

Saanich Water Distribution System 2019 Annual Water Quality Report

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1.0 Introduction

This report is the 2019 annual overview of the results from water quality samples collected from the Saanich Drinking Water System (Map 1). The report summarizes data from District of Saanich owned and operated infrastructure with sample locations including reservoirs, pump stations, pressure regulating stations and locations from the distribution system. The parameters that are routinely monitored in the distribution systems for determining the microbiological quality of the drinking water are *E. coli*, total coliforms, turbidity, and chlorine residual. The water samples are collected by the Capital Regional District (CRD) water quality staff and analytical testing is performed at the CRD Water Quality Lab. Monthly and weekly summary reports on water quality data are posted on the CRD's website at: www.crd.bc.ca/about/data/drinking-water-quality-reports

2.0 Water System Description

The District of Saanich purchases bulk water from the Capital Regional District (CRD) Integrated Water Services. The bulk water typically originates from the Sooke Lake Reservoir. Once a year, usually in December, the CRD supplies water from their Goldstream water source while performing maintenance on the Sooke Lake Reservoir. From Sooke Lake Reservoir the water travels to Saanich through several transmission mains. These mains are shown on the Saanich Water Pressure Zones & Water Mains 2018 map (Appendix A). Saanich is supplied by CRD Transmission Mains #1, #3, & #4.

There are 19 water connections from the CRD transmission system into the Saanich distribution system.

The Saanich Distribution system consists of 31 different pressure zones where source water comes directly from a Capital Regional District supply main or from another Saanich pressure zone.

The distribution system consists of 18 pumping stations, 49 pressure reducing stations, and 4 water reservoirs.

The Saanich Distribution System reservoirs are used to store and supply drinking water but also provide system balancing and fire and emergency storage. Listed from largest to smallest:

- Rithet Reservoir, 15,750 m³ (3,464,516 imperial gallons)
- Mount Tolmie Reservoir, 4,063 m³ (893,735 imperial gallons)
- Wesley Reservoir, 2,632 m³ (578,959 imperial gallons)
- Hartland Reservoir, 118 m³ (25,956 imperial gallons)

3.0 Water Quality Regulations

The District of Saanich Water Distribution System must comply with the British Columbia Drinking Water Protection Act (BCDWPA) and Drinking Water Protection Regulation (BCDWPR) as well as follow federal Guidelines for Canadian Drinking Water Quality (GCDWQ).

The water quality standards for potable water systems are shown in Schedule A of the British Columbia Drinking Water Protection Regulation and in the Guidelines for Canadian Drinking Water Quality Summary Table. These standards are provided in Table 1:

Table 1 - Water Quality Standards for Potable Water – BCDWPR & GCDWQ

Parameter:	Standard:
<i>Escherichia coli</i>	No detectable <i>Escherichia coli</i> per 100 ml
Total coliform bacteria	
(a) 1 sample in 30 day period	No detectable total coliform bacteria per 100 ml
(b) More than 1 sample in a 30 day period	At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml
	No detectable total coliform from consecutive samples from the same site

Schedule B of the BCDWPR requires the number of water samples collected to correspond with population size as shown in Table 2:

Table 2 - Frequency of Monitoring Samples for Prescribed Water Supply Systems - BCDWPR

Population Served by the Prescribed Water Supply System:	Number of Samples Per Month:
Less than 5,000	4
5,000 to 90,000	1 per 1,000 population
More than 90,000	90 plus 1 per 10,000 population in excess of 90,000

4.0 Water Quality Monitoring

The population of Saanich is approximately 114,148 (based on 2016 Census data). Based on Schedule B of the BCDWPR, Saanich is required to collect 93 compliance samples per month. In 2019, a total of 1,208 samples were collected from 64 dedicated sampling stations within Saanich. The requirements from Schedule B of the BCDWPR and the actual samples taken from the Saanich Distribution System are summarized in Table 3.

Table 3 - District of Saanich Frequency of Sampling as per Schedule B of BCDWPR

Year	Population	Number of Sample sites	Required Number of Samples per Month ¹	Actual	
				Average Number of Samples Per Month Collected	Number of Samples Per Year Collected
2019	114,148	64	93	100.7	1,208

¹ Minimum number of samples per month required by Schedule B of BCDWPR and Island Health Drinking Water Officer

In 2019, the water quality samples were collected by Capital Regional District staff for compliance samples each month. The monthly average number of samples has exceeded minimum requirements of 93 samples per month with the least number of samples collected in the months of March and December with 94, see table 4.

5.0 Bacteriological and Physical Water Quality Results

The Canadian Council of Ministers of the Environment state that microbiological pathogens are considered to be the most significant threat to public drinking water affecting the public's health. The effects of microbiological pathogens are acute. If they are ingested, pathogens can give people gastro-intestinal illness within a matter of hours or days. In some cases, ingesting microbiological pathogens can result in permanent damage to internal organs or lead to chronic health issues. In the most severe instances, ingesting pathogens can be fatal.

5.1 Escherichia coli (*E. coli*)

E. coli is used as an indicator of the microbiological safety of drinking water. *E. coli* is a member of the coliform group of bacteria that is naturally found in the intestines of humans and warm blooded animals. No detectable presence in a 100mL water sample is the maximum acceptable concentration for potable water. Monitoring for *E. coli* provides information on the microbial condition of the distribution system. The presence of *E. coli* indicates recent fecal contamination and the potential presence of microorganisms capable of gastrointestinal illnesses. The absence of *E. coli* in drinking water generally indicates that the water system is free of gastrointestinal illness causing bacteria.

If *E. coli* is detected in a water sample, the BCDWPA stipulates that the lab conducting the analysis (CRD) must notify the water supplier (Saanich), the Drinking Water Officer, and the Medical Health Officer. In turn Saanich must also immediately notify the Drinking Water Officer and the Medical Health Officer. Together, an assessment will be made of the possible health risk to the public and the most effective means to protecting the public. The assessment will take into account past water samples, the temperature, turbidity, chlorine residual of the water sample as well as operational changes or disturbances creating low pressures and other relevant information. The water will be resampled immediately. If the risk assessment deems the water system is operating as expected, a decision may be made to wait for results from the second water sample to determine if further action is required.

In 2019, there were 1,208 water samples taken with 1 sample presenting an inconclusive *E. coli* result. The water sample presented some characteristics of *E. coli* during the test incubation period, but not all characteristics that would confirm a positive identification as *E. coli*. A follow up test of the remaining water sample also came back inconclusive. The District of Saanich and the Capital Regional District took an abundance of caution and proceeded to treat the water sample as an *E. coli* positive sample. The Drinking Water Officer and the Medical Health Officer were contacted immediately to advise them of the situation and the initial assessment by District staff and Capital Regional District Water Quality Lab. CRD lab confirmed that there had not been *E. coli* detected in the raw water entering Japan Gulch Treatment Plant from Sooke Lake. The District's assessment of the water distribution system around the water quality sample site confirmed there had not been any operational changes or disturbances in the recent past. The initial water sample had a very strong chlorine residual and low turbidity. Based on those factors, the Drinking Water Officer and the Medical Health Officer along with Saanich and CRD staff proceeded to resample and await results for confirmation of *E. coli* before further action taken. A re-sampling plan was quickly devised by the District and CRD water quality staff for re-sampling for confirmation of initial water quality result. The sample point was re-sampled as well as four other locations in the immediate vicinity. The District had prepared press releases as well as boil water advisories to go to local media and website as well as a comprehensive flushing plan in the event that the re-samples confirmed *E. coli*. The re-sample results showed no *E. coli* present for all five samples. The inconclusive *E. coli* event was likely caused by an anomalous test result. The *E. coli* event ultimately acted as a test exercise for the District of Saanich Waterworks Emergency Response Plan.

5.2 Total Coliforms

In 2019, there were 1,208 water samples taken with 14 testing positive for total coliforms. None of the positive samples exceeded the 10 CFU/100 ml total coliform concentration standard. The sampling stations that tested positive were immediately retested and subsequent results showed no total coliforms present. Therefore, there were no consecutive samples from the same sample site showing total coliforms which is in compliance with the BCDWPR. The remaining 1,207 water samples tested all passed the BCDWPR standard and Canadian Drinking Water Quality Guidelines.

Saanich Water Distribution system complied with the BCDWPR with all months exceeding 90% of samples with no coliform present. The annual average total coliform percentage positive was below the 10% limit at 1.1% (Table 4).

Coliform bacteria are used as operational indicators in water distribution systems. Their presence indicates water quality has degraded, possibly by bacterial regrowth or system contamination. Alternatively, coliform bacteria positive samples can also indicate contamination during sample collection.

Monitoring for total coliforms allows for the detection of changing conditions, intrusion of contaminants, or areas of reduced water quality, which can then be investigated and corrective actions determined.

Table 4 - Saanich Distribution System Bacteriological Water Quality 2019

Month	Bacterial Water Samples Collected	Total Coliforms				E.coli Samples > 0 CFU/100ml
		Samples TC > 0 CFU/100ml	TC > 0 Percent	Resamples TC > 0 CFU/100ml	Samples TC > 10 CFU/100ml	
January	101	2	2.0	0	0	0
February	96	1	1.0	0	0	0
March	94	0	0.0	0	0	0
April	110	3	2.7	0	0	0
May	110	1	0.9	0	0	0
June	100	2	2.0	0	0	0
July	99	1	1.0	0	0	0
August	99	2	2.0	0	0	1 ¹
September	102	1	1.0	0	0	0
October	106	0	0.0	0	0	0
November	97	1	1.0	0	0	0
December	94	0	0.0	0	0	0
Total	1,208	14	1.1	0	0	1 ¹

¹ Sample locations immediately retested and came back no E. coli present.

5.3 Chlorine Residual

The annual median chlorine residual in the Saanich Water Distribution System was 1.39 mg/L (Table 5). The lowest monthly median was in October and November (1.33 mg/L) and the maximum monthly median was in May (1.55 mg/L) (Figure 1). The recommended acceptable range concentration for chlorine in drinking water is 0.2 mg/L - 3.0 mg/L.

Chlorine is used to treat the raw water from Sooke Lake to produce potable, disinfected water. The Chlorine residual in the drinking water post treatment is there to safeguard against microbial regrowth or contamination in the drinking water system. Monitoring the chlorine residual in the drinking water system gives valuable information on the condition of the water currently in the system. A stable chlorine residual indicates that there is no microbial regrowth in the system. Alternately, if the chlorine residual were to suddenly decrease or disappear altogether would indicate that something has changed in the system and further investigation is needed to determine the cause to ensure that there has not been a contamination event in the water system.

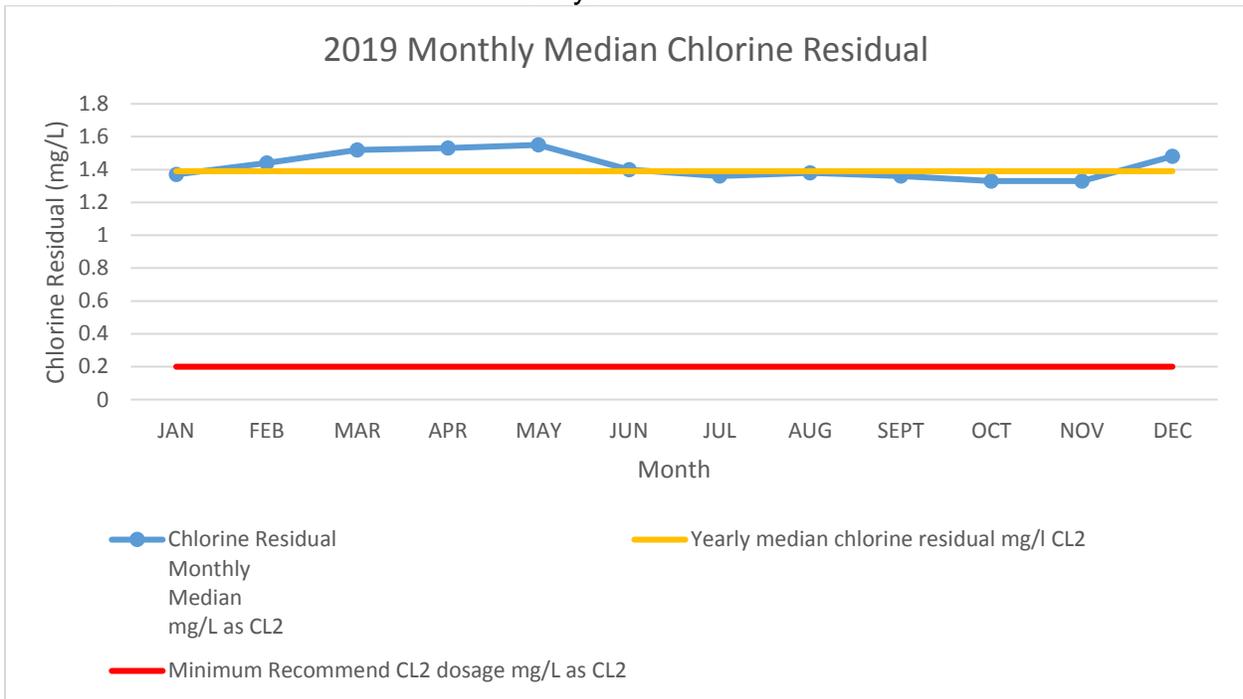


Figure 1 - 2019 Monthly Median Chlorine Residual

5.4 Water Temperature

The CRD's Sooke Lake Reservoir is a surface raw water source subject to a wide seasonal variation in temperatures which affects the water temperature within the Saanich Distribution System. Guidelines for Canadian Drinking Water Quality give temperature as an aesthetic objective of $\leq 15^{\circ}\text{C}$. Aesthetic objective limits apply to certain characteristics of the drinking water that can lower user acceptance due to the perceived palatability of the water. Temperatures above 15°C in the water system can lead to unpleasant tastes and odours. From a consumer perspective, cool water tastes better than warm water.

The annual median water temperature in the Saanich Water Distribution System was 11.95°C . Monthly medians ranged from 6.1°C in February to 19.2°C in August (Figure 2). Temperatures in the Saanich Distribution System stayed below the Aesthetic Objective limit for most of the year except the summer months.

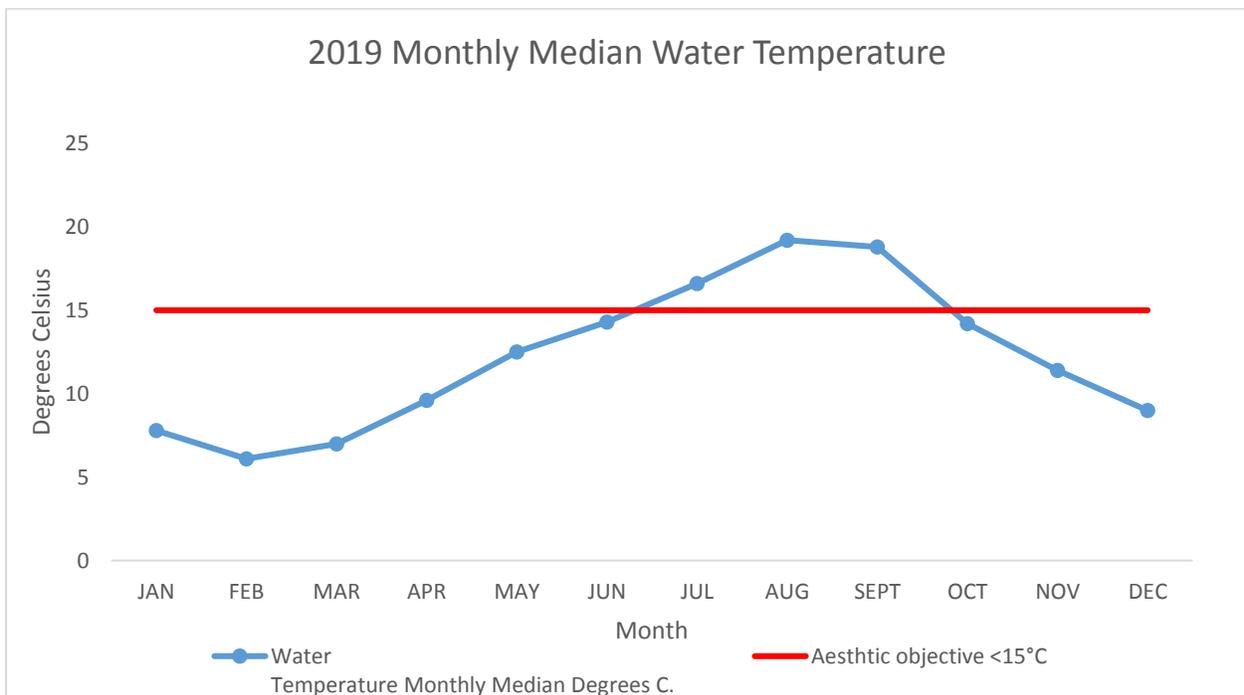


Figure 2 - 2019 Monthly Median Water Temperature (degrees Celsius)

5.5 Turbidity

Turbidity refers to the suspension of small particles of sediment or organic matter within water that causes a cloudy appearance. Turbidity is measured by the amount of light scattered by the particles within the water sample. Turbidity is measured in nephelometric turbidity units (NTU). Guidelines for Canadian Drinking Water Quality recommends that water entering a water distribution system have turbidity of 1.0 NTU or less.

In 2019, there were 51 turbidity samples taken at various locations within the distribution system with one sample exceeding the guidelines. Localized turbidity events were likely caused by water main flushing activities, fire hydrant use, and/or velocity/flow changes due to construction. The resulting dis-colouration or cloudiness can be an aesthetic concern to customers. Turbidity is generally temporary and flushing of cold water taps can clear up the water.

Table 5 - Saanich Distribution System Turbidity, Chlorine Residual, and Water Temperature 2019

Month	Turbidity		Chlorine Residual Monthly Median mg/l as CL2	Water Temperature Monthly Median Degrees C
	Samples Collected	Adverse > 1 NTU		
January	5	0	1.37	7.8
February	4	0	1.44	6.1
March	4	0	1.52	7.0
April	5	0	1.53	9.6
May	4	0	1.55	12.5
June	4	0	1.40	14.3
July	3	0	1.36	16.6 ¹
August	4	1	1.38	19.2 ¹
September	5	0	1.36	18.8 ¹
October	4	0	1.33	14.2
November	4	0	1.33	11.4
December	5	0	1.48	9.0
Total or Median	51	1	1.39	11.95

¹Exceeded Canadian Drinking Water Quality guidelines of $\leq 15^{\circ}\text{C}$

6.0 Lead in Drinking Water

In March of 2019, Health Canada revised the guideline for lead in drinking water. The maximum acceptable concentration (MAC) was lowered from 0.01 mg/L to 0.005 mg/L, based on a sample taken at the tap. More information on the background for this guideline revision and potential public health implication can be found in the reference links provided in Appendix B.

Lead is commonly found in the environment, both naturally and as a result of human activities. Lead is not known to be naturally occurring in the source water for Greater Victoria but can be found in drinking water where it has leached out of distribution and plumbing system components, particularly in aggressive (corrosive) water. Low pH is the most common cause of corrosive water. The extent of leaching depends on the type and age of plumbing materials, corrosiveness of the water, and the length of time that the water is stagnant in the plumbing fixtures.

Fortunately, lead service lines (the pipe connecting the municipal water main to the private water system at property line) were not commonly used in the Saanich Distribution system as they were in other parts of Canada. At this time, there are no known lead service lines in use. If a lead service line is found in use, Saanich policy is to immediately replace the water service. In the past ten years, only a handful of lead service lines have been found active in the distribution system and were subsequently replaced. Pipe materials and water stagnation on the private property side of the service remain a challenge for end point water quality. The District is actively working with the CRD on more data and information for homeowners around this topic.

In November 2019, data from the CRD showed that the water in Greater Victoria can be characterized as a low to moderate risk for corrosivity with a current mean pH of 7.6 and a mean alkalinity of 16.5 mg/L. Those values indicate that the water distribution network is not aggressively leaching lead or metals from pipes or fixtures.

6.1 Greater Victoria pH & Corrosion Study

Starting in August 2019, the District of Saanich partnered with the CRD, along with the City of Victoria, and the District of Oak Bay to commence the “Greater Victoria pH & Corrosion Study”. The study, under the lead of the CRD, assessed corrosiveness of the water in all parts of the water systems to identify areas with higher corrosion potential. The study examined factors such as corrosiveness index, the age of buildings, with the assumption that older homes in the region will likely have a higher likelihood of lead-containing plumbing fixtures.

The first phase of the study developed a comprehensive water sampling plan that covered all water systems in the study area utilizing existing infrastructure such as pump stations, valve stations, fire hydrants, reservoirs and water sampling stations. Water sampling occurred September to October 2019. Each sampling location was field tested for pH and temperature and a water sample was taken for laboratory testing of corrosivity relevant parameters, including total lead concentration. All sample locations tested in the Saanich Water Distribution system produced results that were lower than the maximum allowable concentration (MAC) of 0.005 mg/L (5 µg/L). The data produced from sampling locations within the distribution systems will be used to produce a corrosion potential map based on a corrosivity index for the Saanich Distribution System and all other systems sampled in the study.

The second phase of the study will occur in 2020 where the corrosion potential map and corrosivity index will be further refined to identify areas of higher corrosion potential and thus lead leaching potential in the distribution systems and in the plumbing systems of houses. Based on these results, areas of all the water distribution systems in the study will be selected to sample and test residential taps for lead concentrations in accordance with the Health Canada and BC Ministry of Health Guidelines. The residential samples will help indicate whether certain building age range would have a greater likelihood or concern for elevated lead levels than others due to leaching from the different pipe materials used. The final study results will indicate whether there are any issues around lead concentrations in drinking water in the Saanich Water Distribution System and the Greater Victoria Water Systems. More details on the report outcomes will be discussed in subsequent annual reports.

7.0 System Maintenance

Saanich undertakes daily, monthly, and annual maintenance functions to ensure that the drinking water system and its components are in good working order for reliability purposes in the event of emergency shut downs or repairs. These ongoing maintenance functions help to ensure that the system components have the longest service life possible and keep service disruptions to customers to a minimum.

7.1 Unidirectional Flushing Program

Saanich operates an annual Unidirectional Flushing Program to remove sediment and biofilm from the water mains in order to maintain good water quality. Unidirectional flushing involves isolating segments of the water system by closing valves in order to flush sequentially from source to periphery of system.

Removing sediment and biofilm is important as sediment in water mains gives bacteria a place to live and hide from the chlorine residual in the water. Sediment reduces the flow capacity of the pipe network and sediment and biofilm may get disturbed if normal flow patterns change during fire hydrant use or construction work. Flushing out the sediment on an annual basis helps maintain proper flow and reduce dirty water complaints.

The Saanich water distribution system consists of over 540 km of pipe. 286.3 km of water mains were flushed during the 2019 unidirectional flushing program. Due to the size of the distribution system, it typically takes two years to complete the whole program. The two largest water pressure zones in the system are flushed every other year with the remaining 29 pressure zones typically flushed yearly.

Table 6 - Kilometers of Water Main Flushed by Year

Year	Total Kilometers Flushed
2019	286.3
2018	244.2
2017	295.0
2016	319.2

7.2 Monthly Flush Program

Saanich operates an ongoing Monthly Flush Program to flush out water from dead end sections of water main to maintain water quality and reduce customer complaints caused by taste and odours. Dead end sections of water main tend to have higher water age (length of time from treatment to consumption) than other parts of the system. Typically the higher water age on these dead end water mains are because the localized customer demand is not enough to effectively exchange the water in the pipe adequately. These dead end sections are also more prone to sedimentation where particles that enter the water system from Sooke Lake Reservoir can settle out due to the low flow.

The locations that are currently part of the Monthly Flush Program have been determined by customer complaints, field data and observations from Saanich staff throughout the years. The Monthly Flush Program is used to pro-actively maintain water quality in the dead end water mains within the Saanich Distribution System by removing sediment and bringing in fresh water with a higher chlorine residual to help prevent microbial growth in these areas.

7.3 Valve Maintenance

Water distribution valves are installed in the system to isolate small areas for emergency maintenance or repairs. Saanich undertakes an extensive program of inspection, exercising (opening and closing), and maintenance of valves annually to ensure that valves operate when needed.

There are over 9,800 valves in the Saanich Water Distribution System. Due to the number of valves in the system it takes four to five years to complete the valve program. In 2019, staff exercised 2,224 valves which equates to 23% of all valves.

Table 7 - Water Valves Maintained by Year

Year	Total Valves Maintained
2019	2,224
2018	2,538
2017	2,573
2016	2,500

7.4 Hydrant Maintenance

The Saanich Water Distribution System has 2,312 fire hydrants. As part of the hydrant maintenance program 942 hydrants were inspected and serviced in 2019 to ensure proper operation. All hydrants are inspected and serviced on a 2 – 3 year cycle depending on operational efficiencies.

Table 8 - Hydrants Maintained by Year

Year	Total Hydrants Maintained
2019	942
2018	996
2017	891
2016	972

8.0 Summary

1. The water quality data collected in 2019 indicates that the drinking water in the Saanich Distribution System is of good quality and safe to drink. Temperatures in the Saanich Distribution System stayed below the Aesthetic Objective of 15°C for most of the year except during the summer months.
2. The 2019 average monthly number of samples taken (100.7) exceeds the British Columbia Drinking Water Protection Act and Regulation (93), for all months.
3. The Saanich Distribution System had one inconclusive *E. coli* positive sample in 2019. Immediate subsequent samples showed no presence of *E. coli* at the sample point. All other 1,207 *E. coli* samples in 2019 were negative for *E. coli*.
4. The Saanich Distribution System had less than the 10% Total Coliform standard for all months with a monthly average at 1.1%. The system was also in full compliance due to no samples exceeding the 10 CFU/ 100 ml limit. The sample results that had Total Coliforms were immediately retested and found no consecutive Total Coliform positive samples from the same sample sites. This likely is an indication that the positive samples were contaminated during original collection.
5. Saanich is actively participating in a regional pH and Corrosion study to understand the presence (or lack thereof) of lead in the distribution system in response to the new Health Canada guidelines.

Appendix B - References

Canadian Drinking Water Guidelines:

<https://www.canada.ca/en/health-canada/services/environmental-workplace-health/water-quality/drinking-water/canadian-drinking-water-guidelines.html>

Guidelines for Canadian Drinking Water Quality Summary Table 2017:

https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom-eng.pdf

From Source to Tap: Guidance on the multi-barrier approach to Safe drinking Water:

https://www.ccme.ca/files/Resources/water/source_tap/mba_guidance_doc_e.pdf

British Columbia Drinking Water Protection Act:

http://www.bclaws.ca/civix/document/id/complete/statreg/01009_01

British Columbia Drinking Water Protection Regulation:

http://www.bclaws.ca/civix/document/id/complete/statreg/200_2003

Guidelines for Canadian Drinking Water Quality – Lead Guideline Technical Document:

<https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-lead/guidance-document/guidance-document.pdf>