Canada's Tournament Capital

CITY OF KAMLOOPS DRINKING WATER ANNUAL REPORT 2023

Facility Number: 0660340

City of Kamloops

June 2024

1. Introduction

This report has been prepared to meet the requirements stipulated by the British Columbia *Drinking Water Protection Act* (DWPA) and the Operating Permit issued to the City of Kamloops (the City). A comprehensive overview of the City's treatment and distribution system is provided within this document, accompanied by a detailed summary of total water consumption and a thorough analysis of water quality within the system. Additionally, a summary of ongoing projects and related operational activities is included.

The final report has been formally submitted to Interior Health for review and has been made publicly accessible on the City's official website, facilitating transparency and public access to critical information.

2. Kamloops Water System

The drinking water system managed by the City comprises a singular treatment plant that serves an expansive distribution network, providing water access across the entire community. Notably, the Rayleigh Waterworks District and the Heffley Creek Waterworks District operate independent systems sourced from the North Thompson River.

At the heart of the City's water treatment infrastructure lies the Kamloops Centre for Water Quality (KCWQ), an advanced ultra-filtration membrane treatment facility. This facility ensures the safety and quality of the water supplied throughout the distribution system through chlorination of the treated water.

The water treatment and distribution/storage systems were formally assessed and classified as Level IV systems under the Environmental Operators Certification Program (EOCP). Consequently, the operation of these systems demands the expertise of highly qualified and certified personnel.

2.1 EOCP Certified Operators

The City has a full complement of certified staff to assure the safe treatment and distribution of potable water throughout the City of Kamloops. Staffing levels for EOCP-certified water treatment and distribution operators are shown in Table 1.

Table 1: City of Kamloops Operator Certification Levels in 2023

Certification	Level	Number of Certified Operators
Water Treatment	Operator in Training	0
	I	0
	II	3
	III	1
	IV	4
Water Distribution	I	11
	II	15
	III	1
	IV	3
Total		***38***

2.2 Kamloops Centre for Water Quality

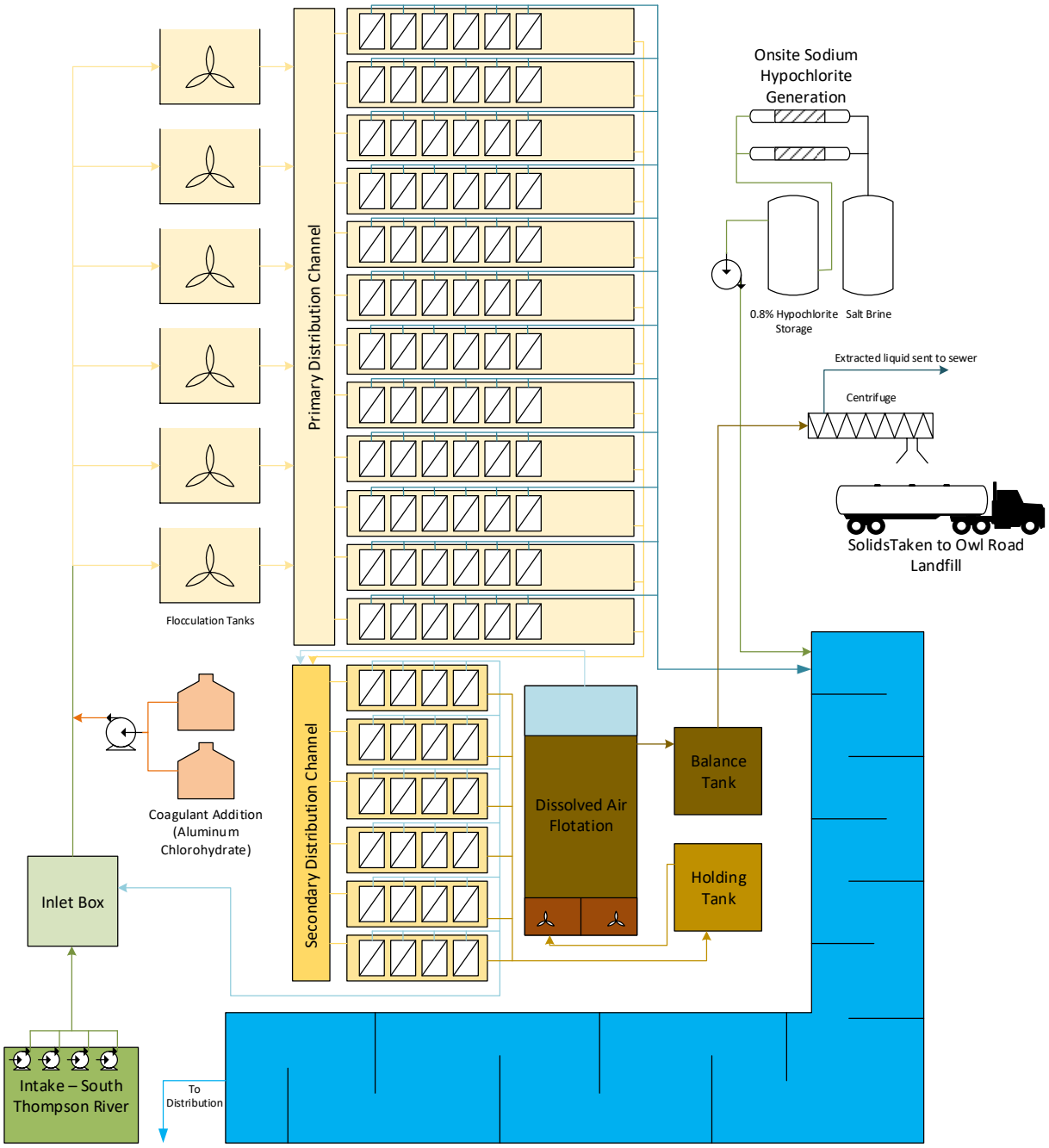
The KCWQ draws water from the South Thompson River to provide drinking water to the majority of the city's population. Utilizing state-of-the-art Veolia ZeeWeed 500D ultra-filtration membrane technology, the facility boasts a capacity to produce 160,000 cubic metres per day (equivalent to 160 million litres per day, MLD).

Recognized for its commitment to environmental sustainability, the KCWQ holds a prestigious gold standard certification from Leaders in Environmental and Energy Design (LEED), a testament to its eco-friendly processes. Remarkably, 99.99% of the water treated within the facility meets the rigorous standards for safe drinking water.

Following the filtration process, the recovered solids from the treated water are transferred to the City's Owl Road Resource Recovery Centre, where they are repurposed as clean cover, aligning with the City's sustainable resource management practices.

A layout of KCWQ and the accompanying process is shown in Figure 1.

Figure 1: The KCWQ Plant Processes



2.2.1 KCWQ Water Production Totals

Water production at the KCWQ varied from 17,261,692 m^3 to 20,004,839 m^3 over the past five years, and total production for 2023 was consistent with the five-year average. Table 2 and Figure 2 show the monthly total water consumption over the past five years. Stringent water use restrictions were implemented in summer 2023 as the South Thompson River hit drought level 5. The restrictions resulted in a drastic decrease in water use during the summer months.

Table 2: Monthly KCWQ Water Production Volumes for the Past Five Years

Month	Total Production (m^3)					5-Year Average
	2019	2020	2021	2022	2023	
January	932,795	950,257	926,492	986,537	1,009,243	961,065
February	853,174	878,837	837,180	884,952	936,915	878,211
March	954,469	927,506	942,894	973,188	984,766	956,565
April	1,070,333	1,153,487	1,332,908	1,170,347	1,193,944	1,184,204
May	2,069,872	1,856,272	2,153,131	1,752,480	2,255,208	2,017,393
June	2,521,622	1,664,247	2,833,400	1,899,884	2,632,915	2,310,413
July	2,434,476	2,216,542	3,421,547	2,796,810	2,929,208	2,759,717
August	2,631,331	2,625,230	2,654,901	2,946,521	2,024,739	2,576,544
September	1,639,083	2,040,135	1,745,439	2,120,876	1,424,526	1,794,012
October	1,082,083	1,097,265	1,173,299	1,336,219	1,150,006	1,167,774
November	953,641	916,257	985,269	998,349	949,694	960,642
December	972,287	935,655	998,380	1,051,439	906,894	972,931
Total	*18,115,165*	*17,261,692*	*20,004,839*	*18,917,602*	*18,398,058*	*18,460,565*
Daily Average	*49,631*	*47,163*	*54,808*	*51,829*	*50,406*	*50,534*
Daily Peak	102,470	97,460	138,446	111,688	109,161	
Peak Date	08-Aug	04-Aug	30-Jun	28-Jul	08-Jun	

Figure 2: Graphical Representation of the Monthly KCWQ Water Production Volumes for the Past Five Years

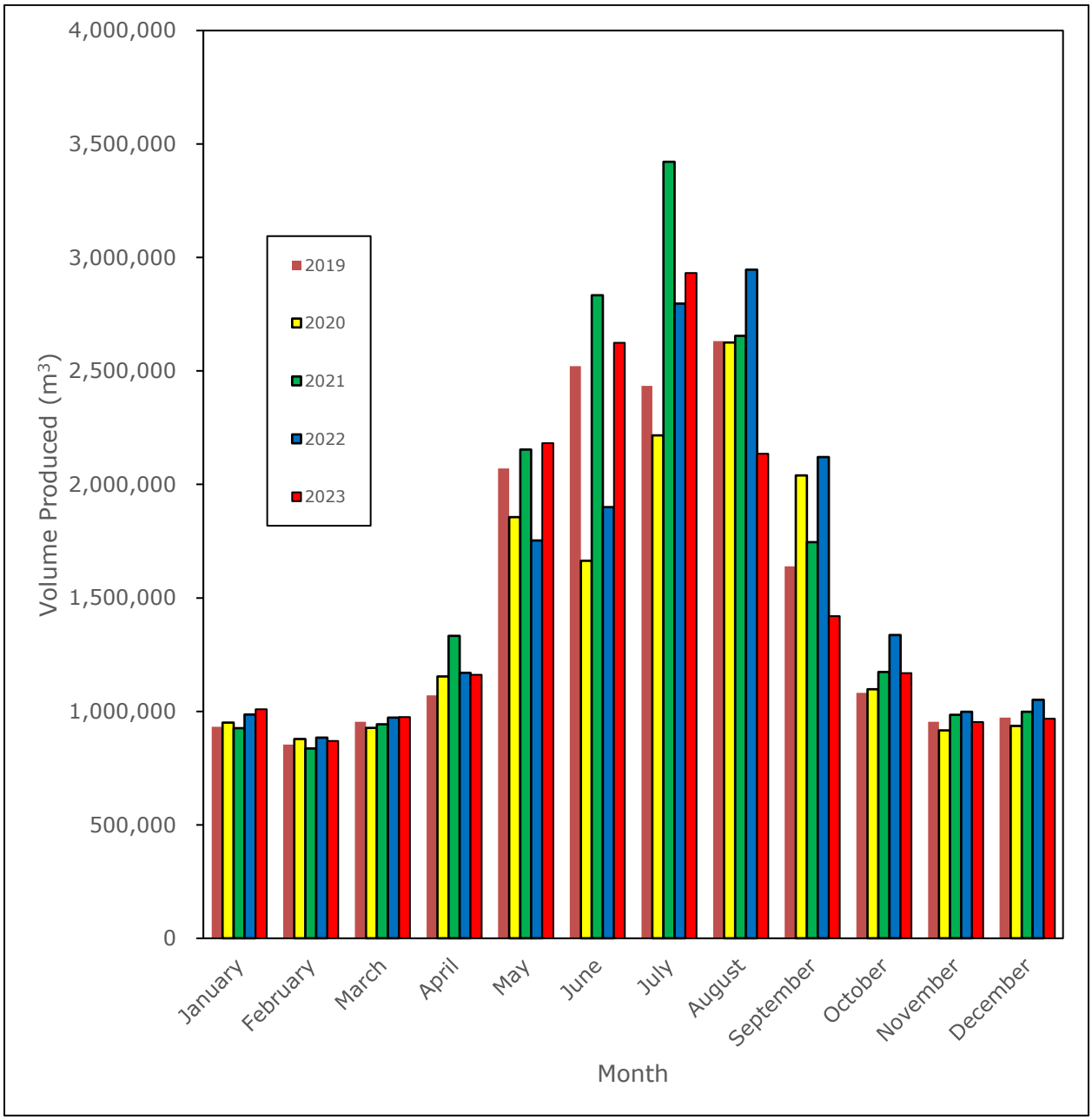
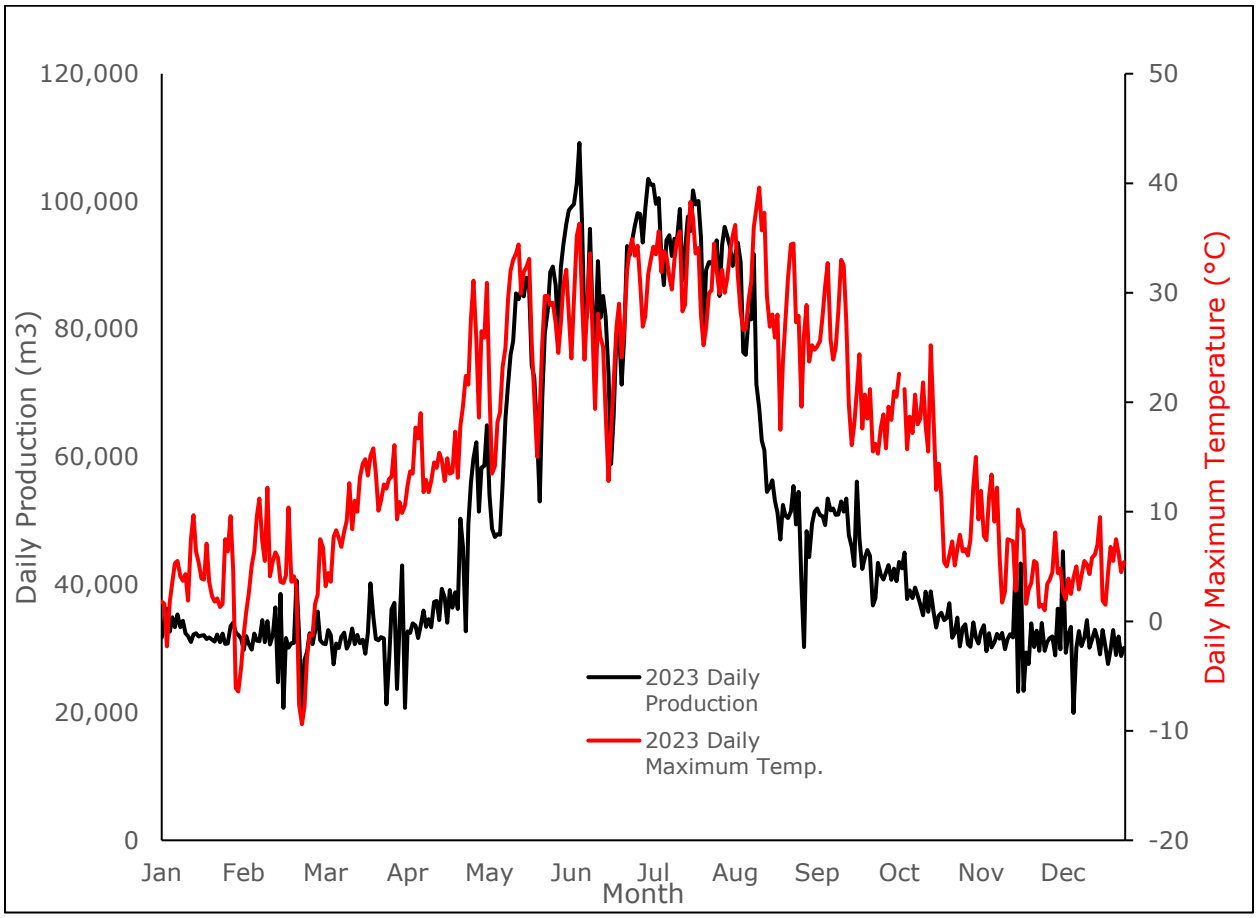


Figure 3 illustrates the daily water consumption for the year 2023, accompanied by an overlay depicting the maximum daily temperatures recorded. Notably, the peak daily consumption for 2023 reached 109,162 cubic metres on June 8. A direct correlation is observed between production volumes and the corresponding temperatures during this period.

Figure 3: KCWQ Daily Water Flows With Daily Average Temperature Overlay for 2023



2.3 Distribution System Overview

The distribution system is one of the most complex water distribution systems in Canada due to the area's unique topography. The distribution system consists of 634.8 km of water mains, 42 booster stations, 45 reservoirs, 2,413 fire hydrants, and a total of 25,514 connections. The City also maintains a trucked-in water system, which supplies potable water to the Tournament Capital Ranch, a sports recreation area north of the City.

The piping material of the water mains in the distribution system is quite varied (Table 3). The City of Kamloops uses asset management practices to identify and strategically plan the replacement of water infrastructure. Water mains are replaced based on their life expectancy, condition, and risk. Typically, new mains are constructed of PVC. Any increases in water main material besides PVC (Table 3) are due to updates in the GIS system on previously unidentified or improperly identified mains; these increases may not reflect the addition of newly installed lines of that type.

Table 3: Water Main Pipe Material Summary

Material	Length (km)	% of Total Pipe	% Change from Last Year
PVC - Polyvinyl Chloride	290.5	45.76%	0.8%
AC - Asbestos Cement	174.2	27.44%	-0.4%
DI - Ductile Iron	102.3	16.12%	0.0%
CI - Cast Iron	36.3	5.72%	0.0%
HYP - High Pressure Concrete	17.3	2.73%	0.0%
STL - Steel	10.8	1.70%	0.0%
PLY - Polyethylene	2.3	0.36%	0.0%
CU - Copper	0.8	0.13%	0.0%
GI - Galvanized Iron	0.3	0.05%	0.0%
Total	***634.8***		

In 2023, the City continued work to improve asset management for the water system. Staff are working to identify future needs based on criticality, life expectancy, condition, and capacity.

3. Water System Highlights in 2023

The following sections will highlight some of the major projects throughout the 2023 operating year as well as summarize the requests for service received for the water distribution system.

3.1 KCWQ Project Summary for 2023

The following is a list of some of the projects started at the KCWQ in 2023:

- Isolation valves in primary distribution channel installed and commissioned.
- Both building boilers replaced.
- Working with consultant for upgrades to source water intake system.

3.2 Distribution System Project Summary for 2023

3.2.1 Booster Stations and Reservoirs

- Completed cleaning of the SW3 reservoir while continuing to keep it online.
- Started design/development stage of the Pemberton Booster/Reservoir upgrade.

3.2.2 Distribution System

- Major watermain replacement projects included:
  - Battle St from 2nd Ave to 3rd Ave.
  - Moncton Ave from Valhalla Dr to 13th St
  - Selkirk Ave from Valhalla Dr to 13th St
  - Tranquille Rd from Crestline St to Aviation Way

3.2.3 Requests for Service

In 2023, there were a total of 2,709 requests for service filed with the City's Civic Operations Department related to water distribution and treatment. Table 4 shows a breakdown of the categories to which each of the requests is related.

Table 4: Service Requests in Water Treatment and Distribution in 2023

Request Categories Related to Utilities/ Water	Number of Requests	
	2022	2023
Water - Booster/Pump Stations	5	6
Water - Filling Stations / Cross Connection	37	52
Water - Frozen Services	3	0
Water - General	67	74
Water - Hydrants	53	28
Water - Hydrant Check After KFR Use	7	15
Water - Hydrant out of Service	70	163
Water - Irrigation On/Off	7	9
Water - No Water	87	30
Water - Reservoirs	3	1
Water - Service Boxes	79	99
Water - Service Location	50	47
Water - Turn Service On/Off	551	537
Water - Water Leak	223	217
Water Pressure	59	59
Water - Water Quality	40	33
Water - Water Restrictions	5	79
Water - Noble Creek Irrigation System	5	61
Water Meters - General	76	58
Water Meters - Final Read Request	1,116	943
Water Meters - Consumption	99	119
Water Meters - Leak Detection	23	13
Water Meters - Leaking Meter Sets	7	31
Water Meters - Meter Change Out	27	35
Totals	***2,699***	***2709***

4. Water Quality Sampling and Analysis

The City's Water Quality Monitoring Program (WQMP) incorporates principles from the Guidelines for Canadian Drinking Water Quality (GCDWQ) and BC's DWPA and *Drinking Water Projection Regulation* (DWPR). The program is designed to monitor water quality for immediate and long-term water quality trends. The WQMP uses the multi-barrier approach. The City has one primary surface water source, the South Thompson River, for all domestic purposes. A second surface water source, the North Thompson River, serves as an emergency backup.

The City's treatment, distribution, and storage system water quality monitoring program is performed by EOCP-certified staff who take samples at designated sites.

The Water Quality Monitoring Program was reviewed by City staff on January 31, 2023, and no changes have been suggested for the program.

4.1 Quality Assurance and Quality Control Program

The City's Civic Operations staff are committed to ensuring accurate information is gathered under the WQMP. Staff taking samples are trained on the proper sampling methods to ensure accuracy of the results and to protect the quality of our water. All samples are collected and shipped in accordance with the 2005 21st Edition Standard Methods for the Examination of Water and Wastewater.

The WQMP includes quality control inspections and calibrations of sampling and analyzing equipment. Field instruments used to test the distribution system water (chlorine residual, turbidity, and pH) are scheduled for weekly/monthly cleaning and calibration. Online chlorine analyzers are checked nightly at KCWQ.

4.2 KCWQ Water Quality Testing

A variety of water quality parameters are measured at the KCWQ to monitor the treatment process. Tables 5, 6, and 7 summarize the results of the nightly testing at the KCWQ. These analyses are performed in-house by the certified operators at the KCWQ.

4.2.1 True and Apparent Colour

Colour in water can be imparted in two ways: through dissolved material or suspended material. The suspended material could be clays, silts, algae, or any other material that can be remain undissolved in water. The dissolved materials are typically organics, such as tannins that leach from plants, trees, or roots and impart a yellowish/brown colour. They may also be from dissolved metals like iron. Suspended material in water is much easier to treat through filtration, while dissolved material may be more difficult to treat. Apparent colour is a measure of all colour in water, including suspended material, and true colour measures only the dissolved colour. Colour is not a health issue, but it is unwanted as aesthetically it does not make for appealing drinking water.

4.2.2 pH

pH is a measure of the activity of the hydrogen ion in water. It represents the acidity or basicity of water. The pH scale goes from 0 to 14, with anything smaller than 7 being acidic, anything greater than 7 being basic, and 7 being neutral. Drinking water is regulated to fall between a pH of 6.5 and 8.5 under the GCDWQ. The KCWQ targets to be on the higher side of neutral pH to protect distribution pipes against corrosion.

4.2.3 Hardness

Hardness is primarily made up of dissolved calcium and magnesium in water. These compounds are not harmful to health; people require them in their diet. However, elevated levels of calcium and magnesium may cause "soap scum" when reacting with soaps. This soap-scum will require more soap or detergent when cleaning and can clog pipes and hot water tanks. Hardness is broken down into the following categories: 0 to 60 mg/L as CaCO3 is considered soft, 61 to 120 mg/L is considered moderate, 121 to 180 mg/L is considered hard, and anything over 180 mg/L is considered very hard.

4.2.4 Alkalinity

Alkalinity is a measure of the buffering capacity of water. Alkalinity will keep the pH stable if something acidic or basic is introduced to the water. The higher the alkalinity, the more stable your pH will remain. In general, this parameter has no health implications and is strictly used as a guideline in treatment processes.

4.2.5 Conductivity and Total Dissolved Solids

Conductivity and total dissolved solids (TDS) are linked as the probe that measures conductivity in water will provide an estimate of the TDS. Conductivity is a measure of how well a water sample conducts electricity. As water is an insulator, its ability to conduct electricity is directly related to the concentration of dissolved solids within the water. In water treatment, this measurement is used to monitor any changes in water quality.

4.2.6 Total Suspended Solids

Total suspended solids (TSS) is a measure of all the colloidal material in water. TSS in the source water gives an indication of the total solids that will be removed in the treatment process. The higher the TSS, the "dirtier" the water is. There is no guideline limit on TSS under the GCDWQ.

4.2.7 Turbidity

Turbidity is a measure of the clarity of the water. It is also directly related to the colloidal material in the water. Turbidity is measured by passing a beam of light through the sample and measuring the amount of water that is refracted at a 90° angle. The units applied are called nephelometric turbidity units (NTU). The GCDWQ state that drinking water should have a turbidity of less than 1 NTU. The KCWQ membrane water treatment plant should not have a turbidity of greater than 0.1 NTU leaving the plant.

4.2.8 Aluminum

An aluminum-based coagulant is used in the treatment process at the KCWQ. Aluminum is monitored in source and treated water to ensure that coagulant is not overdosed and is not entering our drinking water at elevated levels. The GCDWQ sets the operational guideline for water treatment plants at 0.1 mg/L.

4.2.9 Free and Total Chlorine (Cl_2)

Chlorine levels are important in water treatment to ensure that water is safe throughout the distribution system. The primary form of chlorine used in our treatment system is sodium hypochlorite. Free chlorine measures the amount of hypochlorite in our water, while total chlorine measures the free chlorine plus any combined chlorine disinfectants such as chloramines. The KCWQ targets a residual free chlorine level of > 0.2 mg/L at the end of the distribution system. There is no guideline limit on free and total chlorine under the GCDWQ.

Table 5: Monthly Averages for Source Water Analysis in 2023

Month	True Colour (Pt Co Units)	Apparent Colour (Pt Co Units)	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as CaCO3)	TDS (mg/L)	Conductivity (µS/cm)	TSS (mg/L)	Turbidity (NTU)	Aluminum (mg/L)	Temperature (°C)
January	<5	10	7.9	42	41	45.4	85.0	1.6	1.4	0.023	2.5
February	<5	17	7.9	43	42	45.8	86.7	3.7	2.5	0.023	3.0
March	<5	19	7.9	43	42	47.1	89.6	5.1	3.0	0.022	5.0
April	<5	17	8.0	43	43	50.8	95.9	3.5	2.1	0.029	9.6
May	6	43	7.8	39	40	35.6	68.1	9.9	6.2	0.035	12.8
June	<5	20	7.8	36	37	23.3	45.0	9.1	2.6	0.031	13.9
July	<5	18	8.0	37	37	26.9	51.5	6.7	2.7	0.028	20.2
August	<5	14	8.1	37	37	29.7	56.9	3.9	1.6	0.048	21.4
September	<5	15	8.0	39	39	30.9	58.2	3.9	1.6	0.029	18.4
October	<5	16	8.0	39	39	45.4	80.6	2.2	1.6	0.017	14.0
November	<5	13	7.9	40	39	45.0	74.7	1.9	1.3	0.019	8.5
December	<5	16	7.8	40	40	44.5	72.9	3.4	2.0	0.017	6.0
Daily Min.	***<5***	***<5***	***7.5***	***32***	***33***	***19.4***	***32.5***	***0.3***	***0.3***	***<0.008***	***1.9***
Daily Max.	***14***	***102***	***9.0***	***46***	***45***	***73.8***	***128.4***	***36.9***	***12.5***	***0.440***	***23.7***
Annual Avg.	***<5***	***18***	***7.9***	***40***	***40***	***39.1***	***72.0***	***4.6***	***2.4***	***0.027***	***11.3***

In instances where data fell below the limits of analytical detection, half the detection limit was utilized for calculation purposes.

Table 6: Monthly Averages for Treated Water Analysis in 2023

Month	True Colour (Pt Co Units)	Apparent Colour (Pt Co Units)	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as CaCO3)	TDS (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	Aluminum (mg/L)	Temperature (°C)	Free Chlorine (mg/L)	Total Chlorine (mg/L)
January	<5	<5	8.0	43	42	53.2	100.9	0.016	0.024	4.9	1.37	1.47
February	<5	<5	8.0	43	43	53.7	101.8	0.016	0.020	5.5	1.36	1.49
March	<5	<5	8.0	43	42	54.1	102.6	0.016	0.019	6.8	1.36	1.46
April	<5	<5	8.1	43	43	61.5	116.3	0.018	0.024	10.6	1.33	1.44
May	<5	<5	7.9	39	40	43.2	82.0	0.021	0.029	13.3	1.37	1.50
June	<5	<5	7.9	36	37	25.2	48.6	0.022	0.026	14.4	1.35	1.46
July	<5	<5	8.1	37	37	30.2	57.6	0.013	0.028	20.8	1.34	1.43
August	<5	<5	8.2	37	38	34.4	65.5	0.015	0.037	21.9	1.31	1.44
September	<5	<5	8.1	38	39	35.7	66.9	0.014	0.029	18.8	1.36	1.51
October	<5	<5	8.1	39	40	51.7	92.7	0.021	0.016	15.1	1.35	1.47
November	<5	<5	8.0	40	40	50.3	84.5	0.022	0.018	10.0	1.33	1.46
December	<5	<5	7.9	41	41	51.8	86.2	0.022	0.015	8.1	1.32	1.47
Daily Min.	***<5***	***<5***	***7.6***	***34***	***36***	***22.1***	***42.6***	***0.012***	***<0.008***	***4.4***	***1.05***	***1.21***
Daily Max.	***<5***	***<5***	***8.5***	***46***	***46***	***70.9***	***133.9***	***0.045***	***0.070***	***24.4***	***1.87***	***2.02***
Annual Avg.	***<5***	***<5***	***8.0***	***40***	***40***	***45.4***	***83.7***	***0.018***	***0.024***	***12.6***	***1.35***	***1.47***
Guidelines for Canadian Drinking Water Quality Objectives	Aesthetic Objective: ≤ 15 mg/L	Aesthetic Objective: ≤ 15 mg/L	6.5 - 8.5	No guideline for drinking water	No guideline for drinking water	Aesthetic Objective : ≤500 mg/L	No guideline for drinking water	Operational Guideline: ≤0.1 NTU	Operational Guideline: <0.1 mg/L	Aesthetic Objective: ≤ 15 °C	No guideline for drinking water	No guideline for drinking water

In instances where data fell below the limits of analytical detection, half the detection limit was utilized for calculation purposes.

Table 7: Monthly Averages for Distribution System Water Analysis in 2023

Distribution System Water Analysis												
	Reservoir	True Colour (Pt Co Units)	Apparent Colour (Pt Co Units)	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as CaCO3)	TDS (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	Field Temp (°C)	Free Cl_2 (mg/L)	Total Cl_2 (mg/L)
January	Knutsford	<5	<5	8.0	42	42	53.7	100.8	0.090	8.1	0.45	0.53
	CREDS	<5	<5	7.8	42	42	54.7	103.3	0.112	7.7	0.43	0.49
	Juniper #3	<5	<5	8.0	43	42	56.4	106.8	0.090	6.8	0.70	0.78
	418 Booster	<5	<5	8.0	43	43	57.3	108.4	0.127	6.2	1.20	1.28
	Noble Creek	<5	<5	8.1	42	42	58.6	110.9	0.086	6.8	0.84	0.93
	Memorial	<5	<5	7.9	43	42	54.6	103.4	0.129	4.1	1.12	1.21
	Booster #4 SW	<5	<5	8.0	43	42	52.0	98.4	0.069	5.4	1.09	1.18
February	Knutsford	<5	<5	8.1	43	43	56.8	107.4	0.281	6.8	0.59	0.67
	CREDS	<5	<5	8.0	42	42	55.9	105.8	0.361	7.2	0.45	0.53
	Juniper #3	<5	<5	8.0	42	42	55.9	105.4	0.269	6.4	0.82	0.90
	418 Booster	<5	<5	8.1	43	42	54.5	103.1	0.090	5.6	1.17	1.26
	Noble Creek	<5	<5	8.1	43	43	55.6	105.4	0.075	8.6	1.25	1.33
	Memorial	<5	<5	8.0	44	43	56.1	106.1	0.119	4.9	1.22	1.33
	Booster #4 SW	<5	<5	8.0	43	43	56.1	106.2	0.194	5.3	0.99	1.07
March	Knutsford	<5	<5	7.9	43	42	53.3	100.9	0.116	9.2	0.81	0.91
	CREDS	<5	<5	7.9	44	43	54.5	104.0	0.116	7.5	0.59	0.66
	Juniper #3	<5	<5	8.0	44	43	57.8	109.3	0.098	7.2	0.86	0.94
	418 Booster	<5	<5	8.0	44	43	59.1	111.7	0.170	6.8	1.13	1.20
	Noble Creek	<5	<5	8.1	43	43	62.9	118.9	0.218	6.9	1.21	1.28
	Memorial	<5	<5	8.0	43	42	54.0	102.1	0.332	7.3	1.14	1.24
	Booster #4 SW	<5	<5	7.9	43	42	56.6	107.4	0.117	7.3	1.03	1.10
April	Knutsford	<5	<5	8.0	44	44	63.9	120.8	0.251	9.0	0.73	0.81
	CREDS	<5	<5	7.9	43	43	63.9	120.8	0.203	8.4	0.56	0.63
	Juniper #3	<5	<5	8.0	42	42	58.3	110.4	0.194	8.8	0.86	0.95
	418 Booster	<5	<5	8.1	43	43	57.5	108.8	0.080	8.8	1.15	1.21
	Noble Creek	<5	<5	8.1	43	43	58.9	111.6	0.100	14.3	1.05	1.13
	Memorial	<5	<5	7.9	43	43	62.1	117.4	0.187	10.0	1.10	1.17
	Booster #4 SW	<5	<5	8.0	44	44	66.1	124.9	0.359	10.5	0.93	0.99
May	Knutsford	<5	<5	7.9	41	40	46.7	87.5	0.157	11.2	0.73	0.82
	CREDS	<5	<5	7.8	40	40	41.7	79.3	0.079	14.0	0.40	0.46
	Juniper #3	<5	<5	7.9	40	41	41.0	78.6	0.208	13.3	0.79	0.85
	418 Booster	<5	<5	7.9	40	40	39.4	74.9	0.154	12.9	1.01	1.12
	Noble Creek	<5	<5	8.0	40	40	44.8	85.0	0.190	14.1	0.85	0.91
	Memorial	<5	<5	7.8	40	40	45.2	85.7	0.203	13.1	1.02	1.09
	Booster #4 SW	<5	6	7.8	39	39	46.0	87.2	0.129	13.0	0.79	0.85
June	Knutsford	<5	<5	7.9	37	39	24.4	46.8	0.198	14.0	0.99	1.06
	CREDS	<5	<5	7.8	36	37	27.9	53.4	0.377	17.0	0.46	0.54
	Juniper #3	<5	<5	7.8	36	37	24.3	46.6	0.224	15.1	1.07	1.12
	418 Booster	<5	<5	7.9	36	37	27.2	52.1	0.194	15.1	1.28	1.37
	Noble Creek	<5	<5	7.9	37	37	30.7	58.6	0.214	-	1.06	1.12
	Memorial	<5	<5	7.9	36	37	29.8	56.2	0.174	14.3	1.11	1.19
	Booster #4 SW	<5	<5	7.9	37	38	25.0	47.9	0.066	13.8	0.99	1.08
July	Knutsford	<5	<5	8.1	37	37	34.3	65.3	0.110	16.3	0.77	0.85
	CREDS	<5	<5	7.8	37	36	31.9	60.4	0.098	18.7	0.19	0.26
	Juniper #3	<5	<5	8.1	37	37	29.9	57.2	0.225	18.5	0.66	0.72
	418 Booster	<5	<5	8.1	37	39	30.2	57.7	0.096	20.5	1.03	1.10
	Noble Creek	<5	<5	8.1	37	38	30.5	58.1	0.093	21.4	0.71	0.78
	Memorial	<5	<5	8.0	37	37	24.5	47.0	0.326	20.0	1.05	1.14
	Booster #4 SW	<5	<5	8.1	36	37	33.6	63.8	0.146	20.9	0.91	0.99
August	Knutsford	<5	<5	8.1	38	39	34.1	65.0	0.161	17.6	0.52	0.59
	CREDS	<5	<5	8.0	38	38	37.9	72.0	0.169	17.4	0.35	0.42
	Juniper #3	<5	<5	8.0	38	38	44.6	84.6	0.104	22.0	0.55	0.61
	418 Booster	<5	<5	8.1	37	37	38.4	73.0	0.174	22.4	1.05	1.12
	Noble Creek	<5	<5	8.3	36	36	34.5	65.7	0.121	22.7	0.48	0.55
	Memorial	<5	<5	8.2	38	39	36.8	75.6	0.083	22.1	1.02	1.09
	Booster #4 SW	<5	<5	8.3	38	39	30.2	57.3	0.094	21.5	0.85	0.93
September	Knutsford	<5	<5	8.1	38	39	38.0	71.4	0.107	17.0	0.52	0.58
	CREDS	<5	<5	7.9	39	39	29.5	54.4	0.347	16.7	0.09	0.13
	Juniper #3	<5	<5	8.3	39	39	35.6	63.6	0.059	19.8	0.70	0.77
	418 Booster	<5	<5	8.3	39	39	38.1	69.6	0.102	18.9	0.96	1.05
	Noble Creek	<5	<5	8.3	39	40	36.9	65.1	0.081	19.6	0.32	0.38
	Memorial	<5	<5	8.3	38	39	40.9	72.3	0.115	19.0	1.02	1.08
	Booster #4 SW	<5	<5	8.1	39	39	41.4	77.8	0.106	17.6	0.79	0.85
October	Knutsford	<5	<5	8.1	39	40	53.1	92.1	0.165	15.3	0.38	0.45
	CREDS	<5	<5		39	39	52.3	94.6	0.101	15.4	0.16	0.21
	Juniper #3	<5	<5		39	39	52.8	98.4	0.110	15.8	0.58	0.64
	418 Booster	<5	<5		39	39	53.2	94.7	0.096	16.0	0.91	0.98
	Noble Creek	<5	<5		40	40	54.4	89.4	0.105	17.2	0.28	0.35
	Memorial	<5	<5		39	39	50.6	86.9	0.085	15.9	0.91	1.00
	Booster #4 SW	<5	<5		40	40	50.8	83.3	0.090	16.1	0.76	0.82
November	Knutsford	<5	<5	8.2	40	40	52.7	89.0	0.142	13.1	0.57	0.62
	CREDS	<5	<5	7.8	40	40	52.8	96.0	0.154	13.2	0.08	0.15
	Juniper #3	<5	<5	8.1	40	40	52.4	88.4	0.102	11.1	0.63	0.70
	418 Booster	<5	<5	8.0	40	41	51.3	90.8	0.111	11.3	1.06	1.12
	Noble Creek	<5	<5	8.3	42	41	54.7	94.2	0.096	15.8	0.51	0.59
	Memorial	<5	<5	7.9	40	40	51.3	91.8	0.148	9.5	0.96	1.05
	Booster #4 SW	<5	<5	7.9	39	40	51.2	89.8	0.127	8.7	0.92	0.98
December	Knutsford	<5	<5	8.0	41	40	52.6	89.0	0.135	9.9	0.55	0.61
	CREDS	<5	<5	7.8	41	41	52.3	90.9	0.353	9.5	0.31	0.36
	Juniper #3	<5	<5	7.8	41	41	53.2	96.7	0.115	9.1	0.72	0.79
	418 Booster	<5	<5	7.9	40	41	54.3	99.8	0.154	7.5	1.02	1.06
	Noble Creek	<5	<5	8.2	41	41	55.2	96.4	0.171	10.1	1.06	1.13
	Memorial	<5	<5	7.9	40	40	52.4	90.7	0.216	6.2	0.99	1.07
	Booster #4 SW	<5	<5	7.9	41	40	51.8	87.6	0.129	8.7	1.02	1.06
Daily Min.		***<5***	***<5***	***7.7***	***34***	***34***	***22.2***	***42.6***	***0.000***	***3.8***	***<0.02***	***<0.02***
Daily Max.		***<5***	***18***	***8.5***	***45***	***46***	***70.7***	***133.5***	***0.863***	***24.3***	***1.60***	***1.68***
Annual Avg.		***<5***	***<5***	***8.0***	***40***	***40***	***46.9***	***86.8***	***0.155***	***12.7***	***0.80***	***0.87***

In instances where data fell below the limits of analytical detection, half the detection limit was utilized for calculation purposes. pH readings were limited in the distribution system in October 2023 due to supply chain issues in getting a replacement probe delivered.

4.3 Distribution System Bacteriological Monitoring

The City is committed to providing safe drinking water to its customers. As directed in the DWPA and the DWPR, a water supplier is required to have its bacteriological analysis on the distribution system completed by a certified laboratory that is approved by the Provincial Health Officer. The City utilizes a certified third-party laboratory to analyze weekly bacteriological samples. The distribution system is sampled weekly at a minimum of 23 distinct locations and is analyzed for background bacterial counts, total coliforms, and *E. coli*.

4.3.1 Background Bacterial Monitoring

Background bacteria monitoring is done through a heterotrophic plate count (HPC). Heterotrophic bacteria are a group of bacteria that use carbon as a food source and can be found in a variety of water sources. Most bacteria found in water are heterotrophic. In general, these bacteria are not pathogenic, and the HPC test will not indicate whether the water is safe to drink. Because of this, there is no maximum acceptable concentration (MAC), as stated in the GCDWQ. This test will signify if there are conditions within the system that bacteria can regrow or thrive in.

Background bacteria are monitored to show the overall "health" of the distribution system. Any positive counts of any size for background bacteria are resampled immediately. If a sample is positive for background bacteria greater than 200 counts, the system is flushed and resampled.

4.3.2 Coliform Bacterial Monitoring

Coliform bacteria are a group of bacteria that provide a more of a narrow focus compared to the background bacteria test. These bacteria represent a large group of bacteria found in water, in soil, on vegetation, and in the feces of mammals. Most of these bacteria are not harmful to humans, and the ease of testing of these bacteria makes for a good indicator of contamination.

In the water distribution system, there is a zero-threshold allowance for coliforms within water samples. If a sample shows up positive for coliforms, the site is immediately resampled. If coliforms are found again, a boil water advisory is put in place. The distribution area is pulled offline and cleaned before being put back into action and resampled.

4.3.3 *E. coli* Bacterial Monitoring

E. coli bacteria are a subsection of coliform bacteria. These bacteria are found almost exclusively in the feces of mammals; therefore, they are a definite sign of contamination of the distribution system. While generally not harmful to human health, specific strains can cause serious health issues and even death in some instances. Any positive counts for *E. coli* result in an immediate resampling and may result in cleaning of the affected area and boil water advisories.

4.3.4 Bacteriological Monitoring Results

In 2023, bacteriological testing was performed 1,227 times over 24 locations in the distribution system. There were no positive tests for total coliforms or *E. coli* in the system. A total of 17 samples tested positive for background colonies throughout the system during the year, but they were clear upon resampling. Resampling occurs at the discretion of the distribution system chief operator and when background counts are greater than 200 counts. The 2023 results indicate that the City's drinking water is safe for public consumption.

4.4 Source Water and Distribution System Water Quality Analysis in 2023

The following extensive water quality analysis results were completed by a provincially accredited lab on the source water and the water within the distribution system on two dates (May 30 and September 26) in 2023. The sampling events were completed in compliance with the KCWQ operational certificate. The samples were taken by City staff and sent to CARO Analytical Services (CARO) in Kelowna, BC. The results of these analyses are shown in Tables 8 through 16.

Table 8: CARO Anions Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Noble Creek Booster	
				30-May-23	26-Sep-23	30-May-23	26-Sep-23
Bromide	mg/L	0.1	N/A	<0.10	<0.10	<0.10	<0.10
Chloride	mg/L	0.1	AO<=250	0.4	2.24	5.72	7.05
Fluoride	mg/L	0.1	MAC=1.5	<0.10	<0.10	<0.10	<0.10
Nitrate (as N)	mg/L	0.01	MAC=10	0.041	<0.010	0.044	<0.010
Nitrite (as N)	mg/L	0.01	MAC=1	<0.010	<0.010	<0.010	<0.010
Phosphate (as P)	mg/L	0.005	N/A		<0.0050	<0.0050	<0.0050
Sulfate	mg/L	1	AO<=500	4.8	8.4	4.9	6.9

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational guidance value

Table 9: CARO General Parameters Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Noble Creek Booster	
				30-May-23	26-Sep-23	30-May-23	26-Sep-23
Hardness, Dissolved (as CaCO3)	mg/L	0.5	N/A	39.8	43.5	40.3	42.1
Hardness, Total (as CaCO3)	mg/L	0.5	None Required	36.4	43.6	37.8	311
Nitrate+Nitrite (as N)	mg/L	0.01	N/A	0.0413	<0.0100	0.0436	<0.0100
Colour, True	CU	5	AO<=15	6.9	<5.0	<5.0	<5.0
Alkalinity, Total (as CaCO3)	mg/L	1	N/A	49.9	54	44.2	45.8
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	1	N/A	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	1	N/A	49.9	54	44.2	45.8
Alkalinity, Carbonate (as CaCO3)	mg/L	1	N/A	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	1	N/A	<1.0	<1.0	<1.0	<1.0
Ammonia, Total (as N)	mg/L	0.05	None Required	<0.050	0.069	<0.050	<0.050
BOD, 5-day	mg/L	2	N/A	<7.3	<6.5	<7.3	<6.5
Carbon, Total Organic	mg/L	0.5	N/A	2.44	4.37	2.43	2.86
Carbon, Dissolved Organic	mg/L	0.5	N/A	2.06	2.68	2.22	2.66
Cyanide, Total	mg/L	0.002	MAC=0.2			<0.0020	<0.0020
Nitrogen, Total Kjeldahl	mg/L	0.05	N/A	0.091	0.632	0.084	0.206
Oil & Grease, Total	mg/L	2	N/A		<2.0	<2.0	<2.0
Solids, Total Dissolved	mg/L	15	AO<=500	39	63	45	55
Sulfide, Total	mg/L	0.02	AO<=0.05			<0.020	<0.020
Turbidity	NTU	0.1	OG<1	3.26	1.4	0.16	<0.10
pH	pH units	0.1	7.0-10.5	6.65	6.82	6.46	6.92
Conductivity (EC)	uS/cm	2	N/A	90.1	99.9	105	113

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value

The September hardness concentration at Noble Creek Booster was elevated compared to the May reading. Hardness is primarily made up of calcium and magnesium in water (elevated levels were confirmed in Table 10). The causative factors responsible for elevated hardness concentration remain unclear at present. Further investigation is underway, but there are no health concerns.

The reported pH levels were below the drinking water guidelines for both locations on both dates. However, the samples were past the hold time at the external lab for pH bringing into question the reliability of the data. Continuous online monitoring at the KCWQ indicated a daily average pH of 7.72 (May) and 7.98 (September) for the source water and on-site monitoring of the Noble Creek Booster by operations staff showed pH levels of 7.89 (May) and 8.48 (September), suggesting that both source and distribution waters meet the Canadian Drinking Water Guidelines for pH.

Table 10: CARO Total Recoverable Metals Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Noble Creek Booster	
				30-May-23	26-Sep-23	30-May-23	26-Sep-23
Aluminum, total	mg/L	0.005	OG<0.1	0.121	0.0175	0.009	0.0068
Antimony, total	mg/L	0.0002	MAC=0.006	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic, total	mg/L	0.0005	MAC=0.01	<0.00050	<0.00050	<0.00050	<0.00050
Barium, total	mg/L	0.005	MAC=2	0.0106	0.0108	0.0092	0.0296
Beryllium, total	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth, total	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Boron, total	mg/L	0.05	MAC=5	<0.0500	<0.0500	<0.0500	<0.0500
Cadmium, total	mg/L	0.00001	MAC=0.007	0.000034	<0.000010	<0.000010	<0.000010
Calcium, total	mg/L	0.2	None Required	11.1	14.3	11.9	62.5
Chromium, total	mg/L	0.0005	MAC=0.05	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt, total	mg/L	0.0001	N/A	0.00012	<0.00010	<0.00010	<0.00010
Copper, total	mg/L	0.0004	MAC=2	0.00178	0.00662	0.00152	0.00188
Iron, total	mg/L	0.01	AO<=0.3	0.182	<0.010	<0.010	0.02
Lead, total	mg/L	0.0002	MAC=0.005	<0.00020	<0.00020	<0.00020	0.00023
Lithium, total	mg/L	0.0001	N/A	0.00072	0.00072	0.00067	0.00461
Magnesium, total	mg/L	0.01	None Required	2.08	1.92	1.97	37.6
Manganese, total	mg/L	0.0002	MAC=0.12	0.00747	0.00024	0.0013	0.00264
Mercury, total	mg/L	0.00001	MAC=0.001	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum, total	mg/L	0.0001	N/A	0.00056	0.00067	0.00054	0.00143
Nickel, total	mg/L	0.0004	N/A	0.00067	<0.00040	<0.00040	0.00062
Phosphorus, total	mg/L	0.05	N/A	<0.050	0.282	<0.050	<0.050
Potassium, total	mg/L	0.1	N/A	0.86	0.9	0.85	0.83
Selenium, total	mg/L	0.0005	MAC=0.05	<0.00050	<0.00050	<0.00050	<0.00050
Silicon, total	mg/L	1	N/A	3.4	3.2	3.4	4.3
Silver, total	mg/L	0.00005	None Required	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, total	mg/L	0.1	AO<=200	1.51	6.15	5.39	2.43
Strontium, total	mg/L	0.001	MAC=7	0.0783	0.0838	0.0798	0.476
Sulfur, total	mg/L	3	N/A	<3.0	<3.0	<3.0	35.8
Tellurium, total	mg/L	0.0005	N/A	0.00142	<0.00050	<0.00050	<0.00050
Thallium, total	mg/L	0.00002	N/A	<0.000020	<0.000020	<0.000020	<0.000020
Thorium, total	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Tin, total	mg/L	0.0002	N/A	<0.00020	<0.00020	<0.00020	<0.00020
Titanium, total	mg/L	0.005	N/A	0.0063	<0.0050	<0.0050	<0.0050
Tungsten, total	mg/L	0.001	N/A	<0.0010	<0.0010	<0.0010	<0.0010
Uranium, total	mg/L	0.00002	MAC=0.02	0.00029	0.000109	0.00009	0.00136
Vanadium, total	mg/L	0.005	N/A	<0.0050	<0.0050	<0.0050	<0.0050
Zinc, total	mg/L	0.004	AO<=5	<0.0040	<0.0040	<0.0040	0.0221
Zirconium, total	mg/L	0.0001	N/A	0.00048	<0.00010	<0.00010	<0.00010

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value

Table 11: CARO Dissolved Metals Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Noble Creek Booster	
				30-May-23	26-Sep-23	30-May-23	26-Sep-23
Aluminum, dissolved	mg/L	0.005	N/A	0.0072	0.0144	0.0083	0.0164
Antimony, dissolved	mg/L	0.0002	N/A	<0.00020	<0.00020	<0.00020	<0.00020
Arsenic, dissolved	mg/L	0.0005	N/A	<0.00050	<0.00050	<0.00050	<0.00050
Barium, dissolved	mg/L	0.005	N/A	0.0098	0.0122	0.0101	0.0107
Beryllium, dissolved	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth, dissolved	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Boron, dissolved	mg/L	0.05	N/A	<0.0500	<0.0500	<0.0500	<0.0500
Cadmium, dissolved	mg/L	0.00001	N/A	<0.000010	0.000018	<0.000010	<0.000010
Calcium, dissolved	mg/L	0.2	N/A	12.7	13.4	12.9	13.6
Chromium, dissolved	mg/L	0.0005	N/A	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt, dissolved	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Copper, dissolved	mg/L	0.0004	N/A	0.00193	0.0039	0.0022	0.00275
Iron, dissolved	mg/L	0.01	N/A	<0.010	<0.010	<0.010	<0.010
Lead, dissolved	mg/L	0.0002	N/A	<0.00020	<0.00020	<0.00020	<0.00020
Lithium, dissolved	mg/L	0.0001	N/A	0.00072	0.00071	0.00074	0.00069
Magnesium, dissolved	mg/L	0.01	N/A	1.96	2.43	1.94	1.98
Manganese, dissolved	mg/L	0.0002	N/A	<0.00020	<0.00020	<0.00020	<0.00020
Mercury, dissolved	mg/L	0.00004	N/A	<0.000040	<0.000040	<0.000040	<0.000040
Molybdenum, dissolved	mg/L	0.0001	N/A	0.00052	0.00068	0.00054	0.00063
Nickel, dissolved	mg/L	0.0004	N/A	<0.00040	0.00098	<0.00040	<0.00040
Phosphorus, dissolved	mg/L	0.05	N/A	<0.050	<0.050	<0.050	<0.050
Potassium, dissolved	mg/L	0.1	N/A	0.86	1.24	0.87	0.92
Selenium, dissolved	mg/L	0.0005	N/A	<0.00050	<0.00050	<0.00050	<0.00050
Silicon, dissolved	mg/L	1	N/A	3.2	2.8	3.3	2.8
Silver, dissolved	mg/L	0.00005	N/A	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, dissolved	mg/L	0.1	N/A	1.5	2.71	5.41	5.52
Strontium, dissolved	mg/L	0.001	N/A	0.0741	0.0874	0.0765	0.0857
Sulfur, dissolved	mg/L	3	N/A	<3.0	<3.0	<3.0	<3.0
Tellurium, dissolved	mg/L	0.0005	N/A	<0.00050	<0.00050	<0.00050	<0.00050
Thallium, dissolved	mg/L	0.00002	N/A	<0.000020	<0.000020	<0.000020	<0.000020
Thorium, dissolved	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
Tin, dissolved	mg/L	0.0002	N/A	<0.00020	0.0005	<0.00020	<0.00020
Titanium, dissolved	mg/L	0.005	N/A	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten, dissolved	mg/L	0.001	N/A	<0.0010	<0.0010	<0.0010	<0.0010
Uranium, dissolved	mg/L	0.00002	N/A	0.000274	0.000134	0.000098	0.000105
Vanadium, dissolved	mg/L	0.005	N/A	<0.0050	<0.0050	<0.0050	<0.0050
Zinc, dissolved	mg/L	0.004	N/A	<0.0040	0.0056	<0.0040	<0.0040
Zirconium, dissolved	mg/L	0.0001	N/A	<0.00010	<0.00010	<0.00010	<0.00010
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective				

Dissolved calcium and magnesium concentrations did not differ greatly in the Noble Creek Booster samples from May to September, suggesting that the increase in hardness concentrations in September (Table 9) were due to elevated levels of particulate calcium and magnesium.

Table 12: CARO Pesticides, Herbicides, and Fungicides Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water	Noble Creek Booster	
				26-Sep-23	24-May-22	04-Oct-22
Glyphosate	mg/L	0.05	MAC=0.28	<0.050	<0.050	<0.050
Phenolics, Total	mg/L	0.002	N/A			<0.00200
Alachlor	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Aldrin	ug/L	0.006	N/A	<0.006	<0.006	<0.006
Atrazine	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Azinphos-methyl	ug/L	0.2	MAC=20	<0.200	<0.200	<0.200
alpha-BHC	ug/L	0.01	N/A	<0.010	<0.010	<0.010
beta-BHC	ug/L	0.05	N/A	<0.050	<0.050	<0.050
delta-BHC	ug/L	0.05	N/A	<0.050	<0.050	<0.050
gamma-BHC (Lindane)	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Bromacil	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Captan	ug/L	0.1	N/A	<0.100	<0.100	<0.100
alpha-Chlordane	ug/L	0.05	N/A	<0.050	<0.050	<0.050
gamma-Chlordane	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Chlorothalonil	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Chlorpyrifos	ug/L	0.01	MAC=90	<0.010	<0.010	<0.010
Cyanazine	ug/L	0.1	N/A	<0.100	<0.100	<0.100
p,p-DDD	ug/L	0.01	N/A	<0.010	<0.010	<0.010
p,p'-DDE	ug/L	0.01	N/A	<0.010	<0.010	<0.010
p,p'-DDT	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Diazinon	ug/L	0.02	MAC=20	<0.020	<0.020	<0.020
Dichlorvos	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Dieldrin	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Dimethoate	ug/L	0.2	MAC=20	<0.200	<0.200	<0.200
Disulfoton	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Endosulfan I	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Endosulfan II	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Endosulfan sulfate	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Endrin	ug/L	0.02	N/A	<0.020	<0.020	<0.020
Endrin aldehyde	ug/L	0.02	N/A	<0.020	<0.020	<0.020
Endrin ketone	ug/L	0.02	N/A	<0.020	<0.020	<0.020
Fenchlorphos (Ronnel)	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Heptachlor	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Heptachlor epoxide	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Malathion	ug/L	0.1	MAC=290	<0.100	<0.100	<0.100
Methyl parathion	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Metolachlor	ug/L	0.1	MAC=50	<0.100	<0.100	<0.100
Metribuzin	ug/L	0.2	MAC=80	<0.200	<0.200	<0.200
Parathion	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Pentachloronitrobenzene	ug/L	0.1	N/A	<0.100	<0.100	<0.100
cis-Permethrin	ug/L	0.01	N/A	<0.010	<0.010	<0.010
trans-Permethrin	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Phorate	ug/L	0.1	MAC=2	<0.100	<0.100	<0.100
Simazine	ug/L	0.2	MAC=10	<0.200	<0.200	<0.200
Sulfotep	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Terbufos	ug/L	0.1	MAC=1	<0.100	<0.100	<0.100
Triallate	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Trifluralin	ug/L	0.2	MAC=45	<0.200	<0.200	<0.200

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value

Pesticide, herbicide, and fungicide testing was added to source water analysis in September 2023 to provide insight into concentrations entering the KCWQ plant. All values were below detection limits. Biannual sampling for source water will begin next year.

Table 13: CARO Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water	Noble Creek Booster	
				26-Sep-23	30-May-23	26-Sep-23
Acenaphthene	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Acenaphthylene	ug/L	0.2	N/A	<0.200	<0.200	<0.200
Acridine	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Anthracene	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Benz(a)anthracene	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Benzo(a)pyrene	ug/L	0.01	MAC=0.04	<0.010	<0.010	<0.010
Benzo(b+j)fluoranthene	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	ug/L	0.05	N/A	<0.050	<0.050	<0.050
2-Chloronaphthalene	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Chrysene	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	ug/L	0.01	N/A	<0.010	<0.010	<0.010
Fluoranthene	ug/L	0.03	N/A	<0.030	<0.030	<0.030
Fluorene	ug/L	0.05	N/A	<0.050	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	ug/L	0.05	N/A	<0.050	<0.050	<0.050
1-Methylnaphthalene	ug/L	0.1	N/A	<0.100	<0.100	<0.100
2-Methylnaphthalene	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Naphthalene	ug/L	0.2	N/A	<0.200	<0.200	<0.200
Phenanthrene	ug/L	0.1	N/A	<0.100	<0.100	<0.100
Pyrene	ug/L	0.02	N/A	<0.020	<0.020	<0.020
Quinoline	ug/L	0.05	N/A	<0.050	<0.050	<0.050

MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value

Polycyclic aromatic hydrocarbon testing was added to source water analysis in September 2023 to provide insight into concentrations entering the KCWQ plant. All analytes were below detection limits. Biannual sampling for source water will start next year.

Table 14: CARO Volatile Organic Compounds Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water	Noble Creek Booster	
				26-Sep-23	30-May-23	23-Sep-23
Benzene	ug/L	0.5	MAC=5	<0.5	<0.5	<0.5
Bromodichloromethane	ug/L	1	N/A	<1.0	1	1.6
Bromoform	ug/L	1	N/A	<1.0	<1.0	<1.0
Carbon tetrachloride	ug/L	0.5	MAC=2	<0.5	<0.5	<0.5
Chlorobenzene	ug/L	1	AO<=30	<1.0	<1.0	<1.0
Chloroethane	ug/L	2	N/A	<2.0	<2.0	<2.0
Chloroform	ug/L	1	N/A	<1.0	38.7	56.7
Dibromochloromethane	ug/L	1	N/A	<1.0	<1.0	<1.0
1,2-Dibromoethane	ug/L	0.3	N/A	<0.3	<0.3	<0.3
Dibromomethane	ug/L	1	N/A	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	ug/L	0.5	AO<=3	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	ug/L	1	N/A	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	ug/L	1	AO<=1	<1.0	<1.0	<1.0
1,1-Dichloroethane	ug/L	1	N/A	<1.0	<1.0	<1.0
1,2-Dichloroethane	ug/L	1	MAC=5	<1.0	<1.0	<1.0
1,1-Dichloroethylene	ug/L	1	MAC=14	<1.0	<1.0	<1.0
cis-1,2-Dichloroethylene	ug/L	1	N/A	<1.0	<1.0	<1.0
trans-1,2-Dichloroethylene	ug/L	1	N/A	<1.0	<1.0	<1.0
Dichloromethane	ug/L	3	MAC=50	<3.0	<3.0	<3.0
1,2-Dichloropropane	ug/L	1	N/A	<1.0	<1.0	<1.0
1,3-Dichloropropene (cis + trans)	ug/L	1	N/A	<1.0	<1.0	<1.0
Ethylbenzene	ug/L	1	AO<=1.6	<1.0	<1.0	<1.0
Methyl tert-butyl ether	ug/L	1	AO<=15	<1.0	<1.0	<1.0
Styrene	ug/L	1	N/A	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	ug/L	0.5	N/A	<0.5	<0.5	<0.5
Tetrachloroethylene	ug/L	1	MAC=10	<1.0	<1.0	<1.0
Toluene	ug/L	1	MAC=60	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	ug/L	1	N/A	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	ug/L	1	N/A	<1.0	<1.0	<1.0
Trichloroethylene	ug/L	1	MAC=5	<1.0	<1.0	<1.0
Trichlorofluoromethane	ug/L	1	N/A	<1.0	<1.0	<1.0
Vinyl chloride	ug/L	1	MAC=2	<1.0	<1.0	<1.0
Xylenes (total)	ug/L	2	AO<=20	<2.0	<2.0	<2.0
MAC = Maximum Acceptable Concentration AO = Aesthetic objective OG = Operational Guidance Value						

Volatile organic compound testing was added to source water analysis in September 2023 to provide insight into concentrations entering the KCWQ plant. Biannual sampling for source water will begin next year.

Chloroform concentrations were detected at the Noble Creek Booster in 2023. Chloroform has been detected in similar concentrations in City's booster stations at the extremities of the distribution system over the past several years. Chloroform is a disinfection byproduct when hypochlorite, which is used to disinfect water, reacts with organic matter present in the water. Chloroform is not regulated under the Canadian Drinking Water Guidelines.

Table 15: CARO Trihalomethanes and Haloacetic Acids Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Pineview	Simms	Campbell Creek East	Noble Creek
				21-Feb-23			
Calculated Parameters							
Total Trihalomethanes	mg/L	0.00400	MAC: 0.1	0.0466	0.0444	0.0654	0.0522
Haloacetic Acids							
Monochloroacetic Acid	mg/L	0.0020	N/A	0.0026	0.0032	0.0033	0.0027
Monobromoacetic Acid	mg/L	0.0020	N/A	<0.0020	<0.0020	<0.0020	<0.0020
Dichloroacetic Acid	mg/L	0.0020	N/A	0.0098	0.0114	0.0176	0.0159
Trichloroacetic Acid	mg/L	0.0020	N/A	0.0185	0.0173	0.0240	0.0226
Dibromoacetic Acid	mg/L	0.0020	N/A	<0.0020	<0.0020	<0.0020	<0.0020
Total Haloacetic Acids (HAA5)	mg/L	0.00200	MAC: 0.08	0.0309	0.032	0.0449	0.0413
Volatile Oragnic Compounds (VOC)							
Bromodichloromethane	mg/L	0.0010	N/A	0.0018	0.0017	0.0022	0.0018
Bromoform	mg/L	0.0010	N/A	<0.0010	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	0.0010	N/A	0.0448	0.0427	0.0632	0.0504
Dibromochloromethane	mg/L	0.0010	N/A	<0.0010	<0.0010	<0.0010	<0.0010
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective				

Table 16: CARO Perfluorinated Compounds Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Source Water		Noble Creek Booster	
				30-May-23	26-Sep-23	30-May-23	23-Sep-23
Perfluorooctanesulfonate (PFOS)	ug/L	0.2	0.6	<0.200	<0.200	<0.200	<0.200
Perfluorooctanoic acid (PFOA)	ug/L	0.2	0.2	<0.200	<0.200	<0.200	<0.200
Perfluoropentanoic acid (PFPeA)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluorobutanesulfonate (PFBS)	ug/L	10	N/A	<10.0	<10.0	<10.0	<10.0
Perfluorohexanoic acid (PFHxA)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluoroheptanoic acid (PFHpA)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluorohexanesulfonate (PFHxS)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluoroheptane sulfonate (PFHpS)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluorononanoic acid (PFNA)	ug/L	0.02	N/A	<0.020	<0.020	<0.020	<0.020
Perfluorodecanoic acid (PFDA)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluoroundecanoic acid (PFUnA)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluorodecanesulfonate (PFDS)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluorododecanoic acid (PFDoA)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
Perfluorotetradecanoic acid (PFTeA)	ug/L	1	N/A	<1.00	<1.00	<1.00	<1.00
Perfluorooctanesulfonamide (PFOSA)	ug/L	1	N/A	<1.00	<1.00	<1.00	<1.00
Perfluorotridecanoic acid (PFTrA)	ug/L	1	N/A	<1.00	<1.00	<1.00	<1.00
Perfluorobutanoic acid (PFBA)	ug/L	25	N/A	<25.0	<25.0	<25.0	49.7
6:2 Fluorotelomer sulfonate (6:2FTS)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
8:2 Fluorotelomer sulfonate (8:2FTS)	ug/L	0.2	N/A	<0.200	<0.200	<0.200	<0.200
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective	OG = Operational Guidance Value			

The only value above detection levels was perfluorobutanoic acid (PFBA) at 49.7 ug/L at the Noble Creek Booster in September 2023. Perfluorinated compounds are synthetic chemicals that have been used in a variety of industrial and consumer products for decades in various products, such as firefighting foams, stain-resistant coatings, and non-stick cookware. There are currently no drinking water guidelines for PFBAs.

5. Small Water Systems

The City owns and operates two small water systems in areas that the distribution system does not reach. One of those systems is at the Tournament Capital Ranch in Rayleigh, and the other is a reverse osmosis system (RO) for the Kamloops Sewage Treatment Centre (KSTC) administration building.

5.1 Tournament Capital Ranch Water System

The City trucks treated and chlorinated drinking water to the Tournament Capital Ranch potable water system, and the water is stored in a 38 m^3 cistern. The cistern supplies the washroom/concession building and the outdoor fountains/taps with potable water. Operation and monitoring of this site occurs only in the summer months when the site is open to the public. Chlorine residual and microbial water sampling occur weekly, and there were no positive results for any bacteriological species in 2023.

5.2 Kamloops Sewage Treatment Center Water System

As the City municipal water system does not extend to the KSTC, a local water supply and treatment system was installed to provide potable water to the KSTC administration building only.

A 250 mm diameter bedrock well was constructed to a depth of 168 m and completed with a 150 mm diameter Sched 80 PVC liner slotted over the interval 87 – 147 m. The well is located north of the KSTC access road and immediately to the east of the administration building parking lot. The water treatment system was installed in the administration building mechanical room.

Water is pumped from the well through pre-treatment and softening stages before it flows through an ultraviolet disinfection and RO system. After the treatment, it is stored in a 1,590 L storage tank.

5.2.1 In-House Testing

Water use at the KSTC was measured at 313 m^3 from January to December 2023. The usage rate of 0.86 m^3 per day is lower than the design level of 1.35 m^3 per day. The results of the 2023 in-house testing are shown in Table 17.

Table 17: 2023 In-House Testing of RO Treated Water at KSTC

	Temperature (°C)	pH	Conductivity (µS/cm)
Average RO Treated Water Quality (51 samples in 2023)	21.4	8.7	129

The 2023 in-house testing indicated that the RO system is functioning well.

5.2.2 External Testing

In 2023, samples of treated water were taken twice and sent to a commercial laboratory for a full analysis. The results are shown in Table 18.

Table 18: Water Quality Results for RO Treated Water at KSTC in 2023

	RO Treated Water		Government of Canada Drinking Water Quality Guidelines
	June 1	October 5	
General Parameters			
pH	8.01	8.34	7.0–10.5
TSS (mg/L)	<3.3	<2.0	No guideline for drinking water
TDS (mg/L)	60	72	AO: ≤ 500 mg/L
Conductivity (µS/cm)	111	128	No drinking water quality guideline
Total Hardness	12	11	No drinking water quality guideline
Turbidity	0.11	0.18	OG: < 1 NTU
True Colour	<5.0	<5.0	AO: ≤ 15 mg/L
Chloride	6.9	8.6	AO: ≤ 250 mg/L
Fluoride	<0.10	<0.10	MAC: 1.5 mg/L
Sulphate	5.9	8.4	AO: ≤ 500 mg/L
Sulphide	<0.02	<0.02	AO: ≤ 0.05 mg/L
Nutrients (ppm)			
Total Ammonia-N	<0.050	<0.050	No drinking water quality guideline
Nitrate-N	<0.010	<0.010	MAC: 10 mg/L
Nitrite-N	<0.010	<0.010	MAC: 1 mg/L
Total Phosphorus-P	0.0094	0.0075	No drinking water quality guideline
Bacteriological Parameters (CFU/100 mL)			
Faecal Coliforms	<1	<1	0 CFU
Total Coliforms	<1	<1	0 CFU
E. coli	<1	<1	0 CFU
Total Metals (ppm)			

	RO Treated Water		Government of Canada Drinking Water Quality Guidelines
	June 1	October 5	
Aluminum	<0.005	<0.005	OG: 0.1 mg/L
Antimony	<0.00020	<0.00020	MAC: 0.006 mg/L
Arsenic	0.00057	0.00069	MAC: 0.01 mg/L
Barium	<0.0050	<0.0050	MAC: 1.0 mg/L
Beryllium	<0.00010	<0.00010	No drinking water quality guideline
Bismuth	<0.00010	<0.00010	No drinking water quality guideline
Boron	0.888	0.821	MAC: 5 mg/L
Cadmium	<0.000010	<0.000010	MAC: 0.005 mg/L
Calcium	4.5	4.1	No drinking water quality guideline
Chromium	<0.00050	<0.00050	MAC: 0.05 mg/L
Cobalt	<0.00010	<0.00010	No drinking water quality guideline
Copper	0.0192	0.0118	AO: ≤ 1 mg/L
Iron	<0.010	<0.010	AO: ≤ 0.3 mg/L
Lead	<0.00020	<0.00020	MAC: 0.01 mg/L
Lithium	0.00087	0.00085	No drinking water quality guideline
Magnesium	0.1	0.1	No drinking water quality guideline
Manganese	0.0006	0.0006	AO: ≤ 0.02 mg/L
Mercury	<0.00001	<0.00001	MAC: 0.001 mg/L
Molybdenum	0.00878	0.0112	No drinking water quality guideline
Nickel	<0.00040	<0.00040	No drinking water quality guideline
Potassium	<0.1	<0.1	No drinking water quality guideline
Selenium	<0.00050	<0.00050	MAC: 0.05 mg/L
Silicon	2.4	2.5	No drinking water quality guideline
Silver	<0.000050	<0.000050	No drinking water quality guideline
Sodium	20.1	23.8	AO: ≤ 200 mg/L
Strontium	0.013	0.012	No drinking water quality guideline
Sulphur	<3.0	<3.0	No drinking water quality guideline
Tellurium	<0.00050	<0.00050	No drinking water quality guideline
Thallium	<0.000020	<0.000020	No drinking water quality guideline
Thorium	<0.00010	<0.00010	No drinking water quality guideline
Tin	<0.00020	<0.00020	No drinking water quality guideline
Titanium	<0.0050	<0.0050	No drinking water quality guideline
Uranium	<0.000020	<0.000020	MAC: 0.02 mg/L
Vanadium	<0.0050	<0.0050	No drinking water quality guideline
Zinc	<0.0040	<0.0040	AO: ≤ 5 mg/L

	RO Treated Water		Government of Canada Drinking Water Quality Guidelines
	June 1	October 5	
Zirconium	<0.0001	<0.0001	No drinking water quality guideline
Maximum Allowable Concentration: MAC Aesthetic Objective: AO Operational Guideline: OG			

The RO treated water at the KSTC met drinking water quality guidelines.

6. Related City of Kamloops Water Programs

6.1 Source Water Assessment and Protection Plan

The City, in partnership with the Fraser Basin Council, completed a Source Water Protection Plan (SWPP) in 2014. The SWPP included four modules that aligned with the Ministry of Health's drinking Water Source-to-Tap Assessment Guideline, including Source Delineation and Characterization, Hazard Source Inventory, Risk Assessment and Actions to Improve Drinking Water Protection. The SWPP included several recommendations to manage risk. The primary recommendation was construction of the North Thompson Emergency Water Intake to mitigate risks associated with source contamination. The emergency intake was completed in 2019. Recommendations for communication and emergency response were also provided.

In 2022, the City began a preliminary assessment of the South Thompson River specifically to assess the impacts of drought and potential erosion of Kamloops Lake on the existing drinking water intake infrastructure. The results indicated that while there was a downward trend in river levels, the viability of the intake structure was unlikely to be impacted by river levels in the lifetime of the existing infrastructure.

6.2 Cross-Connection Program

The City recently enacted the stand-alone Cross Connection Control Bylaw No. 12-71, which replaces section 30 of Waterworks Bylaw No. 12-31. This updated bylaw is crafted to align with Municipal Ticket Information Bylaw No. 43-15, allowing for the imposition of fines in cases of non-compliance. Oversight and enforcement of the Cross Connection Control Bylaw are jointly managed by the City's utilities operations and community support services.

The Cross Connection Control Bylaw serves the crucial purpose of establishing a robust framework for the organization and utility to meet Interior Health's requirements for operating a water system under the DWPA. Its core objective is to protect public health by preventing the contamination of the City's pristine drinking water supply through backflow incidents. The formulation of this bylaw and its accompanying procedures is informed by industry best practices and closely reflects similar frameworks adopted by municipalities across British Columbia.

This proactive measure underscores our unwavering dedication to ensuring the uninterrupted provision of high-quality drinking water to our residents, all while upholding regulatory standards and safeguarding public health.

6.3 Emergency Response Plan Update

Safe and reliable drinking water is a top priority for the City's Utilities Services Division. Emergency response planning is one in several important steps in preparing our staff for the different scenarios that may arise. Like other water systems of this size, the City's public water system can have emergencies such as pipe breaks, pump malfunctions, bacteriological contamination, and power outages. The purpose of the City's Main Water System Emergency Response Plan, which was created in 2013, is to implement a plan to make these situations more manageable.