Fernwood and Highland Water Service

2022 Annual Report

CRD | Drinking Water

INTRODUCTION

This report provides a summary of the Fernwood and Highland Water Service for 2022. It 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

In 2010 the Highland and Fernwood water services merged to construct new water treatment plant to operate as a single water system. Both former water services hold legacy budgets to repay existing debt and outstanding capital works. The service obtains its drinking water from St. Mary Lake, which lies within an uncontrolled multi-use watershed. The Capital Regional District (CRD) holds five licenses to divert a total of up to 230,000 m^3 per year and store up to 30,800 m^3. St. Mary Lake is subject to seasonal water quality changes and is affected by periodic algae blooms.

The Highland service was first developed in the 1970's under the name Vesuvius Holdings and was converted to the Highland Water System in 1978. It then became a CRD service in 2004. The Fernwood service was created in the 1970's by a private developer and was converted to the Fernwood Improvement Water District in 1984. It then became a Capital Regional District (CRD) service in 1989. The Fernwood and Highland Water Service (Figure 1) is comprised of 333 parcels of land with 321 of those parcels connected to the service.

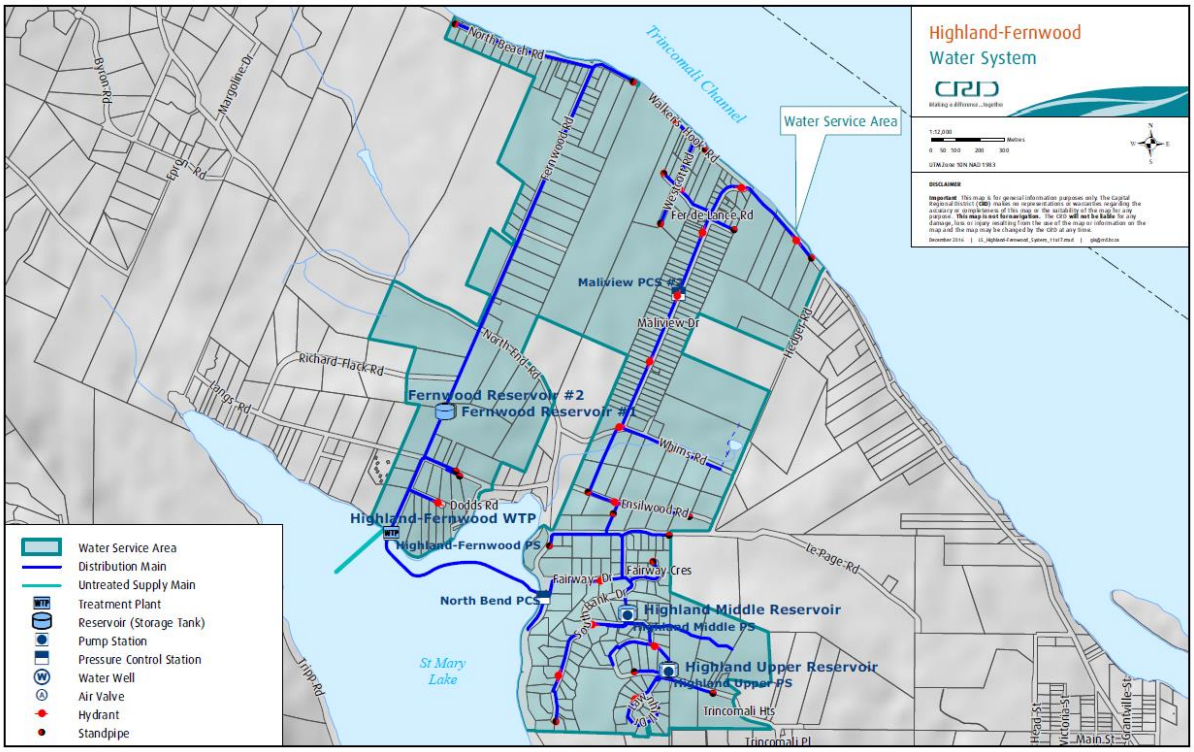

Figure 1: Fernwood and Highland Water Service

The Fernwood and Highland water system is primarily comprised of:

- a water treatment plant (WTP) that draws water from St. Mary Lake and treats it at a location on Maycock Road, adjacent to the lake. The water is treated using a rapid mix system, flocculation, dissolved air floatation (DAF) and filters, ultraviolet disinfection, then chlorination prior to being pumped, via the distribution system to two different reservoirs. The WTP design flow rate is 11.3 l/sec (150 Igpm);
- one raw water pump station on Maycock Road, adjacent to the lake. (flow rate of two pumps running is 4.6 l/sec (60 Igpm);
- approximately 12,000 m of water distribution pipe
- 4 water reservoirs – one 180 m^3 (40,000 Ig) on the Highland system, one 91 m^3 (20,000 Ig) on the Highland system, one 45 m^3 (10,000 Ig) on the Fernwood system and, one 91 m^3 (20,000 Ig) on the Fernwood system
- 2 water system booster pumps:
  - Highlands Middle Reservoir
  - Highlands Upper Reservoir
- fire hydrants, standpipes, and gate valves
- water service connections complete with water meters
- 2 pressure reducing valve stations - one on North End Road and one on Maliview Drive.

WATER PRODUCTION AND DEMAND

Referring to Figure 2, 71,233 cubic meters (m^3) of water was extracted (water production) from St. Marys Lake in 2022; a 4% increase from the previous year and a 9% decrease from the five-year rolling average. Water demand (customer water billing) for the service totalled 55,308 m^3 of water; a 5% increase from the previous year and a 9% increase from the five-year rolling average.

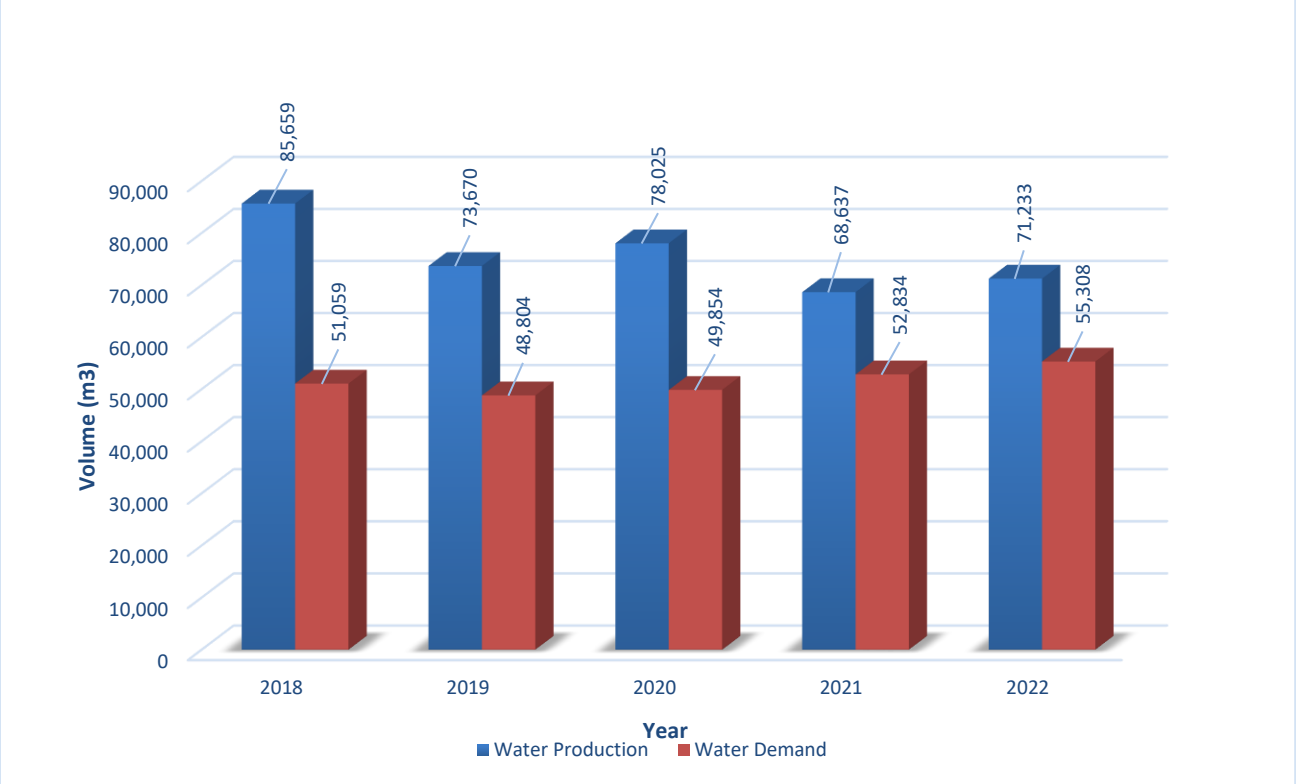

Figure 2: Fernwood and Highland Water Service Annual Water Production and Demand

Water production by month for the past five years is shown in Figure 3. As with most water systems, water consumption follows a typical diurnal pattern where the monthly total flow peaks during the summer months. The 2022 monthly flow information is indicative of this diurnal pattern. However, for prior years it can be seen that the monthly flow trending does not follow this pattern and is indicative of water system leaks that influence and skew monthly water production data, 2018 case in point.

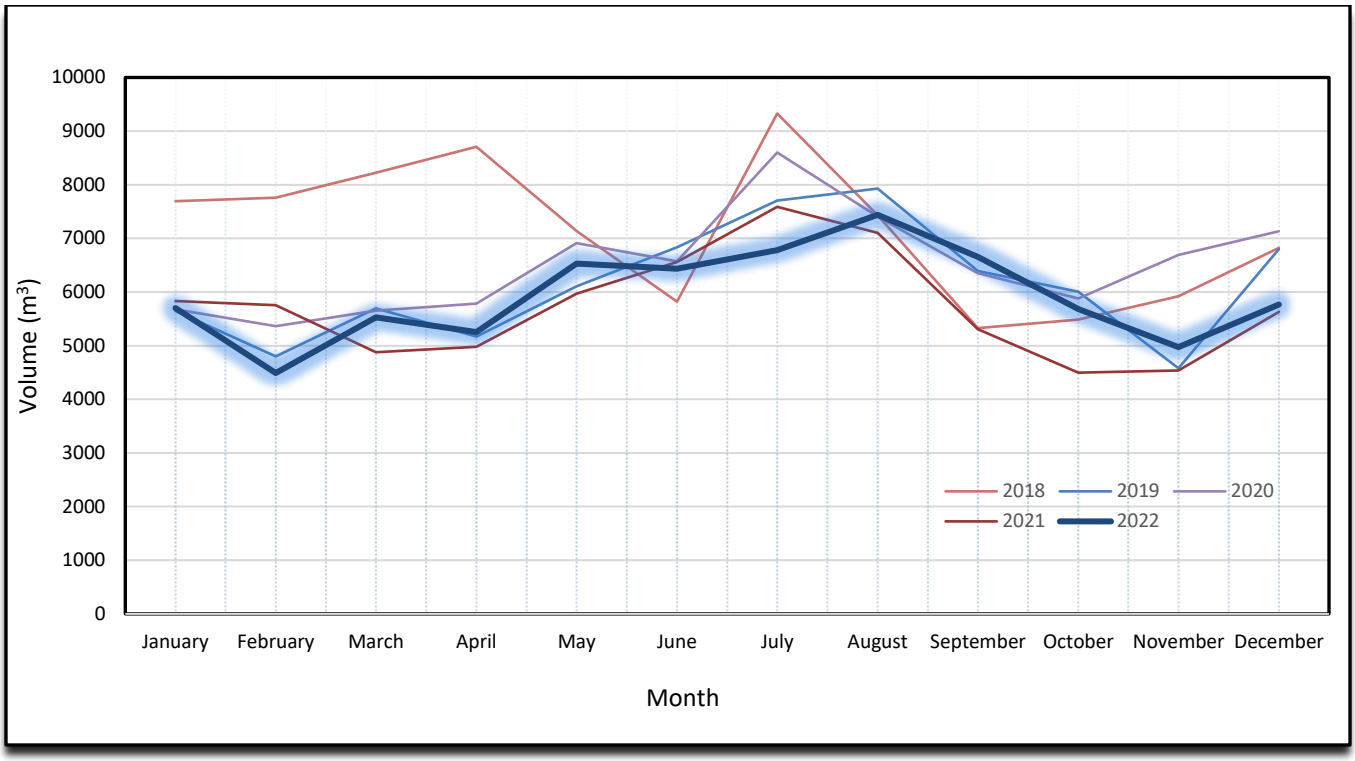

Figure 3: Fernwood and Highland Water Service Monthly Water Production

The Fernwood and Highland Water System is fully metered, and water meters are read quarterly. Water meters are manually read on a quarterly basis and the data enables water production and consumption to be compared in order to estimate leakage losses in the distribution system. The difference between water produced and water demand (total metered consumption) is called non-revenue water and includes distribution leaks, meter error, and unmetered uses such as fire hydrant usage, distribution system maintenance, and process water for the treatment plant. Non-revenue water is approximately 22%. Water loss is estimated to be approximately 19% which is considered low for a small water system such as Fernwood and Highland.

WATER QUALITY

In 2022, the analytical results (biological, chemical and physical parameters) of water samples collected from the Highland/Fernwood Water Systems indicated that the drinking water supplied to the customers was generally of good quality. The Highland distribution system experienced a water main break that led to a partial Boil Water Advisory (BWA) Sept 20 –23). Also, St. Mary Lake experienced an almost continuous cyanobacteria bloom with particularly high activity from April to June and again from September to October. Various species of potentially toxin producing cyanobacteria were responsible for these blooms but all samples taken from the intake of the Highland/Fernwood Water System tested negative for microcystin, a cyanotoxin frequently associated with such blooms. During these algal events, the Highland/Fernwood water treatment plant was able to produce safe and good quality drinking water.

The data below provides a summary of the water quality characteristics in 2022:

Raw Water:

- The raw water exhibited typically low concentrations of total coliform and *E.coli* bacteria throughout the cold weather periods, but much higher spikes during the summer.
- No parasitic *Cryptosporidium* oocysts or *Giardia* cysts were detected in 2022.
- The analyses of raw water samples indicated low concentrations of iron and but elevated concentrations of manganese in the fall (November).
- The raw water was slightly hard (median hardness 36.65 mg/L $CaCO_3$).
- The raw water turbidity (cloudiness) was below or near 1 NTU during the winter and summer months, but well over 1 NTU in the spring (April – June; up to 16 NTU) and in the fall (September – October; up to 4.2 NTU). These episodes of high raw water turbidity were the result of strong cyanobacteria blooms.
- A median annual total organic carbon (TOC) concentration of 3.35 mg/L confirms the mesotrophic (semi-productive) to eutrophic (productive) status of St. Mary Lake.
- Cyanobacteria blooms of various species occurred almost all year long in St Mary Lake. Despite the blooms of potentially toxin producing cyanobacteria species, no cyanotoxins (microcystin) were detected in the raw water entering the treatment plant in 2022.

Treated Water:

- The treated water was safe to drink outside the period with a BWA; no indicator bacteria were detected in any Fernwood Distribution System or Highland System sample throughout the year.
- The treated water turbidity was typically well below the turbidity limit of 1.0 NTU throughout the year in most parts of the system. However, a few standpipes in the Highland system occasionally registered elevated turbidity. These low flow locations need to be flushed regularly to remove accumulated pipe sediments.
- The levels of regulated disinfection by-products trihalomethanes (THM) were well below the limits in the GCDWQ (100 µg/L) across the Fernwood and the Highland Distribution System. Haloacetic acids (HAA) were not tested for in 2022. As long as THM concentrations are low, HAA tests are only performed every 5 years to verify baseline conditions. The last HAA tests were done in 2021.
- The treated water total organic carbon concentration (TOC) in both distribution systems was similar to 2021, ranging from 1.6 to 1.8 mg/L in the Fernwood Distribution System, and 1.2 to 1.9 mg/L in the Highland Distribution System. There is currently no guideline in the GCDWQ for TOC levels, however the USEPA suggests a treated water TOC concentration of < 2 mg/L as confirmation of effective treatment and disinfection by-product control.
- Iron and/or manganese concentrations, which can lead to water discolouration if present in elevated concentrations, have been below the aesthetic guideline limits throughout both distribution systems.

Table 1, 2 and 3 below provide a summary of the 2022 raw and treated water test results.

Water Quality data collected from these two distribution systems can be reviewed on the following 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:

- Emergency response to water system breaks at:
    - Lawnhill Road (resulted in issuing a boil water advisory for a portion of the service area impacted by the watermain break)
    - 307 Maliview Drive (water service line connection)
    - 308 Maliview Drive (water service line connection)
    - 252 Maliview Drive (water service line connection)
    - 196 Maliview Drive (resulted in issuing a boil water advisory for a portion of the service area impacted by the watermain break)
    - 150 Trincomali Drive (water service line connection)
    - 234 Trincomali Drive (water service line connection)
    - 216 Fairway Crescent (water service line connection)
    - Maliview pressure regulating station valve troubleshooting and rebuild
- Water Treatment Plant:
    - UV system repairs (replace UV sensor) and electronic adjustments
    - Replace faulty hand-off-auto (HOA) electronic control switches
    - Replace rinse tank pressure transducer
    - Troubleshooting and rebuild of backflow prevention equipment
    - Repairs dissolved air floatation (DAF) water turbidity meter
- Distribution System:
    - Maliview pressure regulating station valve troubleshooting and rebuild
    - Highlands Upper Pump Station check valve troubleshooting and replacement

CAPITAL IMPROVEMENTS

Fernwood and Highland Water Capital Projects

The following is a summary of the major capital improvements including year ending spending for 2022:

Water Intake and Screen (CE.677.7500): Fernwood water intake has not been performing as it should. Investigation and design of a new intake was commenced by a consultant engaged by the CRD. Detailed design is essentially complete with construction scheduled to take place in 2023.

Project	Spending
Budget	$147,000
Project Management	($9,536)
Designs	($31,228)
Balance Remaining	**$106,236**

Safe Work Procedures (CE.699.4501): The work scope includes reviewing and developing safe work procedures for operational and maintenance tasks. On-going as capital improvements necessitate.

Project	Spending
Budget	$17,000
Project Management	($444)
Contract	($3,386)
Balance Remaining	**$13,170**

Waste Pump Design and Construction (CE.707.7500): The control panel and pump for the DAF waste pump at the Fernwood and Highland water treatment plant requires replacement. Investigation and design of a new waste pump will be completed by a consultant engaged by the CRD.

Project	Spending
Budget	$80,000
Project Management	($7,710)
Designs	($14,247)
Balance Remaining	**$58,043**

Highland Upper Reservoir (CE.360.4655): The Highland Upper Reservoir requires replacement. Investigation and design of a new reservoir is in progress by a consultant engaged by the CRD.

Project	Spending
Budget	$123,179
Project Management	($12,782)
Designs	($27,629)
Balance Remaining	**$82,768**

Power Generation Equipment - Design (CE.735.4501): Preliminary and detailed design for back-up power generation for the service.

Project	Spending
Budget	$49,000
Project Management	($8,346)
Designs	($9,269)
Balance Remaining	**$31,385**

2022 FINANCIAL REPORT

Please refer to the attached 2022 Statement of Operations and Reserve Balances.

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

Expenses includes all costs of providing the service. General Government Services includes budget preparation, financial management, utility billing and risk management services. CRD Labour and Operating Costs includes CRD staff time as well as the costs of equipment, tools, and vehicles. Debt servicing costs are interest and principal payments on long term debt. Other Expenses includes 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 it is then added to any surplus or deficit carry forward from the prior year, yielding an Accumulated Surplus (or deficit). In alignment with Local Government Act Section 374 (11), any deficit must be carried forward and included in the next year's financial plan.

WATER SYSTEM PROBLEMS - WHO TO CALL:

To report any event or to leave a message regarding the Highland/Fernwood Water System, call either:

CRD water system *emergency* call centre: **1-855-822-4426 (toll free)**
1-250-474-9630 (toll)
CRD water system *general enquiries* (toll free): **1-800-663-4425**

When phoning with respect to an emergency, please specify to the operator, the service area in which the emergency has occurred.

Submitted by:	Jason Dales, Senior Manager B.Sc, WD IV, Infrastructure Operations
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Attachment:

2022 Statement of Operations and Reserve Balances

Highland/Fernwood Water

Highland Water (Debt Service)

Fernwood Water (Debt Service)

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

Table 1: 2022 Summary of Raw Water Test Results, Highland / Fernwood Water System

PARAMETER		2022 ANALYTICAL RESULTS				CANADIAN GUIDELINES	2012 - 2021 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	**3.35**	4	3.10	3.50		3.84	24	2.80	5.67
Chlorophyll	ug/L	**1.52**	2	0.84	2.20		5.55	26	1.29	17.50
Colour, True	TCU	**6.00**	19	3.00	8.00		6.00	94	3.00	25.00
Hardness as $CaCO_3$	mg/L	**36.65**	4	36.40	38.50	No Guideline Required	38.90	31	28.10	46.10
pH	pH units	Not tested in 2022				7.0 - 10.5 AO	7.83	25	7.18	8.90
Turbidity	NTU	**1.15**	18	0.50	16.00		1.10	274	0.33	27.10
Water Temperature	°C	**14.00**	36	5.00	25.00	15°C AO	16.00	117	5.00	25.00
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	**31**	18	< 1	302		60	187	<1	6000
E. coli	CFU/100 mL	**< 1**	18	< 1	4		< 1	188	< 1	180
Hetero. Plate Count, 7 day	CFU/1 mL	Last analyzed in 2013								
Algal Toxins										
Microcystin (Abraxis)	ug/L	**<1**	37	<1	<1	1.5	<1	101	<1	<1
Cryptosporidium , Total oocysts	oocysts/100 L	**< 1**	2	< 1	< 1	Zero detection desirable	< 1	20	< 1	1.92
Giardia , Total cysts	cysts/100 L	**< 1**	2	< 1	< 1	Zero detection desirable	< 1	20	< 1	1.2
Metals										
Aluminum	ug/L as Al	**9**	4	< 3	17.3	2900 MAC / 100 OG	< 10	32	< 3	108
Antimony	ug/L as Sb	**< 0.5**	4	< 0.5	< 0.5	6 MAC	< 0.5	32	0.05	< 10
Arsenic	ug/L as As	**0.49**	4	0.42	0.73	10 MAC	< 0.5	32	0.32	0.85
Barium	ug/L as Ba	**13.15**	4	12.4	14.4	100 MAC	12	32	< 1	15.1
Beryllium	ug/L as Be	**< 0.1**	4	< 0.1	< 0.1		< 0.1	32	< 0.01	< 3
Bismuth	ug/L as Bi	**< 1**	4	< 1	< 1		< 1	26	< 0.005	< 1
Boron	ug/L as B	**< 50**	4	< 50	51	5000 MAC	< 50	32	43	343
Cadmium	ug/L as Cd	**< 0.01**	4	< 0.01	< 0.01	5 MAC	< 0.01	32	< 0.005	0.1
Calcium	mg/L as Ca	**9.455**	4	9.32	10	No Guideline Required	10	32	7.85	12.3
Chromium	ug/L as Cr	**< 1**	4	< 1	< 1	50 MAC	< 1	32	< 0.1	< 10
Cobalt	ug/L as Co	**< 0.2**	4	< 0.2	1.23		< 0.2	32	0.0264	< 20
Copper	ug/L as Cu	**1.365**	4	0.93	2.75	2000 MAC / ≤ 1000 AO	1	32	< 0.5	< 8
Iron	ug/L as Fe	**33.65**	4	20.1	98.1	≤ 300 AO	24	32	0.1	176
Lead	ug/L as Pb	**< 0.2**	4	< 0.2	< 0.2	5 MAC	< 0.2	32	0.0954	1.2
Lithium	ug/L as Li	**7**	4	6.4	7.6		8	14	7.2	11.5
Magnesium	mg/L as Mg	**3.23**	4	3.07	3.28	No Guideline Required	3	32	1.09	4.47
Manganese	ug/L as Mn	**25.7**	4	8.5	110	120 MAC / ≤ 20 AO	16	32	< 4	85.8
Molybdenum	ug/L as Mo	**< 1**	4	< 1	< 1		< 1	32	0.059	< 20
Nickel	ug/L as Ni	**< 1**	4	< 1	< 1		< 1	32	0.298	< 50
Potassium	mg/L as K	**0.847**	4	0.776	0.877		1	32	0.145	1.62
Selenium	ug/L as Se	**< 0.1**	4	< 0.1	< 0.1	50 MAC	< 0.1	32	< 0.04	0.775
Silicon	ug/L as Si	**2675**	4	2270	3900		1470	32	345	9530
Silver	ug/L as Ag	**< 0.02**	4	< 0.02	< 0.02	No Guideline Required	< 0.02	32	< 0.005	< 10
Sodium	mg/L as Na	**18.35**	4	17.9	18.8	≤ 200 AO	20	32	< 0.05	87.3
Strontium	ug/L as Sr	**92.9**	4	86.9	96	7000 MAC	95	32	36.7	116
Sulphur	mg/L as S	**4.1**	4	3.6	4.3		5	26	< 3	8.7
Tin	ug/L as Sn	**< 5**	4	< 5	< 5		< 5	32	< 0.2	< 20
Titanium	ug/L as Ti	**< 5**	4	< 5	< 5		< 5	32	0.82	10
Thallium	ug/L as Tl	**< 0.01**	4	< 0.01	< 0.01		< 0.01	26	< 0.002	< 0.05
Uranium	ug/L as U	**< 0.1**	4	< 0.1	< 0.1	20 MAC	< 0.1	26	0.0026	< 0.1
Vanadium	ug/L as V	**< 5**	4	< 5	< 5		< 5	32	< 0.2	16
Zinc	ug/L as Zn	**5.55**	4	< 5	14.4	≤ 5000 AO	< 5	31	< 1	136
Zirconium	ug/L as Zr	**< 0.1**	4	< 0.1	< 0.1		< 0.1	26	< 0.1	< 0.5

Table 2: 2022 Summary of Treated Water Test Results, Fernwood Distribution System										
PARAMETER		**2022 ANALYTICAL RESULTS**				**CANADIAN GUIDELINES**	**2012 - 2021 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 Parameters										
Hardness as $CaCO_3$	mg/L	**38.50**	8	36.6	41.6		40.5	40.5	35	35.1
Carbon, Total Organic	mg/L as C	**1.70**	4	1.6	1.8		2.0	1.95	32	< 0.3
Colour, True	TCU	**< 2**	1	< 2	< 2		2.3	2.29	18	1.5
pH	pH units	Not tested in 2022					7.5	7.455	4	7.3
Turbidity	NTU	**1.30**	18	0.1	1.3	1 MAC and ≤ 5 AO	0.2	0.2	274	< 0.14
Water Temperature	°C	**14.00**	51	6.0	20.0	15°C AO	13.0	13	304	4.0
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	**< 1**	53	< 1	< 1	0 MAC	< 1	< 1	328	< 1
E. coli	CFU/100 mL	**< 1**	53	< 1	< 1	0 MAC	< 1	< 1	328	< 1
Hetero. Plate Count, 7 day	CFU/1 mL	Not tested in 2022				No Guideline Required	< 10	< 10	73	0
Algal Toxins										
Microcystin (Abraxis)	ug/L	Not tested in 2022				1.5				
Anatoxin A	ug/L	Last analyzed in 2013					< 0.16	< 0.16	51	< 0.16
Cylindrospermopsin	ug/L	Last analyzed in 2013					< 0.1	< 0.1	51	< 0.1
Microcystin-RR	ug/L	Last analyzed in 2013					< 0.16	< 0.16	51	< 0.16
Microcystin-YR	ug/L	Last analyzed in 2013					< 0.16	< 0.16	51	< 0.16
Microcystin-LR	ug/L	Last analyzed in 2013				1.5 MAC	< 0.16	< 0.16	33	< 0.16
Microcystin-LA	ug/L	Last analyzed in 2013					< 0.16	< 0.16	26	< 0.16
Nodularin	ug/L	Last analyzed in 2013					< 0.1	< 0.1	51	< 0.1
Disinfectants										
Disinfectants										
Chlorine, Free Residual	mg/L as Cl2	**0.84**	50	0.27	1.47	No Guideline Required	1.06	1.06	1303	0.07
Chlorine, Total Residual	mg/L as Cl_2	Not tested in 2022				No Guideline Required	1.32	1.32	1164	0.29
Disinfection By-Products										
Trihalomethanes (THMs)										
Bromodichloromethane	ug/L	**10.5**	4	10.0	14		13	36	2.01	25.4
Bromoform	ug/L	**< 1**	4	< 1	< 1		< 1	36	< 0.1	< 1
Chloroform	ug/L	**23**	4	16.0	34		22.4	37	9.76	116
Chlorodibromomethane	ug/L	**4**	4	3.6	4.4		4.85	36	<0.1	32.1
Total Trihalomethanes	ug/L	**39**	4	31.0	49	100 MAC	41	35	11.8	146
Haloacetic Acids (HAAs)										
HAA5	ug/L	Not tested in 2022				80 MAC	15.8	10	< 0.1	26
Metals										
Aluminum	ug/L as Al	**5.45**	8	3.3	11.6	2900 MAC / 100 OG	10	35	3.9	389
Antimony	ug/L as Sb	**< 0.5**	8	< 0.5	< 0.5	6 MAC	< 0.5	35	< 0.5	< 0.5
Arsenic	ug/L as As	**0.345**	8	0.2	0.4	10 MAC	0.31	35	0.2	0.76
Barium	ug/L as Ba	**12.25**	8	10.2	13.9	100 MAC	12	35	9.9	16.4
Beryllium	ug/L as Be	**< 0.1**	8	< 0.1	< 0.1		< 0.1	35	< 0.1	< 0.1
Bismuth	ug/L as Bi	**< 1**	8	< 1	< 1		< 1	35	< 1	< 1
Boron	ug/L as B	**< 50**	8	< 50	< 50	5000 MAC	< 50	35	< 50	53
Cadmium	ug/L as Cd	**< 0.01**	8	< 0.01	< 0.01	5 MAC	< 0.01	35	< 0.01	0.016
Calcium	mg/L as Ca	**10.35**	8	9.6	11.5	No Guideline Required	10.9	35	8.9	15.3
Chromium	ug/L as Cr	**< 1**	8	< 1	< 1	50 MAC	< 1	35	< 1	< 1
Cobalt	ug/L as Co	**< 0.2**	8	< 0.2	0.7		< 0.2	35	< 0.2	0.23
Copper	ug/L as Cu	**4.92**	8	2.2	10.4	2000 MAC / ≤ 1000 AO	5.26	35	1.5	83.2
Iron	ug/L as Fe	**31.55**	8	23.3	73.4	≤ 300 AO	48.5	35	19.6	770
Lead	ug/L as Pb	**0.345**	8	< 0.2	2.5	5 MAC	0.56	39	< 0.2	78.1
Lithium	ug/L as Li	**7**	8	6.5	7.2		7.9	11	7.2	11.7
Magnesium	mg/L as Mg	**3.035**	8	2.7	3.3	No Guideline Required	3.08	35	2.52	3.57
Manganese	ug/L as Mn	**2.35**	8	< 1	7.0	120 MAC / ≤ 20 AO	2.2	35	< 1	150
Molybdenum	ug/L as Mo	**< 1**	8	< 1	< 1		< 1	35	< 1	< 1
Nickel	ug/L as Ni	**< 1**	8	< 1	< 1		< 1	35	< 1	< 1
Potassium	mg/L as K	**0.812**	8	0.8	0.8		0.789	35	0.702	0.872
Selenium	ug/L as Se	**< 0.1**	8	< 0.1	< 0.1	50 MAC	< 0.1	35	< 0.1	< 0.1
Silicon	ug/L as Si	**2535**	8	2210.0	3560.0		1310	35	405	3700
Silver	ug/L as Ag	**< 0.02**	8	< 0.02	< 0.02	No Guideline Required	< 0.02	35	< 0.02	0.02
Sodium	mg/L as Na	**20.3**	8	19.8	24.6	≤ 200 AO	22.1	35	19.8	25.2
Strontium	ug/L as Sr	**93.7**	8	85.9	98.1	7000 MAC	96.2	35	87.1	106
Sulphur	mg/L as S	**3.95**	8	3.5	4.1		4.7	35	3.7	5.4
Tin	ug/L as Sn	**< 5**	8	< 5	< 5		< 5	35	< 5	< 5
Titanium	ug/L as Ti	**< 5**	8	< 5	< 5		< 5	35	< 5	< 5
Thallium	ug/L as Th	**< 0.01**	8	< 0.01	< 0.01		< 0.01	35	< 0.01	0.042
Uranium	ug/L as U	**< 0.1**	8	< 0.1	< 0.1	20 MAC	< 0.1	35	< 0.1	< 0.1
Vanadium	ug/L as V	**< 5**	8	< 5	< 5		< 5	35	< 5	< 5
Zinc	ug/L as Zn	**21.55**	8	8.4	27.6	≤ 5000 AO	18.5	35	5.6	76.2
Zirconium	ug/L as Zr	**< 0.1**	8	< 0.1	< 0.1		< 0.1	35	< 0.1	< 0.5

Table 3: 2022 Summary of Treated Water Test Results, Highland Distribution System										
PARAMETER		2022 ANALYTICAL RESULTS				CANADIAN GUIDELINES	2012 - 2021 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 Parameters										
Hardness as $CaCO_3$	mg/L	**45.5**	4	44.2	49.8		46.5	23	40.8	54.9
Carbon, Total Organic	mg/L as C	**1.7**	8	1.2	1.9		1.885	58	< 0.3	19.7
Colour, True	TCU	**< 2**	36	< 2	< 2		< 2	34	< 2	2.1
pH	pH units	Not tested in 2022					7.35	4	7.2	8.1
Turbidity	NTU	**0.2**	44	< 0.14	5.2	1 MAC and ≤ 5 AO	0.3	378	0.1	37.8
Water Temperature	°C	**14.0**	145	4	22	15°C AO	12	712	4	23.5
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	**< 1**	154	< 1	< 1	0 MAC	< 1	1067	< 1	209
E. coli	CFU/100 mL	**< 1**	154	< 1	< 1	0 MAC	< 1	1067	< 1	< 1
Hetero. Plate Count 7 day	CFU/1 mL	Not tested in 2022				No Guideline Required	30	58	< 10	310
Algal Toxins										
Microcystin (Abraxis)	ug/L	Not tested in 2022				1.5				
Anatoxin A	ug/L	Last analyzed in 2013					< 0.16	50	< 0.16	< 0.16
Cylindrospermopsin	ug/L	Last analyzed in 2013					< 0.1	50	< 0.1	< 0.1
Microcystin-RR	ug/L	Last analyzed in 2013					< 0.16	49	< 0.16	< 0.16
Microcystin-YR	ug/L	Last analyzed in 2013					< 0.16	50	< 0.16	< 0.16
Microcystin-LR	ug/L	Last analyzed in 2013				1.5 MAC	< 0.16	32	< 0.16	< 0.16
Microcystin-LA	ug/L	Last analyzed in 2013					0	0	0	0
Nodularin	ug/L	Last analyzed in 2013					< 0.1	50	< 0.1	< 0.1
Disinfectants										
Disinfectants										
Chlorine, Free Residual	mg/L as Cl2	**0.91**	155	0.2	1.89	No Guideline Required	1.05	3357	0.06	4.7
Chlorine, Total Residual	mg/L as Cl_2	Not tested in 2022				No Guideline Required	1.23	2995	0.08	5.6
Disinfection By-Products										
Trihalomethanes (THMs)										
Bromodichloromethane	ug/L	**14.5**	8	12	21		16	67	<0.1	31.9
Bromoform	ug/L	**< 1**	8	< 1	< 1		< 1	66	< 0.1	4.2
Chloroform	ug/L	**29.5**	8	22	58		29	69	9.22	127
Chlorodibromomethane	ug/L	**5**	8	3.8	6.7		5.7	67	<0.1	15.5
Total Trihalomethanes	ug/L	**48.5**	8	38	85	100 MAC	52.5	64	21.4	161
Haloacetic Acids (HAAs)										
HAA5	ug/L	Not tested in 2022				80 MAC	19.5	20	9.21	37.7
Metals										
Aluminum	ug/L as Al	**9.85**	4	7.6	19.1	2900 MAC / 100 OG	16.5	23	4.5	58.8
Antimony	ug/L as Sb	**< 0.5**	4	< 0.5	< 0.5	6 MAC	< 0.5	23	< 0.5	< 0.5
Arsenic	ug/L as As	**0.35**	4	0.2	0.5	10 MAC	0.28	23	0.22	0.45
Barium	ug/L as Ba	**10.25**	4	9.8	12.9	100 MAC	11.2	23	6.7	14.3
Beryllium	ug/L as Be	**< 0.1**	4	< 0.1	< 0.1		< 0.1	23	< 0.1	< 0.1
Bismuth	ug/L as Bi	**< 1**	4	< 1	< 1		< 1	23	< 1	< 1
Boron	ug/L as B	**< 50**	4	< 50	< 50	5000 MAC	< 50	23	< 50	51
Cadmium	ug/L as Cd	**< 0.01**	4	< 0.01	< 0.01	5 MAC	< 0.01	23	< 0.01	< 0.01
Calcium	mg/L as Ca	**15.2**	4	14.5	17.8	No Guideline Required	16	23	11.1	19.1
Chromium	ug/L as Cr	**< 1**	4	< 1	< 1	50 MAC	< 1	23	< 1	< 1
Cobalt	ug/L as Co	**< 0.2**	4	< 0.2	< 0.2		< 0.2	23	< 0.2	< 0.2
Copper	ug/L as Cu	**2.405**	4	2.3	2.8	2000 MAC / ≤ 1000 AO	3.65	23	2.02	8.38
Iron	ug/L as Fe	**91.45**	4	87.0	96.0	≤ 300 AO	123	23	40.9	591
Lead	ug/L as Pb	**< 0.2**	4	< 0.2	0.2	5 MAC	0.27	23	< 0.2	1.35
Lithium	ug/L as Li	**6.85**	4	6.6	6.9		7.4	7	7	8.2
Magnesium	mg/L as Mg	**1.825**	4	1.3	2.0	No Guideline Required	1.9	23	0.95	3.16
Manganese	ug/L as Mn	**1.95**	4	1.3	5.5	120 MAC / ≤ 20 AO	3	23	< 1	57.9
Molybdenum	ug/L as Mo	**< 1**	4	< 1	< 1		< 1	23	< 1	< 1
Nickel	ug/L as Ni	**< 1**	4	< 1	< 1		< 1	23	< 1	< 1
Potassium	mg/L as K	**0.8285**	4	0.8	0.8		0.779	23	0.721	0.902
Selenium	ug/L as Se	**< 0.1**	4	< 0.1	< 0.1	50 MAC	< 0.1	23	< 0.1	< 0.1
Silicon	ug/L as Si	**2775**	4	2320.0	3150.0		1770	23	1190	3490
Silver	ug/L as Ag	**< 0.02**	4	< 0.02	< 0.02	No Guideline Required	< 0.02	23	< 0.02	< 0.02
Sodium	mg/L as Na	**20.4**	4	20.3	21.6	≤ 200 AO	22.3	23	19.9	24.1
Strontium	ug/L as Sr	**97.45**	4	92.9	105.0	7000 MAC	102	23	93	115
Sulphur	mg/L as S	**4.1**	4	3.6	4.1		4.8	23	3.4	5.7
Tin	ug/L as Sn	**< 5**	4	< 5	< 5		< 5	23	< 5	< 5
Titanium	ug/L as Ti	**< 5**	4	< 5	< 5		< 5	23	< 5	< 5
Thallium	ug/L as Th	**< 0.01**	4	< 0.01	< 0.01		< 0.01	23	< 0.01	< 0.01
Uranium	ug/L as U	**< 0.1**	4	< 0.1	< 0.1	20 MAC	< 0.1	23	< 0.1	< 0.1
Vanadium	ug/L as V	**< 5**	4	< 5	< 5		< 5	23	< 5	< 5
Zinc	ug/L as Zn	**7.55**	4	< 5	10.1	≤ 5000 AO	8.4	23	< 5	17
Zirconium	ug/L as Zn	**< 0.1**	4	< 0.1	< 0.1		< 0.1	23	< 0.1	< 0.5