nitrate (as Nitrogen)	mg/L	1.2	1.2	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	0.032	0.038	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	1.2	1.2	MCL = 10 MCLG = 10	No	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits
Sodium ¹	mg/L	2.6	7.1	MCL = N/A MCLG = N/A	No	Erosion of natural deposits
Volatile Organic Chemicals						
p-Dichlorobenzene	µg/L	<0.5	0.7	MCL = 75.0 MCLG = 75.0	No	Discharge from industrial chemical factories
Bromate (mg/L)	mg/L	<0.001	0.001	MCL = 0.01 MCLG = 0.0	No	Byproduct of drinking water disinfection
Haloacetic Acids	µg/L	<6.0	42	MCL = 60 MCLG = N/A	No	Byproduct of drinking water disinfection
Trihalomethanes (Total)	µg/L	<2.0	57.5	MCL = 80 MCLG = N/A	No	Byproduct of drinking water disinfection
Chloramine (As Total Chlorine)	mg/L	ND	2.0	MRDL = 4.0 MRDL = 4.0	No	Water additive used to control microbes
Disinfectant/Disinfection Byproducts						
Bromate (mg/L)	mg/L	<0.001	0.001	MCL = 0.01 MCLG = 0.0	No	Byproduct of drinking water disinfection
Haloacetic Acids	µg/L	<6.0	42	MCL = 60 MCLG = N/A	No	Byproduct of drinking water disinfection
Trihalomethanes (Total)	µg/L	<2.0	57.5	MCL = 80 MCLG = N/A	No	Byproduct of drinking water disinfection
Chloramine (As Total Chlorine)	mg/L	ND	2.0	MRDL = 4.0 MRDL = 4.0	No	Water additive used to control microbes

Notes: 1) Sodium has no established MCL per OEBGD. 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	
Radionuclides²						
Gross Alpha	pCi/L	1.2	1.2	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	6.3	6.3	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	2.1	2.1	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	<0.05	0.21	AL = 1.3 MCLG = 0	No	Corrosion of household plumbing systems: erosion of natural deposits
Lead	mg/L	<0.001 0	0.0018	AL = 0.015 MCLG = 0.0	No	Corrosion of household plumbing systems: erosion of natural deposits
Unregulated Contaminants³						
Perfluorobutanesulfonic acid	ng/L	<90	<90	N/A	No	Emergent contaminant screening
Perfluoroheptanoic acid	ng/L	<10	<10	N/A	No	Emergent contaminant screening
Perfluorohexanesulfonic acid	ng/L	<30	<30	N/A	No	Emergent contaminant screening
Perfluorononanoic acid	ng/L	<20	<20	N/A	No	Emergent contaminant screening
Perfluorooctanesulfonic acid	ng/L	<40	<40	N/A	No	Emergent contaminant screening
Perfluorooctanoic acid	ng/L	<20	<20	N/A	No	Emergent contaminant screening

Notes: 2) Radionuclides last tested in 2013. Required frequency of sampling & testing for is once every 4 years.

3) In 2015 U.S Navy Overseas Drinking Water Systems were required to screen potable water for perfluorinated chemicals. No perfluorinated chemicals were detected in the NRCS system. The range and average of the results was zero.