Lyall Harbour/Boot Cove Water Service

2023 Annual Report

CRD | Drinking Water

Introduction

This report provides a summary of the Lyall Harbour/Boot Cove Water Service for 2023 and includes a description of the service, summary of the water supply, demand and production, drinking water quality, operations highlights, capital project updates and financial report.

Service Description

The community of Lyall Harbour/Boot Cove is primarily a rural residential development with community and commercial properties located on Saturna Island in the Southern Gulf Islands Electoral Area which was originally serviced by a private water utility and in 1978 the service converted to the Capital Regional District (CRD). The Lyall Harbour/Boot Cove water service is made up of 171 parcels (Figure 1) encompassing a total area of approximately 100 hectares. Of the 171 parcels, 155 properties (164 Single Family Equivalent's) are connected to the water system.

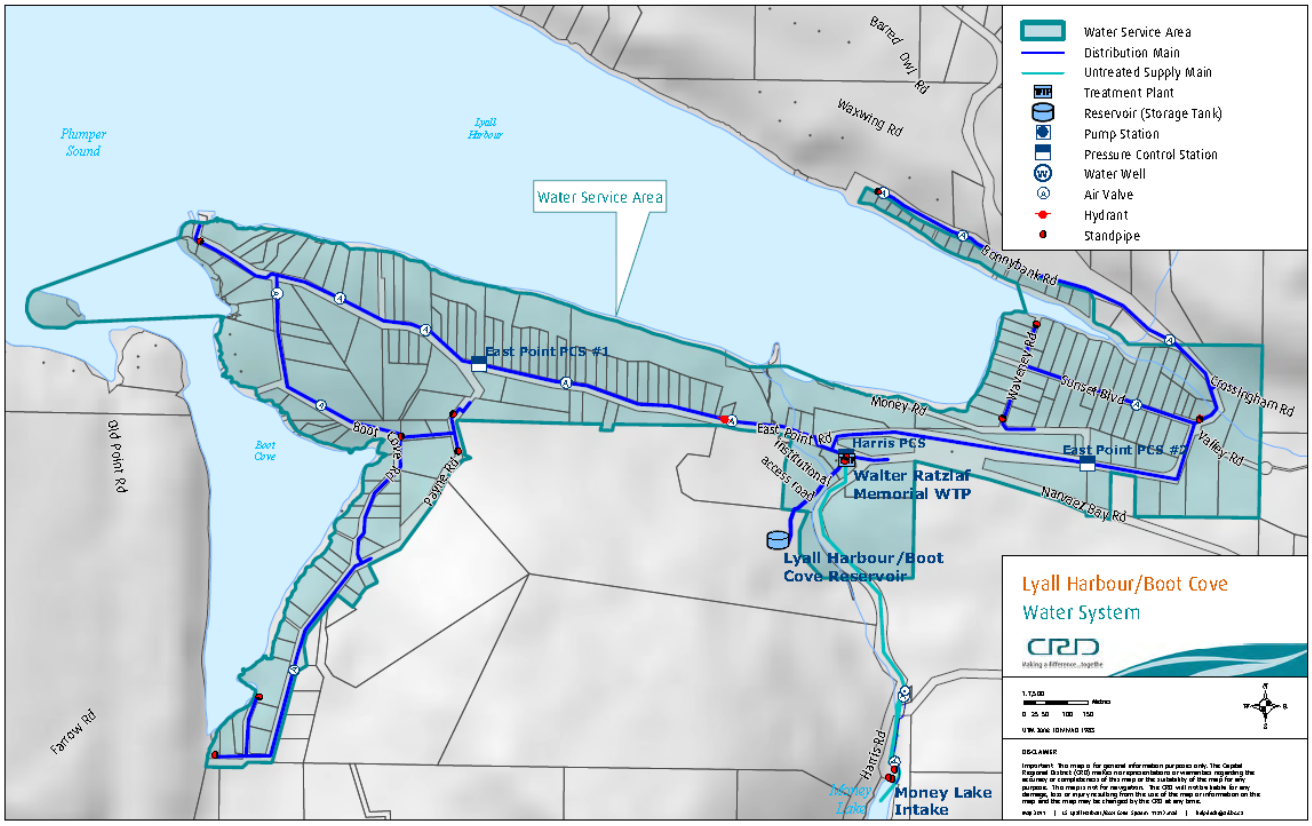

Figure 1: Map of Lyall Harbour/Boot Cove Water System

The Lyall Harbour/Boot Cove water system is primarily comprised of:

- Two raw water sources:
  - Money Lake, a small, impounded, surface water body that lies within a 94 hectare (230 acre) watershed on private and public lands.
  - Ground water spring (seepage pit) located near the base of Money Lake Dam.
- One earthen dam structure, Money Lake Dam No. 1.
- Treatment equipment including ozonation (currently offline), two stages of filtration (granular and absorption), ultraviolet light disinfection and chlorine disinfection.
- One steel storage tank (total volume 136 cubic meters or 36,000 US gallons).
- Supervisory Control and Data Acquisition (SCADA) system.
- Distribution system and supply pipe network (8,390 meters of water mains).
- Other water system assets: water service connections and meters, three pressure reducing valve stations, 50 gate valves, 12 standpipes and a small auxiliary generator.

Water Supply

Referring to Figure 2 below, Money Lake monthly water levels are highlighted for 2023. It is important to note that water supply levels in Money Lake, prior to 2008, were historically lower during the summer period. An upgrade to mitigate the low water levels involved the installation of a groundwater seepage spring recirculation pumping system. Excess water from the seepage spring is pumped back to Money Lake to keep the Lake as full as possible. The groundwater seepage spring water level is not monitored; however, the seepage spring weekly flow rate is monitored to confirm production rate. The seepage spring typically provides 100% of the winter water system demand for the community. Money Lake water is used periodically to supplement seepage spring flows, typically during the summer dry period.

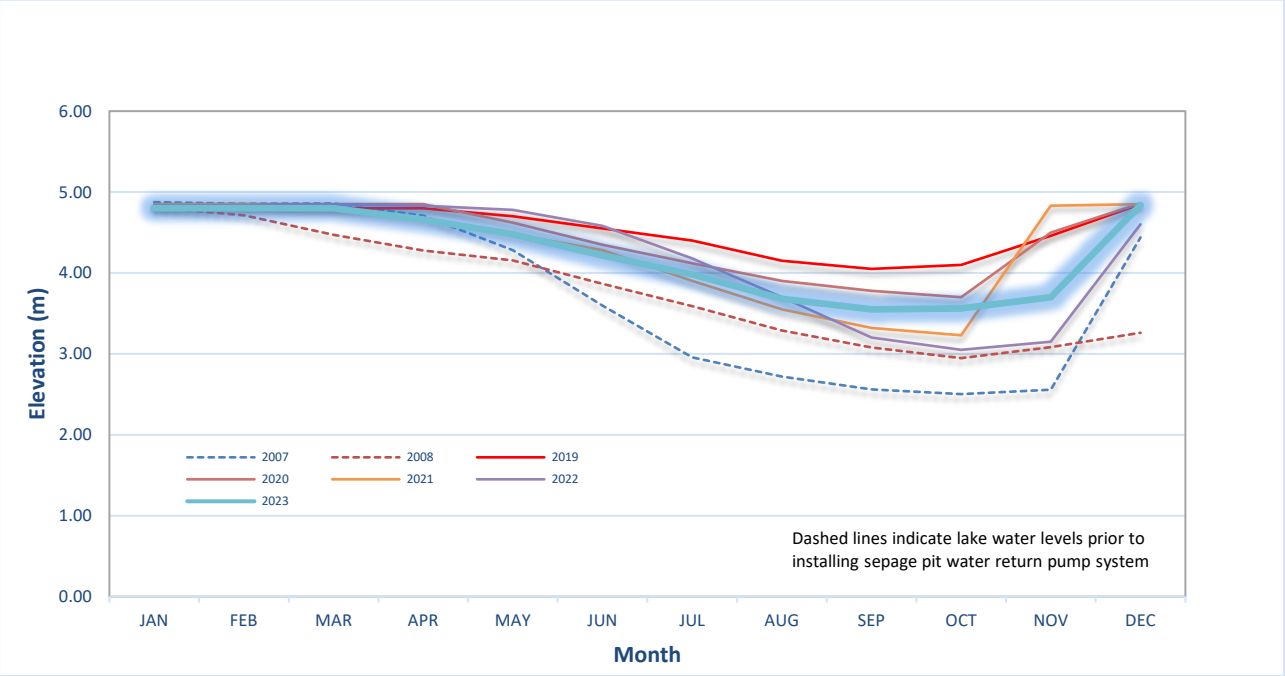

Figure 2: Money Lake Monthly Water Level

Water Production and Demand

Referring to Figure 3, 23,171 cubic meters of water was extracted (water production) from the seepage spring and Money Lake Reservoir in 2023; a 15% decrease from the previous year and a 7% decrease from the five-year average. Water demand (customer water billing) for the service totaled 19,534 cubic meters of water; 10% decrease from the previous year and an 1% increase from the five-year average.

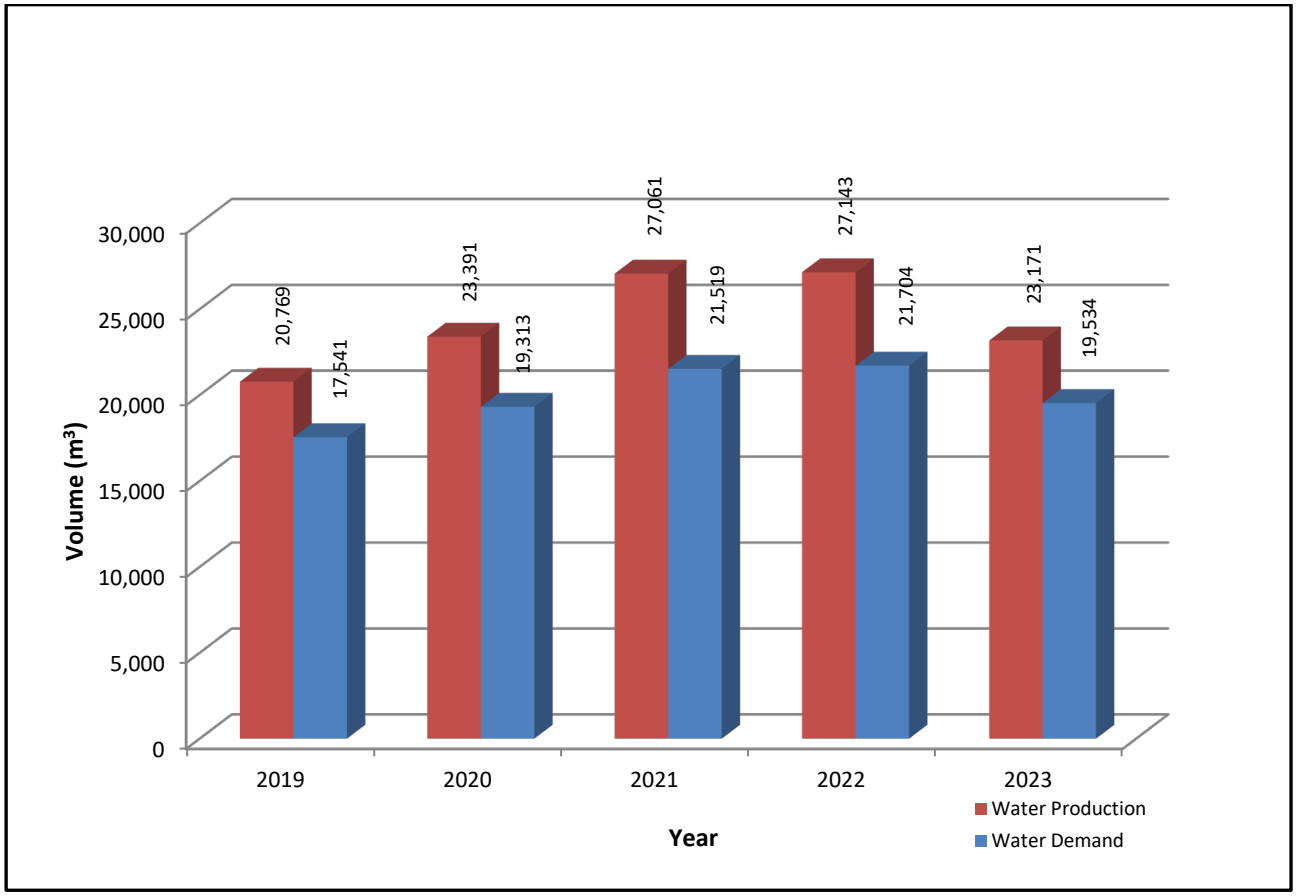

Figure 3: Lyall Harbour/Boot Cove Water System Annual Water Production and Demand

The difference between annual water production and annual customer demand is referred to as non-revenue water and can include water system leaks, water system maintenance and operational use (e.g. water main flushing, filter system backwashing), potential unauthorized use and fire-fighting use.

The 2023 non-revenue water (3,637 cubic meters) represents about 16% of the total water production for the service area. However, almost 14% of the total water can be attributed to operational use which includes water main flushing to keep chlorine residuals at acceptable levels at the extremities of the water system and water treatment filtration system backwashing activities. Therefore, the non-revenue water associated with system losses is approximately 2% which is considered acceptable for small water systems.

Figure 4 illustrates the monthly water production for 2023 along with the historical water production information. The monthly water production trends are typical for small water systems such as the Lyall Harbour/Boot Cove water system.

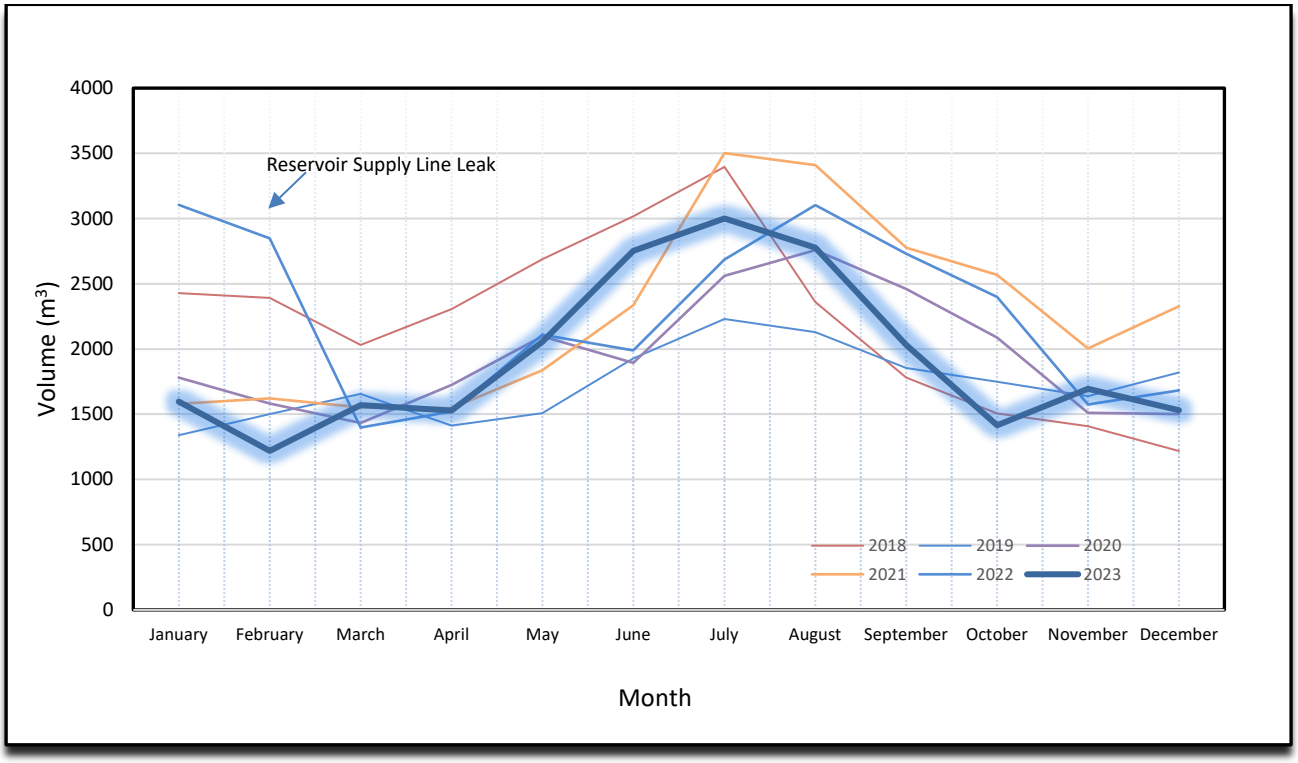

Figure 4: Lyall Harbour/Boot Cove Water Service Monthly Water Production

Drinking Water Quality

The Lyall Harbour/Boot Cove Water System uses predominantly seepage water collected from below the Money Lake dam as the primary raw water source. During the summer months this source is supplemented or completely replaced with flows from Money Lake. During summer and early fall 2023, all source water was supplied by Money Lake only, as the seepage water collection system ran dry. There is sufficient evidence to conclude that the seepage water is hydraulically connected to the lake source.

The Lyall Harbour/Boot Cove Water System experienced another challenging year in 2023. In total, it was under boil water advisories (BWA) for 179 days throughout the year. The first BWA was a continuation of a turbidity related event that has now developed into an annual pattern which sees the treated water turbidity starting to exceed one Nephelometric Turbidity Unit (NTU) in late fall and remaining above this threshold until the spring, typically until March. In 2023, this turbidity related BWA lasted even until April 21. On October 25, this annual winter turbidity pattern set in again and necessitated another BWA that lasted into 2024. CRD staff, in collaboration with scientists at the University of Victoria, concluded in a 2022 study that turbidity measurement interference likely contributes to this annual turbidity and BWA pattern. The study found evidence that dissolved organic matter interferes with the turbidity readings. CRD staff are working on a solution to this issue.

Between mid-June and mid-July, Money Lake experienced a strong cyanobacteria bloom. An even stronger cyanobacteria bloom occurred from early August to mid-October, with the peak in early September. Multiple cyanotoxin tests did not detect microcystin toxins in the raw water during these blooms.

These blooms did not pose a public health risk through the drinking water supplied. The annual average concentration for both regulated disinfection by-products, total Trihalomethanes (TTHM) and Haloacetic Acids (HAA), remained below the maximum acceptable concentration (MAC) in the Guidelines for Canadian Drinking Water Quality (GCDWQ).

The data below provides a summary of the water quality characteristics in 2023:

Raw Water:

- The raw water exhibited overall low concentrations of total coliform bacteria, with much higher concentrations during the summer and early fall months when lake water was the primary water source and water temperatures were high. Throughout most of the year, the raw water entering the treatment plant contained either none or only very low concentrations of *E. coli* bacteria.
- The raw water turbidity ranged from 0.9 to 18.2 NTU. The highest raw water turbidity period was recorded during a strong cyanobacteria bloom from mid-June to mid-July. The median annual raw water turbidity was 2.25 NTU.
- No *Giardia* cysts and no *Cryptosporidium* oocysts were detected in two sample sets in 2023.
- The raw water had naturally high concentrations of iron and manganese especially during the fall season. Elevated iron and manganese concentrations are typically released during the fall turnover event in Money Lake and can be compounded by the ground passage of the seepage water. Iron concentrations were especially high on November 15, likely because of the lake turnover event and in the wake of the first significant post-summer rainfalls in early November.
- The raw water was slightly hard (median hardness 40.1 mg/L $CaCO_3$).
- The natural total organic carbon (TOC) in the source water was moderately high (median 5.6 mg/L).
- The water had high colour, above the aesthetic objective in the GCDWQ in the fall and winter periods.

Treated Water:

- Outside the periods with a BWA, the treated water was safe to drink. No treated water sample from the distribution system tested positive for *E. coli* bacteria. Two distribution samples from July and September tested positive for total coliform bacteria. Immediate resamples from the same locations did not confirm an actual drinking water contamination.
- The treated water turbidity was regularly > 1 NTU from January to March and November/December and caused the two periods with BWAs. Investigations are underway to determine if the turbidity measurements could be affected by dissolved organic matter and whether such effect constitutes a risk to the safety of the drinking water or not. For this, a secondary turbidity analyzer with less interference from colour was installed in November 2023. Conclusions will be drawn after 1 year test period.
- The treated water TOC was periodically high within a range from 3.5 to 7.6 mg/L. The annual mean was 4.9 mg/L. There is currently no guideline in the GCDWQ for TOC levels, however TOC levels > 2 mg/L indicate a potential for disinfection by-product exceedances. TOC levels > 4 mg/L are usually a precursor for high disinfection by-product concentrations.
- As a result of a chlorination optimization process, the disinfection by-product (DBP) concentrations remained below the GCDWQ health limits. The annual average TTHM and HAA concentrations were 89.8 µg/L and 70.7 µg/L respectively and therefore below the MAC (100 µg/L and 80 µg/L respectively).

- Iron concentrations in exceedance of the aesthetic objective were found in distribution system samples from November and February. This was a result of high iron concentrations in the raw water and the lack of adequate treatment for metals. Manganese concentrations, while elevated in the raw water, were consistently low in the treated water. Elevated iron concentrations are not a health concern but can lead to discolouration of the drinking water which can be a nuisance for the customers. The newly established GCDWQ MAC for aluminum was not exceeded in 2023.
- The treated water had colour concentrations above the aesthetic objective throughout the fall and winter season.
- The annual median pH of the treated water was 6.2. This is well below the Health Canada recommended range of 7 - 10.5. Drinking water with low pH can cause corrosion issues on metallic pipes and fittings and potentially leach toxic metals such as lead into the drinking water. Lead in drinking water is typically not found in samples from distribution systems but in samples from building taps and faucets.

Table 1 and 2 below provide a summary of the 2023 raw and treated water test results.

Water quality data collected from this drinking water system can be also reviewed on the CRD website:

https://www.crd.bc.ca/about/data/drinking-water-quality-reports

Operational Highlights

The following is a summary of the major operational issues that were addressed by CRD Integrated Water Services staff:

- Operational effort due to the boil water advisory issued on October 18, 2022, and rescinded on April 21, 2023.
- System leak detection activities performed in January, April, May, and June because of low reservoir alarms due to high water demands. As a result, several leaks were identified to be on the private side of the system.
- Installed physical hand off auto switch (HOA) switch at Water Treatment Plant (WTP) to allow for operator control without use of SCADA.
- Replaced 2” isolation valve for standpipe at WTP.
- Installed and configured VPN connection and internet communications connection at WTP.
- Communications failure at WTP due to challenges with remote communications connection.
- Money Lake Line Leak Repair on Mill connection. Excavate, expose, and replace corroded fittings.
- Installation of second turbidimeter within WTP.
- Replacement of Chlorine Contact Tank isolation valves in March to allow for tank inspection that was completed November.
- Planned storage tank drain, clean and inspect completed in October.

Capital Project Updates

The Capital Projects that were in progress or completed in 2023 included:

1. Money Lake Dam - Dam Safety Review (Audit) Report - finalized. This report is a regulatory requirement and was funded by Community Works Funds.
2. Money Lake Dam Seismic Stability Assessment – finalized. The detailed 3D assessment was completed following the DSR Report to better understand the seismic hazards of the dam.
3. Dam Improvements – Geotechnical analysis was completed by Thurber Engineering including a draft toe filter design. Based on original design assessments, available funding is believed to be insufficient with the remaining Community Works Funds. CRD will continue to pursue grant funding opportunities but have discussed with the commission that options to secure debt will need to start being considered in 2024.

Financial Report

Please refer to the attached 2023 Statement of Operations and Reserve Balances.

Revenue includes parcel taxes (Transfers from Government), fixed user fees (User Charges), interest on savings Interest earnings), transfer from Operating Reserve Fund and miscellaneous revenue such as late payment charges (Other revenue).

Expenses include all costs of providing the service. General Government Services include budget preparation, financial management, utility billing and risk management services. CRD Labour and Operating Costs include CRD staff time as well as the cost of equipment, tools, and vehicles. Debt servicing costs are interest and principal payments on long term debt. Other Expenses include all other costs to administer and operate the water system, including insurance, supplies, water testing and electricity.

The difference between Revenue and Expenses is reported as Net revenue (expenses). Any transfers to or from capital or reserve funds for the service (Transfers to Own Funds) are deducted from this amount and are added to any surplus or deficit carry forward from the prior year, yielding an Accumulated Surplus (or deficit) that is carried forward to the following year.

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Attachments: Table 1
Table 2
2023 Statement of Operations and Reserve Balances

For questions related to this Annual Report please email IWSAdministration@crd.bc.ca

Table 1

Table 1: 2023 Summary of Raw Water Test Results, Lyall Harbour / Boot Cove Water System										
PARAMETER		**2023 ANALYTICAL RESULTS**				**CANADIAN GUIDELINES**	**2013-2022 ANALYTICAL RESULTS**			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum	Range Maximum
ND means Not Detected by analytical method used										
Physical/Biological Parameters										
Carbon, Total Organic	mg/L as C	**5.6**	12	3.5	7		5.03	114	3.2	18
Colour, True	TCU	**27.5**	12	10	88		19	65	9	RC 71
Hardness as $CaCO_3$	mg/L	**40.05**	4	36.8	43.3	No Guideline Required	43	71	34.7	52.2
pH	pH units	**6.35**	2	5.7	7	7.0 - 10.5 AO	6.81	27	6.2	7.52
Turbidity, Field Tests	NTU	**2.535**	68	1.22	18.2		3.125	352	0.67	36.1
Turbidity, Grab Samples	NTU	**2.25**	12	0.9	5		1.9	124	0.2	20.3
Water Temperature	Degrees C	**13.9**	102	1.3	22.3	15°C AO	10.8	472	-0.1	25.5
Metals										
Aluminum	ug/L as Al	**36.45**	4	10.4	145	2900 MAC / 100 OG	73.1	71	8.7	739
Antimony	ug/L as Sb	**< 0.5**	4	< 0.5	< 0.5	6 MAC	< 0.5	71	0.042	< 0.5
Arsenic	ug/L as As	**0.49**	4	0.34	0.6	10 MAC	0.4	71	0.22	1.06
Barium	ug/L as Ba	**3**	4	2.5	4.9	1000 MAC	3.3	71	1.47	40.4
Beryllium	ug/L as Be	**< 0.1**	4	< 0.1	< 0.1		< 0.1	71	< 0.01	< 3
Bismuth	ug/L as Bi	**< 1**	4	< 1	< 1		< 1	67	0.017	< 1
Boron	ug/L as B	**< 50**	4	< 50	< 50	5000 MAC	< 50	71	11	74
Cadmium	ug/L as Cd	**< 0.01**	4	< 0.01	< 0.01	7 MAC	< 0.01	71	< 0.01	< 0.1
Calcium	mg/L as Ca	**10.2**	4	9.32	11.3	No Guideline Required	10.8	71	8.65	13.2
Chromium	ug/L as Cr	**< 1**	4	< 1	< 1	50 MAC	< 1	71	0.15	< 10
Cobalt	ug/L as Co	**< 0.2**	4	< 0.2	< 0.2		< 0.2	71	0.022	< 20
Copper	ug/L as Cu	**2.33**	4	2.16	3.14	2000 MAC / ≤ 1000 AO	3.82	71	1.34	285
Iron	ug/L as Fe	**452.5**	4	188	1610	≤ 300 AO	273	73	25.6	1960
Lead	ug/L as Pb	**0.29**	4	< 0.2	0.46	5 MAC	0.24	71	<0.2	105
Lithium	ug/L as Li	**< 2**	4	< 2	< 2		2.13	39	< 2	20.1
Magnesium	mg/L as Mg	**3.525**	4	3.28	3.67	No Guideline Required	3.82	71	2.98	4.67
Manganese	ug/L as Mn	**45.5**	4	9.5	61.9	120 MAC / ≤ 20 AO	27.5	72	< 1	1370
Molybdenum	ug/L as Mo	**< 1**	4	< 1	< 1		< 1	71	0.065	< 20
Nickel	ug/L as Ni	**< 1**	4	< 1	< 1		< 1	71	0.353	< 50
Potassium	mg/L as K	**0.639**	4	0.509	0.889		0.659	71	0.387	1.36
Selenium	ug/L as Se	**< 0.1**	4	< 0.1	< 0.1	50 MAC	< 0.1	71	< 0.04	< 0.5
Silicon	mg/L as Si	**7270**	4	5840	8660		7310	71	2750	10100
Silver	ug/L as Ag	**< 0.02**	4	< 0.02	< 0.02	No Guideline Required	< 0.02	71	< 0.005	< 40
Sodium	mg/L as Na	**8.715**	4	7.77	9	≤ 200 AO	9.11	71	6.44	13.2
Strontium	ug/L as Sr	**93.75**	4	80.2	99.4	7000 MAC	95.8	71	70	120
Sulfur	mg/L as S	**< 3**	4	< 3	< 3		< 3	67	< 3	6.1
Tin	ug/L as Sn	**< 5**	4	< 5	< 5		< 5	71	0.46	65
Titanium	ug/L as Ti	**< 5**	4	< 5	7.5		< 5	71	1.44	65
Thallium	ug/L as Tl	**< 0.01**	4	< 0.01	< 0.01		< 0.01	67	0.008	< 0.05
Uranium	ug/L as U	**< 0.1**	4	< 0.1	< 0.1	20 MAC	< 0.1	67	0.007	< 0.1
Vanadium	ug/L as V	**< 5**	4	< 5	< 5		< 5	71	0.5	< 10
Zinc	ug/L as Zn	**6.55**	4	5.8	8.1	≤ 5000 AO	9.2	71	< 1	258
Zirconium	ug/L as Zr	**0.11**	4	< 0.1	0.25		0.17	67	< 0.1	0.57
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	**170**	11	10	7300		105	119	<1	9200
E. coli	CFU/100 mL	**< 1**	11	< 1	15		< 1	121	<1	29
Hetero. Plate Count, 35C (2 day)	CFU/1 mL	Not tested in 2023					2200	2	1100	3300
Parasites										
Cryptosporidium, Total oocysts	oocysts/100 L	**< 1**	2	< 1	< 1	Zero detection desirable	< 1	19	< 1	2.8
Giardia, Total cysts	cysts/100 L	**< 1**	2	< 1	< 1	Zero detection desirable	< 1	19	< 1	< 1
Algal Toxins										
Microcystin	ug/L	<1	10	<1	<1	1.5 ug/L MAC	<1	27	<1	<1

Table 2

Table 2: 2023 Summary of Treated Water Test Results, Lyall Harbour / Boot Cove Water System										
PARAMETER		**2023 ANALYTICAL RESULTS**				**CANADIAN GUIDELINES**	**2013-2022 ANALYTICAL RESULTS**			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Min.	Range Max.	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum	Range Maximum
ND means Not Detected by analytical method used										
Physical Parameters										
Carbon, Total Organic	mg/L as C	**4.9**	16	3.5	7.6		4.395	152	1.1	66.9
Colour, True	TCU	**16**	24	2	> 50		7	60	< 2	40
pH	No units	**6.2**	2	5.9	6.5	7.0 - 10.5 AO	6.795	20	6.3	8
Hardness	mg/L as CaCO3	**40.2**	8	37.2	43.6		43.2	63	37.2	50.1
Turbidity	NTU	**0.85**	24	0.3	3.4	1 MAC and ≤ 5 AO	0.955	206	0.18	5.3
Turbidity, Field Tests	NTU	**0.79**	39	0.32	3.8		0.81	340	0.09	4
Water Temperature	Degrees C	**9.4**	209	4.5	19.4	≤ 15 AO	11.3	1780	0	RES 20.8
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	**< 1**	99	< 1	65	0 MAC	< 1	815	0	A 460
E. coli	CFU/100 mL	**< 1**	99	< 1	< 1	0 MAC	< 1	817	<1	1
Hetero. Plate Count, 7 day	CFU/1 mL	**1950**	40	< 10	15,000	No Guideline Required	610	119	< 10	A 24000
Algal Toxins										
Algal Toxins										
Microcystin	ug/L	Not tested in 2023				1.5 ug/L MAC	<1	3	<1	<1
Disinfectants										
Disinfectants										
Chlorine, Free Residual	mg/L as Cl2	**0.18**	189	0.02	5.7	No Guideline Required	0.35	1802	0.01	8.8
Chlorine, Total Residual	mg/L as Cl_2	Not tested in 2023				No Guideline Required	0.51	1394	0.01	8.8
Disinfection By-Products										
Haloacetic Acids										
HAA5	ug/L	**60**	3	12	140	80 MAC	52	29	< 0.1	160
Trihalomethanes (THMs)										
Bromodichloromethane	ug/L	**14**	4	12	15		15	44	0.643	40.6
Bromoform	ug/L	**< 1**	4	< 1	< 1		< 1	44	< 0.1	< 1
Chloroform	ug/L	**66.5**	4	52	110		80	44	7.26	250
Chlorodibromomethane	ug/L	**1.2**	4	< 1	1.6		1.6	44	<0.1	31
Total Trihalomethanes	ug/L	**82**	4	65	130	100 MAC	99	44	7.9	EXG 280
Metals										
Aluminum	ug/L as Al	**21.35**	8	6.7	115	2900 MAC / 100 OG	18.1	63	7.3	138
Antimony	ug/L as Sb	**< 0.5**	8	< 0.5	< 0.5	6 MAC	< 0.5	63	0.035	< 50
Arsenic	ug/L as As	**0.385**	8	0.28	0.49	10 MAC	0.34	63	0.2	0.8
Barium	ug/L as Ba	**2.75**	8	2.4	3.5	1000 MAC	2.5	63	1.5	16.1
Beryllium	ug/L as Be	**< 0.1**	8	< 0.1	< 0.1		< 0.1	63	< 0.01	< 0.1
Bismuth	ug/L as Bi	**< 1**	8	< 1	< 1		< 1	63	0.005	< 1
Boron	ug/L as B	**< 50**	8	< 50	< 50	5000 MAC	< 50	63	13	< 50
Cadmium	ug/L as Cd	**< 0.01**	8	< 0.01	< 0.01	7 MAC	< 0.01	63	< 0.005	0.087
Calcium	mg/L as Ca	**10.15**	8	9.44	11.3	No Guideline Required	10.9	63	9.55	13.2
Chromium	ug/L as Cr	**< 1**	8	< 1	< 1	50 MAC	< 1	63	< 0.1	< 10
Cobalt	ug/L as Co	**< 0.2**	8	< 0.2	< 0.2		< 0.2	63	0.01	< 0.5
Copper	ug/L as Cu	**26.4**	8	9.74	71.1	2000 MAC / ≤ 1000 AO	31.7	63	2.14	595
Iron	ug/L as Fe	**297**	8	68.2	1290	≤ 300 AO	118	65	28.8	EXG 1670
Lead	ug/L as Pb	**0.96**	8	0.47	2.29	5 MAC	0.915	63	<0.2	25.8
Lithium	ug/L as Li	**< 2**	8	< 2	< 2		< 2	34	1.74	< 5
Magnesium	mg/L as Mg	**3.585**	8	3.29	3.72	No Guideline Required	3.87	63	3.2	4.53
Manganese	ug/L as Mn	**3.75**	8	1.4	12.4	120 MAC / ≤ 20 AO	1.7	65	< 1	26.3
Molybdenum	ug/L as Mo	**< 1**	8	< 1	< 1		< 1	63	0.076	< 1
Nickel	ug/L as Ni	**1.05**	8	< 1	2.7		1.5	63	0.288	80.9
Potassium	mg/L as K	**0.6575**	8	0.514	0.868		0.681	63	0.479	0.956
Selenium	ug/L as Se	**< 0.1**	8	< 0.1	< 0.1	50 MAC	< 0.1	63	< 0.04	0.12
Silicon	mg/L as Si	**7135**	8	5940	8800		7220	63	2970	8850
Silver	ug/L as Ag	**< 0.02**	8	< 0.02	< 0.02	No Guideline Required	< 0.02	63	< 0.005	< 0.02
Sodium	mg/L as Na	**11.05**	8	10.1	14.4	≤ 200 AO	11.6	63	9.26	15.6
Strontium	ug/L as Sr	**95.9**	8	80.5	99.4	7000 MAC	96.2	63	81.5	121
Sulfur	mg/L as S	**< 3**	8	< 3	< 3		< 3	63	< 3	5.6
Tin	ug/L as Sn	**< 5**	8	< 5	< 5		< 5	63	< 0.2	47.8
Titanium	ug/L as Ti	**< 5**	8	< 5	6.1		< 5	63	0.79	9.3
Thallium	ug/L as Tl	**< 0.01**	8	< 0.01	< 0.01		< 0.01	63	< 0.002	< 0.05
Uranium	ug/L as U	**< 0.1**	8	< 0.1	< 0.1	20 MAC	< 0.1	63	0.008	< 0.1
Vanadium	ug/L as V	**< 5**	8	< 5	< 5		< 5	63	0.48	< 5
Zinc	ug/L as Zn	**26.05**	8	16.3	39.4	≤ 5000 AO	26.6	63	< 5	102
Zirconium	ug/L as Zr	**< 0.1**	8	< 0.1	0.46		0.12	63	< 0.1	0.66