Greater Vernon Water 2024 Annual Report

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LIST OF ACRONYMS

AO	Aesthetic Objectives
AWWA	American Water Works Association
BMP	Best Management Practice
BoD	Board of Directors
CCC	Cross Connection Control
CoV	City of Vernon
CR	Coldstream Ranch
CT	Contact Time
DAF	Dissolved Air Flotation
DBP	Disinfection By-Product
DCWAPR	Duteau Creek Watershed Assessment Response Plan
DCWTP	Duteau Creek Water Treatment Plant
DMP	Drought Management Plan
DoC	District of Coldstream
DOC	Dissolved Organic Carbon
DWPA / DWPR	*BC Drinking Water Protection Act and Regulation*
EOCP	Environmental Operators Certification Program
ERT	Encoder-Receiver-Transmitter
FLOC	Flocculent
GCDWQ	Guidelines for Canadian Drinking Water Quality
GIS	Geographic Information Systems
GVW	Greater Vernon Water
HAA	Haloacetic Acid
IH	Interior Health
MAC	Maximum Acceptable Concentrations
MDD	Maximum Day Demand
MHWTP	Mission Hill Water Treatment Plant
MWP	Master Water Plan
MoE	Ministry of Environment
NTU	Nephelometric Turbidity Units
OBWB	Okanagan Basin Water Board
PAC	Poly Aluminum Chloride
PRV	Pressure-Reducing Valve
PS	Pump Station
RDNO	Regional District of North Okanagan
SCADA	Supervisory Control and Data Acquisition software
TAC	Technical Advisory Committee
TWG	Technical Working Group
TCU	True Colour Units
THM	Trihalomethane
TOC	Total Organic Carbon
UVT	Ultra Violet Transmissivity
WQI	Water Quality Indicators

INTRODUCTION

As required by the *British Columbia Drinking Water Protection Act*, the Regional District of North Okanagan (RDNO), Greater Vernon Water (GVW) provides the following annual report in accordance with our conditions on permit.

This report summarizes data from the GVW system from the source water to the municipal distribution system. The report outlines where water comes from, how it is treated to ensure safe drinking water and how that water is distributed and used. Drinking water can be complex and much of the information provided in this report is technical in nature. Please contact GVW (phone: 250-550-3700 or email: utilities@rdno.ca) should you have any questions.

In British Columbia, a community water system must hold a "Permit to Operate" as directed in the *Drinking Water Protection Act (DWPA)* and *Drinking Water Protection Regulations* (*DWPR*) passed May 16, 2003 by the Province of BC. Community water systems must also follow Health Canada Guidelines for Canadian Drinking Water Quality (GCDWQ) and the technical documents.

Interior Health (IH), through the Drinking Water Officers (DWOs) who have the delegated legislative authority, regulate GVW from source to tap under the DWPA.

This report outlines the programs and projects GVW has developed and implemented to meet legislation.

WATER SYSTEM OVERVIEW

GVW is a regional water system that supplies and delivers water to customers in the City of Vernon (CoV), the District of Coldstream (DoC), and portions of Electoral Areas "B", "C" and "D" and the Township of Spallumcheen. Based on the 2021 census, growth, and service connections, the population served is approximately 67,000.

The RDNO owns and manages the GVW water system in addition to operating the supply and treatment facilities, while the CoV and DoC are contracted for the operations and maintenance of the distribution system.

GVW holds 40 water licences and supplies water to customers via six (6) water intakes from the following surface water sources:

1. Duteau Creek (Duteau Creek intake and Goose Lake intake)
2. Kalamalka Lake
3. Okanagan Lake (Outback and Delcliffe intakes)
4. King Edward Lake (Deer Creek intake).

Duteau Creek supplies the largest water volume to the GVW service area, with both non-potable (untreated) and potable (treated) water. Kalamalka Lake is the second largest water supply and provides only potable water. There are two (2) intakes on Okanagan Lake that service two (2) small potable water systems: the Outback and Delcliffe (these water systems have stand-alone annual reports available on the RDNO website).

Goose Lake functions as an open reservoir, receiving water from the Duteau Creek Water Treatment Plant (DCWTP), to provide non-potable water to agricultural customers on the western side of Swan Lake and in the Bella Vista Area. Deer Creek (King Edward Lake) provides non-potable water to a limited number of Coldstream agricultural customers combined with some groundwater.

GVW also manages four (4) groundwater wells:

- Coldstream Ranch (CR) Wells 2 and 3 – both are in service all year round to supply agricultural non-potable water. Well 3 is approved as an emergency supply in the potable / domestic supply if required.
- Antwerp Springs (Antwerp) Deep and Shallow Wells – are currently not in service. The Antwerp Deep is approved as emergency supply in the potable / domestic supply if required. The Antwerp Shallow Well is currently not operational and will only be used for irrigation once a non-potable water main is installed close enough to connect the well.

GVW has approximately 21,000 service connections. There are approximately 800 active farm or agriculture status connections, 1,500 commercial, institutional / park, or industrial connections (ICI) and approximately 20,000 residential connections. All active service connections are metered.

Staffing

The overall management of GVW lies with the RDNO (Table 1, Appendix). The RDNO operations team is responsible for treatment and supply (Table 2, Appendix). Distribution system operations are contracted under agreement with the CoV and DoC under the direction of RDNO staff (Tables 3 and 4, Appendix). Section 12 of the DWPR outlines the qualification standards for water supply system operators. Operators must be certified by the Environmental Operators Certification Program (EOCP) for their specific system class.

Drinking Water Sources and Treatment

Duteau Creek

Water from Duteau Creek supplies domestic (potable) and agricultural (non-potable) water for GVW. Duteau Creek originates on the Aberdeen Plateau and the watershed is controlled with seven (7) earthen dams forming three (3) reservoirs: Grizzly, Aberdeen, and Haddo Lakes. The Duteau Creek watershed covers an area of approximately 21,275 hectares (ha) (213 km^2) between Grizzly Hills summit (elevation of 1,800 metres (m)) on the Aberdeen Plateau and the Duteau Creek Intake (point of diversion) at an elevation of 660 m.

Duteau Creek flows out of Haddo Lake and continues downstream for approximately 13 km before entering Harvey Lake, a small reservoir created by Headgates Dam, which also contains the Duteau Creek intake. Water is diverted into the GVW system at this point through a transmission main pipe to the DCWTP, with a bypass for the non-potable system located before the DCWTP. Water is also released through the Headgates Dam low-level outlet into Duteau Creek for Environmental Flow Needs as per an agreement between the RDNO and the Province.

Duteau Creek – non-potable

Just before entering the DCWTP, water can either be diverted into the DCWTP for treatment or diverted to the non-potable system, bypassing treatment and supplying irrigation water to farms in the Von Keyserlingk and Springfield areas.

Duteau Creek – potable

Water diverted to the DCWTP for treatment is first clarified by Dissolved Air Flotation (DAF), then injected with chlorine before entering the 10 ML covered reservoir and finally disinfected by Ultraviolet (UV) disinfection before entering the distribution system.

Approximately 60% of organic carbon is removed through the DAF process, which removes the yellow colour from the water. The water is chlorinated before the reservoir to provide sufficient contact time for viruses. UV disinfection after the reservoir adds another layer of treatment and assists GVW in meeting the *4-3-2-1-0 Drinking Water Treatment Objectives* (BC MOH, 2024). The UV inactivates Cryptosporidium and Giardia.

Kalamalka Lake

Water from Kalamalka Lake supplies domestic (potable) water for GVW. The Kalamalka Lake Pump Station (PS) is located on West Kal Road in Coldstream, BC, with the intake located 327 m from the shoreline at a depth of 20 m and 3 m off the lake bottom to improve water quality. Water is pumped from Kalamalka Lake to the Mission Hill Water Treatment Plant (MHWTP) for disinfection treatment using a UV reactor and chlorine. The plant has a design capacity of 60 ML/d.

Separated Non-Potable Water Sources

Goose Lake

Goose Lake is located west of Swan Lake. Since 2013, the water stored in Goose Lake is used solely for agricultural (non-potable) purposes. Goose Lake reservoir is filled with treated water from the DCWTP, but once it enters the open reservoir, it is no longer potable. There is a backflow prevention device installed to ensure there is no cross connection with the potable water system.

King Edward Lake

The Deer Creek intake is supplied by releases from the King Edward Lake reservoir. It is used for agricultural demands in the “King Edward Lake Service Area” (Coldstream Creek and Grey Road area).

Coldstream Ranch (CR) Groundwater Wells

CR Wells 2 and 3 are both located on the CR lands near the intersection of Highway 6 and Kalamalka Road. These well sources are used primarily to help meet agricultural irrigation demands in the King Edward Lake Service Area.

CR Well 2 is 24 m deep, screened in an unconfined aquifer with no annular seal and has a pumping capacity of 50 L/sec. This well is only used as a non-potable source and meets the requirements of provincial water licencing authorities at this time.

CR Well 3 is 50 m deep, screened in a confined aquifer with an annular seal and is also designated as an emergency backup supply for the potable water system authorized by Interior Health and meets the requirements of provincial water licencing authorities at this time. The well pump has a variable frequency drive and produces between 57 and 63 L/sec, which controls pressure in the service area. Chlorination, a turbidity meter, and a backflow prevention device have been installed at this well in case it is needed for potable water in an emergency.

Drinking Water Distribution System

The GVW distribution system has a service area of 244 km^2 with approximately 700 km of pipeline, 39 pump stations, 93 pressure reducing stations, 21 concrete balancing reservoirs, and 105 pressure zones.

New Water Mains

Disinfection of new water mains is completed in accordance with AWWA C651 - Continuous Feed Method. If water samples taken following initial disinfection are not acceptable and do not meet water quality standards, the process is repeated.

Pressure Reducing Valve (PRV) Station

The maximum design water pressure for piping within most of the water distribution system is 1,040 kPa (150 psi). 93 Pressure Reducing Valves (PRV) within the GVW system control the pressure in the water system by creating head losses that prevent pressures from exceeding the design maximum.

The operators currently service the PRV stations as required to extend their service life. The BC Building Code requires all buildings to have an on-site PRV to protect internal plumbing systems from high or fluctuating pressures. Most internal plumbing and fixtures are rated at a maximum of about 50 psi.

System Control – Supervisory Control and Data Acquisition Software

Operators and management use the Supervisory Control and Data Acquisition Software (SCADA) system for monitoring reservoir water levels, operating pumps, monitoring water quality control equipment, and maintaining a historical data file of the water system's operations. All monitoring is done through wireless connections. When a problem is detected within the system, the SCADA system sends out alarms and, depending on the location of the problem, either the RDNO, CoV, or DoC operators respond.

Water System Value and Asset Management

GVW has an Asset Management Investment Plan (AMIP). The primary goal of an AMIP is to replace infrastructure to obtain full lifecycle and to extend the life of an asset where possible. Criteria has been developed to guide this process that reviews actual conditions as opposed to only using the estimated lifespan listed for an asset. This has allowed GVW to extend the life of certain assets, delay replacement of others and focus on assets that are truly at the end of their life to more efficiently use replacement dollars.

The approximate total value of the GVW water system in 2024, is estimated to be $1.325 billion (Figure 1).

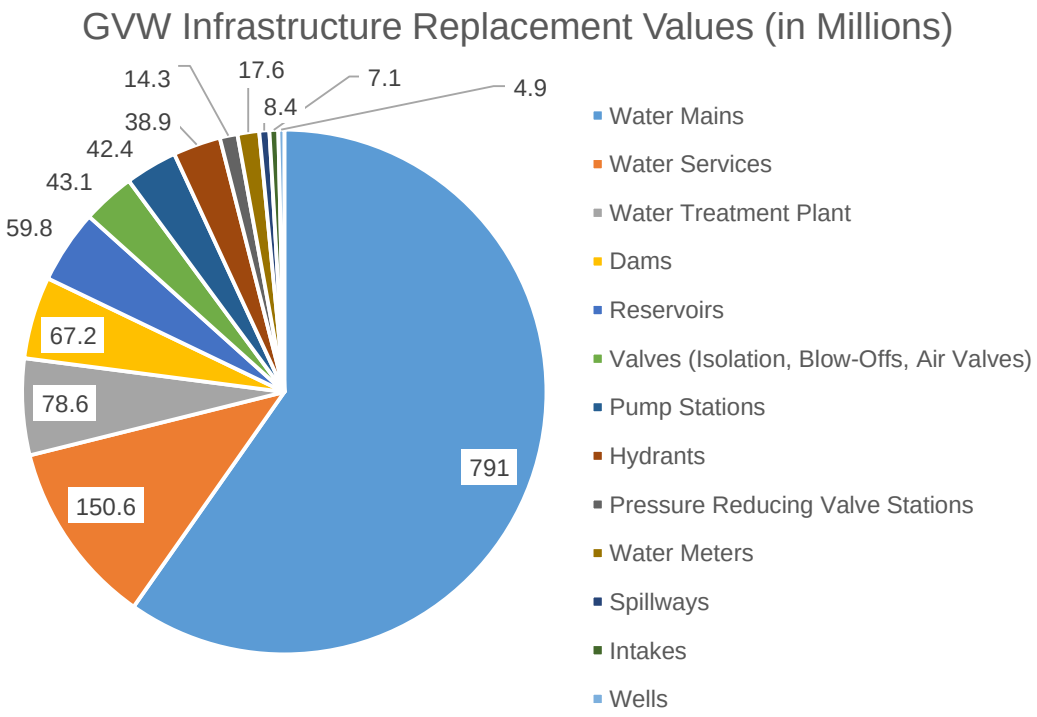


Figure 1: GVW Infrastructure Replacement Values

All GVW assets are entered into the Geographic Information Systems (GIS). Attributes for each asset include year of install, material, size, number of breaks for pipes and other features depending on the asset.

GVW uses a modelling tool developed in partnership with UBC Okanagan to analyze risk of failure in GVW's water mains, which is used to rank their replacement based on soil corrosivity, water aggressiveness, pressure, age of pipe, number of breaks and consequence of failure. High-ranked projects are reviewed with operations, and the highest ranked pipes are incorporated into a 5-year rolling capital plan focusing on the water mains with the highest breaks. GVW also collaborates with the CoV and DoC to schedule projects with their works, such as road and sewer renewal projects, to save costs and reduce the public impact related to infrastructure projects.

GVW employs a summer student to locate, survey, enter curb stops and services into GIS and report necessary repair of service valves to operations staff. This aids in asset management and helps operations staff to easily locate curb stops and ensure valves are operational during emergencies.

Capital Works Projects

Capital works projects completed in 2024 are shown in Table 5.

Table 5: Capital Projects Completed in 2024

Project Number	Project (Partner Jurisdiction)	Total Actual Costs	Project Class Asset Mgt
372-14-14	Headgates Dam Improvements - Spillway Upsizing (Dam Safety requirement)	$ 5,766,899	Improvement
372-19-07	North BX 2 Pump Station: Transformer upgrade	$ 809,209	New
372-19-08	Surge Protection Valve	$ 1,572,476	New
372-21-10	Stepping Stones Pump Station: Improvements	$ 63,804	Improvement
372-22-04	37 Ave: 16 st to 14 St & 14 St: 37 Ave to 35 Ave	$ 201,269	Replacement
372-22-09	24 Ave: 34A St to 39 St Pipe Replacement	$ 1,642,983	Replacement
372-22-10	Shantz Road: 11 St to end of road Pipe Replacement	$ 367,189	Replacement
372-22-12	Coldstream Creek Road: Tassie to Kalamalka Lake Pipe Replacement (District of Coldstream)	$ 1,742,693	Replacement
372-22-15	33 St: 42 Ave to 43 Ave: Pipe Replacement (City of Vernon)	$ 238,281	Replacement
372-23-03	34 St: 42 Ave to End: Construction: Pipe Replacement	$ 146,800	Replacement
372-23-04	Springfield: Connect to Hwy 6 for Looping (District of Coldstream)	$ 91,581	New
372-23-15	25 Street Pipe Decommissioning 43 to 45 Ave	$ 125,425	Decommission
372-23-17	35 St: 34 Ave to Centennial Dr Pipe Replacement	$ 338,638	Replacement
372-23-18	34A St: 24 Ave to 25 Ave Pipe Replacement (City of Vernon)	$ 374,829	Replacement
372-23-19	Upsizing main on Learmouth: School Rd to Angus Dr	$ 180,182	Replacement
372-24-04	Ultrasonic Algae Control on Goose Lake	$ 95,304	New
372-24-08	Delcliffe Reservoir Membrane Coat	$ 58,777	Improvement
372-24-09	Operations Vehicle - EV and charger	$ 57,061	New
372-24-10	32 Ave: 18 St to 15 St Pipe Replacement (City of Vernon)	$ 693,907	Replacement
372-24-14	18 Ave - 33 St to 34 St - Pipe Decommissioning	$ 22,614	Decommission

WATER EFFICIENCY PROGRAM

GVW has a Water Efficiency Program (WEP) that focuses on water demand management, accounting for lost water and managing the Water Shortage Management Plan (WSMP). The WEP is essential to GVW for using water efficiently, reducing lost water from the system, conserving water resources, reducing operational costs, and protecting the environment. It enables the utility to adapt to climate variability and maintain a reliable water supply while also raising public awareness and promoting sustainable water use.

Drought Management

GVW follows the WSMP when assessing drought conditions and water system demands. Staff use available data and forecasted conditions to assess the potential stage restrictions and the level of conservation messaging.

Figure 2 shows the Duteau Creek storage level trend for 2024. The trend shows the early spring levels were below average and the reservoirs stopped filling by mid-June, when GVW began using stored water to meet customer demands. This highlights the importance of snow melt and June precipitation in determining water availability for the rest of the year.

GVW remained in “Stage 1” restrictions through the summer of 2024 due to lack of precipitation and low storage levels following freshet. Stage 1 restrictions affect GVW operations, Environmental Flow Needs (EFN), and is accompanied with increased messaging to consumers to conserve water.

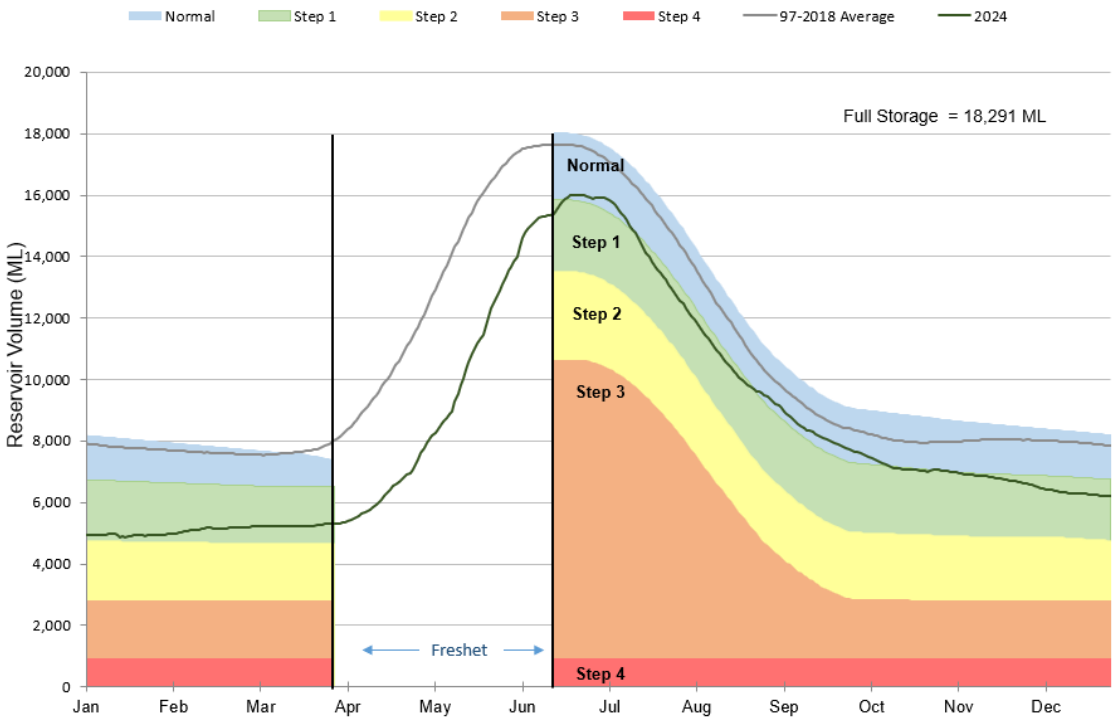


Figure 2: Duteau Creek Water Storage Graph

Based on concerns for infrastructure due to lack of precipitation in the fall of 2023, staff reviewed the WSMP in early 2024 and updated the Duteau Creek Water Storage Graph to better protect infrastructure and downstream EFNs. The updated WSMP is available at www.rdno.ca/gvw.

In 2024, the Thompson Okanagan Regional Technical Drought Working Group declared the Okanagan and Bessette Creek Water Basins at Level 3 and Level 4 drought conditions; however, this declaration does not directly apply to GVW but demonstrates the on-the-ground conditions at the time.

Water Consumption

Figure 3 shows the GVW water consumption trend for 2015 to 2023 with the 2024 actual consumption pattern. The trend shows increased water usage early in the spring and near-average use mid-May through mid-June. Peak use occurred mid-July for both potable and non-potable sources.

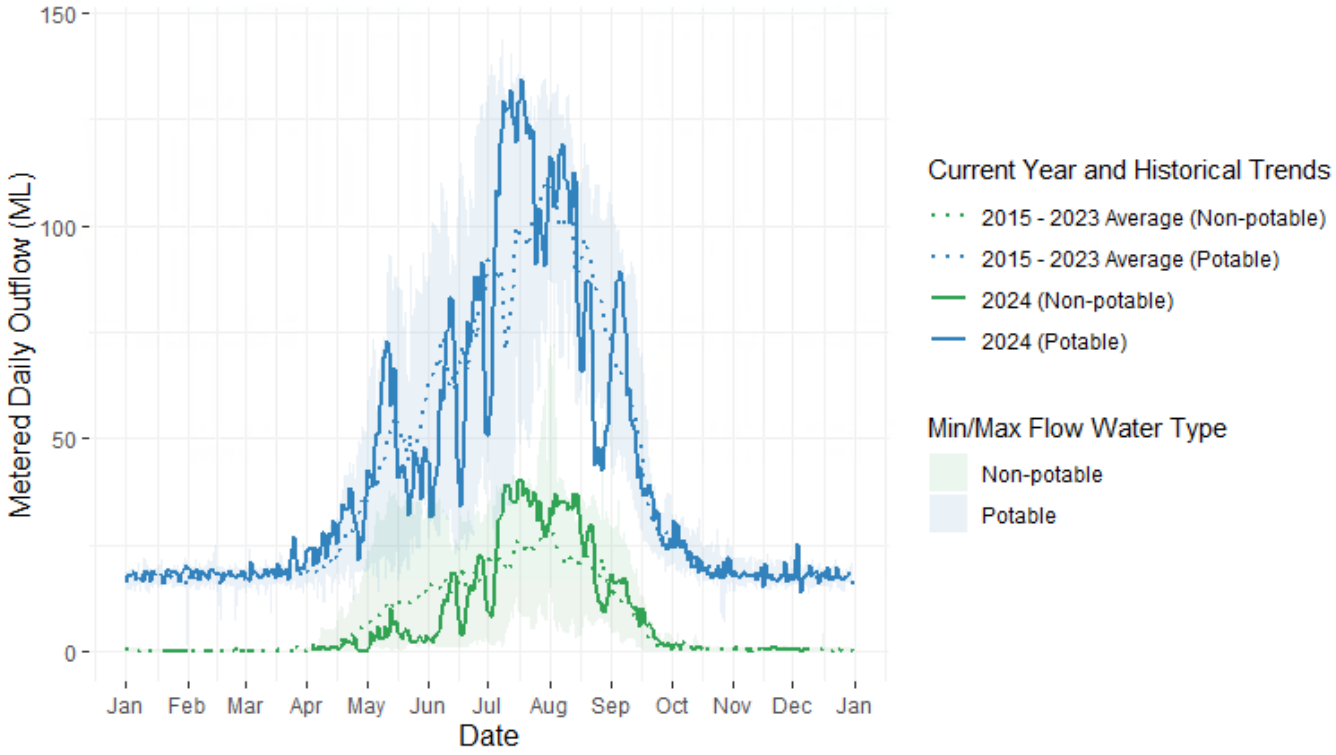


Figure 3: GVW Total Water Demand

Conservation-Oriented Water Rates

GVW uses tiered water rates for the potable water system to encourage conservation by charging higher rates as customer water use increases. This system provides a financial incentive for customers to reduce consumption. Tiered rates paired with education programs help customers understand their water bills, adopt conservation practices, and make informed decisions about water use. For more information, visit www.rdno.ca/conservation.

Water Consumption

GVW monitors water flows at multiple entry points. These sources are Duteau Creek, Kalamalka Lake, Deer Creek / King Edward Lake, and the groundwater wells. In 2024, approximately 17,326 ML of water was supplied to GVW from these sources. Figure 4 shows the breakdown of sources. Total inflow volumes differ from the metered water consumption due to several factors, including unmetered water use activities, such as firefighting, water main flushing, fire hydrant usage, consumption at water quality monitoring stations, or unauthorized consumption, such as leaks or

theft. Table 6 summarizes metered and estimated unmetered water consumption in comparison to source inflows. The estimated unaccounted-for water (UFW) percentage in 2024 was 15%. GVW continues to work to reduce water losses in the system with leak detection programs, water audits, system metering, bypass enforcement and infrastructure improvements.

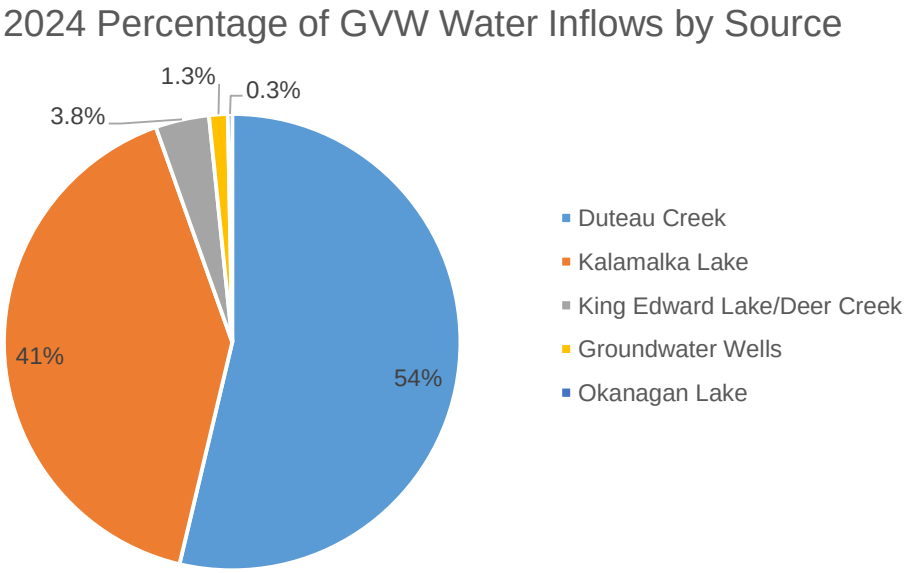


Figure 4: Percentage of GVW Water Supplied by Source

Table 6: Comparison of Source Inflows to Estimated Metered and Unmetered Consumption

2024 Summary Table	
Category	**Total Volume (ML/yr)**
Water Supplied	
Metered Supply from Sources	17,326
Authorized Consumption	
Metered & Unmetered Consumption	14,356
Water Losses	
UFW & Systemic Losses	2,969
Performance Indicators	
% UFW	15 %
% Total Water Lost (UFW & Systemic Losses)	17%

WATERSHED MANAGEMENT PROGRAM

The first step to providing safe, clean, reliable drinking water is to ensure source water quality and quantity is maintained to a high standard. With ever-increasing activity on both public and private land, it is critical to ensure good and abundant source water even before it is treated.

An integral part of watershed management is partnerships with those who have jurisdiction and impact on the landscape. The RDNO has benefited from good relationships, coordinated efforts, and regular meetings.

Duteau Creek Source Assessments and Source Protection Plans

The Duteau Creek community watershed is primarily public land. While the RDNO has no legislative authority over land use and practices on public land, it is required under the GVW operating permit to complete and implement a comprehensive source assessment and response plan. The Duteau Creek Watershed Assessment and Recommendations for Source Protection Report (Watershed Assessment) was received by the RDNO Board of Directors (BoD) in December 2008.

The Duteau Creek Watershed Protection Plan Technical Advisory Committee (TAC) was formed in 2009 and includes representation from provincial agencies, First Nations, forest licencees and range tenure holders.

In 2014, the Duteau Creek Watershed Assessment Response Plan (DCWARP) was endorsed by the RDNO BoD and accepted by IH. The DCWARP aims to action the recommendations in the Watershed Assessment and is reviewed annually by the TAC through the development of annual work plans.

In 2023, the TAC was renamed the Duteau Creek Watershed Technical Working Group (TWG). The TWG re-evaluated and refocused the goals and recommendations of the 2014 DCWARP through a facilitated workshop. This resulted in an updated 2024 DCWARP and a 5-year action plan based on the actions identified in the workshop. The plan will be reviewed annually at the TWG spring meeting and updated again in 2029.

Kalamalka Lake Source Assessments and Source Protection Plans

In 2011, the RDNO BoD endorsed the Source Assessment of the Regional District of North Okanagan – Greater Vernon Water Utility North Kalamalka Lake Intake Report (Assessment).

The North Kalamalka Intake Response Plan was completed in 2017 and aims to respond to recommendations from the Assessment and provide actions to reduce risks to water quality and identify responsible parties. In 2024, staff focused on referral responses relating to impacts on Kalamalka Lake and coordinated responses with the Okanagan Indian Band and the District of Lake Country. Work continues to forward the goals of the source response plans.

Watershed Monitoring Program

From a water quantity perspective, the RDNO monitors the source water availability through a series of RDNO-owned hydrometric stations, remote lake level readings, snow courses, and flow measurements within the Duteau Creek watershed. Within the Kalamalka Lake watershed, the RDNO monitors the Water Survey Canada stations and the lake levels to understand water availability.

From a water quality perspective, the RDNO monitors the water quality in the Duteau Creek watershed to assess if best management practices (BMPs) by public land users are protecting water quality. The major tributary to Kalamalka Lake, Coldstream Creek, is monitored in partnership with the Ministry of Environment (MoE) to observe water quality changes. Additionally, Kalamalka Lake is monitored in partnership with the District of Lake Country, to track long-term changes and determine protection goals. Further analysis of Kalamalka Lake and Coldstream Creek is conducted by Larratt Aquatic Consulting (LAC). Monitoring source water can often signal when changes are occurring and trigger actions to prevent long-term contamination, ultimately reducing operating costs for water treatment and distribution. Further water quality information for the Duteau Creek and Kalamalka Lake watersheds will be discussed in the following section, Water Quality Monitoring Program.

WATER QUALITY MONITORING PROGRAM

The Water Quality Monitoring Program (WQMP) has been designed so that water is monitored weekly, monthly, quarterly and annually to understand variations in water quality and provide sufficient data to statistically analyze trends from the source to the tap. The following legislation, regulation and guidelines are used to develop a reporting and monitoring program:

1. Guidelines for Canadian Drinking Water Quality (GCDWQ)
2. *Drinking Water Protection Act and Regulation* (DWPA and DWPR)
3. Source Drinking Water Quality Guidelines (SDWQG)
4. Drinking Water Treatment Objectives for Surface Water Supplies in BC
5. Decision Tree for Responding to Turbidity Event in Unfiltered Drinking Water.

Drinking water quality is influenced by source water quality, water treatment, and distribution system characteristics. As a result, the monitoring of drinking water quality consists of four (4) components in the Source to Tap Approach:

1. Source (raw) water monitoring
2. Monitoring after treatment (at outflow of treatment plant)
3. Monitoring in the distribution system (including cross connection control)
4. Monitoring and addressing customer concerns.

The WQMP outlines the sample locations, parameters analyzed and their frequency throughout the year. The program is updated annually and submitted to IH. The 2024 WQMP has been included in this report as Attachment A. The following sections describe the results of the 2024 program.

Source Monitoring Program

Source water quality monitoring is an important component of the multi-barrier approach to drinking water management. The source monitoring program focuses on the point where raw, untreated water first enters the water system. This location also serves as the final monitoring point for the watershed monitoring program. Results are compared to both health and aesthetic guidelines, criteria and regulations. Water quality trends are monitored to evaluate the impacts of watershed activities and to indicate potential effects on treatment and chlorine demand. Chemical, physical and biological parameters are tested weekly, monthly, seasonally and annually at each source, as scheduled in the WQMP (Attachment A).

Turbidity is one of the most important physical parameters monitored by the RDNO. Turbidity is caused by suspended matter such as clay, silt, finely divided organic and inorganic matter, soluble coloured organic compounds, plankton, and other microscopic organisms. Excessively high turbidity can have a negative effect on disinfection techniques. The Drinking Water Treatment Objectives for Surface Water Supplies in BC states that nonfiltered surface water should have an average daily turbidity of around 1.0 NTU but not exceeding 5.0 NTU for more than two (2) days in a 12-month period to be acceptable as a drinking water source supply.

At this time, GVW does not have filtration on any of its sources, making it challenging to remove source water turbidity. With good operational oversight, the DCWTP DAF treatment system removes turbidity from normal freshet and events, but significant events such as landslides or debris flows can overwhelm the treatment system, requiring it to be turned off. Turbidity is continuously measured at Kalamalka Lake and Duteau Creek intakes through online turbidity meters that are monitored through the system-wide Supervisory Control and Data Acquisition (SCADA) system, as well as regular comparisons with hand-held turbidity meters.

Raw water (untreated) monitoring for 2024 was completed on the following sources:

- Duteau Creek watershed
- Duteau Creek intake
- Kalamalka Lake watershed (Coldstream Creek)
- Kalamalka Lake intake
- Deer Creek intake
- Goose Lake surface and intake.

Duteau Creek Source Monitoring Program Summary

Duteau Creek Watershed

Depending on water availability and water quality within the reservoirs, four (4) to five (5) sites are sampled biweekly during the snow-free season, approximately May to November. The sites are chosen and adjusted based on activities in the watershed such as range cattle, recreation, and forestry. The water flowing over the weir at Haddo Lake is sampled the most frequently, as it is the point where the water enters the main stem of the creek. The sampling parameters and frequency are detailed in the WQMP (Attachment A).

Data from the monitoring sites in 2024 did not reveal any significant or immediate impacts on water quality; however, there were no significant rainfall events that tend to cause high turbidity events. Over the years, it has been observed that water quality is influenced by land activities within the watershed, which can increase erosion during freshet and extreme weather events, which are becoming increasingly more common. Erosion brings more sediment, nutrients, and potentially bacteria into the water system if the adjacent lands aren’t stable or are strongly impacted from recreation or cattle presence in sensitive areas. The cumulative effects of these activities continue to be monitored.

Duteau Creek Intake

The Duteau Creek intake is sampled at a line located in the intake building. Water quality is monitored online and by taking samples on a weekly, monthly, and annual schedule as detailed in the WQMP (Attachment A).

Physical-Chemical Monitoring

Turbidity

Monthly water quality reports and the GVW Water Quality Deviation Response Plan provide further details regarding turbidity events and/or trigger levels for response and notification (Attachment B).

Figure 5 shows the daily average turbidity for both the raw water at the Duteau Creek intake and the treated water leaving the DCWTP from 2020 to 2024. This graph demonstrates the effectiveness of the water treatment process, showing that treated turbidity, even without filtration, remains well below the MAC of <1 NTU. Turning off the DCWTP is rare and has only been done in 2013 and 2017 during extreme rainfall events. 2024 did not have any events that caused water quality concerns that required the DCWTP to be turned off. Figure 6 compares the daily average turbidity to the 2020 to 2023 historical range, highlighting the notably lower turbidity in spring 2024 and slightly elevated turbidity during a period in the fall.

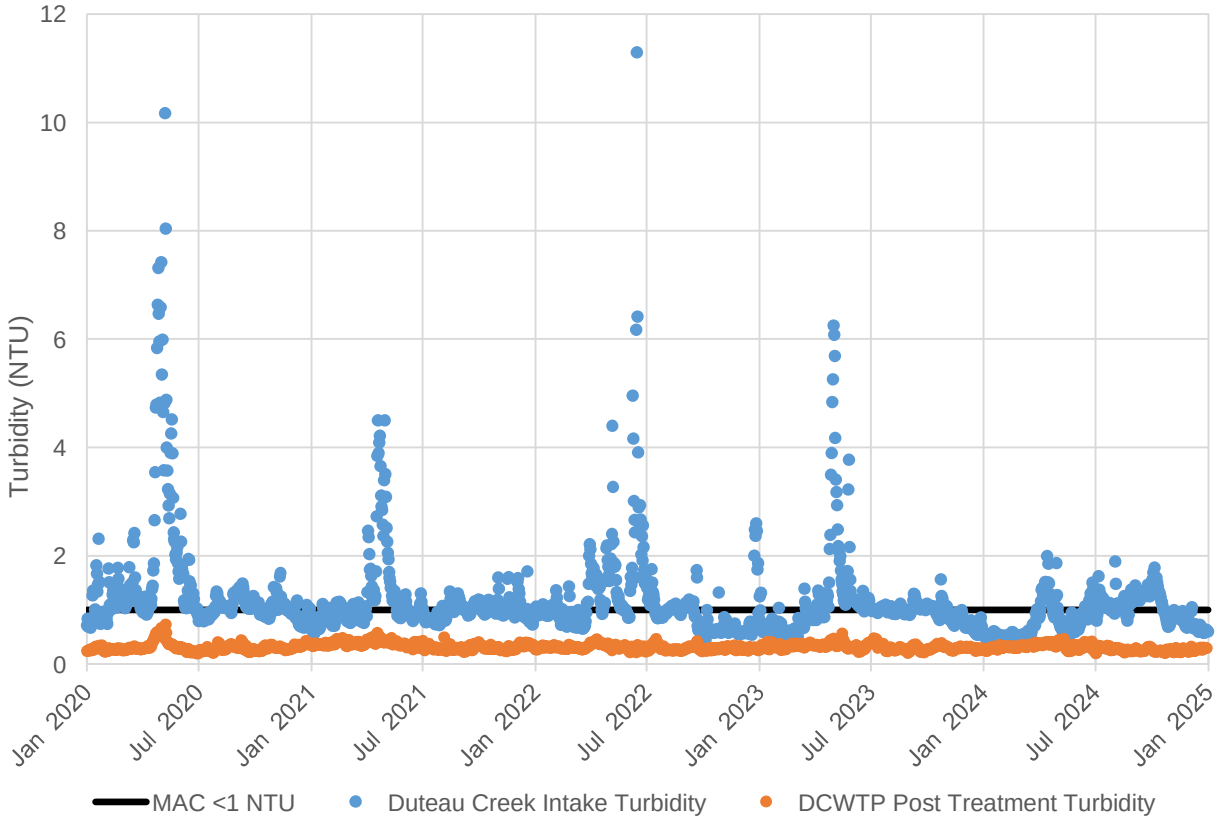


Figure 5: SCADA daily average turbidity at Duteau Creek Intake and DCWTP Post Treatment from 2020 to 2024

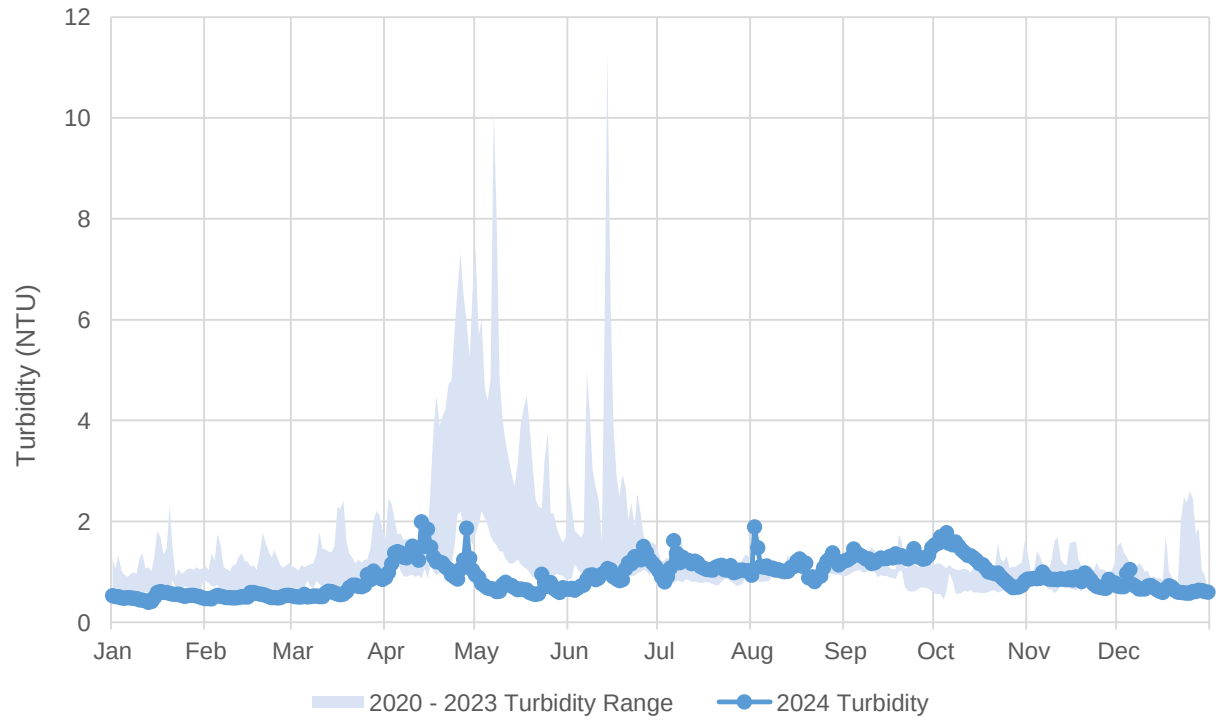


Figure 6: SCADA daily average turbidity at Duteau Creek Intake in 2024, compared with the 2020 to 2023 historical range

Temperature

Analyzing water temperature trends over time can indicate long-term changes and fluctuations. Incoming temperature is important for the effectiveness of the treatment process. Dramatic fluctuations in temperature can make treatment more difficult. Although Duteau Creek raw water temperature showed an early onset of warming in 2024, it then cooled and remained lower than previous years through the spring. By late June, however, temperatures increased rapidly, reaching the highest summer values observed in the last five (5) years (Figure 7). It is expected that climate change will have an impact on source and distribution water temperatures, potentially affecting drinking water quality. Figure 8 compares raw water temperature and turbidity over recent years, illustrating the correlation between increasing temperature and turbidity during the spring freshet.

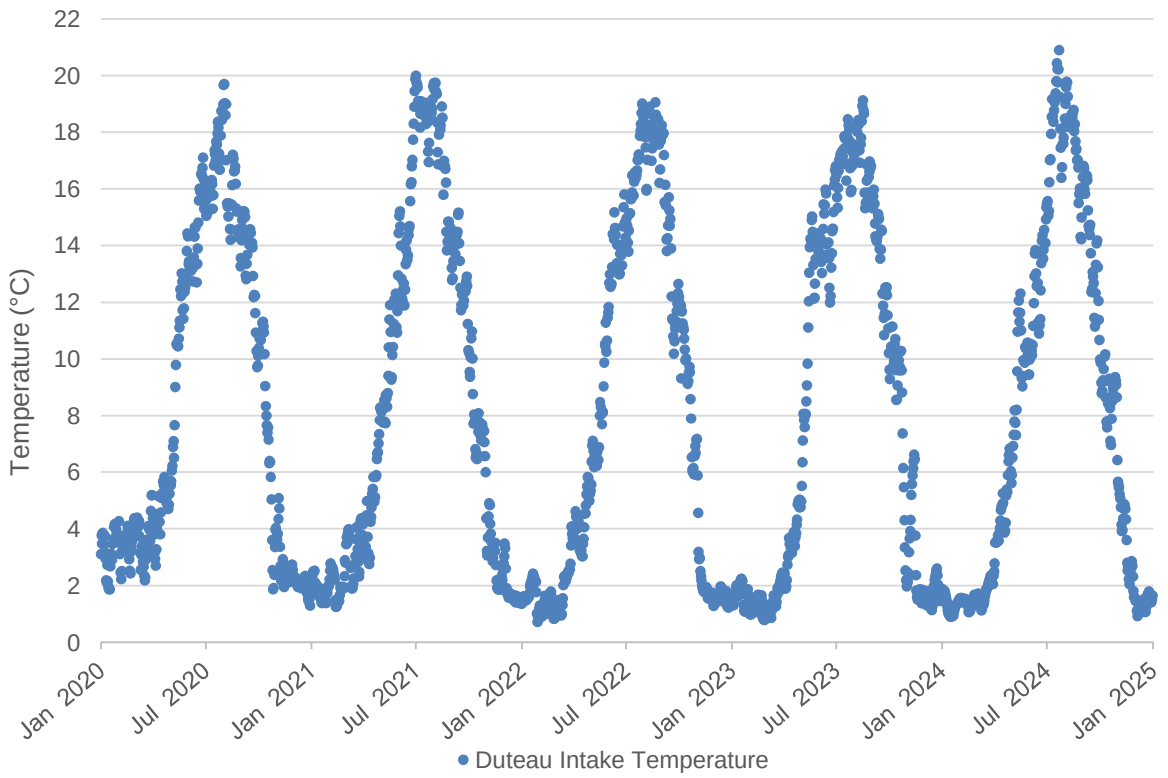


Figure 7: SCADA daily average temperature of the raw water entering DCWTP from 2020 to 2024

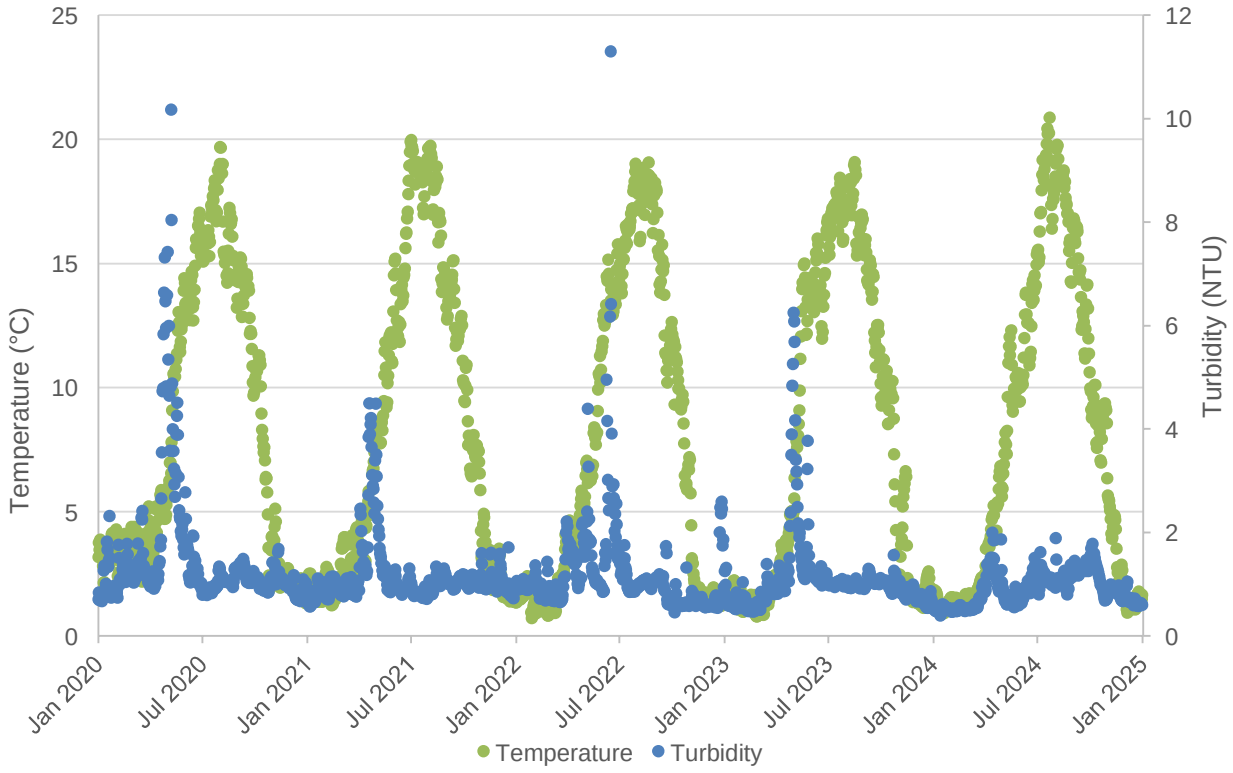


Figure 8: SCADA daily average temperature of the raw water entering DCWTP compared to the SCADA daily average turbidity at the Duteau Creek Intake from 2020 to 2024

pH

pH is a key factor to consider as it impacts the treatment process and the distribution system. Figure 9 shows a fluctuating long-term trend with lows observed during 2008-2010 and peaks from 2015-2017. Since 2020, the trend appears to be moving toward lower pH levels, which may correspond to lower amounts of rainfall during this time. This will be investigated further in the coming years. Low pH is an indication of corrosive water, which leads to concerns in the distribution system. Some pH adjustments do occur at the Duteau Creek Water Treatment Plant.

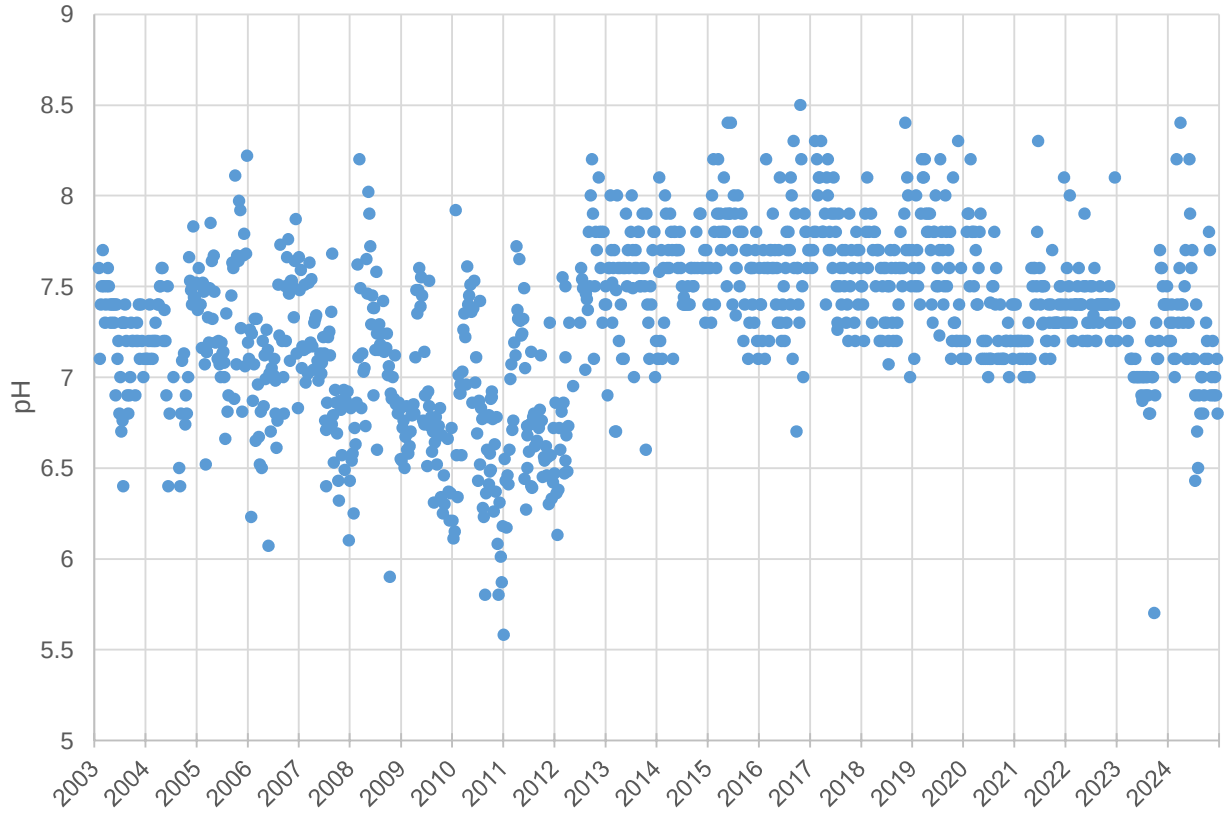


Figure 9: Weekly pH grab samples at Duteau Creek Intake from 2003 to 2024

Chlorophyll a

Chlorophyll a, a measure of the concentration of the green pigment found in plants, is generally used as an indicator of phytoplankton (algae) in the water sampled. Monthly measurements of chlorophyll taken from May to November in 2024 were within the normal range seen historically (Figure 10). Chlorophyll a samples collected from April to July 2024 were 0 µg/L. While similar to the low concentrations observed in 2023, this pattern remains different compared to earlier years of monitoring.

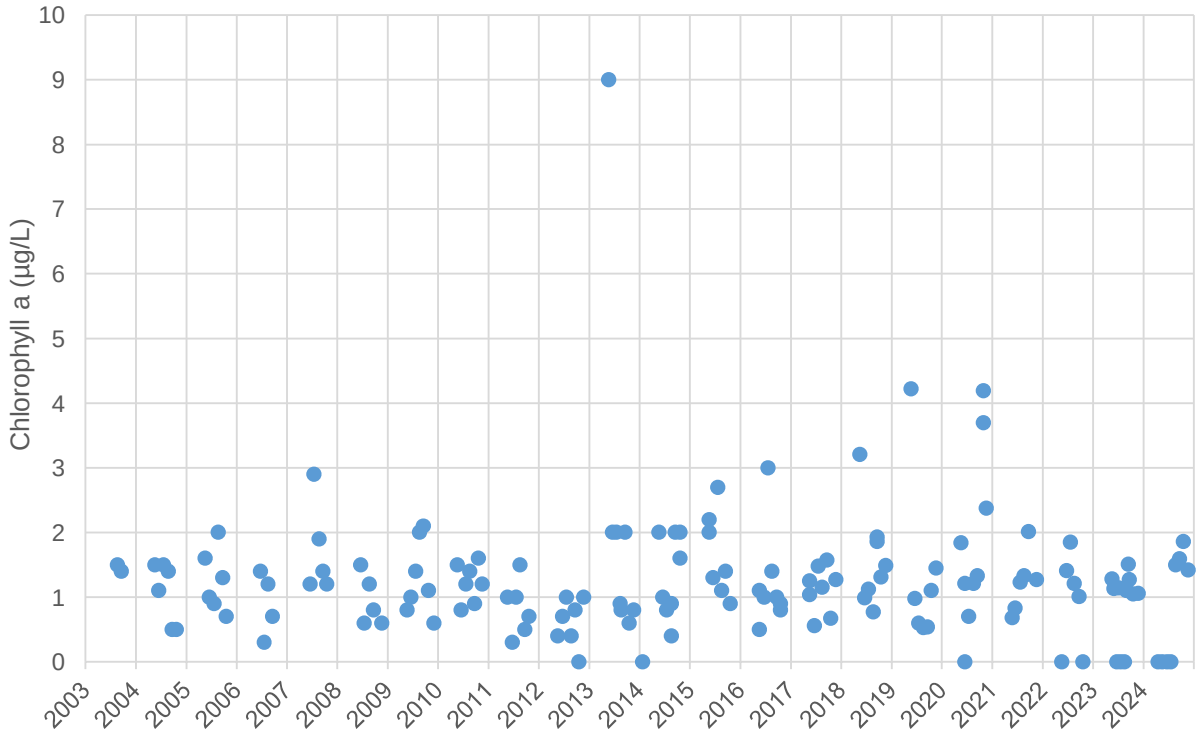


Figure 10: Chlorophyll a concentration from grab samples at Duteau Creek Intake from 2003 to 2024

Organic Carbon

Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) are measures of suspended and dissolved carbon bound in organic molecules and organisms. TOC and DOC are important to monitor in the Duteau Creek source as they are precursors for disinfection by-products (DBPs), which will be discussed further in the Distribution section of this report. DOC is particularly relevant at the DCWTP as elevated levels can reduce the effectiveness of the UV disinfection. The Source Drinking Water Quality Guideline MAC for TOC is 4.0 mg/L.

In 2024, the Duteau Creek Intake samples showed an average TOC of 9.0 mg/L and an average DOC of 8.8 mg/L, which dropped to 4.5 mg/L for TOC and 4.2 mg/L for DOC following treatment. This demonstrates that DAF treatment at the DCWTP is effective in reducing the organic carbon significantly, as shown in Figure 11. TOC and DOC levels in Duteau Creek water are strongly correlated (Figure 12) which shows that the TOC is mostly made up of DOC. The organic carbon component is composed of humic and fulvic acids, typical of the water quality found on the Aberdeen Plateau (e.g. Oyama Lake, Beaver Lake, and King Edward Lake).

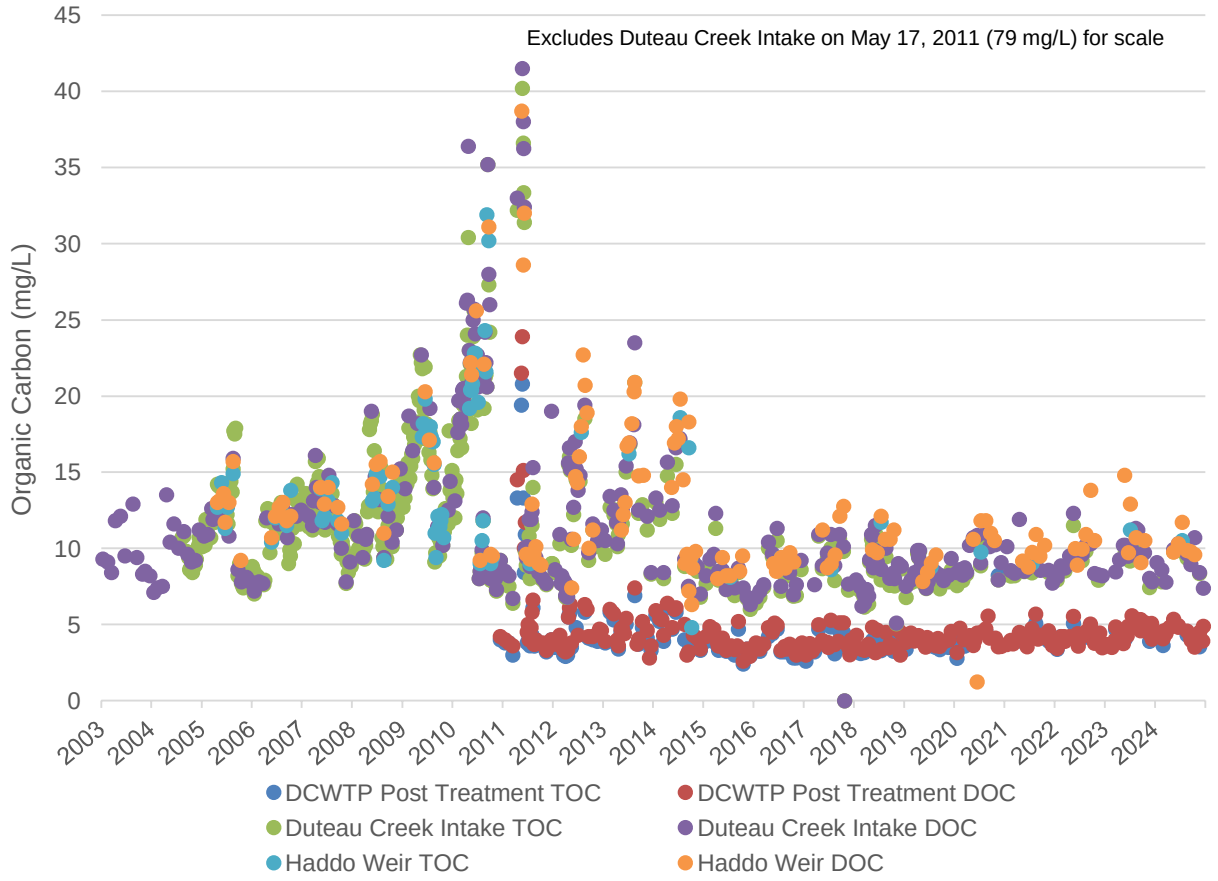


Figure 11: Organic carbon concentrations from grab samples in Duteau Creek, the Intake and Post Treatment from 2003 to 2024. Excludes one (1) data point from Duteau Creek Intake on May 17, 2011 at 79 mg/L to improve readability of the chart.

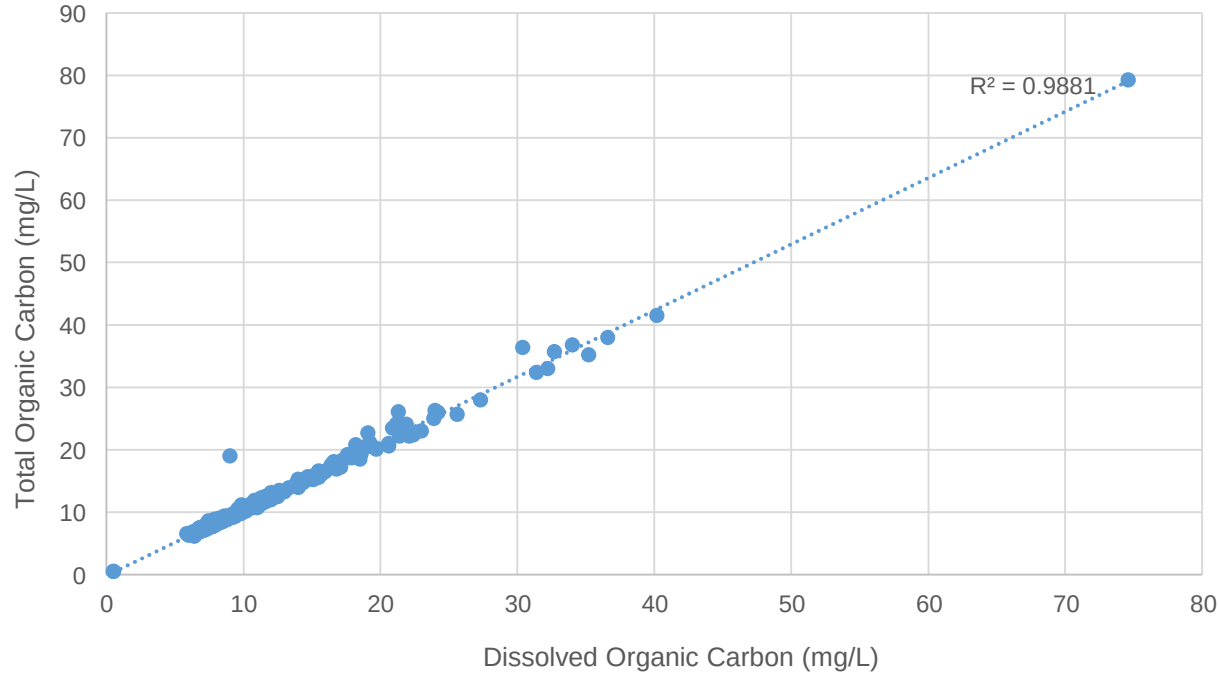


Figure 12: TOC and DOC correlation at Duteau Creek Intake from 2003 to 2024

Biological Monitoring

Bacteria

Monitoring for Total Coliform bacteria (TC) and *Escherichia Coli* (*E.coli)* is an important part of understanding source water quality and detecting potential changes. Table 7 summarizes the TC and *E.coli* bacteria sample results from Duteau Creek Intake in 2024.

Table 7: Duteau Creek Intake Bacteria Sample Summary

Total Coliform MPN/100 mL	**Accredited Lab**	**RDNO Lab**
# of Samples	51	114
Min	17	19.7
Max	3,450	2,909
Mean	710	573
# of Samples > 100 MPN/100 mL	30	64
# of Samples < 1 MPN/100 mL	0	0
***E.coli* MPN/100 mL**	**Accredited Lab**	**RDNO Lab**
# of Samples	51	114
Min	<1	<1
Max	33	50.4
Mean	5	5
# of Samples > 20 MPN/100 mL	3	8
# of Samples < 1 MPN/100 mL	13	43

Total Coliforms

In 2024, TC concentrations were low through winter and spring, then began to rise in July, reaching a peak in late August and September, before steadily declining through October and November (Figure 13). This trend is consistent with previous years of monitoring at the Duteau Creek Intake; however, the typical spring increase associated with freshet was minimal in 2024 likely due to a very minimal freshet. Figure 13 compares 2024 values to the range observed from 2022 to 2023. Prior to 2022, in-house laboratory methods were limited by an upper detection limit of 200.5 MPN/100 mL. Including this earlier data would bias the range downward.

The late summer rise in TC could be attributed to warmer temperatures promoting bacterial growth, along with increased recreational and animal activity in the watershed. Additionally, reduced streamflow during the summer and fall may result in less dilution.

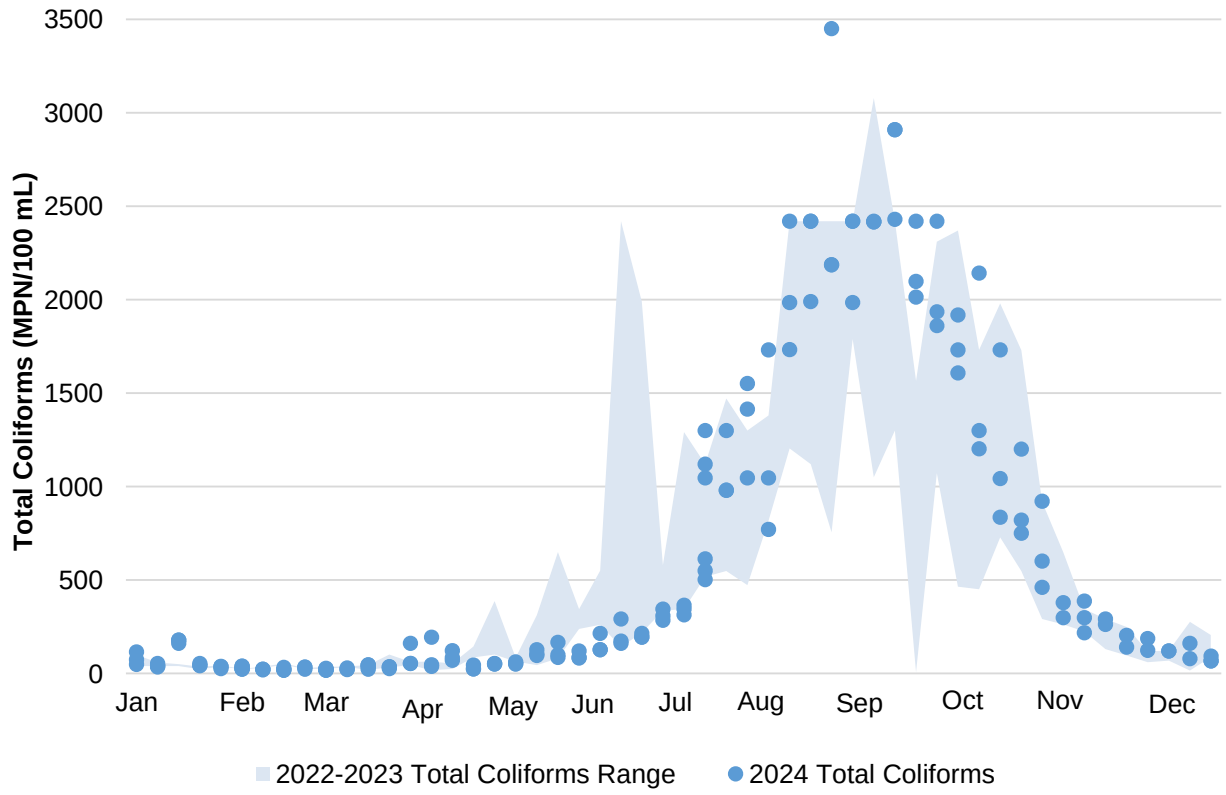


Figure 13: Total coliform counts from 2024 grab samples at Duteau Creek Intake, compared with the 2022 to 2023 historical range

E. Coli

E. coli levels at the Duteau Creek Intake in 2024 were low throughout the late-winter and early-spring, with none of the elevated values typically observed during this time. An increase and peak occurred in late July but remained below historical seasonal highs. Unlike total coliforms, the *E. coli* figure extends back to 2014 because pre-2022 results were less affected by the in-house laboratory upper detection limit, with relatively few values exceeding 200.5 MPN/100 mL. This allows for a longer and more interpretable time series chart (Figure 14).

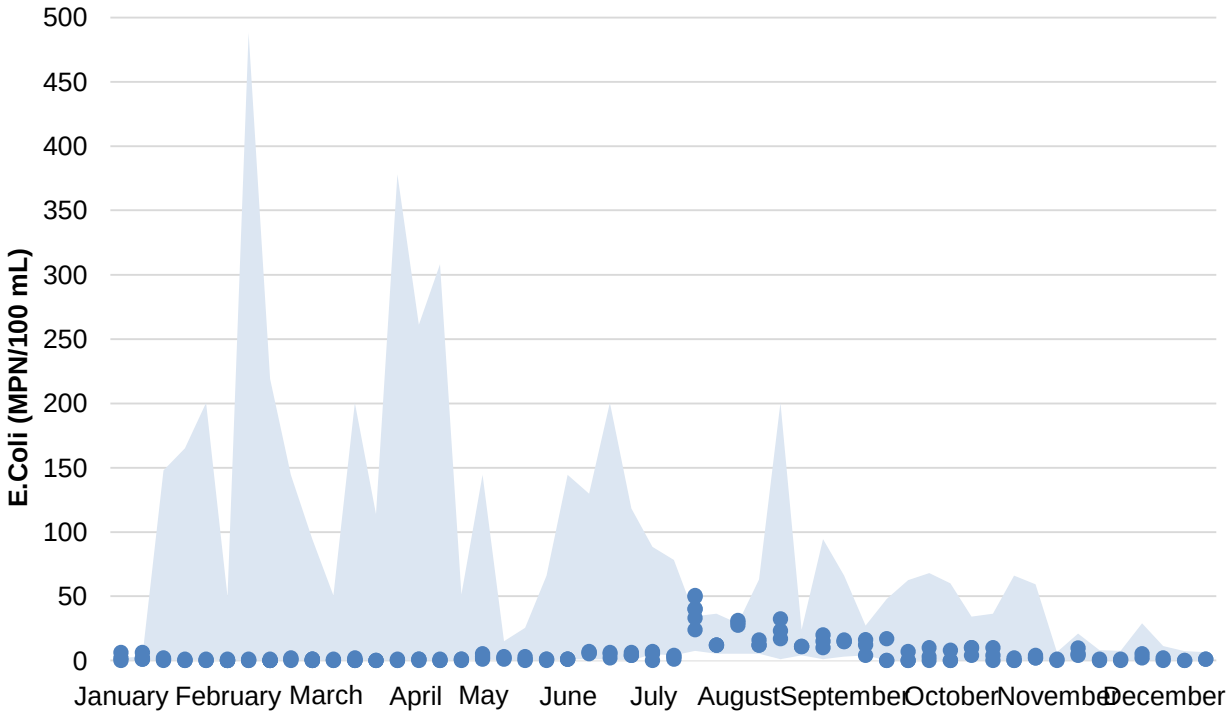


Figure 14: E. coli counts from 2024 grab samples at Duteau Creek Intake, compared with the 2014 to 2023 historical range

Algae

Algae are monitored as they contribute to the organic loading in the system and contribute to taste and odour. Algae was not a concern in 2024 at the Duteau Creek intake and the treatment at the DCWTP is currently able to address algae present in the water. A shift to different types of algae and increasing cyanobacteria blooms could create a situation where the treatment process needs to be adjusted.

Kalamalka Lake Source Monitoring Program Summary

Kalamalka Lake Watershed

Since 2017, four (4) sites on Coldstream Creek have been regularly monitored. The sites were chosen in collaboration with the Ministry of Environment (MoE). In 2024, two (2) additional sites, Noble Canyon Road and Coldstream Ranch, were added to the monitoring program to better assess potential input sources. Figure 15 shows the sampling site locations along Coldstream Creek, with Noble Canyon Road being the most upstream site and Kirkland Drive the closest to

Kalamalka Lake. An increase in turbidity is typically observed during freshet from late April to mid-June, along with a decrease in conductivity as overland water dilutes the base flow of the system.

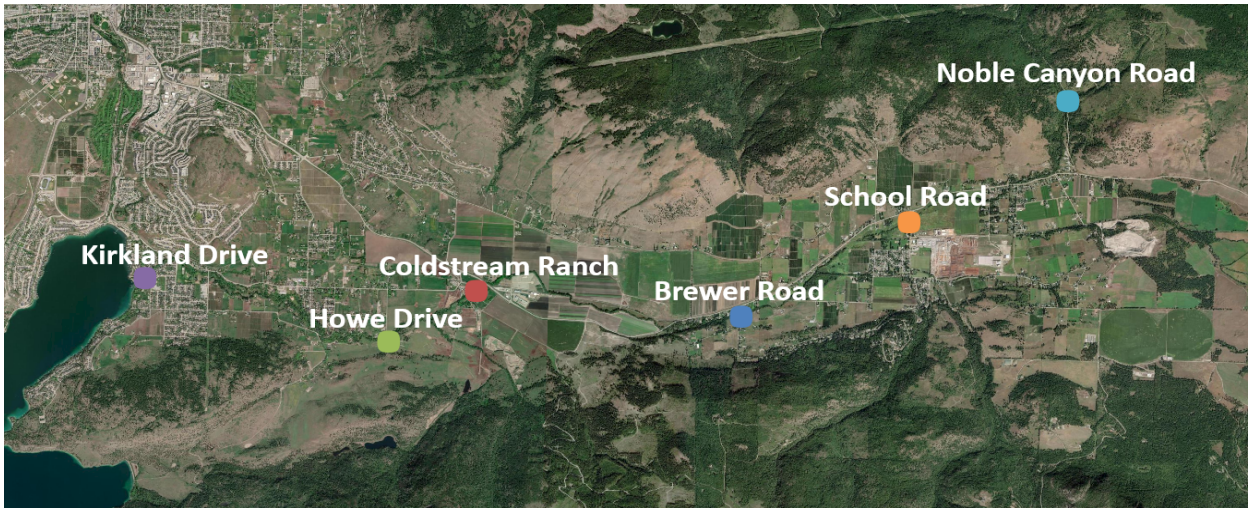


Figure 15: Coldstream Creek sampling location map.

Chloride

Chloride concentrations are measured to monitor for human impacts, and based on the observed trends in Coldstream Creek, is primarily associated with road salt used for winter maintenance. Historical data shows that chloride increases through the spring and summer and peaks in winter. Concentrations typically decline rapidly in spring, likely after the “first flush” washing most of the accumulated road salt into the streams. As temperatures rise, increased agricultural irrigation can mobilize chloride stored in soils and fertilizers, and reduced stream volume can further concentrate chloride in the water. This interpretation is supported by the low chloride concentrations observed at the upstream Noble Canyon Road site in 2024 (Figure 16).

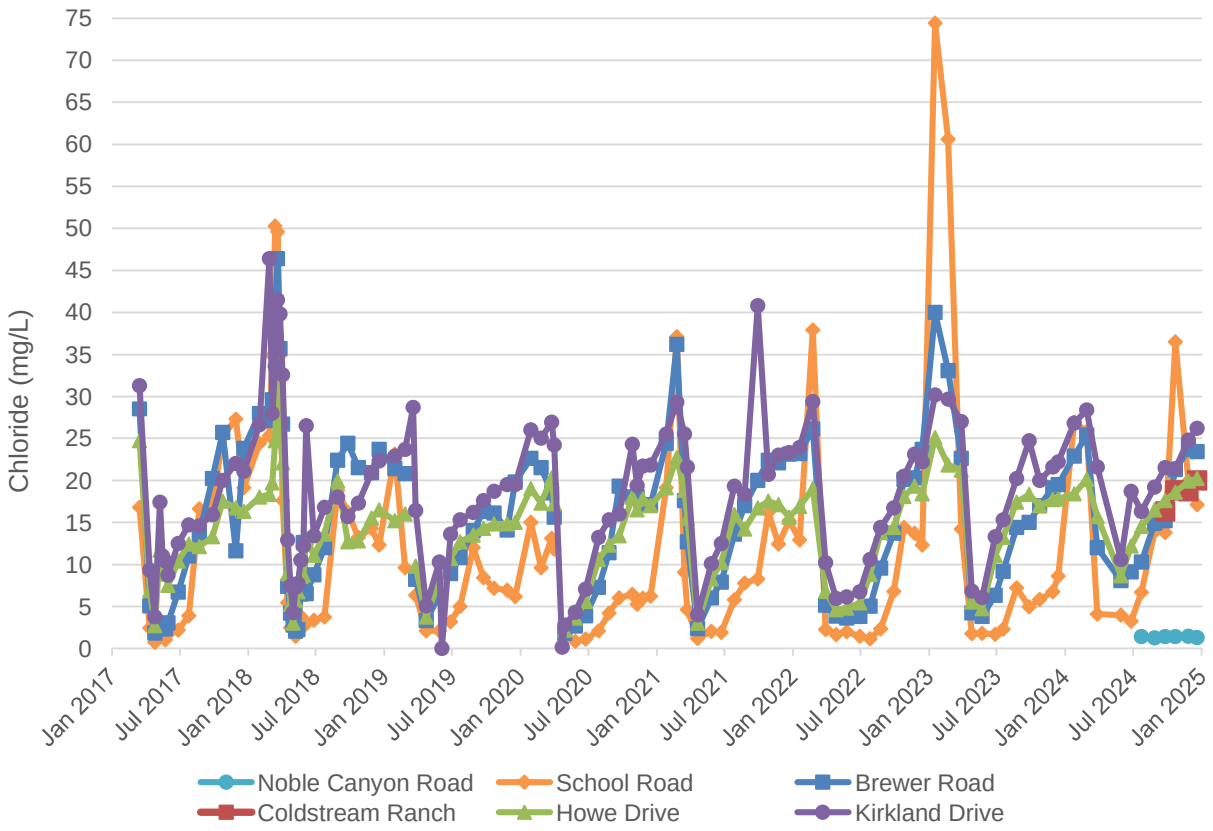


Figure 16: Chloride concentrations from grab samples taken at Coldstream Creek sample sites from 2017 to 2024

Nitrogen

Nitrogen is monitored in Coldstream Creek to assess human impacts and is especially harmful to fish and provides nutrients for algae blooms. Nitrogen sources in this area are likely primarily from fertilizers and septic fields. The nitrogen trending shows that at Noble Canyon Road and School Road, the most upstream sample locations, nitrogen is already being detected but the concentrations are the lowest. The Brewer Road site shows a large variable input source that is reduced between Brewer Road and Howe Drive, likely from dilution of other drainages. Between Howe Drive and Kirkland Drive, the nitrogen remains consistent, showing no dilution and no apparent significant inputs (Figure 17). These observations are cursory and GVW looks to further external expertise to assist in evaluating the watershed conditions and source water impacts.

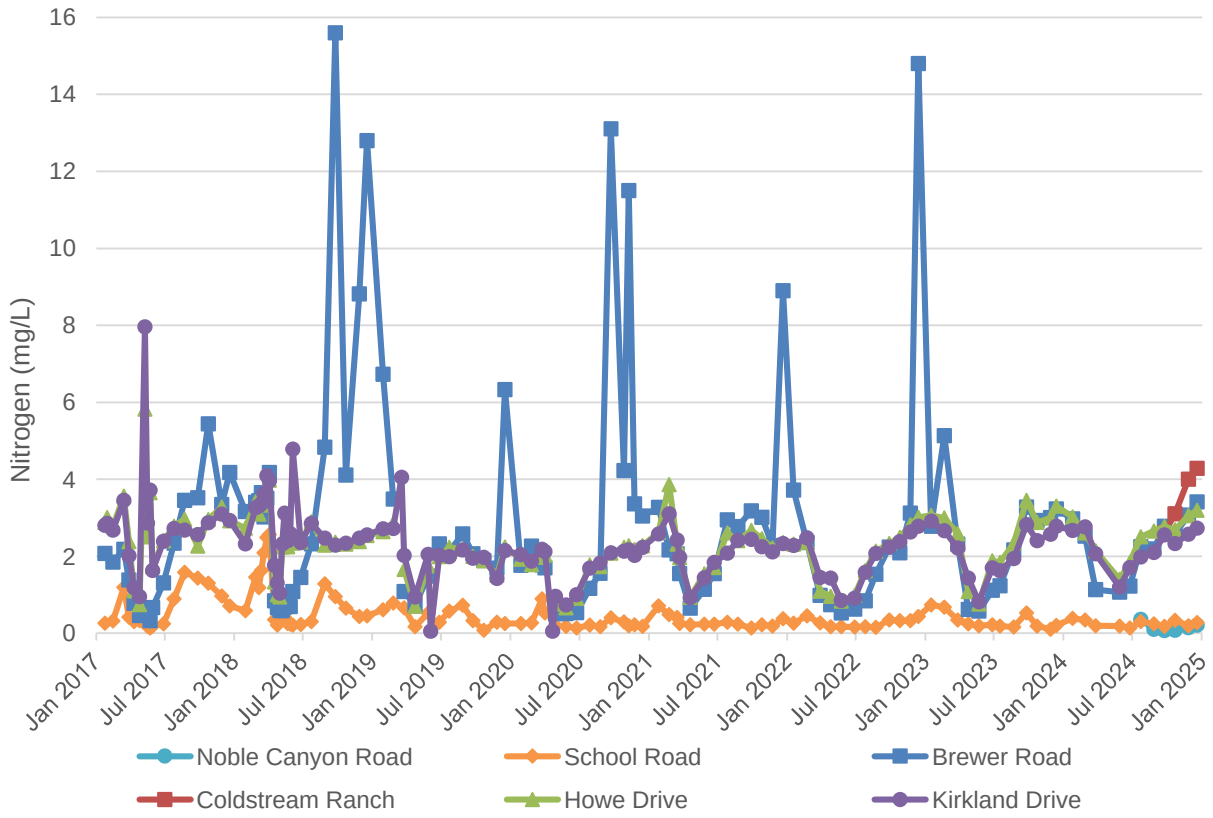


Figure 17: Nitrogen concentrations from grab samples taken at Coldstream Creek sample sites from 2017 to 2024

There are both large tracks of agricultural land and a significant number of septic fields between School Road and Howe Drive as well as significant inflows (Brewer and Deer Creek). Larratt Aquatic Consulting (LAC) conducts further analysis of Coldstream Creek which can be found in the LAC 2024 Kalamalka Wood Lake Water Quality Study; however, it is necessary to investigate Coldstream Creek specifically as the LAC study focuses more on the limnological review of Kalamalka Lake and Wood Lake systems.

Kalamalka Lake Intake

The Kalamalka Lake Intake is sampled from the Kalamalka Lake Pump Station (PS). Water quality is monitored through SCADA and by taking samples on a weekly, monthly, and annual schedule as outlined in the WQMP (Attachment A). Further information and analysis can be found in the LAC 2024 Kalamalka Wood Lake Water Quality Study.

Physical-Chemical Monitoring

Turbidity

Turbidity in Kalamalka Lake is a challenging factor for water quality as it can affect the MHWTP UV disinfection process. The MHWTP has dual disinfection (UV and chlorine) but no pre-treatment (i.e. clarification) or filtration; therefore, RDNO operators have developed procedures to direct operations during increasing turbidity events. Historically, Kalamalka Lake water turbidity stays below 1 NTU except during freshet and the natural marl process.

Marl occurs due to the lake's naturally high calcium and sulphate concentrations, which are believed to be from the significant input of groundwater into Kalamalka Lake. Marl is primarily

composed of calcium carbonate, which precipitates seasonally due to an increase in water temperature and changes in water chemistry. These precipitates increase the turbidity in the lake and typically reduce algae by reducing phosphorous levels and physically settling out algae cells. Marl creates the colour in Kalamalka Lake, as the precipitates diffract the sunlight. The timing and the intensity of the colour varies from year to year due to fluctuations in water chemistry, water temperature and algae growth. Turbidity increases due to marl, with no increase in total coliforms or *E.coli* at the intake. Additionally, marl is inorganic and the resulting turbidity does not negatively impact disinfection in the same way as organic carbon does.

In 2024, turbidity at Kalamalka Lake Intake and MHWTP Post Treatment increased during spring freshet, but levels were not as elevated as in previous years. Marl turbidity occurred later than typical, with the seasonal peak occurring in early September (Figures 18 and 19).

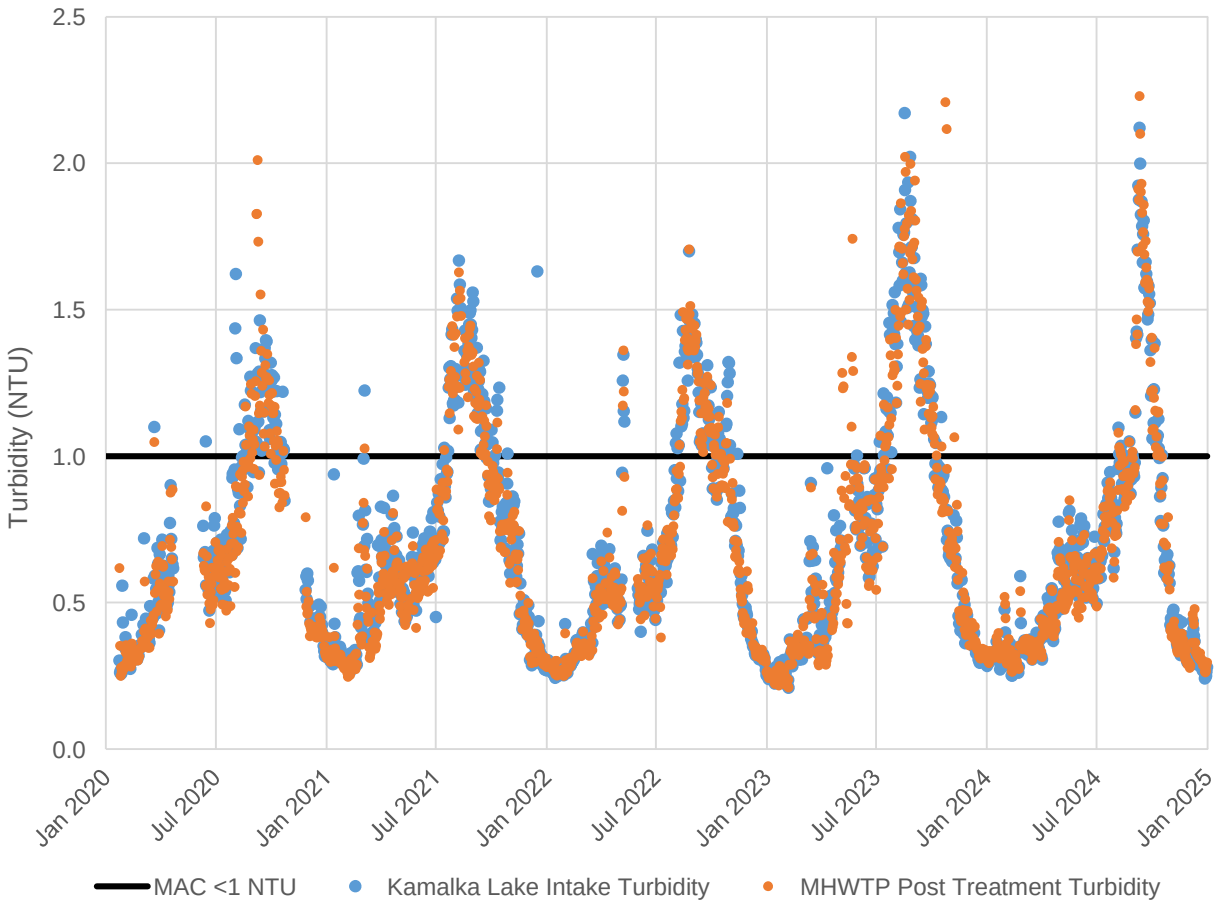


Figure 18: SCADA daily average turbidity at Kalamalka Lake Intake and MHWTP Post Treatment from 2020 to 2024

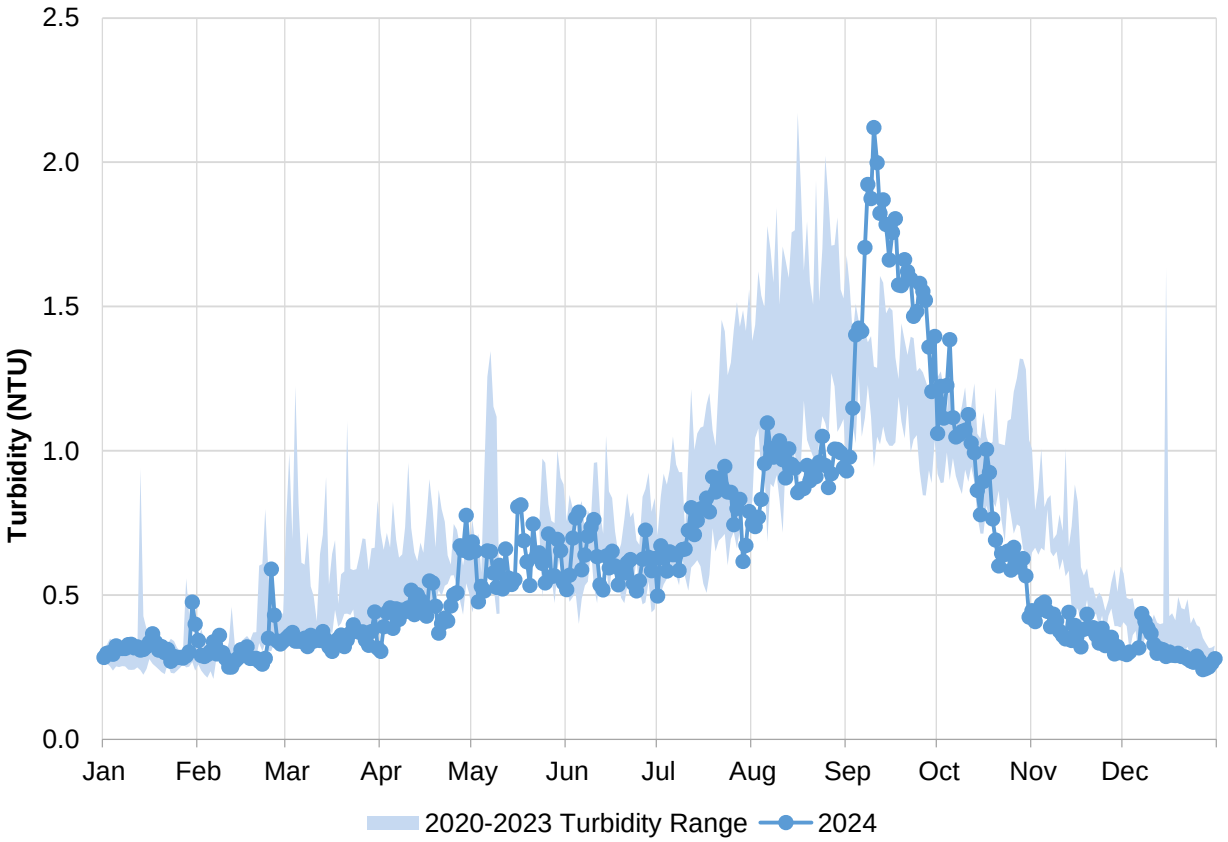


Figure 19: SCADA daily average turbidity at Kalamalka Lake Intake in 2024, compared with the 2020 to 2023 historical range

Temperature

Temperature in Kalamalka Lake is influenced by weather and air temperature, incoming surface and groundwater, wind-driven whole lake seiches, and natural lake turnover. Temperature is often linked with turbidity, as marl precipitation occurs when temperature increases, in combination with other factors (Figure 20).

In 2024, grab sample temperature readings ranged between 5.1°C and 14.5°C. The annual average temperature was slightly higher than the historical average. Figure 21 provides the average annual temperature at the Kalamalka Lake Intake from 2003 to 2024. The trend indicates a gradual increase in temperature at the intake, which will be further explored.

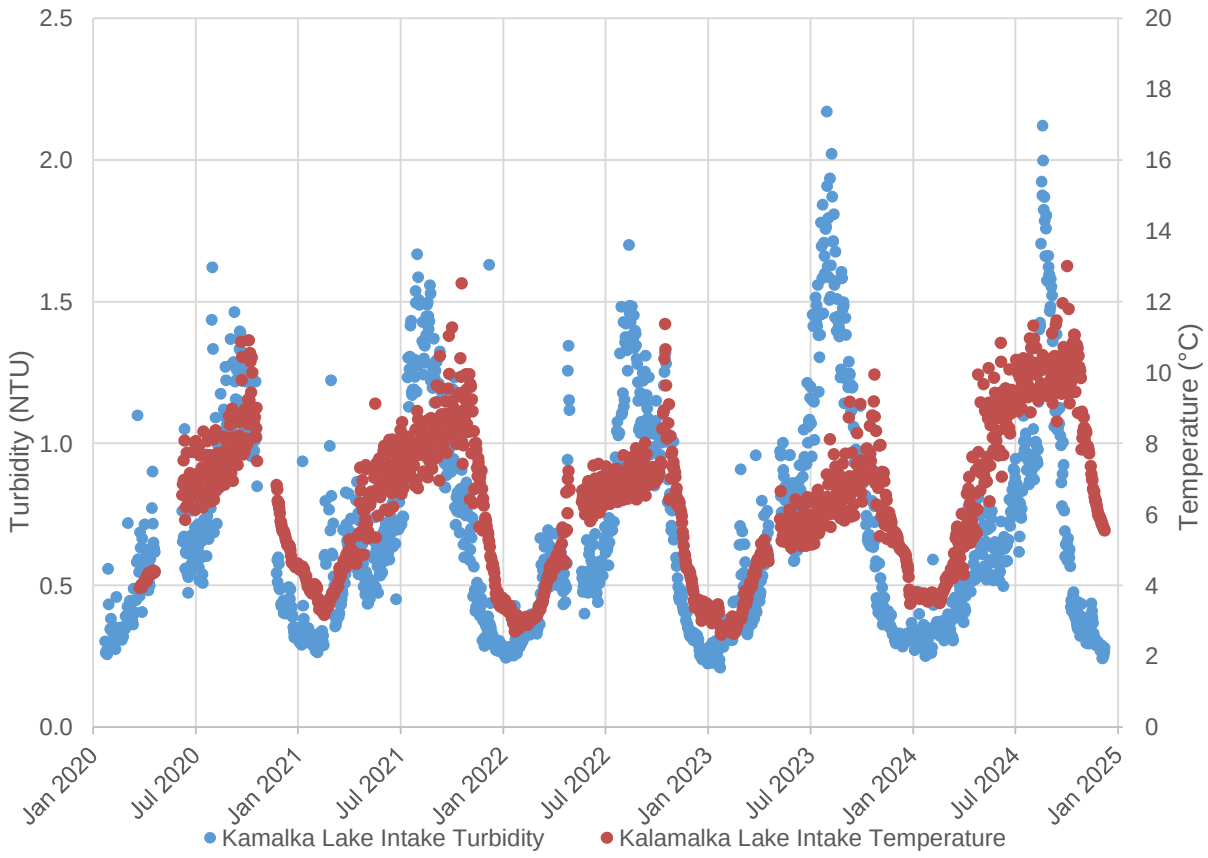


Figure 20: SCADA daily averages of temperature and turbidity at Kalamalka Lake Intake from 2020 to 2024

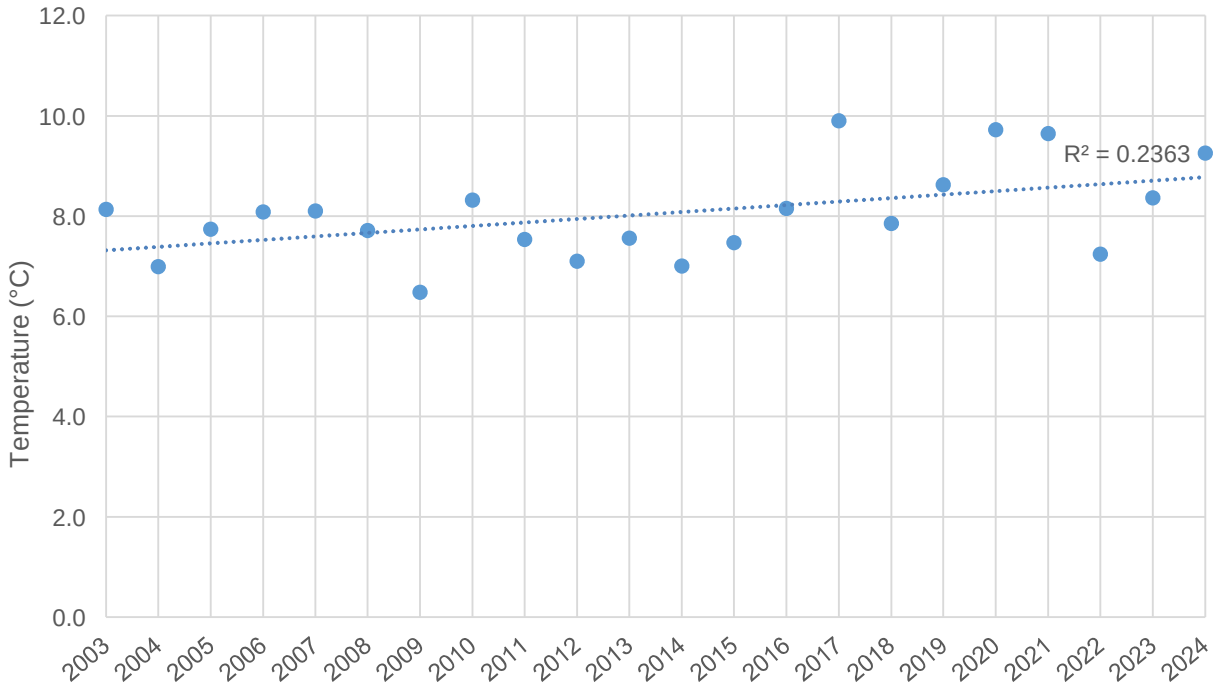


Figure 21: Annual average temperature from grab samples taken at Kalamalka Lake Intake from 2003 to 2024

pH

The pH at the Kalamalka Lake Intake has historically ranged between 6.7 and 8.7. In 2024, the annual average pH was 7.7. The pH appears to be decreasing over time at this sample location (Figure 22) and will be further investigated.

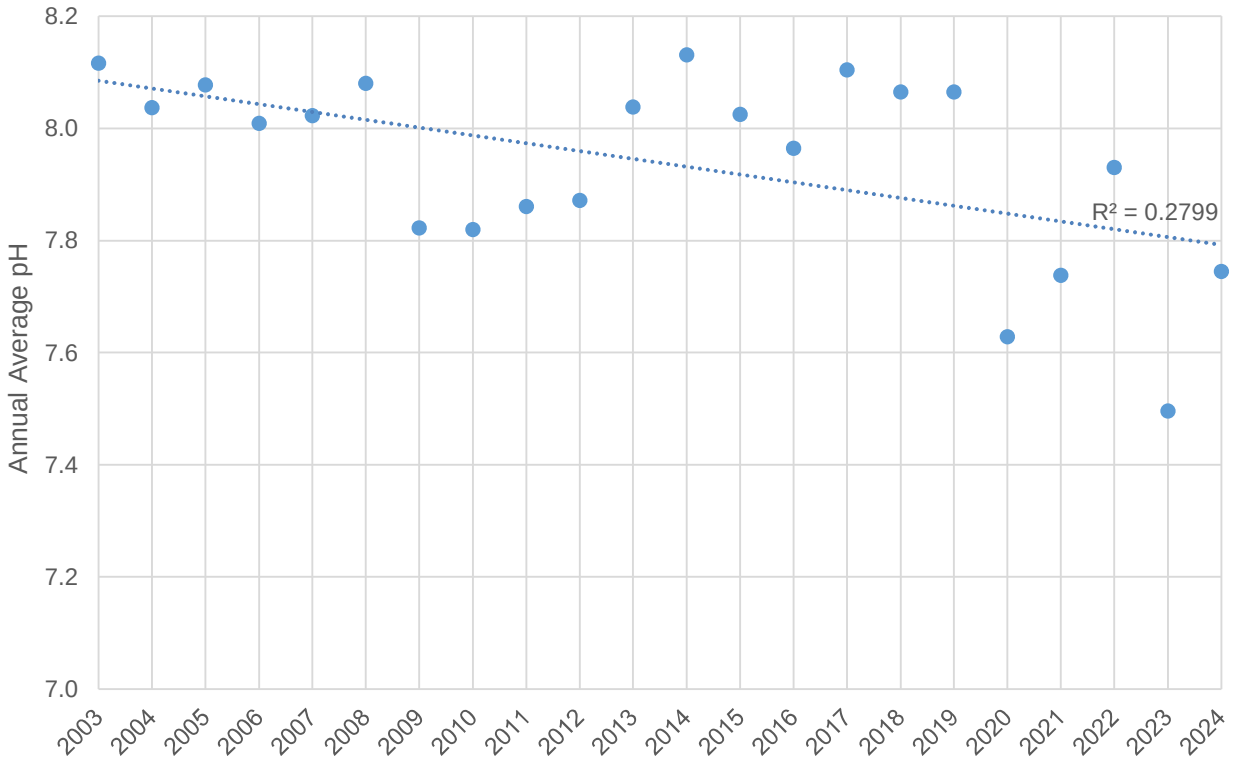


Figure 22: Annual average pH from grab samples taken at Kalamalka Lake Intake from 2003 to 2024

Alkalinity / Hardness

Alkalinity is a measure of the water's ability to buffer pH changes. In Kalamalka Lake, alkalinity has been relatively stable but has fluctuated over the years of record, ranging from 107 to 176 mg/L $CaCO_3$. This is considered to be high alkalinity, which means the lake is more resistant to influences that would cause pH change.

Hardness has also remained stable and results have ranged between 158 to 187 mg/L as $CaCO_3$, except for three (3) outlying samples around 130 mg/L. According to Health Canada, water with a hardness between 120 and 180 mg/L is considered hard. The high alkalinity and hardness of Kalamalka Lake water makes it less corrosive to water pipes but can cause scale.

Chlorophyll a

The data suggests that annual average chlorophyll a concentration in Kalamalka Lake follows a cyclical pattern, with peaks observed in 2004, 2009, 2015, and 2020, approximately every five (5) years (Figure 23). In 2020, chlorophyll a levels were notably elevated, which coincided with a significant algae bloom in the lake. In 2024, the annual average chlorophyll a concentration was the lowest on record, due to five (5) of the eight (8) samples taken being below detection limit (<1.0 mg/L), which is unusual and requires further study to assess the potential influence of methods or other external factors (Figure 24). Regardless of this, chlorophyll a concentration appears to be increasing over time, likely in relation to the increasing algae densities observed.

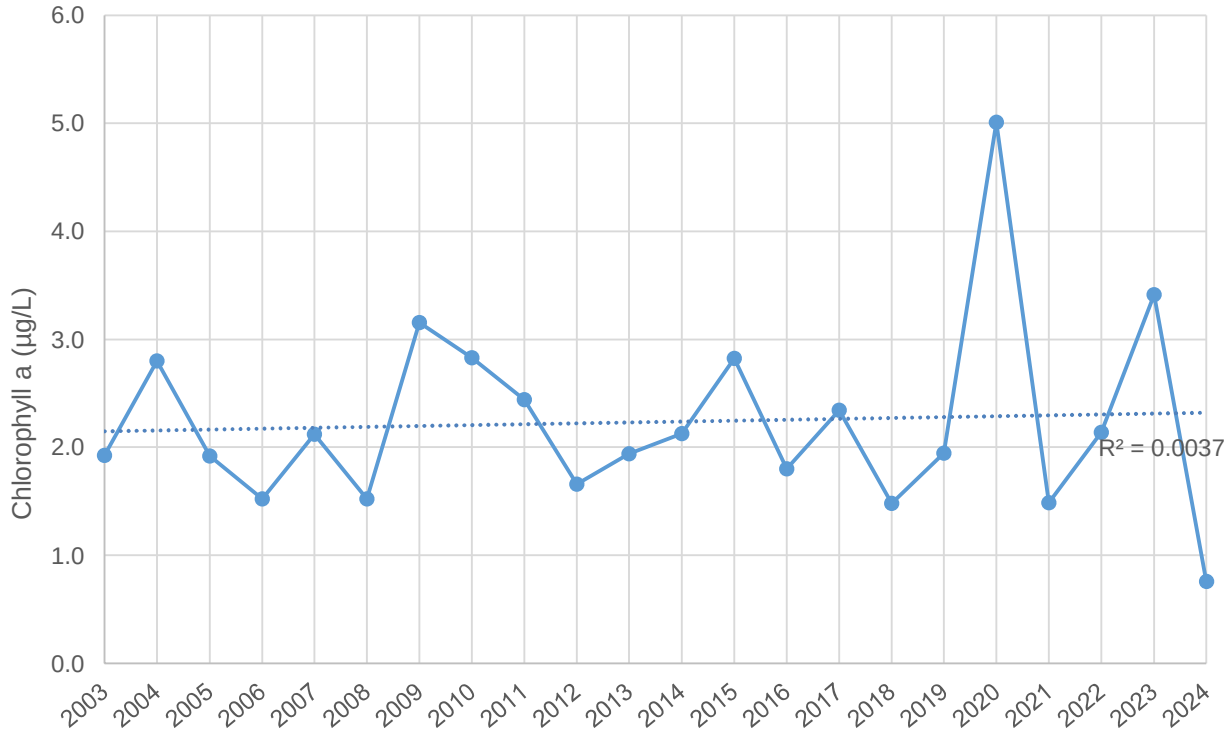


Figure 23: Annual average chlorophyll a from grab samples taken at Kalamalka Lake Intake from 2003 to 2024

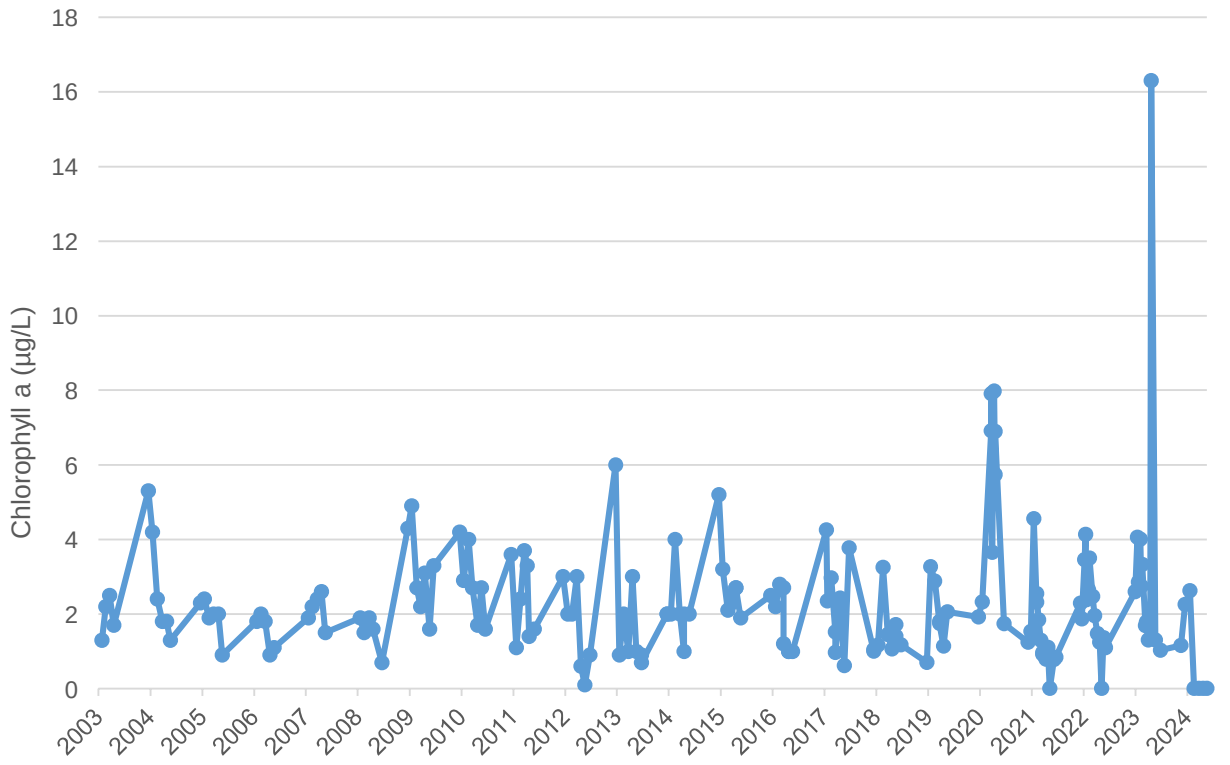


Figure 24: Chlorophyll a concentrations from grab samples taken at Kalamalka Lake Intake from 2003 to 2024

Organic Carbon

A significant peak in TOC and DOC occurred around 2010 in Kalamalka Lake, with TOC reaching nearly 15 mg/L, suggesting an organic input event—potentially linked to watershed disturbance or runoff. Following this spike, concentrations stabilized, generally ranging between 3 and 7 mg/L for both parameters (Figure 25). Like Duteau Creek, TOC and DOC are strongly related in Kalamalka Lake when incorporating all data from 2003 to 2024 (Figure 26). This long-term relationship suggests that most organic carbon in the lake is typically present in dissolved form; however, in 2024, the relationship is not as strong ($R^2 = 0.46$), indicating that the organic carbon may have been present in particulate or non-dissolved forms during the year. These organic compounds are important to monitor as they are precursors to disinfection by-products (DBPs) in the system, which will be discussed further in the Distribution section of this report.

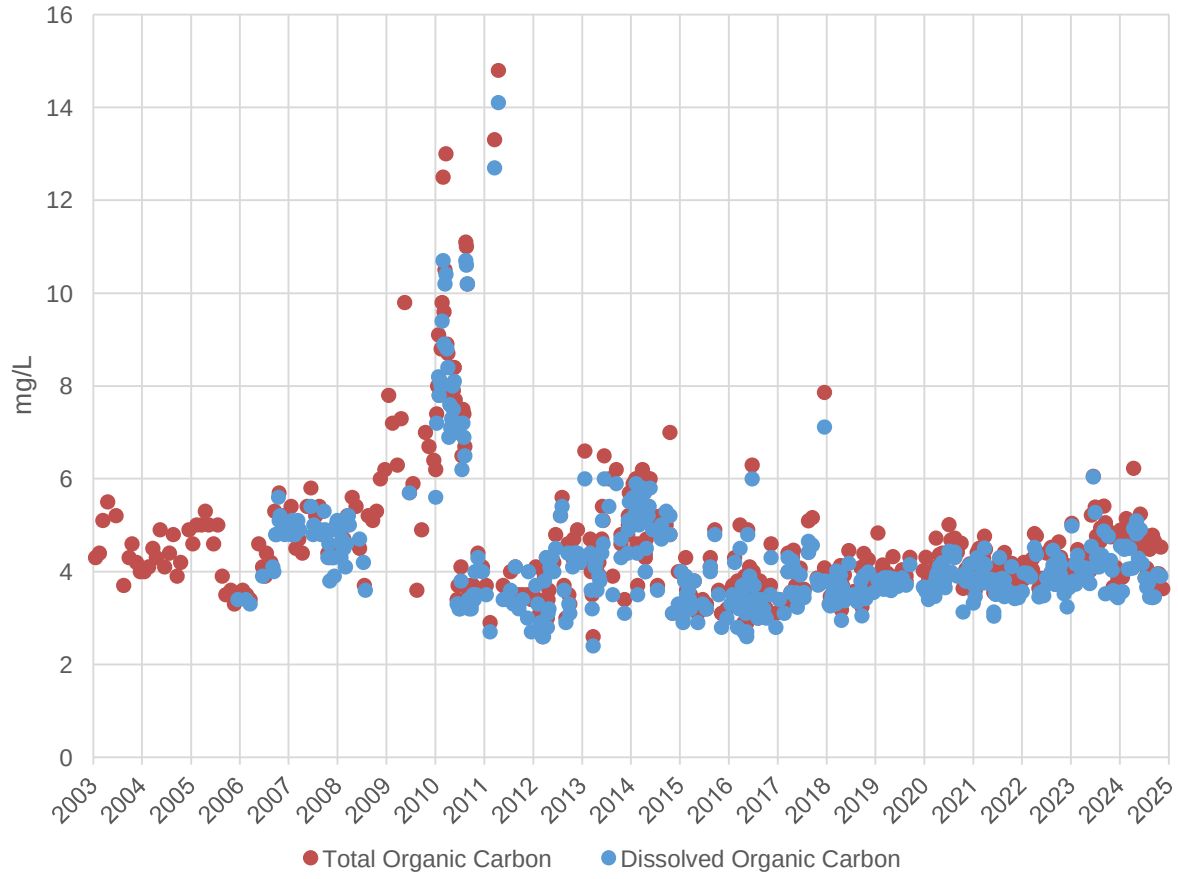


Figure 25: TOC and DOC concentrations from grab samples taken at Kalamalka Lake Intake from 2003 to 2024

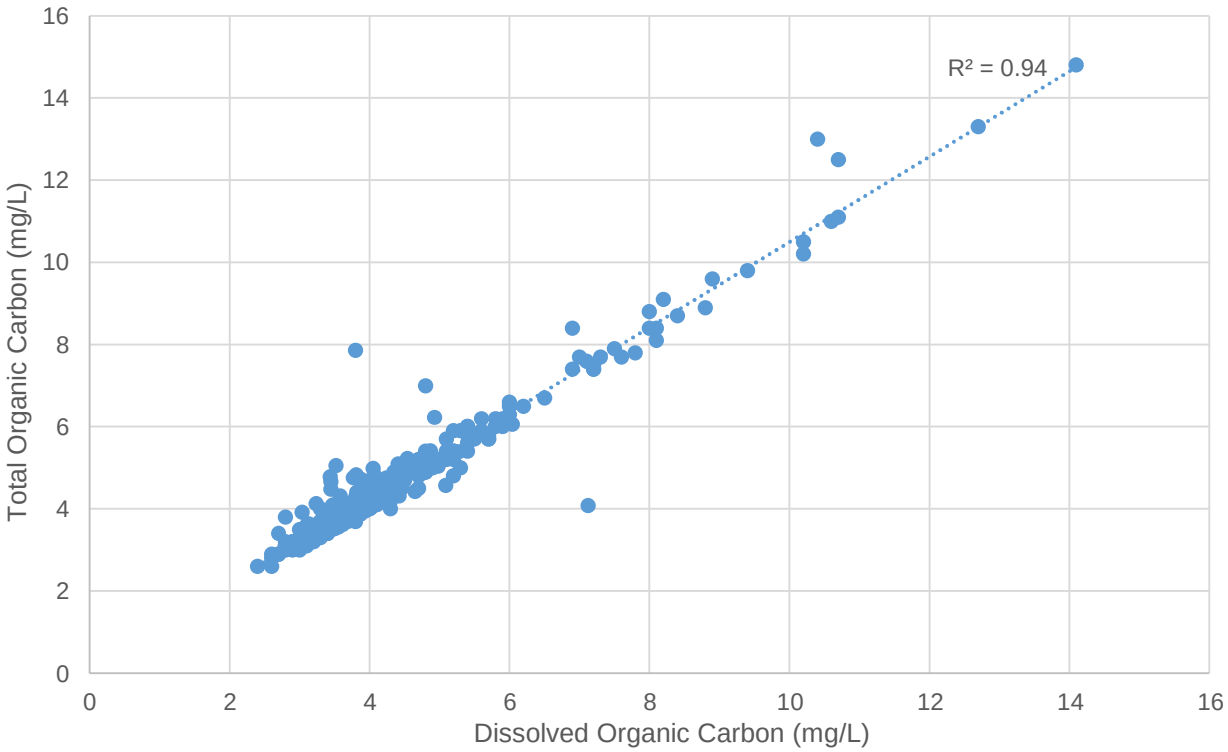


Figure 26: TOC and DOC correlation at Kalamalka Lake Intake from 2003 to 2024

Volatile Organic Compounds

Volatile Organic Compounds (VOC's) are monitored to assess human impact and are an indication of petrochemical contamination (i.e. gasoline, solvents). VOC's have been sampled annually at the Kalamalka Lake Intake since 2004 due to the higher risk related to boating activities. All parameters and results have been non-detect during this time.

Light Extractable Petroleum Hydrocarbons (LEPH) / Heavy Extractable Petroleum Hydrocarbons (HEPH)

Fuel, LEPH, and HEPH are monitored to assess human impact and are another test for petrochemical contamination but from a broader source (i.e. gasoline, solvents, creosote). These tests have been analyzed approximately every two (2) years at the Kalamalka Lake Intake since 2011. They are completed in August or early September to monitor if any of these chemicals could be entering the lake due to human activities. No compounds were detected in 2023. Sampling is scheduled to be completed again in 2025.

Pesticides and Herbicides

Pesticides and herbicides are monitored to assess human impact in the watershed and determine if they travel from surrounding lands to the lake. A scan of the most common compounds in use is analyzed approximately every two (2) years at the Kalamalka Lake Intake since 2013. No compounds tested for were detected in 2023. Sampling is scheduled to be completed again in 2025.

Biological Monitoring

Bacteria

Monitoring for Total Coliform bacteria (TC) and *Escherichia Coli* (*E.coli)* is an important part of understanding source water quality and detecting potential changes. Table 8 summarizes the TC and *E.Coli* bacteria sample results from Kalamalka Lake Intake for 2024.

Table 8: Kalamalka Lake Intake Bacteria Sample Summary

Total Coliform MPN/100 mL	Accredited Lab	RDNO Lab
# of Samples	46	112
Min	<1	<1
Max	155	167.4
Mean	20	18
Counts > 100 MPN/100 mL	2	2
Counts < 1 MPN/100 mL	3	4
E. coli MPN/ 100 mL	**Accredited Lab**	**RDNO Lab**
# of Samples	46	112
Min	<1	<1
Max	88	84.5
Mean	7	8
Counts > 20 MPN/100 mL	3	7
Counts < 1 MPN/100 mL	15	30

Total Coliforms

In 2024, TC counts were slightly elevated in late-winter and early-spring, compared to previous years (Figure 27). Despite these samples, overall TC counts were lower in 2024 compared to previous years. Figure 27 compares 2024 values to the range observed from 2022 to 2023. Prior to 2022, in-house laboratory methods were limited by an upper detection limit of 200.5 MPN/100 mL. Including this earlier data would bias the range downward.

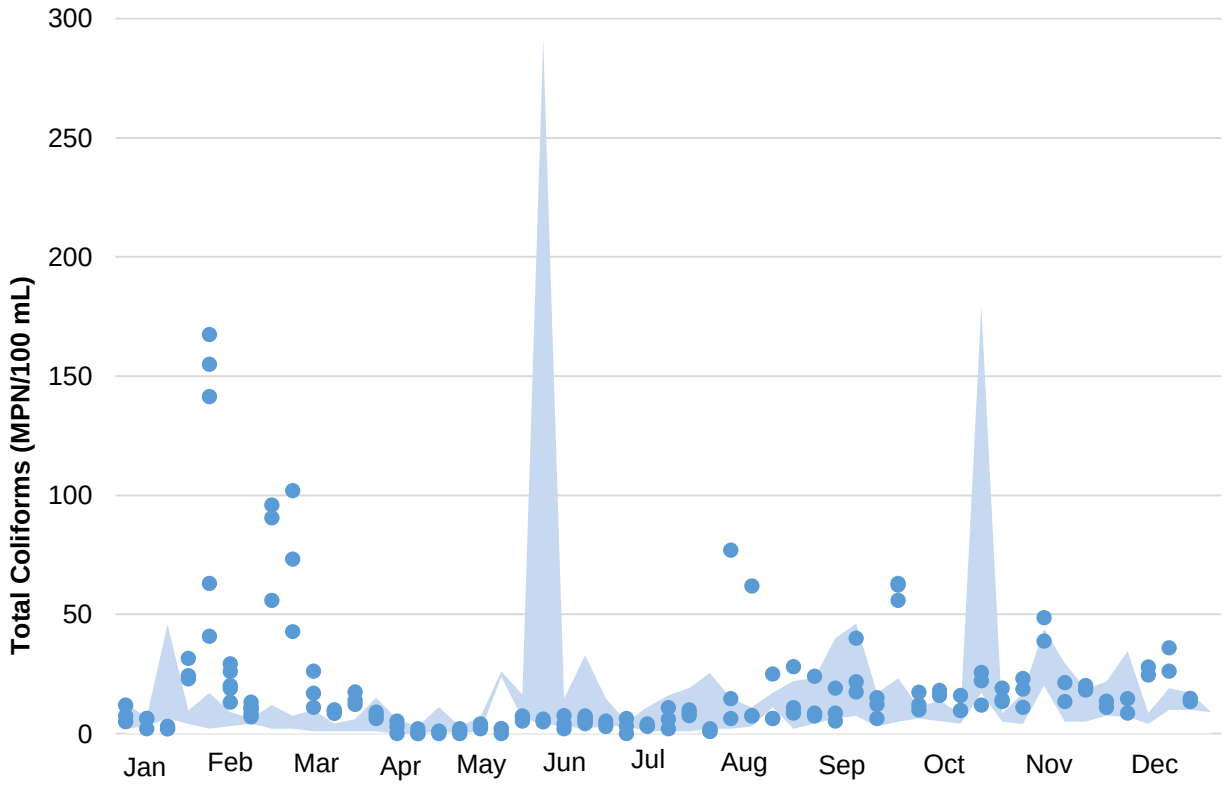


Figure 27: Total coliform counts from 2024 grab samples at Kalamalka Lake Intake, compared with the 2022 to 2023 historical range

E.Coli

E.coli grab samples from the Kalamalka Lake Intake in 2024 showed elevated counts in the late-winter and early-spring. E. coli results were low for the remainder of the year. Unlike total coliforms, the *E. coli* figure extends back to 2014 because pre-2022 results were less affected by the in-house laboratory upper detection limit, with relatively few values exceeding 200.5 MPN/100 mL. This allows for a longer and more interpretable time series chart (Figure 28).

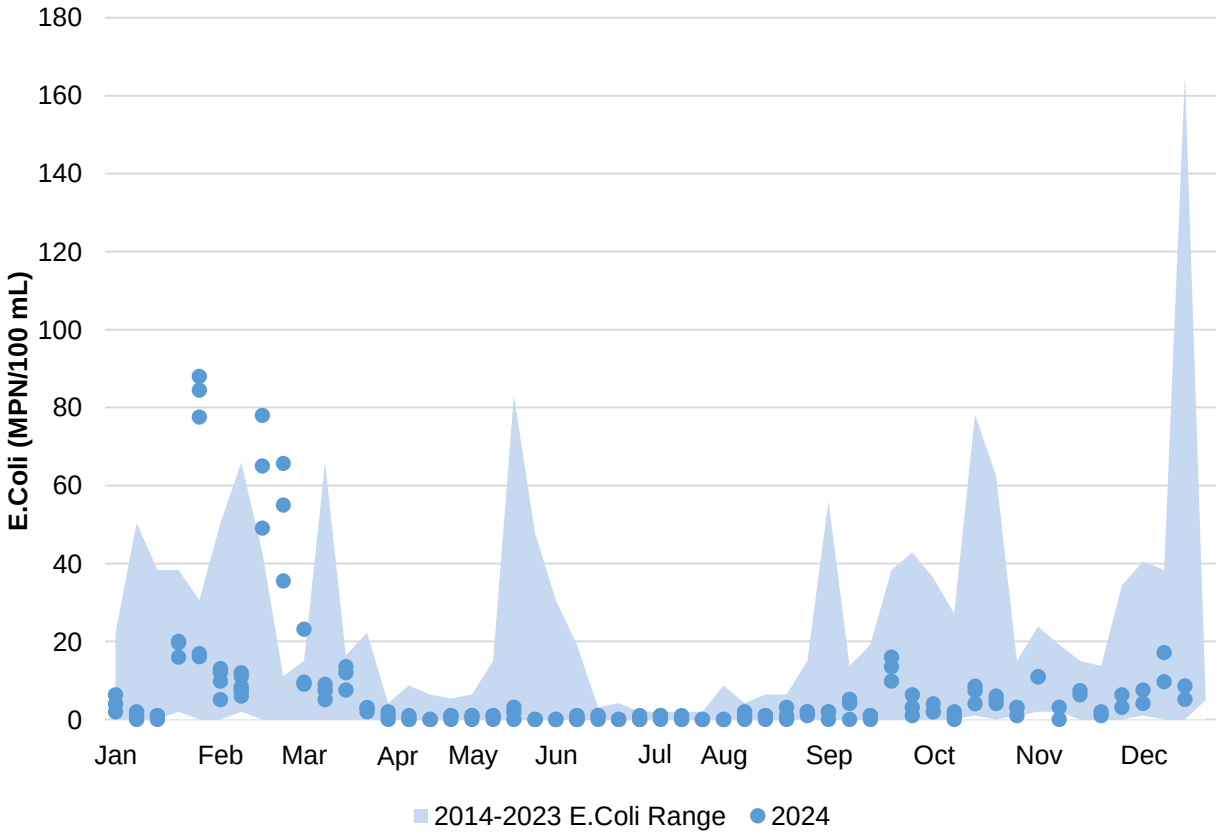


Figure 28: E. coli counts from 2024 grab samples at Kalamalka Lake Intake, compared with the 2014 to 2023 historical range

Algae

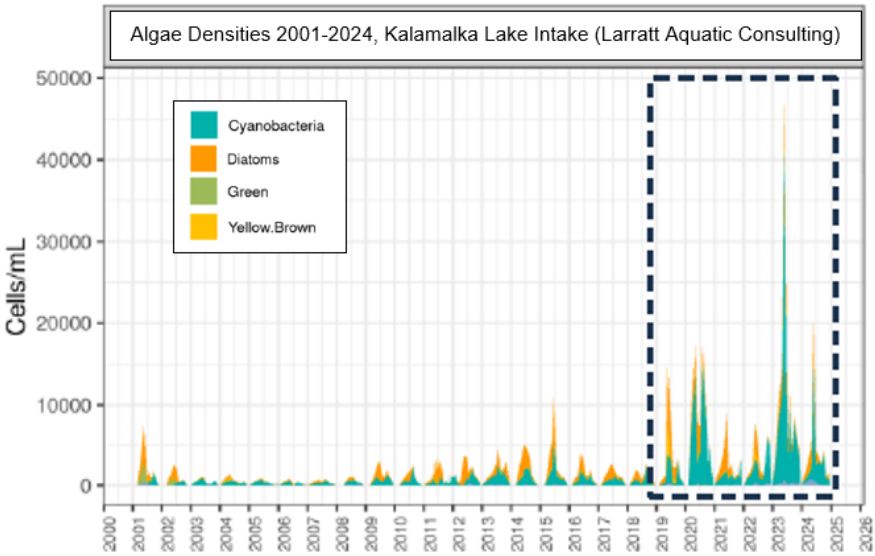
Algae is an ongoing concern in Kalamalka Lake, affecting taste and odour, adding to the biomass in the distribution system, fueling regrowth, and has the potential to be toxic if Cyanobacteria is present. The RDNO conducts year-round sampling to identify, speciate, and count the algae present at the Kalamalka Lake Intake. The RDNO also conducts sampling for nutrients that contribute to algal growth, which are often indicators of human impacts to the source water quality. Further study and observation on Kalamalka Lake microflora (water chemistry and thermal profiles), is conducted by Larratt Aquatic Consulting Ltd.

To understand nutrient loading and the potential for algae blooms, an outline is provided in the BC Decision Protocol for Cyanobacterial Toxins (MOH, 2018). Within the protocol, further investigation into toxin formation is recommended if any of the following conditions are met:

1. nitrogen greater than 658 ug/L
2. phosphorous greater than 26 ug/L
3. N:P ratio less than 23
4. algae blooms observed.

In 2024, the highest nitrogen (total) observed at the Kalamalka Lake Intake was 407 µg/L and the highest phosphorus (total) was 23 µg/L, both below the protocol thresholds for the first two (2) points; however, there were four (4) instances where the N:P ratio was less than 23 in October and November. The RDNO monitors cyanobacteria counts and conducts microcystin testing when these counts exceed a threshold level. The RDNO will continue to monitor inputs to Kalamalka Lake in Coldstream Creek and Kalamalka Lake for changes to conditions.

Since 2020, algae densities have increased dramatically in Kalamalka Lake as shown in the figure to the right from the Larratt Aquatic Consulting (LAC) 2024 Kalamalka Lake Water Quality Study. Microflora, Water Chemistry and Thermal Profiles. In 2024, the was a spring diatom bloom throughout the lake. Cyanobacteria counts were high in the spring and early-fall at the surface in the north end of the lake where the intake is located; however, intake samples were below the level requiring notification or the threshold for microcystin testing.



For a detailed summary of the lake's water quality and algae data, see the Larratt Aquatic Consulting (LAC)'s 2024 Kalamalka Wood Lake Water Quality Study.

Treatment Monitoring Program

Duteau Creek Water Treatment Plant

Water quality at the DCWTP is monitored online through SCADA, as well as through sampling and analysis of certain parameters throughout the treatment process by RDNO operators. The sampling analysis and frequency is outlined in the WQMP (Attachment A). Water quality staff take samples weekly at the reservoir outlet, and complete additional sampling on a monthly and annual schedule as detailed in WQMP (Attachment A). The chlorine Contact Time (CT) for 4-log inactivation of viruses is applied when the water enters the DCWTP reservoir and the dosage can be adjusted when required. Table 9 summarizes the DCWTP monthly averages for post-treatment free chlorine, pH, and pre-treatment UV in 2024.

Table 9: Duteau Creek Water Treatment Plant 2024 Monthly SCADA Averages

DCWTP Monthly SCADA Averages			
Parameter	**Post Treatment Free Chlorine (mg/L)**	**Post Treatment pH**	**Pre Treatment UVT (%)**
January	1.90	7.30	90.20
February	1.90	7.29	91.09
March	1.90	7.31	90.85
April	1.91	7.26	88.34
May	1.90	7.22	88.78
June	1.91	7.26	89.31
July	1.90	7.17	86.25
August	1.91	7.19	84.18
September	1.91	7.19	85.97
October	1.94	7.25	89.61
November	1.91	7.33	90.48
December	1.91	7.29	90.50

Treatment Targets for Turbidity

Online turbidity analyzers continuously record raw and treated water turbidity to ensure that the treatment process is functioning correctly and that water entering the distribution system meets provincial standards. Online turbidity analyzers are monitored through SCADA and trigger alarms when turbidity exceeds predefined thresholds. Operators and staff respond as outlined in the GVW Water Quality Deviation Response Plan (Attachment B).

The DCWTP is effective at reducing raw water turbidity levels to ensure the levels entering the distribution system are less than 1 NTU. No water with a daily average turbidity greater than 1 NTU entered the distribution system in 2024.

Ultraviolet Transmittance

UV Transmittance (UVT) is monitored at 254 nm to evaluate the effectiveness of UV disinfection at the DCWTP, which has a minimum validation threshold of 76%. UVT (unfiltered) is continuously recorded online when the plant is running, with daily grab samples collected for verification to ensure the UVT does not drop below 76%. As shown in Figure 29, UVT values ranged from 82.9% and 92.8% before UV treatment, indicating optimal conditions for effective UV disinfection.

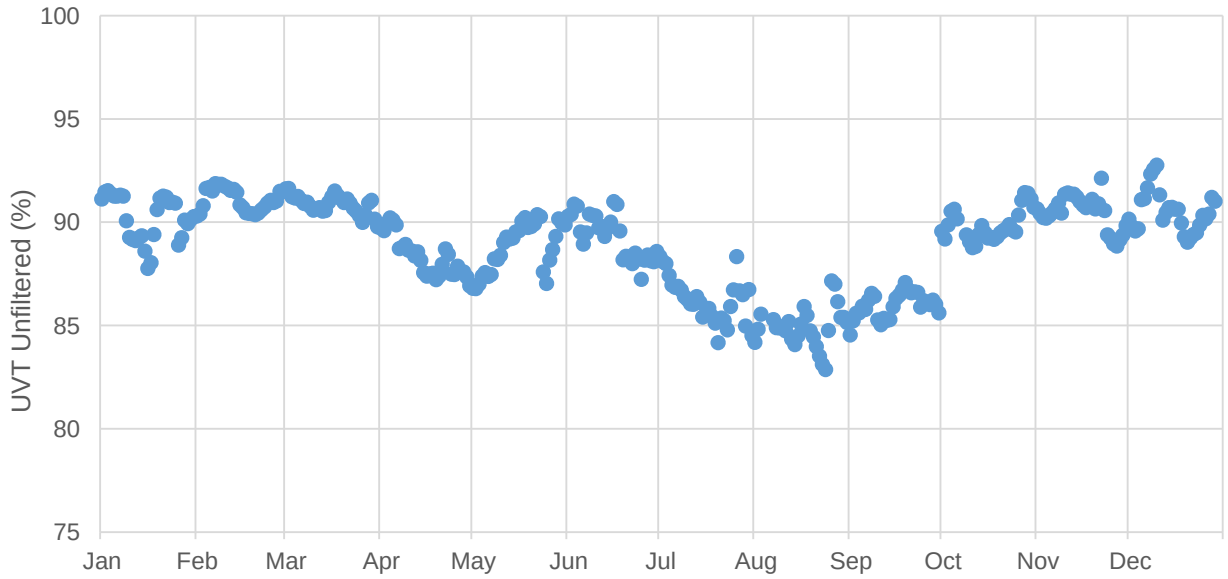


Figure 29: SCADA daily average UVT (Unfiltered) at the DCWTP (Pre-UV Treatment) in 2024

Aluminum

Aluminum in drinking water is subject to operational guidance values, which are specifically applicable to treatment plants using aluminum-based coagulants. For conventional treatment facilities, the operational guidance value is 0.1 mg/L, while for other types of treatment systems, it is 0.2 mg/L. These values are reported as a 12-month running average.

At the DCWTP, both total and dissolved aluminum concentrations are monitored monthly at the reservoir intake and within the distribution system. These measurements reflect residual aluminum carryover from the DAF process. Elevated levels of dissolved aluminum may indicate either high aluminum content in the raw water or overdosing of Poly Aluminum Chloride (PAC), the plant's primary coagulant. Such carryover is a concern not only for immediate water quality but also for potential aluminum accumulation in the distribution system, which can degrade long-term water quality.

Figure 30 shows the annual average total aluminum concentrations from 2011 to 2024, including data from the Duteau Creek Intake, DCWTP Post Treatment, and within the distribution system at PRV 1 and PRV 2. As shown in the figure, the source water contains measurable levels of naturally occurring total aluminium. It also highlights the improved control of coagulant dosing over time since the treatment plant began operating in late 2010. Total aluminum is one (1) of the parameters monitored as part of the Water Quality Indicators (WQI) for plant operations. In the distribution system, total aluminum was historically measured at PRV 1, with monitoring shifting to PRV 2 in 2019 to better represent the broader system. Overall, the data shows that current total aluminum levels do not pose a health concern. The GCDWQ MAC for total aluminum is 2.9 mg/L.

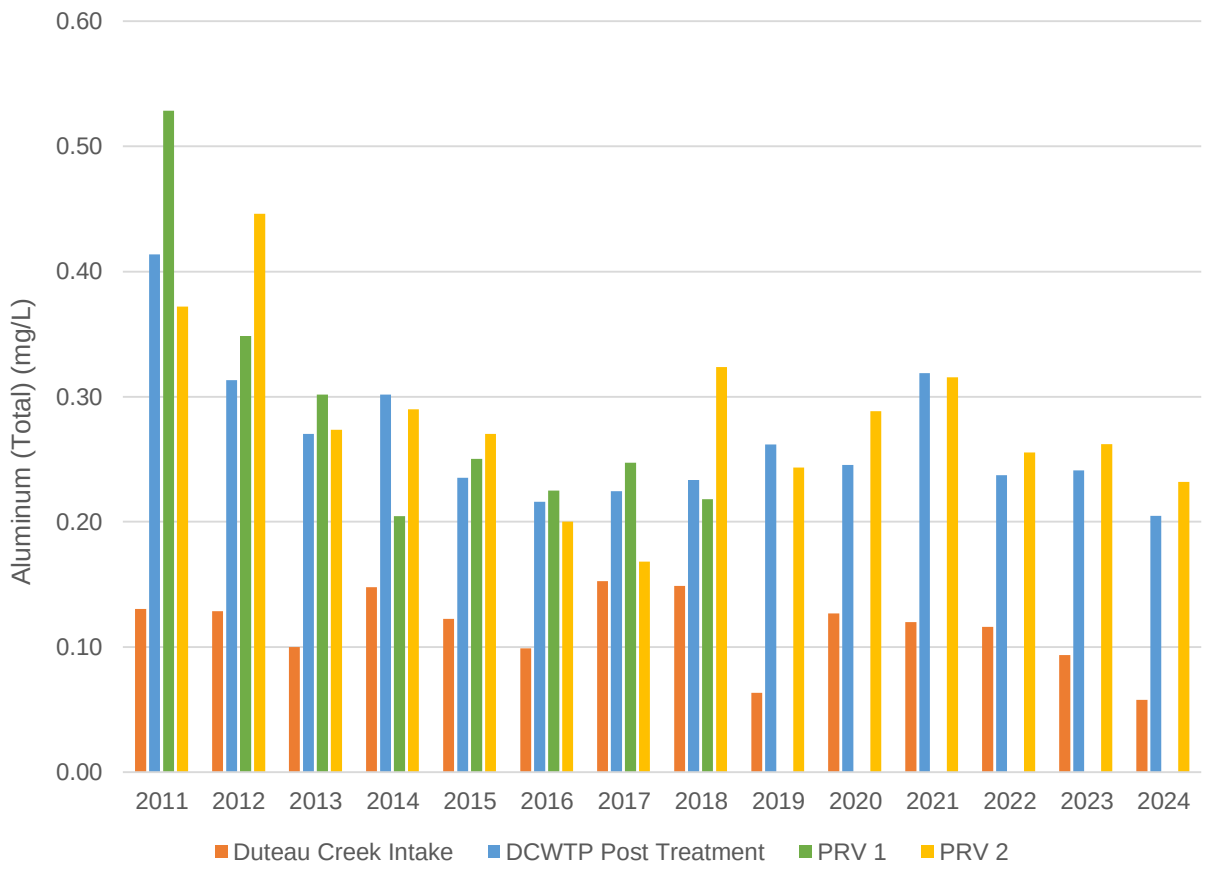


Figure 30: Annual average total aluminum from grab samples in the Duteau Creek System from 2011 to 2024

Mission Hill Water Treatment Plant

Water quality at the MHWTP is monitored online through SCADA, and through sampling and analysis of certain parameters throughout the treatment process by RDNO operators. The sampling analysis and frequency is outlined in the WQMP (Attachment A). Water quality staff take samples weekly at the wet well outlet, and complete additional sampling on a monthly and annual schedule as detailed in the WQMP (Attachment A). The chlorine Contact Time (CT) for 4-log inactivation of viruses is applied at the MHWTP reservoir and the dosage can be adjusted if required. Table 10 summarizes the monthly averages for post-treatment free chlorine and pre-treatment UVT (%) in 2024. The UV at MHWTP has a minimum validation of 86%. All off-spec water is reported in the monthly water quality reports available on the RDNO website at https://www.rdno.ca/gvw/waterquality.

Table 10: Mission Hill Water Treatment Plant 2024 Monthly SCADA Averages

MHWTP Monthly SCADA Averages		
Parameter	**Post Treatment Free Chlorine (mg/L)**	**Pre Treatment UVT (%)**
January[1]	2.00	91.51
February[2]	2.00	91.59
March[3]	2.00	91.54
April	2.00	91.44
May	2.00	91.25
June	1.99	91.04
July	2.08	91.43
August	2.19	91.50
September	2.20	91.95
October	2.18	92.62
November	1.99	92.86
December[4]	2.00	91.12

[1]Two (2) days of data were excluded due to a MHWTP shutdown related to power and communication issues.

[2] Three (3) days of data were excluded due to a MHWTP shutdown related to power and communication issues.

[3]One (1) day of data was excluded due to a planned MHWTP shutdown for hypo pump download.

[4]Three (3) days of data were excluded due to a planned MHWTP shutdown for maintenance.

Treatment Targets for Turbidity

Online turbidity analyzers continuously record raw and treated water turbidity to ensure that water entering the distribution system meets the provincial standards. Turbidity analyzers are monitored through SCADA and trigger alarms when turbidity exceeds predefined thresholds. Unlike the DCWTP, the type of treatment at the MHWTP does not reduce turbidity from the source water. When turbidity levels at the Kalamalka Lake intake are trending greater than the defined values in the GVW Water Quality Deviation Response Plan, and when system demand allows, the source is turned off and switched to the DCWTP to avoid having to issue a Water Quality Advisory. The MHWTP was not required to be turned off in 2024 as a result of high turbidity conditions. Figure 31 compares the daily average turbidity of the treated water leaving MHWTP from 2020 to 2024. Gaps in the chart correspond to periods when the plant was offline due to maintenance or increasing turbidity, during which the data are not valid.

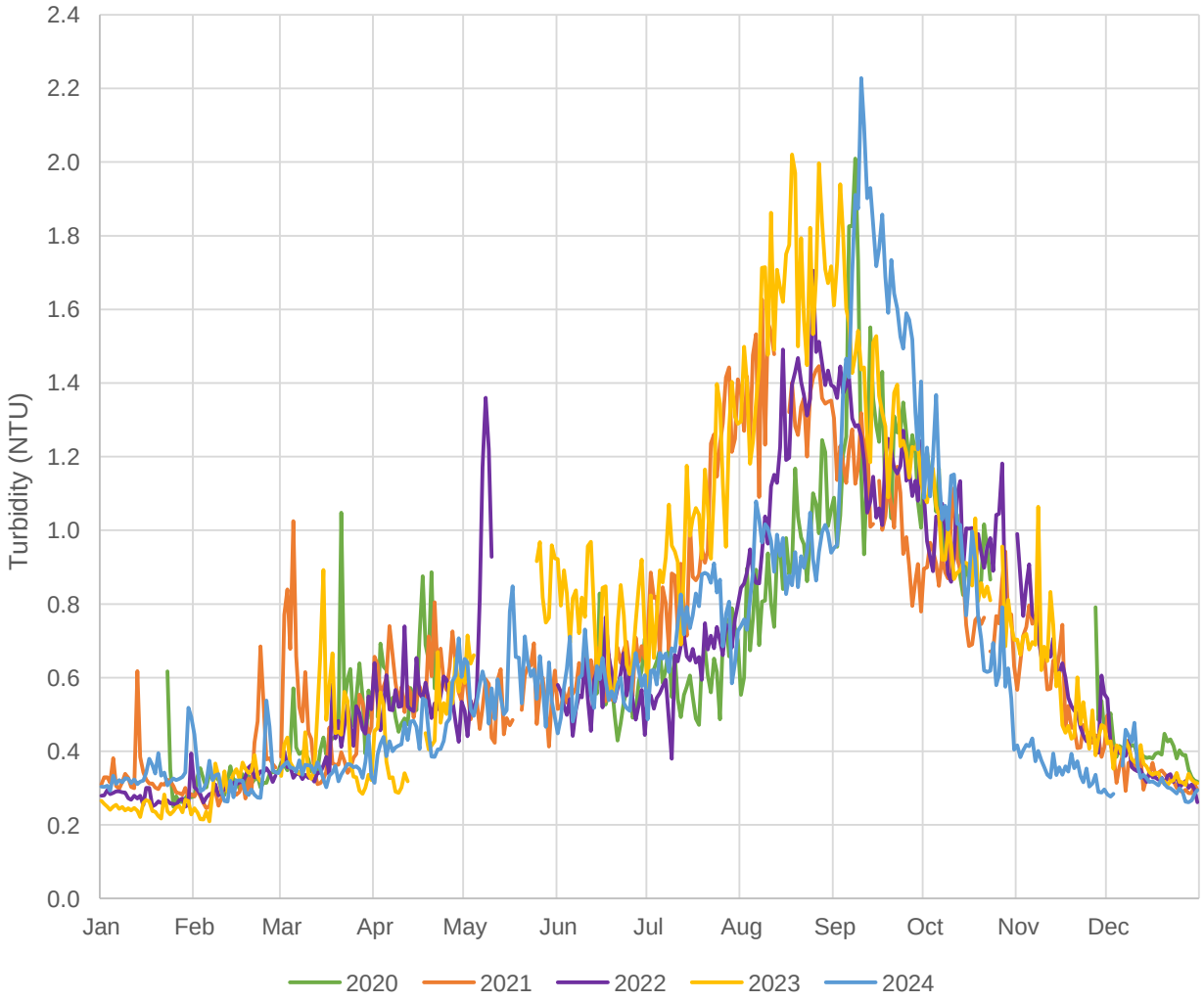


Figure 31: SCADA daily average turbidity at MHWTP Post Treatment, comparison from 2020 to 2024. Gaps in the chart correspond to periods when the plant was offline and the data are not valid.

Ultraviolet Transmittance

UV Transmittance (UVT) is monitored at 254 nm to evaluate the effectiveness of UV disinfection at the MHWTP, which has a minimum validation of 86%. UVT (unfiltered) is continuously recorded online when the plant is running and monitored through SCADA. As shown in Figure 32, UVT values ranged from 90.2% and 93.1% before UV treatment, indicating optimal conditions for effective UV disinfection. Some data points are missing from the figure in January and December due to maintenance and power disruptions.

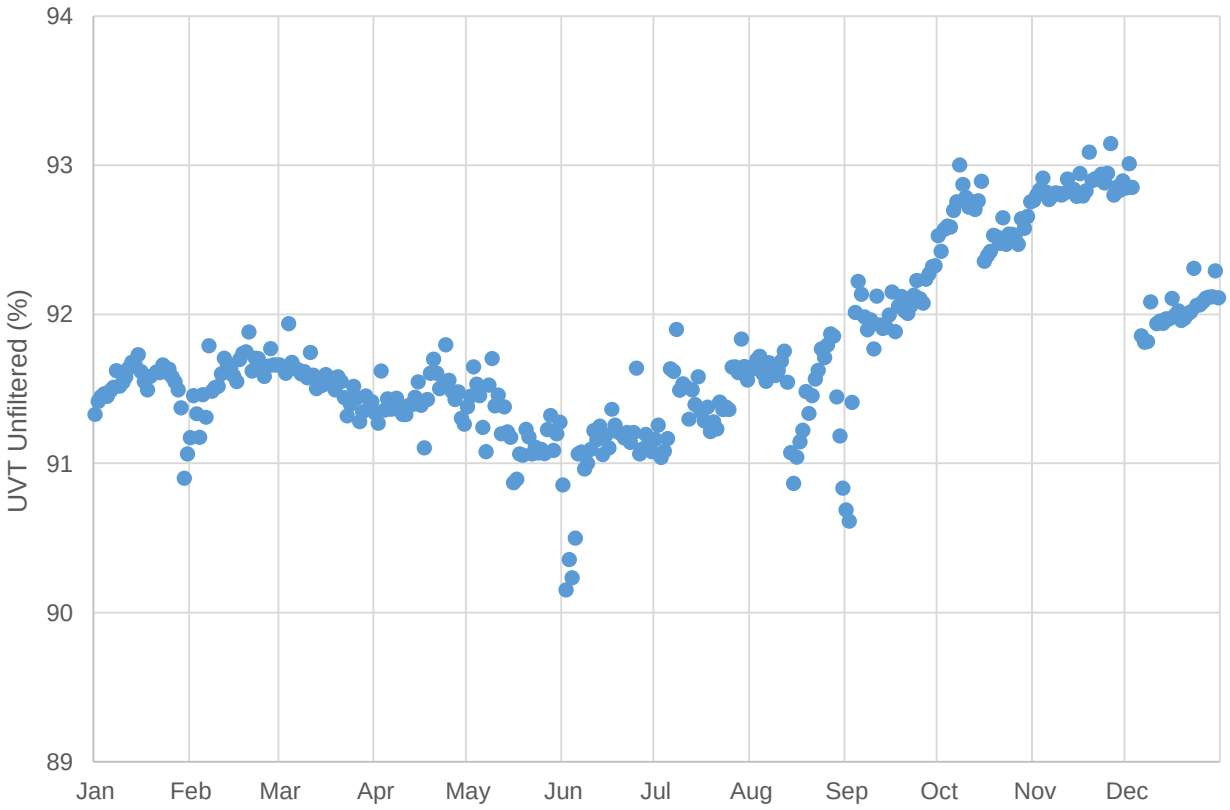


Figure 32: SCADA daily average UVT (Unfiltered) at the MHWTP (Pre-UV Treatment) in 2024

Distribution Monitoring Program

Following treatment and/or disinfection, the distribution water quality program is designed to meet the community water system regulations prescribed by the *DWPR* Schedules A and B, as well as the *GCDWQ,* including Maximum Acceptable Concentrations (MACs) and Aesthetic Objectives (AOs). Additional parameters may be monitored if they are known to create problems within the water distribution system or are required for individual projects.

The water distribution system is monitored weekly by operators and water quality staff. If unacceptable field parameters are observed, further investigation is conducted and flushing may be initiated. Routine field parameters include: pH, turbidity, temperature, conductivity, free and total chlorine, and bacteria.

Distribution sampling site locations and frequency are determined by GVW and / or following provincial requirements. The monitoring program is designed to capture changes in water quality as it flows through the distribution system. GVW submits an annual Water Quality Monitoring Plan (WQMP) to IH, included as Attachment A.

During normal operations, the distribution system acts as two (2) separate systems, each area supplied by either Duteau Creek or Kalamalka Lake; however, the system is integrated and can be supplied by either source or by blending sources, which impacts the results at sampling sites. Conductivity measurements are used to identify the source water where Kalamalka Lake water has a conductivity between 400 and 500 µS/cm and treated Duteau Creek water has a conductivity between 100 and 200 µS/cm. Blending of sources will be somewhere in the middle.

GVW is a very large system that has a service area of 35 km from north to south and close to 700 km of pipes. Water quality throughout the service area can be very different depending on proximity to treatment plants or chlorine booster stations, water age and the amount of water used in an area. To obtain representative samples throughout the distribution system, GVW uses both dedicated and continuously running sample analysers for certain parameters located at utility-owned sites (i.e. reservoirs and pump stations) and grab samples from water quality sample stations. GVW has 84 regularly monitored sample stations connected directly to water lines throughout the system to ensure accuracy and accessibility. In certain cases, sampling may be completed at public buildings or residential homes but is not preferred as the sites can be unreliable due to access issues or may not provide accurate results due to issues with the internal plumbing or stagnant water. Sampling sites are re-evaluated and updated as the GVW program evolves.

GVW is committed to the health and safety of the water system and maintaining public confidence. Close collaboration with IH helps ensure that residents receive safe, high-quality drinking water.

Bacterial Testing Overview

The *DWPA* and DWPR have established the following water quality standards for potable water systems where more than one (1) sample is taken in a 30-day period, as set out in Schedule A:

- No detectable *E. coli* per 100 mL in any sample of water.
- At least 90% of samples have no detectable TC per 100 mL, and
- No sample has more than 10 TC per 100 mL.

GVW, as the drinking water purveyor serving the Greater Vernon area with a population of approximately 67,000, is required to test a minimum of 67 bacterial samples per month at an accredited lab as outlined in Schedule B of the DWPR. GVW exceeds the number of samples required as additional sites are added to the program due to the complexity and long pipe lengths in the distribution system as well as added sampling in low chlorine areas.

In 2024, there were a total of 1,839 bacterial samples taken at 87 sample sites in the GVW distribution system for the routine sampling program. Table 11 summarizes the 2024 bacterial routine sampling program results.

Table 11: Distribution Bacterial Sampling Summary

2024 Distribution Bacterial Sampling Summary			
RDNO Lab Results	Distribution		
	Duteau Creek	Kalamalka Lake	Meets Regulation
Number of samples	530	501	Yes
Number of samples containing *E.coli*	0	0	Yes
Number of samples containing TC	0	5	Yes
% of samples with zero TC	100%	99%	Yes
Number of occasions with consecutive samples containing TC	0	1	Yes

Accredited Lab Results	Distribution		
	Duteau Creek	Kalamalka Lake	Meets Regulation
Number of samples	310	498	Yes
Number of samples containing *E.coli*	0	0	Yes
Number of samples containing TC	0	2	Yes
% of samples with zero TC	100%	99.6%	Yes
Number of occasions with consecutive samples containing TC	0	0	Yes
Both Lab Results Combined	**Distribution**		
	Duteau Creek	**Kalamalka Lake**	**Meets Regulation**
Number of samples	840	999	Yes
Number of samples containing *E.coli*	0	0	Yes
Number of samples containing TC	0	7	Yes
% of samples with zero TC	100%	99.3%	Yes
Number of samples with >10 TCs	0	0	Yes

Disinfection By-Products

Trihalomethanes (THMs) are disinfection by-products formed when chlorine reacts with naturally occurring organic compounds in the source water. The concentration of THMs in treated water is influenced by numerous factors, including TOC, temperature, pH, water age, and chlorine dose. 10 distinct THM compounds can form, but only four (4) are commonly found at significant levels in treated drinking water:

- Chloroform
- Bromodichloromethane
- Dibromochloromethane
- Bromoform

These four (4) compounds are collectively referred to as Total Trihalomethanes (TTHMs). In this report, TTHMs refer to the average concentration of these four (4) compounds at each sampling site.

The GCDWQ MAC for TTHMs is 0.1 mg/L (100 µg/L) and is based on a locational running annual average, calculated from a minimum of quarterly samples collected at the point in the distribution system where THMs are expected to be highest.

Haloacetic acids (HAAs) are another group of disinfection by-products formed through the reaction of chlorine with organic compounds in source water. Their formation is influenced by several factors such as bromide concentration, temperature, pH, water age, and chlorine dose. While several HAA compounds can form, five (5) are commonly found in treated drinking water:

- Monochloroacetic acid
- Monobromoacetic acid

- Dichloroacetic acid
- Trichloroacetic acid
- Dibromoacetic acid.

These compounds are collectively referred to as Total Haloacetic Acids (THAAs). In this report, THAAs refer to the average concentration of all five (5) compounds at each sampling site.

The GCDWQ MAC for HAAs is 0.08 mg/L (80 µg/L), also based on a locational running annual average of a minimum of quarterly samples taken in the distribution system. HAAs may enter water sources through agricultural runoff, industrial wastewater, or accidental spills.

Health Canada advises that water utilities should make every effort to maintain disinfection by-product concentrations as low as reasonably achievable, without compromising the effectiveness of disinfection.

GVW collects THM and HAA samples quarterly at eight (8) sample sites throughout the distribution. Conductivity measurements are also taken to identify the source water (Tables 12 and 13).

Duteau Creek Distribution System TTHMs

As noted in the Treatment Monitoring Program section, the DCWTP removes THM precursors such as organic carbons. This also reduces the chlorine demand and the colour of the water. As a result, the TTHMs have been reduced by almost 50% since the commissioning of the DCWTP in 2010. In 2024, the combined annual average of TTHMs was below the GCDWQ MAC of 100 µg/L (Figure 33).

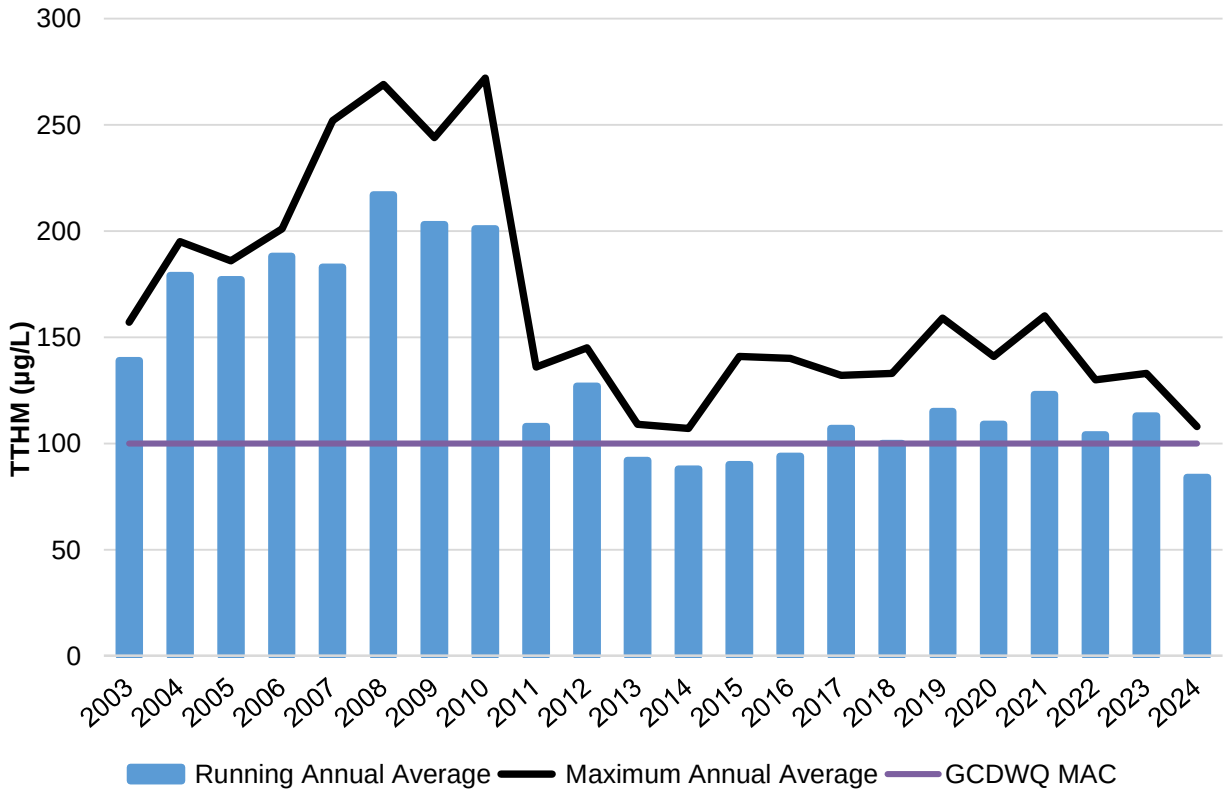


Figure 33: Combined annual average TTHMs in the Duteau Creek Distribution System from 2003 to 2024

Figure 34 shows the 2024 TTHMs for the Duteau Creek distribution system sampling sites. The annual average TTHM levels at all locations were below the GCDWQ MAC except for Golfview Place SS. Some of the sample sites were receiving Kalamalka Lake source water or a blend at the time of sampling, which may influence the TTHM concentration (Table 12). To address elevated TTHM levels, further improvements are being studied through chlorine management strategies within both the treatment process and the distribution system (looping, re-chlorination stations, reservoir management, and operational adjustments).

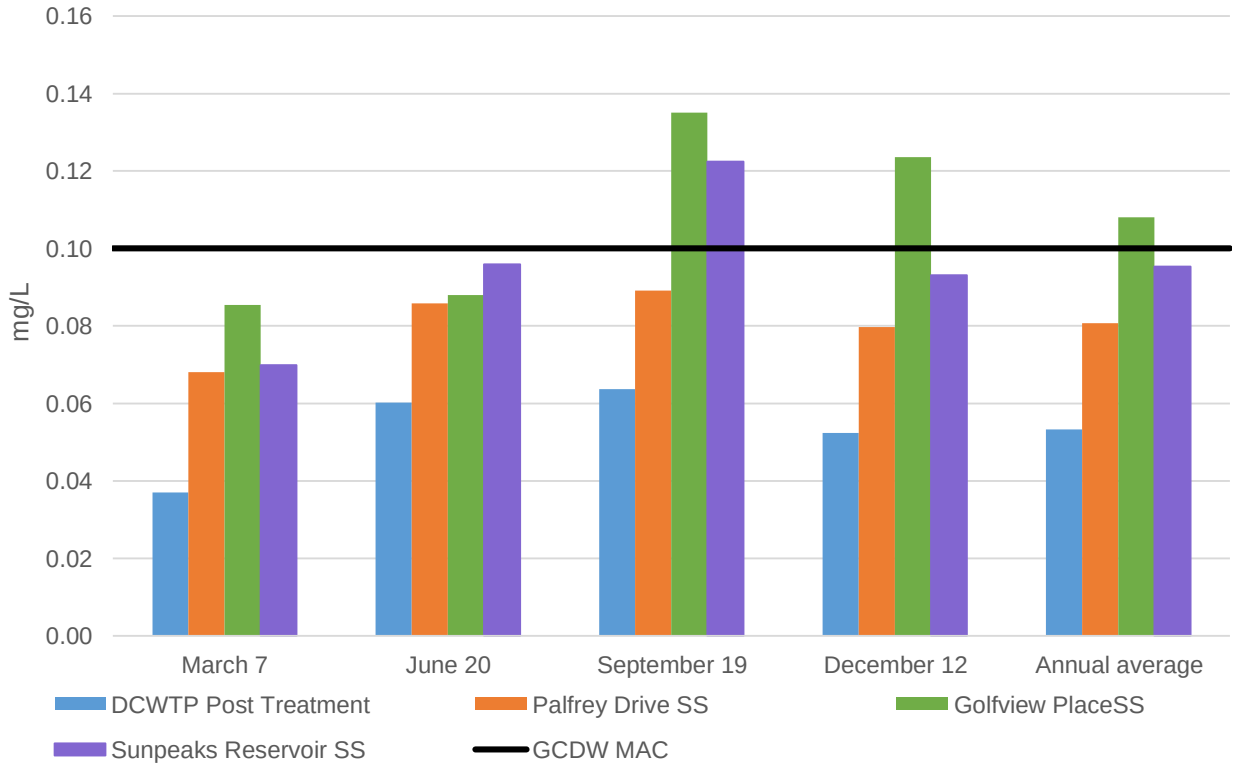


Figure 34: 2024 TTHMs in the Duteau Creek Distribution System

Table 12: Conductivity at Duteau Creek Distribution TTHM and THAA Sample Sites in 2024

Date	DCWTP Post Treatment	Palfrey Drive SS	Golfview Place SS	Sunpeaks Reservoir SS
March 7	121	123	250	440
June 20	114	119	311	393
September 19	105	109	137	225
December 12	99	104	123	120

Duteau Creek Distribution System THAAs

HAAs have been monitored since 2011 in the GVW water distribution system at the same locations as THM's. In 2024, the combined annual average of THAAs at the Duteau Creek distribution system sample sites was just above the GCDWQ MAC of 80 µg/L (Figure 35).

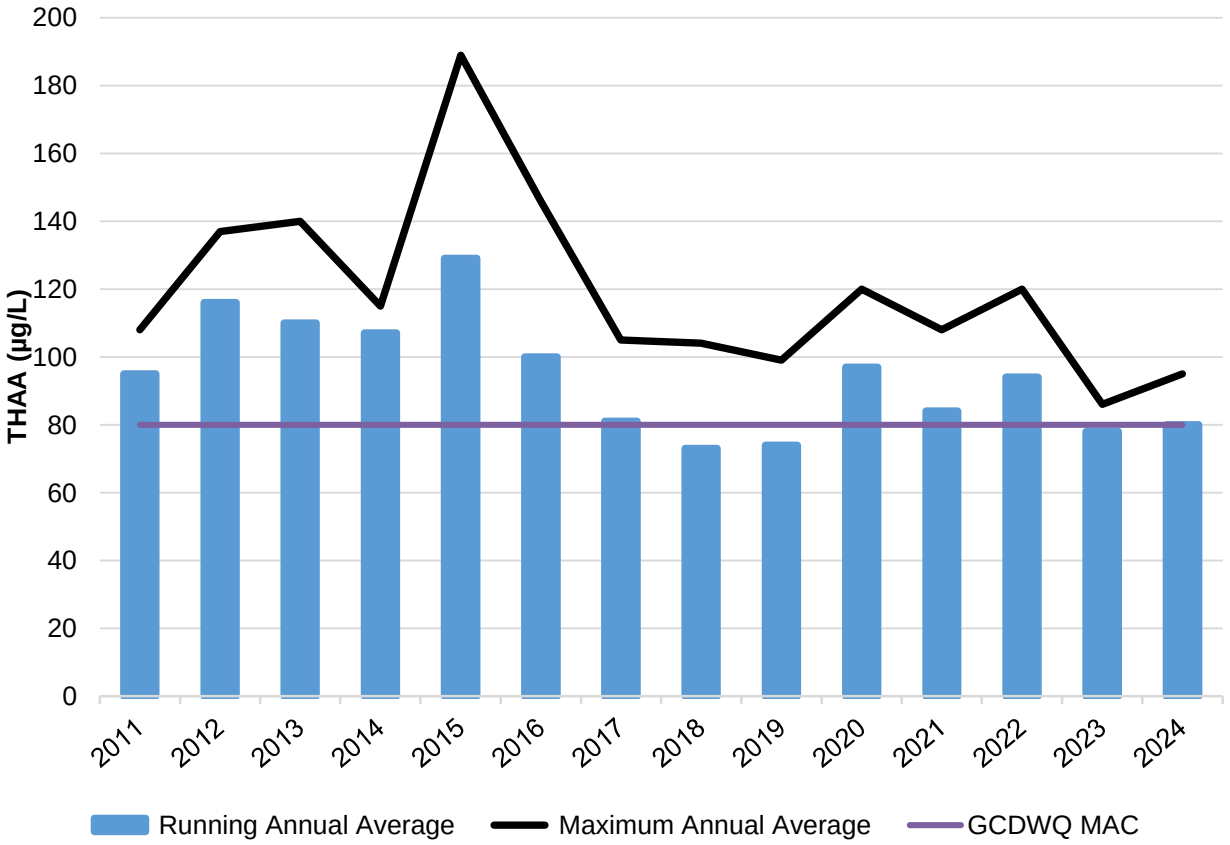


Figure 35: Combined annual average THAAs in the Duteau Creek Distribution System from 2011 to 2024

Figure 36 shows the 2024 THAAs for the Duteau Creek distribution system sample sites. The average annual THAAs for all sampling sites exceeded the GCDWQ MAC, except for the DCWTP sample site. Some of the sample sites were receiving Kalamalka Lake source water or a blend at the time of sampling, which may influence the THAA concentration (Table 12).

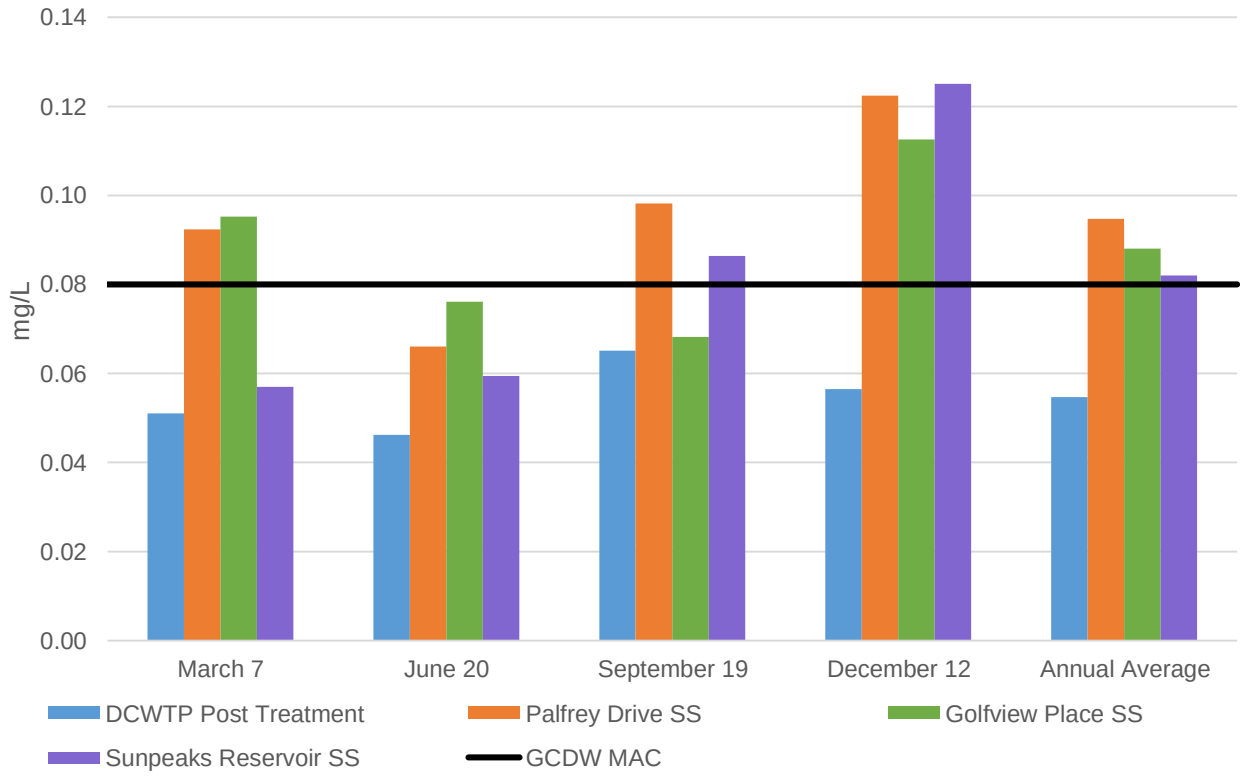


Figure 36: 2024 THAAs in the Duteau Creek Distribution System

Kalamalka Distribution System TTHMs

The Kalamalka Lake distribution system has been monitored for THMs since 2003. Unlike Duteau Creek, Kalamalka Lake has lower levels of disinfection by-product precursors, including little to no measurable colour and lower organic carbon levels throughout most of the year. The Kalamalka Lake distribution system has many pressure zones and a grid system with bidirectional flow to and from reservoirs, markedly different from the long, linear Duteau Creek distribution system.

In 2024, the Kalamalka distribution system combined annual average was below the GCDWQ MAC (Figure 37).

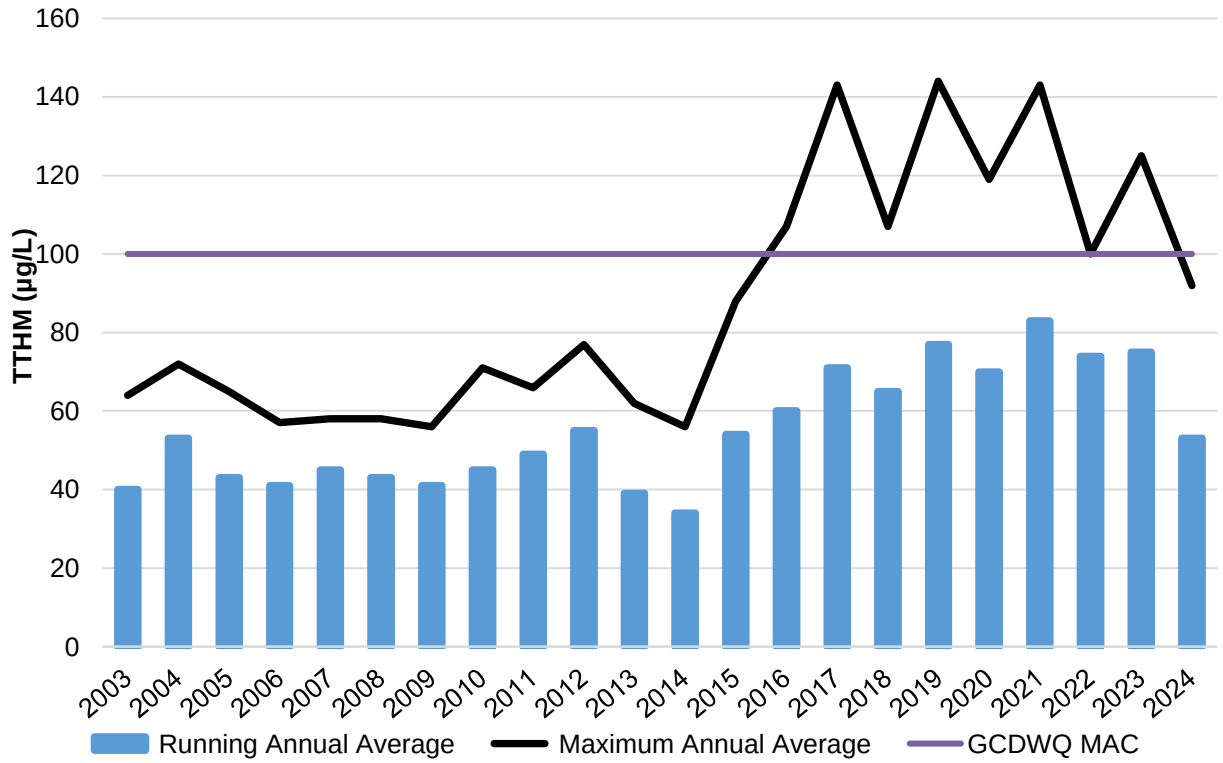


Figure 37: Combined annual average TTHMs in the Kalamalka Lake Distribution System from 2003 to 2024

Tavistock Reservoir and Longspoon Reservoir sample sites have the longest retention time and continue to have the highest THMs in the Kalamalka distribution system in 2024 (Figure 38). These sample sites have been close to or have exceeded the GCDWQ MAC for TTHMs for several years. This trend appears to coincide with the flood year of 2017 and, more recently may be influenced by elevated algae levels observed since 2020. Once the planned filtration plant at the MHWTP is completed, precursors for all disinfection byproducts should be reduced. All sample sites appear to have been receiving Kalamalka Lake source water at the time of sampling in 2024, based on the conductivity measured (Table 13).

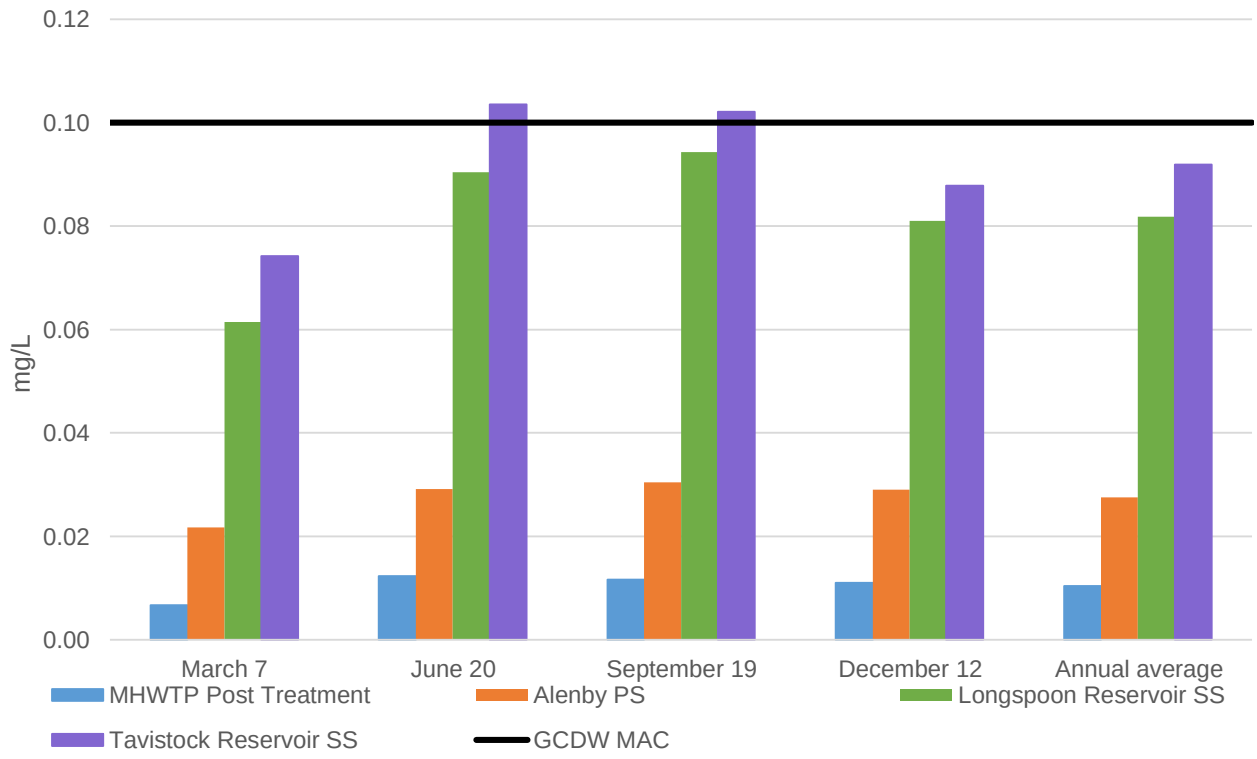


Figure 38: 2024 TTHMs in the Kalamalka Lake Distribution System

Table 13: Conductivity at Kalamalka Lake Distribution TTHM and THAA Sample Sites in 2024.

Date	MHWTP Post Treatment	Allenby PS	Longspoon Reservoir SS	Tavistock Reservoir SS
March 7	438	467	456	467
June 20	434	436	452	454
September 19	459	452	445	463
December 12	451	483	454	451

Kalamalka Lake Distribution System THAAs

In 2024, the combined annual average of THAAs at the Kalamalka Lake distribution system sample sites was below the GCDWQ MAC of 80 µg/L (Figure 39). This has been true since the start of THAA monitoring in 2011.

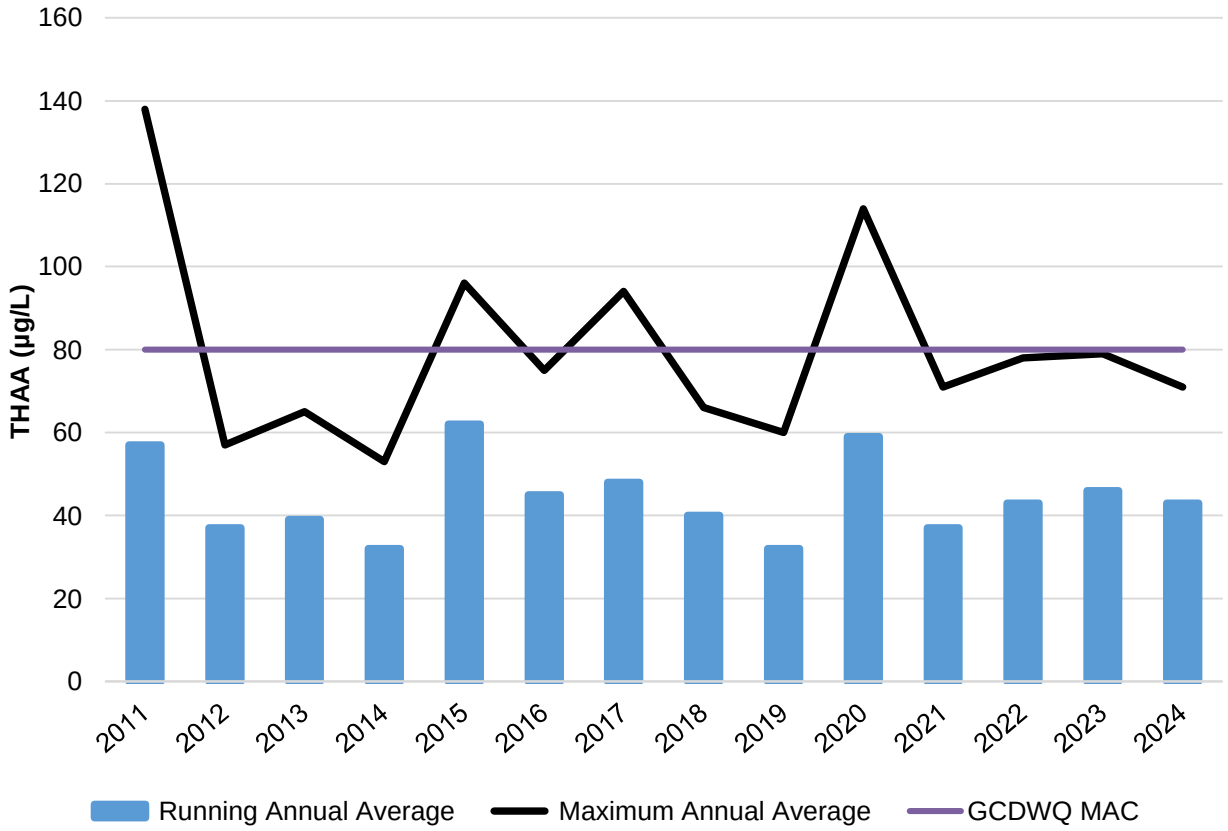


Figure 39: Combined annual average THAAs in the Kalamalka Lake Distribution System from 2011 to 2024

Figure 40 shows the 2024 THAAs for the Kalamalka Lake distribution system sample sites. As with TTHMs, the Tavistock Reservoir and Longspoon Reservoir sample sites consistently have the highest THAA concentrations throughout the year; however, all samples were below the GCDW MAC in 2024.

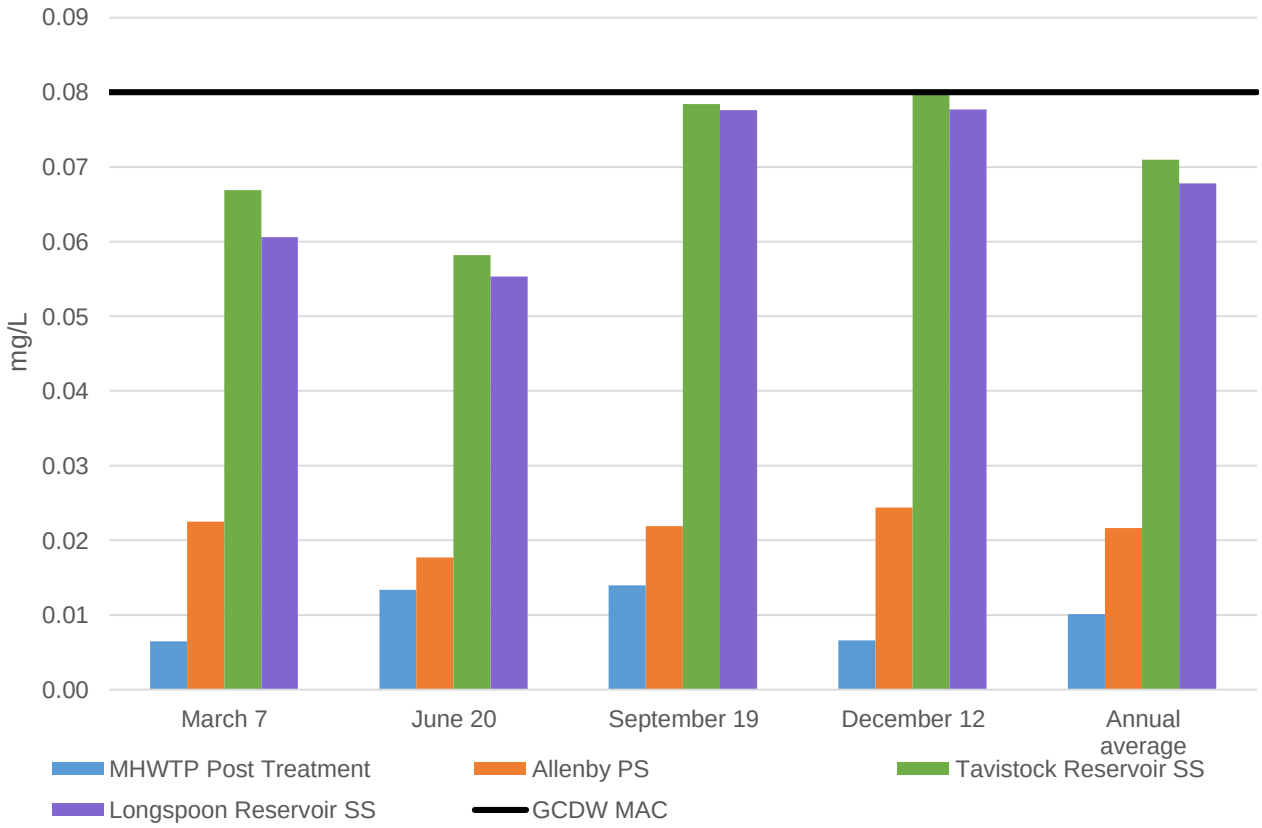


Figure 40: 2024 THAAs in the Kalamalka Lake Distribution System

Zinc Orthophosphate and Corrosion Control

Water sourced from Duteau Creek is considered corrosive due to the neutral to low pH, low alkalinity, and low hardness. This causes internal corrosion of metal pipes and creates a water quality issue by imparting a colour to the water, which is typically related to iron in the water. To mitigate corrosion within the distribution system, zinc orthophosphate (Zn O-PO4) is added to the Duteau Creek treated water as a corrosion inhibitor during low flows (typically from October / November to March / April). Zn O-PO4 minimizes the leaching of metals such as iron, lead, and copper from the distribution pipes and connections into the water. Additionally, caustic soda can be added at the DCWTP to adjust the pH. In 2024, the target pH for water leaving the DCWTP was 7.0 to 7.2.

Quality Assurance and Quality Control Program

To assess the quality of the sampling and analytical results, the RDNO carries out a comprehensive quality assurance and quality control program (QA / QC) as defined in the Water Quality Monitoring Program (Attachment A). The program ensures the quality of field samples, RDNO lab results, travel quality of samples, and accredited lab results.

Customer Calls and Response

In 2024, RDNO water quality staff responded to 66 customer calls: 26 general inquiries and 40 water quality investigations.

Customer general inquiries range from clarification regarding the source water they are on to questions about specific parameters within the water system.

Water quality investigations involved 16 reports of coloured or turbid water, 11 complaints regarding taste and odour, six (6) inquiries about clogged filters, six (6) inquiries about buildup of bacteria or calcium in toilets or faucets, and one (1) concern related to skin irritation.

Customers concerned with illness or skin irritation are recommended to consult a medical professional as treated drinking water commonly does not cause these issues.

Water quality investigations start with standard diagnostic questions for the customer to determine if the issue is internal (within the customer's property) or if further analysis is required.

After speaking with the customer, water quality staff communicates with the CoV and/or the DoC to determine if there are any water main breaks, flushing or maintenance work occurring within the area. Staff review maps which show the types of water mains and typical flows in the area, as well as historic water quality information for the area. Staff will proceed with collecting samples if needed. After the water is analysed, the results are reviewed, and further action is determined if necessary.

All water quality calls are tracked in an online database and summarized in monthly reports available on the RDNO website.

CROSS CONNECTION CONTROL PROGRAM

GVW has a Cross Connection Control (CCC) bylaw and program as required by the conditions on permit issued by IH since 2005. The CCC program is guided by the current bylaw: *Regional District of North Okanagan Cross Connection Control Regulation Bylaw No. 2651, 2014* and CSA Standard B64.10.

The CCC program uses FAST to track identified CCC risks in the system and, as of 2024, tracks 3,206 active devices at 2,210 facilities. The number of devices and facilities tracked has continually increased as properties are developed and risks are identified through surveys, as shown below in Figure 41.

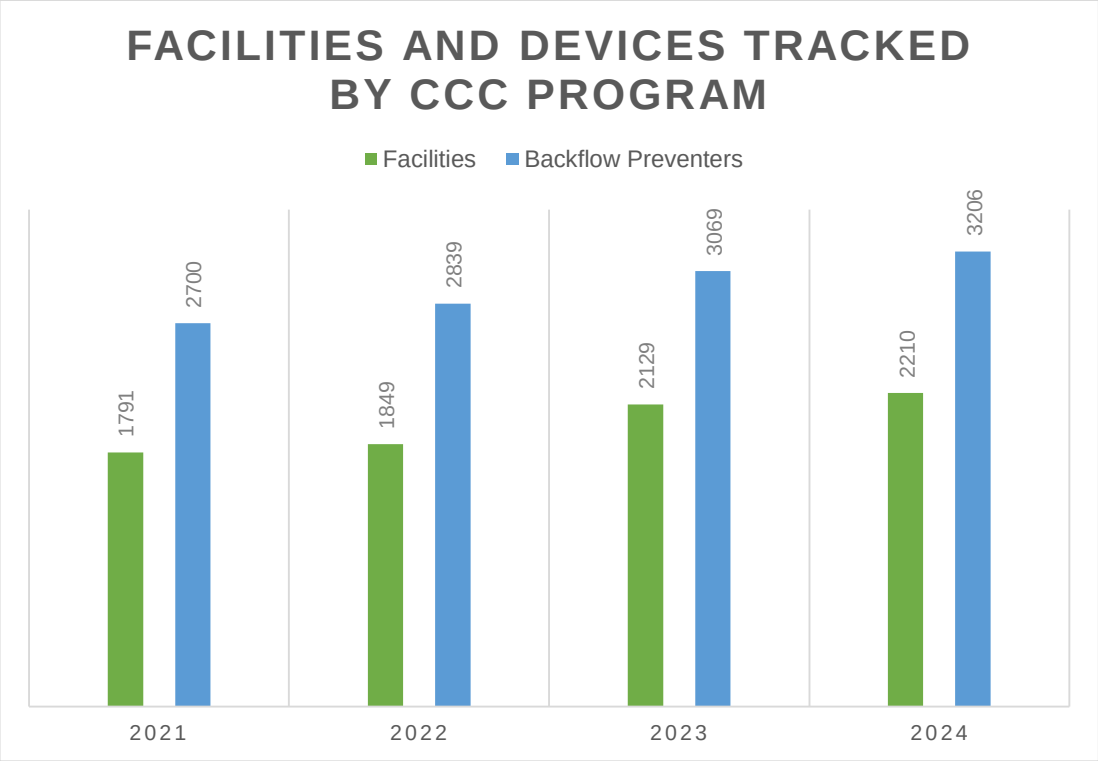


Figure 41: Number of facilities and devices tracked by the CCC Program in 2021, 2022, 2023 and 2024

Agricultural properties are considered high-risk and GVW requires all properties to have backflow prevention in place. Farmers have 45 days after turn-on to have their devices tested and submit a report to GVW, and if they don't, they are shut off. In 2024, 18 agricultural properties were not in compliance with the backflow preventer testing requirement and had their agricultural water service turned off until compliant as an enforcement action.

The FAST management system and tester portal was implemented in 2022. As of January 1, 2023, testers are now charged a fee to submit paper copies of tests, but no fee if they submit using the FAST portal. The move to the FAST tester submission portal has reduced follow-up with testers and staff time for data entry.

Beginning in late 2022, a contractor was retained to complete CCC surveys at properties that were identified as requiring assessment for cross connections. 22 CCC surveys were completed in 2024.

EMERGENCY RESPONSE / INCIDENTS / NOTIFICATION

Water Quality Notification and Communication

GVW has an Emergency Response Plan (ERP) which includes the GVW Water Quality Deviation Response Plan. These documents contain the contacts, criteria, and procedures necessary to assist operators and staff to make timely, informed decisions in the event of water quality changes or emergencies. GVW requires all CoV and DoC operators to attend an annual training session where these documents are discussed. The GVW ERP is reviewed and updated annually and provided to IH, CoV and DoC operators.

GVW must inform customers when there is a change in drinking water quality or service. Most notices are precautionary or related to a change in the water, which may be of interest to some consumers. A Water Quality Advisory (WQA) is issued when a public health threat from the water supply system is higher than considered normally acceptable, but not serious enough to warrant (or will not be resolved by) a Boil Water Notice (BWN). A BWN is issued when testing reveals a contaminant such as *E.coli* or other coliform organisms in the water supply system, and/or the system fails to meet drinking water treatment objectives, and the associated public health threat can be effectively addressed by boiling the water. Notices describe the purpose, provide actions that can be taken to reduce risks, and alert customers of system changes.

Most water utilities frequently experience minor disruptions. Pipes break, valves seize, hydrants leak, and power outages occur. Although these are not anticipated, the problems experienced can usually be corrected with minimal disruption, and regular service can be restored quickly. As of 2024, GVW is required to issue a WQA or BWN to all affected customers of a water system disruption that results in a loss of pressure. The level of notification required depends on several factors, including the size of the affected area, the duration of depressurization, and potential risk of contamination. As a result of this change, the number of notifications to customers has increased.

In cases of water main breaks, GVW adheres to the procedures set out in the American Water Works Association (AWWA) Standard C651-14 regarding water main chlorination prior to re-commissioning of the main.

In 2024, GVW issued a total of 63 public notices to customers, summarized in Table 14.

Table 14: Summary of Customer Notification in 2024

Number of Notices	Type of Notice
16	Boil Water Notice (BWN)
26	Water Quality Advisory (WQA)
18	Service Interruption
2	Water Source Change
1	Water Reduction Request

An advisory or notice is provided to customers as quickly and efficiently as possible. Notification may include media releases, email to subscribers, social media, road signs, radio, and/or newspaper ads. Under specific circumstances, notifications are hand-delivered.

If customers are interested in getting more timely notices, it's advised they subscribe to the RDNO mailing list to receive notifications for their area.

AVAILABLE DOCUMENTS AND REPORTS

The following supporting documents and reports are available on the RDNO website or are available upon request:

- Monthly Water Quality Reports
- Comprehensive Water Quality Analysis Results
- Current Water Supply Reports
- Greater Vernon Water 2017 Master Water Plan
- Greater Vernon Water 2024 Water Shortage Management Plan
- 2014 Duteau Creek Watershed Assessment Response Plan
- DCWARP 2024 – 2029 Action Plan
- Larratt Aquatic Consulting 2024 Kalamalka Wood Lake Water Quality Study, Microflora, Water Chemistry and Thermal Profiles

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APPENDIX

Table 1: RDNO Utilities Department

RDNO Utilities	
Zee Marcolin, P.Eng	General Manager, Utilities
John Lord, P.Eng	Manager, Water Distribution
Sandy Edwards, AScT	Manager, Projects
Tricia Brett, P.Ag	Manager, Water Quality
Amanda Summerfelt	Water Efficiency Coordinator
Connie Hewitt, AScT	Water Quality Technologist
Jamie Ferris	Water Quality Technician
Chris Cannon	Water Quality Technician
Alec Busby, EIT	Assistant Utilities Engineer
Mike Philips, AScT	Engineering Technologist/Bylaw Officer
Skyler Ganz, AScT	Engineering Technologist
Kimberley Berndt	Engineering Technician
Keiko Parker, AScT	Manager, Small Utilities
Nathan Betz	Cross Connection Control Officer
Jonathan McLuskie	Utilities Quality Assurance Inspector

Table 2: RDNO Water Treatment Operators

RDNO Operators			
Last Name	**First Name**	**Certification #**	**Certification Held**
Heidt	Dustin	4498	WDIII, WTIV
McGaw	Becky	9086	WTIII
Tucker	Chris	6489	WTIII, WTIV, WDII
Lockwood	Ryan	1000755	WTII, WDI
Cimon	Caroline	1001075	WTII, WWTII
Beckett	Jemma	1001610	WTII
Radu	David	1002040	WTII
Saric	Jozo		WTI
Schwartz	Johnathan		WTI
Hartwig	Corey	9378	WTI, Electrical Instrumentation Technician
Schepers	Aaron		Electrical Instrumentation Technician

Table 3: CoV Water Distribution Operators

City of Vernon Operators			
Last Name	**First Name**	**Certification #**	**Certification Held**
Austin	Mercedes	1001060	WD I, WWC I
Bouchard	Marty	1000696	WD I, WWC II
Becraft	Spencer	1001538	WD 1, WWC I
Briggs	Geordie	6495	WD III, WWC II
Browne	Ryan	8176	WD III, WWC II
Callbeck	Brad	1001930	WWC I
Cleverley	Curt	7193	WD III, WWC I
Cruz	Edwin	1001325	WD II, WWC I
Dobson	Scott	1000438	WD II, WWC II
Gaythorpe	Glen	7271	WD III, WWC II, SCS1
Gibbins	Richard		
Greenan	Craig	1001795	WWC I
Holloway	Ryan	8876	WD II, WWC I
Holtz	Collin	9158	WD I, WWC II, WWC I
Irwin	Sean	8610	WD II, WWC II
Jacob	Mason	1000333	WD I, WWC I
Johannson	Iain	9427	WD II, WWC I
Knight	Jessie	1000335	WD II, WWC I
Lochhead	Chuck	1002120	WD II, WD 1
Martin	Derek	1001431	WD I, WWC I
Novakowski	Dan	1001106	WD II, WWC I
Parker	Ryan	6988	WD IV, WWC II, CH
Pope	Carson	8840	WWC I
Price	Eric	9215	WD II, WWC I
Rempel	Chris	7192	WD I, WWC I
Rennie	DYLAN	1000532	WD I, WWC I
Roberts	Alex	1001050	WD I, WWC I
Rowan	Jared	1001263	WD II, WWC I
Stowards	Blaine	8247	WD II, WWC II
Vandermeer	Ray	5742	WD II, WWC II, WWT OIT

Table 4: DoC Water Distribution Operators

District of Coldstream Operators			
Last Name	**First Name**	**Certification #**	**Certification Held**
Comeau	Brent	5662	WDII, WWCII
Davyduke	Matt	7160	WDII, WWCI
Lerbeck	Ron	9379	WDI
Mazereeuw	Jack	5747	WDII, WWCII, SWS
McKay	Gordon	3471	WDI
Nicholson	Cory	7053	WDI
Scherck	James	7776	WDII, WWCI
Webster	Jason	1000440	WDI

ATTACHMENTS

Attachment A: GVW 2024 Water Quality Monitoring Program

Attachment B: GVW Water Quality Deviation Response Plan

Attachment A: GVW 2024 Water Quality Monitoring Program

2024

Greater Vernon Water
Water Quality Monitoring Program

Prepared for: Interior Health

Regional District of North Okanagan

9848 Aberdeen Road, Coldstream, BC

1/25/2024

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1. INTRODUCTION

1.1 Acronyms and Definitions

Aesthetic Objectives (AO) – Guidelines for Canadian Drinking Water Quality (GCDWQ) applies these objectives to different substances in water that may affect the acceptance by the customer.

CARO - a full service environmental laboratory that provides analytical services.

Accredited Lab – a lab with formal recognition by an authoritative body and the Provincial Health Officer of the competence to work to specified standards.

Colilert™ - a product used to detect total coliforms and *E.coli* in water. It is based on IDEXX's patented Defined Substrate Technology (DST). When total coliforms metabolize Colilert's nutrient-indicator, ONPG, the sample turns yellow. When *E.coli* metabolize Colilert's nutrient-indicator MUG, which fluoresces when exposed to UV light.

CoV – City of Vernon.

DAF – Dissolved Air Floatation.

DCWTP – Duteau Creek Water Treatment Plant.

DoC – District of Coldstream.

DWPA – *Drinking Water Protection Act*.

DWPR – *Drinking Water Protection Regulation*.

DWTP - Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies

E.coli – *Escherichia coli* is a gram negative rod of the family Enterobacteriaceae. Most strains of *E.coli* do not produce debilitating toxins but there are a few strains that do, one being the *E.coli* O157:H7 strain.

ENKI – internet based data software system with centralized information management.

ERA – Environmental Resource Associates – company who provides Certified Reference Materials (CRMs) and Proficiency Testing (PT) products.

GCDWQ – Guidelines for Canadian Drinking Water Quality.

GVW – Greater Vernon Water.

HPC – Heterotrophic Plate Count.

IMAC – Interim Maximum Concentrations – GCDWQ has established these concentrations which estimates lifetime risks of cancer associated with the guideline.

MAC – Maximum Acceptable Concentrations – GCDWQ has established these concentrations for different substances which may have adverse effects on health.

MF – Membrane Filtration – testing method that theoretically detects a single bacterium in a 100/mL sample.

MHWTP – Mission Hill Water Treatment Plant.

MPN – Most Probable Number– quantification of coliforms and *E.coli*.

PHO – Provincial Health Officer.

Quanti-Tray® Enumeration Procedure – used to numerate Colilert™ procedures by counting the number of positive wells and referring to the MPN table.

RDNO – Regional District of North Okanagan.

RPD - Relative Percent Difference.

SCADA – Supervisory Control and Data Acquisition – is a system for remote monitoring and control that operates with coded signals over communication channels.

Source Water – untreated water before treatment or disinfection.

TC – Total Coliform group is a gram negative, non-spore forming rod-shaped bacteria. A group of specific bacteria called indicator bacteria which indicate a probable presence of pathogenic bacteria.

UV – Ultraviolet.

Water Distribution System – RDNO owned and administrated by GVW. The operations and maintenance is contracted to the CoV and DoC.

1.2 Background

As guidance for the Greater Vernon Water (GVW) Water Quality (WQ) Monitoring Program, the Guidelines for Canadian Drinking Water Quality (GCDWQ), the British Columbia *Drinking Water Protection Act and Regulation* (DWPA and DWPR) and the Drinking Water Treatment Objectives (Microbiological) for Surface Water Supplies (DWTO); have been drawn on to develop this "Monitoring Program". The program is designed to monitor water at the source, treatment plants and the distribution system for variations and trending.

GVW uses the multi-barrier approach in the monitoring program. Staff monitor the source water in the watersheds, at the intakes and the wellheads before treatment or disinfection. GVW has two surface water sources used for domestic purposes, two surface water sources and two groundwater wells used for agriculture purposes and two groundwater wells that may be used as an emergency backup. The source water monitoring is discussed in section 2.

The treatment facilities are monitored by the Regional District of North Okanagan (RDNO) operators and WQ staff. The treatment monitoring is discussed in section 3.

The transmission and distribution system incorporates certified operators from the City of Vernon (CoV), District of Coldstream (DoC), and WQ staff to sample at designated sample sites. WQ staff sample for disinfection by-products quarterly and comprehensive analysis bi-annually. During normal operations, there are two potable water systems (Duteau Creek and Kalamalka Lake). The distribution monitoring is discussed in in section 4. The system has multiple interconnections within the distribution that are used when necessary. Either Duteau Creek or Kalamalka Lake can provide water to the whole water system

There are three irrigation systems; Goose Lake, Deer Creek (King Edward Lake) and untreated Duteau Creek water. These systems have limited monitoring, discussed in section 2.

1.3 Quality Assurance and Quality Control Program

To ensure good data is collected, a sampling program should include a Quality Assurance (QA) plan. QA is a system of activities designed to make sure the data meets defined standards of quality. It pertains to the overall management of the sampling program, and includes; planning, documentation, training, consistency in collecting and handling samples and analysis, validation and reporting. An important part of QA is *Quality Control* (QC). QC refers to the technical activities used to reduce errors throughout the sampling program. These activities measure the performance of a process against defined standards to verify the data meets the expected quality. Errors can occur in the field, laboratory or while handling the data. QC should include both internal and external measures. Internal QC is a set of measures undertaken by the project's own samplers and analysts. External QC involves people and laboratories outside of the project utility (USEPA 1996).

The following steps have been employed by GVW to ensure reliable information from the WQ Monitoring Program:

1. As directed in the *DWPA and DWPR,* a water supplier is required to have their bacteriological analysis completed by a certified laboratory approved by the Provincial Health Officer (PHO). GVW uses CARO Analytical Services (CARO) to analyze bacteriological samples plus a multitude of other parameters.

2. Due to the nature of the water system there are a number of operators taking WQ samples and performing field measurements. Training through GVW for WQ sampling and emergency response is provided annually to operators to ensure collection and responses are correct. This refresher is used to reduce errors in the sampling program.

3. To assess the quality of the sampling and analytical results, field duplicates are analyzed for the program at a rate of approximately 10% of the total number of samples collected. A duplicate sample is defined as a field sample of water collected from the same location, split into two equal parts, and submitted to the analytical laboratory under a separate label so the laboratory has no knowledge of the samples site location. The collection and analysis of the duplicate samples provide information on the combined (field and analytical) precision of the sampling and analytical program. The individual analytical results in each of the samples of the duplicate pair are compared and the Relative Percent Difference (RPD) is calculated for each analyte pair. RPDs are calculated using the following formula, where *"a" a*nd *"b"* are duplicate pair values in identical units.

$$RPD = \left(\frac{(a-b)}{\left(\frac{a+b}{2}\right)} \right) \times 100$$

4. A RPD of 30% or less is generally considered acceptable while a RPD of greater than 30% may indicate a problem in either sampling or analysis (MoE 1998b). This limit may vary somewhat depending on the analysis involved and the concentration of the analyte.

5. The RPD also tends to increase as the result approaches the detection limit. Therefore, use of this threshold is restricted to values five times over their detection limit.

In 2024, GVW WQ staff will take 4 field blanks, 4 travel blanks and 50 duplicate samples. Three sample sites have been selected for field blanks which including a water watershed, a source and a treatment facility. Duplicates will be taken within the Duteau Creek watershed, on Coldstream Creek, water sources, and treatment facilities. DoC and CoV operators will take duplicates weekly at distribution sites.

Field instruments, including handheld conductivity and pH meters, turbidimeters and colorimeters are brought to the RDNO laboratory for regular maintenance. Handheld conductivity and pH meters are scheduled once a month, turbidimeters are scheduled once every three months. Colorimeters are brought in annually for a secondary check. Operators have been instructed to calibrate pH and conductivity meters before each sampling routine.

In addition to the samples sent to an external lab, the RDNO laboratory uses the Quanti-Tray® Enumeration Procedure to perform Most Probable Number (MPN) for Total Coliform and *E.coli.* These analyses are used to supplement the program. There is a QC procedure for these tests. This is completed by running IDEXX-QC test weekly when samples are analyzed. The IDEXX-QC meets standards for maintaining accreditation. This is completed by running three sterile vessels with:

- *Escherichia coli*,
- *Klebsiella variicola*, and
- *Pseudomonas aeruginosa*.

All samples are collected and shipped in accordance with the 2005 21st Edition Standard Methods for the Examination of Water and Wastewater (APHA, AWWA, and WEF). A sample confirmation or requisition and chain of custody form accompany all samples sent to an accredited laboratory.

GVW WQ staff have developed laboratory procedures that are updated when required.

2. SOURCE WATER

2.1 Source WQ Monitoring

Source WQ monitoring is designed to compare source water with guidelines, criteria and regulations that have been set for both health and aesthetic reasons. It is also designed to observe seasonal trends that may affect treatment and chlorine demand, and to monitor for potential threats from watershed land use practices. It is an important component of the multi-barrier approach and drinking water management.

It is important for monitoring programs to be as comprehensive as possible. (Source to Tap: Guidance on the Multi-Barrier Approach to Safe Drinking Water; Canadian Council of Ministers of the Environment, 2004).

Parameters include; turbidity, temperature, pH, conductivity, and bacteria (Total Coliform and *E.coli*). Some of these parameters are also incorporated in the "GVW Water Quality Deviation Response and Notification Program". Source monitoring includes the Duteau Creek Watershed and the Kalamalka Lake / Coldstream Creek Watershed. The results are reported as part of the GVW Annual Report, source WQ information and watershed response plans.

GVW is committed to long-term monitoring for all sources.

2.2 Sampling Locations

GVW uses two surface water intakes for domestic/potable purposes; Kalamalka Lake and Duteau Creek which are routinely monitored. Two groundwater sources are available for emergency purposes; Coldstream Ranch Well 3 and Antwerp Springs PH 2, which are monitored before and when in use. A comprehensive water analysis is completed annually on Kalamalka Lake and Duteau Creek.

Non-potable water sources; Deer Creek (King Edward), Coldstream Ranch Well 2, Goose Lake, and untreated Duteau Creek are separated from the domestic water system and are used for irrigation water only. The following tables outline the sources, sampling point location and a descriptor of the site. Sampling location maps are located in Appendix A.

The irrigation sites are not monitored extensively, with the exception of Goose Lake. Goose Lake is monitored weekly during the irrigation season due to the chemistry of the lake. A comprehensive water analysis is completed every 5 years on Coldstream Ranch Well 2, Coldstream Ranch Well 3, Goose Lake Intake and Deer Creek Intake Pond.

Table 1 Domestic Potable Water Sources – Raw Water (untreated)

Intake / Source Year Round	Location	Sample Site Comment
Kalamalka Lake Intake	*13204 West Kal Road, Coldstream*	Sample station is located outside on the south side of the Kalamalka Pump Station (PS)
Duteau Creek Intake	*95 Lewis Road, RDNO, Electoral Area "D"*	Sample site inside building at Duteau Creek Intake
Antwerp Springs PH 2	*6282 Highway 6, Coldstream*	Pre-chlorination (emergency Well only)
Coldstream Ranch Well 3	Well located on Coldstream Ranch	Pre-chlorination (emergency Well only)

★ An annual sampling program for Kalamalka Lake is completed by Larratt Aquatic Consulting.

Table 2 Duteau Creek Watershed Sample Sites

Duteau Creek Watershed	Sample Site Comment
Haddo Weir	Sample on south side of weir. Outflow of Haddo Lake
Duteau Creek Bridge	Downstream of bridge at 12km on Haddo main
16 km Aberdeen Road Tributary	Off Aberdeen main – used to monitor impacts of increasing logging in Flyfish subbasin
18 km Aberdeen Road Tributary	Aberdeen main – downstream of culvert – Flyfish Creek

Table 3 Kalamalka Lake Watershed Sample Sites

Kalamalka Lake Watershed★ Coldstream Creek	Sample Site Comment
Coldstream Creek at Howe Drive	Downstream of the bridge
Coldstream Creek at Kirkland Drive	Upstream of the bridge
Coldstream Creek at Brewer Road	Downstream of bridge and the culvert
Coldstream Creek at School Road	Downstream of the bridge

Table 4 Irrigation Water Sources - Watershed and Sample Stations

Intake / Watershed Irrigation	Sample Site Comment
Deer Creek Intake Pond	Intake pond
King Edward Outflow	Dam structure outlet
Coldstream Ranch Well 3	Well located on Coldstream Ranch
Coldstream Ranch Well 2	Well located on Coldstream Ranch
Goose Lake Intake	Raw water copper line at intake building

2.3 Source Monitoring Schedule and Parameters

Samples for source water are collected weekly. The 2024 sampling schedule for chemical and physical parameters is outlined in Appendix B. The analysis is completed in the field, at the RDNO laboratory and at CARO Analytical Services. Further information on some WQ parameters in the following sections.

2.3.1 Bacteriological

Samples of untreated water for domestic/potable purposes are collected weekly at water supply intakes and analyzed for Total Coliform and *E.coli*. Iron related bacteria and Sulfate reducing bacteria are collected monthly at Kalamalka Lake intake and annually at Coldstream Ranch Well 3 or before being brought online and after any operational maintenance work as an indicator of microbial changes in the aquifer.

Bacterial levels at the source are indicators of contamination. Historical data has assisted in developing trends for each source and therefore a deviation from “normal” initiates a response.

The response includes a second bacterial sample for confirmation, a site visit to investigate and possibly determine the contamination source. *E.coli* levels that rise above and remain high over an extended period of time will undergo further evaluation.

2.3.2 Adenosine Triphosphate

Adenosine Triphosphate (ATP) measures the biological activity within the water. There are two types of ATP, intracellular and extracellular. Extracellular ATP is outside of the cell which is released from dead or stressed microorganisms, while intracellular ATP is contained within the living cell. The ATP tests used, measure *free* ATP, which is also referred to as *extracellular* ATP and *total* ATP, which is the sum of *free* ATP and intracellular ATP.

Untreated water for domestic/potable purposes are tested for Adenosine Triphosphate (ATP) weekly at water supply intakes.

Table 5 Adenosine Triphosphate Sample Sites

Sample Sites	Type	Frequency
Kalamalka Lake Intake	source water	weekly
Duteau Creek Intake	source water	weekly

2.3.3 Turbidity

Kalamalka Lake Intake and Duteau Creek Intake, have online turbidimeters and are monitored by SCADA. Operations have a maintenance schedule for all online analyzers.

The turbidity is reported from the Mission Hill Water Treatment Plant (MHWTP) before chlorination and Ultraviolet (UV) disinfection and at the Duteau Creek Water Treatment Plant (DCWTP) after the Dissolved Air Floatation (DAF), chlorination and UV disinfection. The provincial guidance “Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water, April 2013” and the “GVW Water Quality Deviation Response and Notification Plan” which provides details on turbidity events and/or trigger levels used for response and notification.

2.3.4 Chemical, Biological and Physical

Comprehensive samples are taken annually for each water source as well as at two distribution sites; Allenby PS for the Kalamalka distribution and PRV 2 for the Duteau Creek distribution. Allenby PS and PRV 2 are completed biannually to identify seasonal changes in flow and quality. The comprehensive list of parameters is outlined below.

Table 6 Comprehensive Water Analysis

Parameters		
Alkalinity (Total)	Cyanide (Total)	Selenium (Total)
Aluminum (Dissolved)[1]	Dissolved Solids (Total)	Sodium (Total)
Aluminum (Total)	Fluoride	Strontium (Total)
Antimony (Total)	Hardness (Total)	Sulfate
Arsenic (Total)	Iron (Total)	Turbidity
Barium (Total)	Lead (Total)	Temperature
Boron (Total)	Magnesium (Total)	Uranium (Total)
Cadmium (Total)	Manganese (Total)	Zinc (Total)
Calcium (Total)	Mercury (Total)	Dissolved Organic Carbon*
Chloride	Molybdenum (Total)	UV_{254}*
Chromium (Total)	Nickel (Total)	Phosphorus (Total)*
Cobalt (Total)	Nitrate	Total Dissolved Phosphorous*
Color (True)	Nitrite	Total Kjeldahl Nitrogen*
Conductance @ 25 C	pH	Total Organic Carbon*
Copper (Total)	Potassium (Total)	Chlorophyll a*

[1] The Duteau Creek source.
* Sampled at surface water sources only.

Parameters checked routinely at surface sources are in Appendix B with more detail below:

- ***Total Organic and Dissolved Organic Carbon*** relate to Trihalomethane's production and UV disinfection effectiveness. Organic loading is also an indicator of pollutants in the water.

- ***Aluminum*** is monitored at the Duteau Creek source as the natural level is part of the cumulative value after treatment (Poly-Aluminum-Chloride, the flocculants used in the treatment process) in the Duteau Creek system.

- ***Chlorophyll a, Algae density, Total Phosphorous, Total Nitrogen*** is monitored at sources during the "growing" season, algae growth period and during lake turnovers (fall and spring).

- ***Total Phosphorous, Total Nitrogen and Ammonia*** are monitored at the Coldstream Creek locations monthly with increased monitoring during early snow melt, freshet, and flooding. Phosphorous and ammonia loading is an indicator of fertilizers and biological degradation.

- ***Herbicides, pesticides and fuel scans*** are completed every two years for the Kalamalka Lake Intake (scheduled for 2023). E very five years for the groundwater wells: Coldstream Ranch Well 2 and 3, and Antwerp Springs PH 2 (scheduled for 2023).

- **Volatile Organic Compounds (VOC)** are scheduled annually for the Kalamalka Lake Intake.

An emergency sampling kit is available in the RDNO laboratory to be used in the case of a spill, possible cross connection or other emergency testing.

3. TREATMENT AND DISINFECTION FACILITIES

3.1 DCWTP

The DCWTP has flocculation, DAF, chlorine (generated on site) and UV treatment. The DCWTP operators complete the following sampling and analysis:

Table 7 DCWTP Samples and Analysis

Raw	Online – Real Time	Grab Sample Frequency
Turbidity	Online	Daily
Temperature	Online	Daily
pH	Online	Daily
Conductivity	Online	Daily
Alkalinity	N/A	Daily
True Color	N/A	Daily
Apparent Color	N/A	Daily
Dissolved Organic Carbon	Online	N/A
Total Aluminum	N/A	Weekly
Mid-Process	Online – Real Time	Grab Sample Frequency
pH - each train	Online	Monday, Wednesday, Friday
Streaming Current - each train	Online	N/A
Turbidity - each DAF	Online	Daily
DAF Effluent	Online – Real Time	Grab Sample Frequency
Turbidity	Online	Daily
Alkalinity	N/A	Daily
Dissolved Aluminum	N/A	Tuesday, Friday
True Colour	N/A	Daily
UVT	Online	Daily
Pre-UV (Reservoir Outlet)	Online - Real Time	Grab Sample Frequency
Free Chlorine residual	Online	Daily
UVT (2)	Online	Daily
pH	Online	Daily
Post-UV	Online - Real Time	Grab Sample Frequency
Free Chlorine residual	Online	Daily
Alkalinity	N/A	Monday, Wednesday, Friday
Reactive phosphate[1]	N/A	Monday, Wednesday, Friday
Post-UV	Online - Real Time	Grab Sample Frequency
Temperature	N/A	Daily
pH	N/A	Daily
Turbidity	Online	Daily

[1]Reactive phosphate is analyzed from September through April.

WQ staff will also sample and analyze bacteria and conductivity at the UV outlet.

The monthly and quarterly sampling schedules are outlined in the Appendices. The Chlorine Contact Time (CT) is applied at the DCWTP reservoir and dosage can be adjusted if required. Bacteria samples are taken after contact time which are analyzed at: CARO and the RDNO Lab.

3.2 MHWTP

The MHWTP consists of UV disinfection and chlorination generated on site.

Table 8 MHWTP Samples and Analysis

MHWTP	Online – Real Time	Grab Sample Frequency (excluding holidays)
Free Chlorine residual (before contact chamber)	Online	Monday to Friday
Free Chlorine residual (after contact chamber)	Online	Monday to Friday
Turbidity	Online	Monday to Friday
UVT	Online	Monday to Friday
Conductivity	Online	Monday to Friday
Temperature	Online	Monday to Friday
pH	Online	Monday to Friday
Total Organic Carbon	Online (calculated number using UV254)	N/A
MHWTP	**Grab Samples**	**Grab Sample Frequency (excluding holidays)**
Conductivity	Grab Sample	Monday to Friday
Temperature	Grab Sample	Monday to Friday

A chlorine residual analyzer monitors free chlorine levels after 20 minutes of contact time. The UVT is monitored online before the reactors. Both instruments are alarmed for low levels.

WQ staff will also sample at the point where chlorine contact time should be achieved.

The sampling schedules are outlined in the Appendices. Bacteria samples are taken after contact time which are analyzed at: CARO and the RDNO Lab.

3.3 Coldstream Ranch Well 3, Antwerp Springs PH 2

Coldstream Ranch Well 3 and Antwerp Springs PH 2 are both chlorinated when used as an emergency potable source. Both are equipped with chlorine residual analyzers and turbidity meters tracked through SCADA.

4. TRANSMISSION / DISTRIBUTION SYSTEM

4.1 Distribution WQ Monitoring

This portion of the WQ program is designed to meet the community water system regulations prescribed by the *DWPA and DWPR,* Schedules A and B. Supporting this design is also in the *Canadian Drinking Water Guidelines* which provide levels set for health reasons, Maximum Acceptable Concentrations (MAC), aesthetic values and Aesthetic Objectives (AO). Other parameters may be monitored if they are known to create problems within water distribution systems.

4.2 Sampling Stations – Type, Location and Number

GVW has a long and somewhat complex distribution system. Sample sites (as per DWPA and the DWO Guidebook 2022) testing must include representative samples within a distribution system.

Type - the locations for distribution sampling have been determined by the Manager, WQ, GVW staff operations, and IH. The monitoring regime is designed to capture the changes in WQ as it flows through the pipeline (i.e. flow patterns in the water distribution system). The site locations are broken down into flow ratings of high, medium and low or dead ends. The ideal combination is:

- 10% high flows/ main transmission/ Entry Point (H or EP),
- 40% medium flow (M),
- 40% low flow (L), and
- 10% dead-ends, un-looped lines and stagnant areas (DE).

The following is based under normal operations, as operational changes are often required at times. After the annual review of the sampling sites, each water system is broken down as follows:

Duteau Creek supplied system has a total of 41 sample sites:

- 12 % (5 sites) high flows/ main transmission/ entry point,
- 32% (13 sites) medium flow,
- 34 % (14 sites) low flow, and
- 22 % (9 sites) dead-ends, un-looped lines and stagnant areas.

Kalamalka Lake supplied system has a total of 33 sites:

- 9 % (3 Sites) high flows/ main transmission/ entry point,
- 52 % (17 Sites) medium flow,
- 27 % (9 Sites) low flow, and
- 12 % (4 sites) dead-ends, un-looped lines and stagnant areas.

Number - at this time there are 74 sampling sites regularly sampled throughout the GVW distribution system.

Location - the preferred location for dedicated sampling sites are sites connected directly to a water main. Public buildings or residential are the least preferred sampling sites as they may not be accessible at all times and results may not always be reliable. If a sample line cannot be run continuously, it should be a suitable size to allow water from the main to reach the tap after a brief flushing. Sampling sites are being re-evaluated as the GVW program evolves.

Every year, the RDNO discusses sample site locations with CoV and DoC operators. Some sample stations are moved to better locations and approximately three new sample stations are installed annually. In 2024, the sample station site locations will be reviewed to determine any changes required.

4.3 Distribution Monitoring Schedule

During regular operations, GVW has two main water sources with two treatment plants supplying the distribution systems:

- Duteau Creek Water Treatment Plant (DCWTP) - Duteau Creek Water Distribution system (gravity fed system), and
- Mission Hill Water Treatment Plant (MHWTP) - Kalamalka Lake Water Distribution system (pumped system).

As mentioned above, the two water systems have many interconnections which allow some blending of treated water. The water distribution system can also run on one source (treatment plant) if an emergency arises or a planned shutdown is required. There are some obstacles if this happens during peak demand periods (i.e.: summer flows) but GVW could include seasonal source Coldstream Ranch Well 3 and Antwerp Springs PH 2 to provide extra volume.

The distribution monitoring schedule is prepared by management and WQ staff. Operators and staff from the DoC, CoV and the RDNO have routes covered on a rotating four week schedule.

Appendix A has a map of all the distribution sampling sites. This schedule rotates the sampling sites from week to week to assist in a weekly overview of the entire water system.

The distribution sites are listed in the following Tables which include:

- Sample Site Name
- Site Description/Location, and
- Flow Rating:
    - Entry Point (EP): where the water enters the distribution system (treatment plants);
    - High (H): in the distribution system where disinfectant residual is expected to be higher than typical (after entering the distribution system or after re-chlorination);
    - Medium (M): midpoint in the distribution system where disinfectant residual is expected to be typical;
    - Low (L): where disinfectant residual is the lowest; and
    - Dead ends (DE): where disinfectant residual is the lowest.

Table 9 Duteau Water Distribution Sites

ENKI Sample Site Name	Site Description / Location	Flow Rating
43rd Avenue SS	2001 43 Street	DE
6015 Highway 6	6015 Highway 6	L
7900 McClounie Road	7900 McClounie Road – Kalamalka Secondary School	L
Aberdeen Road SS	9007 Aberdeen Road	DE
Boss Creek 1 PS Return	Boss Creek PH 1 (Lower) Return/Inlet	DE
Boss Creek 2 PS Return	Boss Creek PH 2 (Upper) Return/Inlet	DE
Braeburn Drive SS	8835 Braeburn Drive (PRV 270)	L
Brewer Road SS	6815 Brewer Road	L
Coldstream Creek Road SS	12408 Coldstream Creek Road	L
Cosens Bay Road SS	Cosens Bay Road and Grieves Drive	L
Cunliffe Reservoir SS	6910 Cunliffe Road	M
DCWTP Post Treatment	1014 Whitevale Road	EP
East Dedecker Road SS	East Dedecker Road at the park	M
Foothills Booster	6805 Foothills Drive	M
Golfview Place SS	466 Golfview Place	L
Goose Lake Road PS	6604 Goose Lake Road	L
Haney Road SS	located near SPCA	DE

ENKI Sample Site Name	Site Description / Location	Flow Rating
Highway 6 SS	7446 Highway 6	L
Husband Road PS	11701 Husband Road	M
Kosmina Road SS	1701 Kosmina Road	M
Marmot Court SS	364 Marmot Court	DE
McMechan Booster	901 39 Avenue	M
Mt Grady Road SS	corner of Mt. Grady Court and Mt. Grady Road	L
Noble Canyon Road Hydrant	Noble Canyon	DE
North BX 2 PS	6302 Apple Lane	H
Old Kamloops Road SS	Highway 97 and Old Kamloops Road	M
Palfrey Drive SS	Cunliffe Road and Palfrey Drive	M
Pine Road SS	Pine Road and Coldstream Creek Road SS	M
Pleasant Valley Road SS	6522 PV Road	M
Ponderosa Way SS	13900 Ponderosa Way	L
PRV 076	8101 Highland Place	DE
PRV 1	8798 Buchanan Road	H
PRV 2	4714 Pleasant Valley Road	H
Ravine Drive PS	35 Ravine Drive	M
Rugg Road SS	6926 Rugg Road	DE
South BX 1 PS	3600 East Vernon Road	H
South BX 2 PS	5121 Dixon Dam	H
Springfield Road SS	5608 Petworth/Springfield	L
Sunpeaks Reservoir SS	7444 Sun Peaks Drive	L
Upland Drive SS	488 Upland Drive	L
Total Duteau Sites	**EP = 1 / H = 4 / M = 13 / L = 14 / DE = 9**	

Table 10 Kalamalka Lake Distribution Sites

Sample Site Names	Site Description / Location	Type
15th Street SS	2702 15 Street	M
21st Avenue SS	2101 32 Street	M
25 Street SS	4404 25 St SS	M
30th Street SS	3402 - 30 Street	M
35 Street SS	2806 35 Street	M
43rd Street SS	2001 43rd Street SS	M
4714 Pleasant Valley SS	City Yard fill station at 4714 Pleasant Valley Road	M

Sample Site Names	Site Description / Location	Type
Allenby PS	5715 Bella Vista Road	M
Amber Drive SS	7095 Amber Drive	DE
Anderson Way SS	5100 Anderson Way	M
Balsam Reservoir SS	558 Balsam Court	M
Brassy Place SS	803 Brassy Place	DE
College Way SS	Highway 97 and College Way	M
Dunsmuir Road SS	3025 Dunsmuir SS	L
Kidston Road SS	12101 Kidston Road	DE
Kirkland Drive SS	7906 Kirkland Drive	L
Kokanee Booster	9320 Kokanee Road	M
Longacre Drive SS	6532 Longacre Drive	L
Longspoon Court SS	595 Longspoon Court	L
McMechan Reservoir SS	39 Avenue	H
MHWTP Post Treatment	3350 Reservoir Road	EP
Mission Road SS	1400 Mission Road	L
Mt Grady Court SS	Mt Grady Court and Mt Grady Road	L
Okanagan Landing 1 PS	7864 Okanagan Landing Road	M
Okanagan Landing 2 PS	8979 Okanagan Landing Road	M
Okanagan Landing Road SS	5871 Okanagan Landing Road	M
Pottery Road SS	1802 Pottery Road	H
Tavistock Reservoir SS	9033 Tavistock Road	L
Tronson Road SS	Beachcomber Bay Road & Tronson Road	M
Turtle Mountain PS	3600 Turtle Mountain Blvd	M
Upper Commonage Booster	461 Commonage Road	L
Weeks Road SS	7540 Weeks Road	L
West Kal Road SS	7603 West Kal Road	DE
Total Kal Sites	**EP = 1 / H = 2 / M = 17 / L = 9 / DE = 4**	

4.4 Bacteriological

The frequency and number of samples for microbiological control monitoring is based on recommendations from the *DWPA and DWPR.*

Schedule A - WQ Standards for Potable Water Fecal Coliform bacteria – no detectable fecal Coliform bacteria per 100mLs.

Escherichia coli (*E.coli)* – no detectable *E.coli* per 100mLs.

Total Coliform Bacteria:

(a) one sample in a 30 day period - no detectable Total Coliform per 100 mls.

(b) more than one sample in a 30 day period - at least 90% of samples have no detectable total bacteria per 100 mls.

Schedule B – Frequency of Monitoring Samples

Population served by the prescribed water supply system: 5,000 to 90,000.

Number of samples per month: 1 per 1,000 populations.

Other considerations when developing a WQ monitoring program:

- quality of the source water
- number of water sources
- past frequency of unsatisfactory samples
- adequacy of treatment and capacity of the treatment plant
- size and complexity of the distribution system
- practice of disinfection; and
- size of population served.

The following table summarizes the population sizes and number of sources, which help determine the number of bacterial samples to be completed each month for GVW's WQ program. A minimum of **67** bacteriological samples are sent to CARO for analysis each month for the Kalamalka Lake and Duteau Creek systems, based on normal operations. A minimum of **50** bacterial samples are completed at the RDNO laboratory using the Colilert® methods for MPN. A total of **118** bacterial samples are analyzed monthly for the water distribution system. The schedule for the water systems is shown below.

Note: Staff and operators are asked to collect an extra bacterial sample if the free chlorine is lower than 0.20 mg/L and to deliver it to the RDNO laboratory for analysis.

Table 11 Distribution Bacteria Sampling Frequency

System	Population (approx.)	Sources/ Intakes	Sample Sites	Samples per month to Caro	Minimum Bacterial Samples per Month
Kalamalka Lake	45,000	1	33	42	41
Duteau Creek	22,000	1	41	26	17
Total 2023	**67,000**	**2**	**74**	**68**	**58**

4.5 Adenosine Triphosphate

Adenosine Triphosphate (ATP) is samples at sources, treatment plants and within the distribution. The sample sites and frequency are found in the following table.

Table 12 ATP Sample Sites

Sample Sites	Type	Frequency
MHWTP Post Treatment	treatment	weekly
DCWTP Post Treatment	treatment	weekly

4.6 Low Chlorine Monitoring

Chlorine is used as a disinfectant for the GVW system. As required in the DWPA, Section 6(b) and Section 5.2(a) of the DWPR. All sampling sites are monitored for free and total chlorine by operators or GVW WQ staff.

A more in-depth look at chlorine management will continue in 2024. Additional chlorine checks will be added to provide operators and the WQ team with more data for chlorine residual and optimization. The sites are as follows:

Table 13 Low Chlorine Sample Sites

Chlorine Sites	Description
Galiano Road BO	water pumped from South BX #1
Brookside Road BO	small road off Dixon Dam Road
Longspoon Court SS	Predator Ridge - chlorination
Golfview Place SS	north west - Swan Lake
Tavistock Reservoir SS	Adventure Bay
Aberdeen Road SS	Aberdeen Road

4.7 Chemical and Physical Parameters

The chemical and physical testing within the distribution system includes conductivity, temperature, turbidity, free and total chlorine and pH. Parameters chosen for the weekly analysis help identify WQ issues before they become problematic or where source blending is occurring in some areas of the distribution system.

Further examination of WQ in the distribution system is completed quarterly at two sampling sites, which are:

1. Allenby PS (Kalamalka Lake supply), and
2. PRV 2 (Duteau Creek supply).

These sites help determine if there are WQ issues due to changes in alkalinity, pH, flow (high/low), chlorine levels or the type of water mains. The schedule and parameters for these sites are located in Appendix B.

Further WQ information on the following parameters:

4.7.1 Aluminum

Dissolved and total Aluminum are monitored monthly before and after treatment on the Duteau water source. Total aluminum values can reflect on the flocculation process carried through to the treated water. Elevated dissolved aluminum can be an indicator of over application of Poly

Aluminum Chloride (PAC), the plant's primary coagulant. Aluminum is a treatment related parameter; with an Operational Guideline, developed in 1998, (OG) of < 0.2 mg/L (other treatment type, not conventional). The OG applies to treatment plants using aluminum-based coagulants; it does not apply to naturally occurring aluminum. OGs are based on a running annual average of monthly samples. The naturally occurring Aluminum in the Duteau Creek source averages around 0.12 mg/L.

Currently, Health Canada has developed a technical guideline document to solicit comments on the proposed guideline and OG values. The document proposed a MAC of 2.9 mg/L for total aluminum and a OG value of 0.050 mg/L is proposed for total aluminum to optimize water treatment and distribution systems.

4.7.2 Orthophosphate Corrosion Inhibitor

Orthophosphates are used primarily as a corrosion inhibitor with its ability to create passivity film on the surface of distribution pipes. In this project, WQ staff have investigated the effectiveness of the zinc orthophosphate addition to the water distribution system. Zinc orthophosphate is injected into the treated water at the DCWTP in the fall until spring to reduce issues arising from cast and ductile iron waterlines in the distribution system. The Zinc orthophosphate has the ability to create an inert and resilient protective, microscopic layer on metal surfaces. This film acts as a barrier between the oxygenated and corrosive potable water and the metal pipe surface which minimizes the release of iron, lead, copper, and other metals that indicate corrosion is occurring and can produce harmful effects in the system. If properly applied, all the Zinc orthophosphate reacts with the pipe surface and there is no active residual left in the water. Samples are routinely collected at the sites listed in the following table, then brought to the RDNO laboratory for analysis. Operators at the DCWTP grab and analyze samples from the reservoir three times per week to analyze reactive phosphate.

Table 14 Corrosion Inhibitor Monitoring Sites

Sample Sites	Parameters Apply to All Sample Sites
DCWTP Post Treatment	Reactive Phosphate, Iron
Aberdeen Road SS	
Sunpeaks Reservoir SS	
Golfview Place SS	
Noble Canyon Road Hydrant	

4.7.3 Disinfection By-Products

Disinfection By-products (DBP) are monitored as per the GCDWQ. The distribution systems are monitored quarterly for Trihalomethanes (THM's) and Haloacetic acids (HAA's) have been designed to look at the following conditions:

- first customer or point of entry - water treatment plants,
- at points in the distribution system with the longest disinfectant retention time,
- the worst case scenario (longest contact time), and
- the effect of different sources blending in the distribution system.

The maximum acceptable concentration (MAC) for the distribution system is based on a locational running annual average of the quarterly samples taken at the sample sites with the longest disinfectant retention time. The following sample sites will be monitored in March, June, September and November of annually.

Table 15 Disinfection By-Products Monitoring Sites

Sample Sites	Location in Distribution	Most Common Source	Parameters
DCWTP Post Treatment	first customer – entry point	Duteau Creek	THM, HAA, Bacterial, TOC
Palfrey Drive SS	mid-point - after re-chlorination at PRV#1	Duteau Creek	THM, HAA, Bacterial
Sunpeaks Reservoir SS	longest disinfectant retention time	Duteau Creek	THM, HAA, Bacterial
Golfview Place SS	longest disinfectant retention time	Duteau Creek	THM, HAA, Bacterial
MHWTP Post Treatment	first customer - entry point	Kalamalka Lake	THM, HAA, Bacterial, TOC
Tavistock Reservoir SS	longest disinfectant retention time	Kalamalka Lake	THM, HAA, Bacterial
Allenby PS	mid-point	Kalamalka Lake	THM, HAA, Bacterial
Longspoon Reservoir SS	longest disinfectant retention time	Kalamalka Lake	THM, HAA, Bacterial

5. REPORTING

RDNO uses ENKI, an internet based data software system with centralized information management. The ENKI database is accessible to all who have been registered as “users” by the administrator (GVW Manager, WQ).

At this time, WQ notification and maintenance activities such as flushing can be found on the RDNO website at www.rdno.ca. Customers can subscribe to receive announcements, media releases, and updates by email at https://www.rdno.ca/subscribe.

Weekly reports are generated by GVW WQ staff for Operations Supervisors by Friday of each week. This allows an overview of chlorine residuals, turbidity and bacterial results within the distribution system and some source water information.

Monthly WQ reports are generated by GVW WQ staff for Interior Health each month. All reports are sent to the Drinking Water Officer, Operations Supervisors and the WQ Manager by the 15 day of the following month. Following review, the reports are posted on the RDNO website.

An annual WQ report is due on June 30 for the previous year. The report includes microbiological, inorganic and organic parameters for the sources and the distribution system plus recommendations to improve WQ where standards and aesthetic issues are not met.

6. REFERENCES

Decision Tree for Responding to a Turbidity Event in Unfiltered Drinking Water, Ministry of Health, BC, April 2013.

Drinking Water Protection Act [SBC 2001] Chapter 9, *Assented to April 11, 2001.*

Drinking Water Protection Regulation, B.C. Reg. 200/2003 [includes amendments up to B.C. Reg. 87/2011, May 19, 2011].

Guidelines for Canadian Drinking Water Quality, Health Canada, *February 2017.*

WQG-01 Source Drinking Water Quality Guidelines, Ministry of Environment & Climate Change Strategy, Water Protection & Sustainability Branch , *2017*.

APPENDICES

APPENDIX A - WQ Maps of Sample Sites

Legend

Sampling Stations - Water System

- Duteau Creek
- Goose Lake
- Kalamalka Lake
- King Edward Lake
- Okanagan Lake
- Well
- GVW Boundary
- Watermains
- Parcels

O'Keefe Flushing Station
Golfview SS
Hwy 97 / Old Kamloops Rd SS
Highland Pl PRV 77
Goose Lake
Goose Lake Building
Sun Peaks PS
Rugg Rd SS
Foothills PS
PRV #109
Goose Lake PS
PV Rd SS
Marmot Court SS
6198 Brookside Road B/O
North BX #2 PS
North BX #1 PS
BX Park SS
Anderson Way SS
Haney Road SS
South BX #2
City Yard Fill Station (K)
PRV #2
Kin Race Track SS
4404 25 St SS
McMechan Pump Station
McMechan Reservoir
Boss Creek PS #2
Turtle Mountain PS
Vernon City Hall SS
Allenby Pump Station
Boss Creek PS #1

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GVW Sampling Stations - North

Plot Date: Apr 27, 2022

Scale: 1:50,000

0 2 4 8 Kilometers

Plot Size: 17" x 11"

REGIONAL DISTRICT NORTH OKANAGAN

RDNO

Legend

Sampling Stations - Water System

- Duteau Creek
- Goose Lake
- Kalamalka Lake
- King Edward Lake
- Okanagan Lake
- Well

- GVW Boundary
- Watermains
- Parcels

Boss Creek PS #2
Boss Creek PS #1
1101 Galiano Road B/O
Upland Dr SS
Ravine Pumphouse
RDNO Lab
PRV #24
PRV #1
Venables / Northcott SS
9007 Aberdeen Rd SS
Grey Rd Station
DOC Public Works Yard
Well 1
Well 2
Pine Dr PRV 16
Kidston Rd SS
West Kal Rd
Kalamalka Secondary
Palfrey SS
Cosens Bay Rd SS
Cunliffe Reservoir
Ponderosa Lift Station
Deer Creek
7446 Hwy 6 SS
Brewer Rd SS
Warren Rd PS
Antwerp PS
Lavington Superette
Springfield Rd SS
Bessette Station
Brewer PH
DCWTP
Headgates Bldg

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GVW Sampling Stations - East

Plot Date: Apr 27, 2022

Scale: 1:50,000

0 2 4 8 Kilometers

Plot Size: 17" x 11"

REGIONAL DISTRICT NORTH OKANAGAN

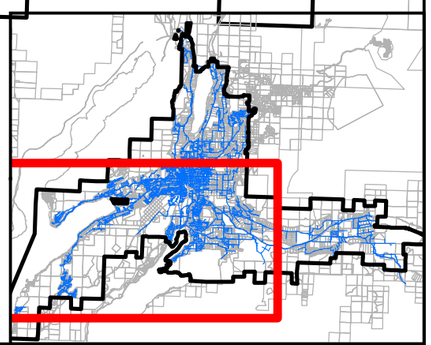
RDNO

Legend

Sampling Stations - Water System

- Duteau Creek
- Goose Lake
- Kalamalka Lake
- King Edward Lake
- Okanagan Lake
- Well
- GVW Boundary
- Watermains
- Parcels

Turtle Mountain PS
McMechan Reservoir
Boss Creek PS #2
Vernon City Hall SS
South BX #1
Boss Creek PS #1
1101 Galiano Road B/O
Balsam Reservoir
Dunsmuir SS
Allenby Pump Station
35th Street SS
2702 15 St SS
2001 43 St SS
Vernon Jubilee Hospital
Amber Dr SS
1802 Pottery Rd
Nordic House SS
Kosmina SS
Tronson Rd SS
Ok. Landing SS
Upland Dr SS
Ravine Pumphouse
Tavistock Reservoir
Kal View Meter SS
Mt Grady Crt SS
Mt. Ida PRV
RDNO Lab
PRV #24
Claremont SS
Mt Grady Rd SS
8844 Oxford Road SS
OK #1
Weeks Rd SS
Husband Rd PS
PRV #1
Mission Hill Water Treatment Plant
Venables / Northcott SS
16506 Kalamalka Road SS
Kal Lake PS
9007 Aberdeen Rd SS
Commonage PS
Braeburn Dr SS
Grey Rd Station
Kirkland Dr
Kidston Rd SS
DOC Public Works Yard
Well 1
West Kal Rd
Pine Dr PRV 16
Well 2
OK #2
Kalamalka Secondary
Coldstream Creek Rd SS
Palfrey SS
Cosens Bay Rd SS
Deer Creek
Kokanee PS
Cunliffe Reservoir
Ponderosa Lift Station
Brassy Place SS
Delcliffe Lake Station
Delcliffe Booster Station
Longspoon Crt SS
Outback Reservoir
Outback PS



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GVW Sampling Stations - West

Plot Date: Apr 27, 2022

Scale: 1:50,000

0 2 4 8 Kilometers

Plot Size: 17" x 11"

REGIONAL DISTRICT NORTH OKANAGAN

RDNO

APPENDIX B - Parameters and Schedule

Weekly Sampling

1st, 2nd, 4th (5th) Tuesdays

SOURCES	Kalamalka Lake Intake	Freshet (Feb/March - June)
	Duteau Creek Intake	Summer (May - Nov)
TREATMENT PLANTS	DCWTP Post Treatment	Winter (October to April)
	MHWTP Post Treatment	Irrigation (April 15 to September 30)
KALAMALKA WATERSHED	Coldstream Creek	Marl (mid June - ??)
IRRIGATION	Goose Lake	
SEASONAL / POTABLE	Coldstream Ranch Well 1 (Prechlorination)	

*NOTE: take algae density sample if distinct odor to the water
(fishy, septic, skunky and grassy)

SOURCES

SAMPLE SITE	BOTTLES	PARAMETERS
Kalamalka Lake Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - 250 mL Caro	DOC (1st week of Month)
	1 - TOC (2 bottles)	TOC (1st week of Month)
Kalamalka Lake Intake Extra Sampling	1 - 125 ml Caro (Yellow Lid)	TP
	1 - 250 mL Caro	TN

Freshet and Lake flips (Feb/March and May/June) and (October/November)- Take TP and TN when lake flips (Turbidity <1)

NOTE: if Kalamalka Lake Source is turned off, there is a pump running to take source samples at the sample line and run the online turbidimeter

NOTE: Marl increases Turbidity

SAMPLE SITES	BOTTLES	PARAMETERS
Duteau Creek Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
Duteau Creek Intake Extra Sampling	1 - 125 ml Caro (Yellow Lid)	TP
	1 - 250 mL Caro	TN

Duteau Creek Intake during freshet and if turbidty or flows pick up take extra samples: TP, TN

Weekly Sampling

TREATMENT PLANTS

SAMPLE SITES	BOTTLES	PARAMETERS
DCWTP Post Treatment	1 - 100 mL PA	Bacterial (Most ProbableNumber)
	1 - Caro Bacterial	Total Coliform, E.Coli
MHWTP Post Treatment	1 - 100 mL PA	Bacterial (Most ProbableNumber)
	1 - Caro Bacterial	Total Coliform, E.Coli

KALAMALKA WATERSHED

COLDSTREAM CREEK

WEEKLY: February/March to June (Freshet) sampled every Tuesday and during major rain events.

MONTHLY: July to January/February: Coldstream Creek will be sampled one per month (fourth Tuesday) and during any major rain events

Freshet: during the snow melt; water level, turbidity will be higher in creek

Monthly - Fourth or Fifth Tuesday of month
(and during events)

COLDSTREAM CREEK SAMPLING

SAMPLE SITES	BOTTLES	PARAMETERS
Coldstream Creek at Kirkland Drive	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at Howe Drive	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at Brewer Road	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at School Road	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC

Weekly Sampling

Coldstream Creek Sampling

1st, 2nd and 3rd & 5th Tuesday of month during freshet (March until June)

SAMPLE SITES	BOTTLES	PARAMETERS
Coldstream Creek at Kirkland Drive	1 - Caro Bacterial	Total Coliform, E.coli
Coldstream Creek at Howe Drive	1 - Caro Bacterial	Total Coliform, E.coli
Coldstream Creek at Brewer Road	1 - Caro Bacterial	Total Coliform, E.coli
Coldstream Creek at School Road	1 - Caro Bacterial	Total Coliform, E.coli

IRRIGATION

every week during irrigation season: April 15 to September 30

SAMPLE SITES	BOTTLES	PARAMETERS
Goose Lake Intake	1 - 1 L Algae Density	
Goose Lake Shore	1 - 1 L Algae Density	Approximately start Mid June until September 30
	* Lake Observation visual / odor comments	

SEASONAL SOURCE sample if being used for potable water

Annual to be completed prior to Well turn on for the season

SAMPLE SITES	BOTTLES	PARAMETERS
Coldstream Ranch Well 3 Prechlorination	1 - 100 mL PA	Bacterial (Most ProbableNumber)

3rd Tuesday of every month

Monthly Sampling

SOURCES	Kalamalka Lake Intake
	Duteau Creek Intake
TREATMENT PLANTS	DCWTP Post Treatment
	MHWTP Post Treatment
SOURCES	Outback Intake
	Delcliffe Intake
TREATED	Outback Reservoir SS
KALAMALKA LAKE WATERSHED	Coldstream Creek
IRRIGATION	Goose Lake
SEASONAL / POTABLE	Coldstream Ranch Well 1 (Prechlorination)

Freshet (Feb/March - June)
Summer (May - Nov)
Winter (October to April)
Irrigation (April 15 to September 30)

*NOTE: take algae density sample if distinct odor to the water
(fishy, septic, skunky and grassy)

SOURCES

SAMPLE SITE	BOTTLES	PARAMETERS
Kalamalka Lake Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria) IRB (Iron Related Bacteria)
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - TOC Caro (2 bottles)	TOC
	1 - 250 mL Caro	DOC
	1 - 1 L (in house)	Algae Density
	1 - 4 L Caro	chlorophyll a
	1 - 1 L Caro	Heather Larratt schedule →
Kalamalka Lake Intake Extra Sampling	1 - 125 ml Caro (Yellow lid)	TP
	1 - 250 mL Caro	TN

Kalamalka Lake Intake - Freshet and Lake flips (Feb/March and May/June) and (October/November)- Take TP and TN when lake flips (Turbidity <1)

NOTE: if Kalamalka Lake Source is turned off, there is a pump running to take source samples at the sample line and run the online turbidimeter

3rd Tuesday of every month | Monthly Sampling

Duteau Creek Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - Metals Caro	Al
	1 - TOC Caro (2 bottles)	TOC
	1 - 250 mL Caro	dissolved Al
	1 - 500 mL in house	Iron
	1 - 1 L in house	Algae Density (June - October)
	1 - 4 L Caro	chlorophyll a
Duteau Creek Intake Extra Sampling	1 - 125 ml Caro (Yellow lid)	TP
	1 - 250 mL Caro	TN

Duteau Creek Intake during freshet and if turbidty or flows pick up take extra samples: TP, TN

note: Marl increases Turbidity

TREATMENT PLANTS

SAMPLE SITES	BOTTLES	PARAMETERS
DCWTP Post Treatment	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 100 mL PA	Bacterial (Most ProbableNumber)
	1 - 500 mL Caro	dissolved Aluminum, UVT (Unfiltered)
	1 - Metals Caro	Aluminum
	1 - TOC Caro (2 bottles)	TOC
	1 - 500 mL in house	Iron
MHWTP Post Treatment	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria) IRB (Iron Related Bacteria)
	1 - PA	Bacterial (Most ProbableNumber)
	1 - TOC Caro (2 bottles)	TOC
	1 - 250 mL Caro	DOC

3rd Tuesday of every month Monthly Sampling

SOURCES - OUTBACK AND DELCLIFFE

Outback (Monthly - Fourth Monday of every Month)

SAMPLE SITES	BOTTLES	PARAMETERS
Outback Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria), IRB (Iron Related Bacteria)
	1 - 200 mL PA (Duplicate)	Bacterial (Most Probable Number)
	1 - TOC Caro	TOC
	1 - 1 L in house	Algae Density (May to November)
	1 - 4 L Caro	Chlorophyll a (May to November)

Note: WQ samples raw water at Outback and Delcliffe monthly
no distribution except quarterly THM's at Outback Reservoir

Delcliffe (Monthly - Fourth Monday of every Month)

SAMPLE SITES	BOTTLES	PARAMETERS
Delcliffe Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 200 mL PA (Duplicate)	Bacterial (Most Probable Number)
	1 - 125 mL Caro (yellow lid)	TP
	1 - 250 mL Caro	DOC, TN
	1 - TOC (2 bottles)	TOC
	1 - 500 mL in house	UVT (UF)
	1 - 1 L in house	Algae Density (May to November)
	1 - 4 L Caro	Chlorophyll a (May to November)

NOTE: Delcliffe Intake: call operator to meet so they can turn the raw water on

NOTE :Please take a Chlorine at the raw before taking a sample to ensure there is not chlorine

3rd Tuesday of every month Monthly Sampling

KALAMALKA WATERSHED

Coldstream Creek Sampling

WEEKLY: February/March to June (Freshet) sampled every Tuesday and during major rain events.

MONTHLY: July to January/February: Coldstream Creek will be sampled one per month (fourth Tuesday) and during any major rain events

Freshet: during the snow melt; water level, turbidity will be higher in creek

Monthly - Fourth or Fifth Tuesday of month (and during events)

Coldstream Creek Sampling

SAMPLE SITES	BOTTLES	PARAMETERS
Coldstream Creek at Kirkland Drive	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at Howe Drive	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at Brewer Road	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at School Road	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC

3rd Tuesday of every month Monthly Sampling

IRRIGATION

SAMPLE SITES	BOTTLES	PARAMETERS
Goose Lake Intake	1 - 100 mL PA	Bacterial (Most ProbableNumber)
	1 - 1 L Algae Density	in house - algae
	1 - 125 ml Caro (Yellow lid)	TP
	1 - 500 mL Caro	TN, DOC
	1 - 4 L Caro	Chlorophyll A
Goose Lake Shore	1 - 1 L Algae Density	Approximately Mid June until September 30
	* Lake Observation visual / odor comments	

send out a voyent alert stating we are no longer monitoring Goose Lake

October 1st - Just sampling algae until the end of October due to high counts and we have learned that Goose Lake is never actually fully turned off.

SEASONAL SOURCE (sample if being used for potable water)

SAMPLE SITES	BOTTLES	PARAMETERS
Coldstream Ranch Well 3 Prechlorination	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	HPC
	1 - Caro Bacterial	Iron Related Bacteria
	1 - 100 mL PA	Bacterial (Most ProbableNumber)
	1 - Metals Caro	Manganese
	1 - 500 mL in house	Sulphate, Iron, Manganese

3rd Tuesday of every 3rd month

Quarterly Sampling

Quarterly (Feb, May, Aug, Nov)

SOURCES	Kalamalka Lake Intake	Freshet (Feb/March - June)
	Duteau Creek Intake	Summer (May - Nov)
TREATMENT PLANTS	DCWTP Post Treatment	Winter (October to April)
	MHWTP Post Treatment	Irrigation (April 15 to September 30)
DISTRIBUTION	PRV 2	Various Sample dates
	Allenby PS	
SOURCES	Outback Intake	
	Delcliffe Intake	
TREATED	Outback Reservoir SS	
KALAMALKA LAKE WATERSHED	Coldstream Creek	
IRRIGATION	Goose Lake	
SEASONAL / POTABLE	Coldstream Ranch Well 1 (Prechlorination)	

*NOTE: take algae density sample if distinct odor to the water (fishy, septic, skunky and grassy)

SOURCES

SAMPLE SITE	BOTTLES	PARAMETERS
Kalamalka Lake intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria) IRB (Iron Related Bacteria)
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - TOC Caro (2 bottles)	TOC
	1 - 125 ml Caro (Yellow lid)	TP* (May & August only)
	1 - 500 mL Caro	DOC, Bromide TN* (May & August only)
	1 - 500 mL in house	Colour (true & apparent), Alkalinity, Hardness
	1 - 1 L (in house)	Algae Density (May to November)
	1 - 4 L Caro	chlorophyll a (May to November)
	1 - 1 L Caro	Heather Larratt schedule →

Kalamalka Lake Intake - Freshet and Lake flips (Feb/March and May/June) and (October/November)- Take TP and TN when lake flips (Turbidity <1)

NOTE: if Kalamalka Lake Source is turned off, there is a pump running to take source samples at the sample line and run the online turbidimeter

3rd Tuesday of every 3rd month Quarterly Sampling

SAMPLE SITE	BOTTLES	PARAMETERS
Duteau Creek Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - Metals Caro	Aluminum
	1 - TOC Caro (2 bottles)	TOC
	1 - 125 ml Caro (Yellow lid)	TP
	1 - 500 mL Caro	DOC, TN, dissolved Aluminum, Chloride, Bromide
	1 - 500 mL in house	Iron
	1 - 1 L in house	Algae Density (June - October)
	1 - 4 L Caro	chlorophyll a

Duteau Creek Intake during freshet and if turbididty or flows pick up take extra samples: TP, TN

TREATMENT PLANTS

SAMPLE SITE	BOTTLES	PARAMETERS
DCWTP Post Treatment	1 - Caro Bacterial	Total Coliform, E. Coli
	1 - 100 mL PA	Bacterial (Most ProbableNumber)
	1 - 500 mL Caro	dissolved Aluminum, DOC
	1 - Metals Caro	Aluminum
	1 - TOC Caro (2 bottles)	TOC
	1 - 500 mL in house	Iron
MHWTP Post Treatment	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria) IRB (Iron Related Bacteria)
	1 - 100 mL PA	Bacterial (Most ProbableNumber)
	1 - 250 mL Caro	DOC
	1 - TOC Caro (2 bottles)	TOC
	1 - 500 mL in house	Colour (apparent), Sulfate

3rd Tuesday of every 3rd month Quarterly Sampling

DISTRIBUTION

SAMPLE SITE	BOTTLES	PARAMETERS
PRV 2	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 100 mL PA	PA (MPN if Cl_2 <0.20)
	1 - 125 mL Caro	Dissolved Aluminum
	1 - 125 mL Metals Caro	Aluminium
	1 - 1 L in house	Iron, Colour (apparent), Alkalinity, Hardness
Allenby PS	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 100 mL PA	PA (MPN if Cl_2 <0.20)
	1 - 1 L in house	Sulfate, Colour (apparent), Alkalinity, Hardness

KALAMALKA WATERSHED

COLDSTREAM CREEK

WEEKLY: February/March to June (Freshet) sampled every Tuesday and during major rain events.

MONTHLY: July to January/February: Coldstream Creek will be sampled one per month (fourth Tuesday) and during any major rain events

Freshet: during the snow melt; water level, turbidity will be higher in creek

Fourth or Fifth Tuesday of month

COLDSTREAM CREEK SAMPLING

SAMPLE SITE	BOTTLES	PARAMETERS
Coldstream Creek at Kirkland Drive	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at Howe Drive	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at Brewer Road	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC
Coldstream Creek at School Road	1 - Caro Bacterial	Total Coliform, E.coli
	1 - 125 mL Caro (Yellow Lid)	TP, Ammonia
	1 - 250 mL Caro	TN, Chloride, Sulphate
	1 - TOC (2 bottles)	TOC

3rd Tuesday of every 3rd month Quarterly Sampling

SOURCES - OUTBACK AND DELCLIFFE

Note: WQ samples raw water at Outback and Delcliffe monthly
no distribution except quarterly THM's at Outback Reservoir

Outback - Quarterly - Fourth Monday of (March, June, September, December)

SAMPLE SITE	BOTTLES	PARAMETERS
Outback Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria), IRB (Iron Related Bacteria)
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - TOC Caro	TOC
	1 - 125 mL Caro (yellow lid)	TP
	1 - 250 ml Caro	TN
	Quarterly: 1 - 500 mL in house	sulfate, Apparent Colour, Total Alkalinity, Total Hardness
	1 - 1 L in house	Algae Density
	1 - 4 L Caro	Chlorophyll a
Outback Reservoir SS	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	Quarterly: 2 - THM bottles	THM's
	Quarterly: 2 - HAA bottles	HAA's

Delcliffe - Monthly

NOTE: Delcliffe Raw: call operator to meet so they can turn the raw water on

NOTE:Please take a Chlorine at the raw before taking a sample to ensure there is not chlorine

SAMPLE SITE	BOTTLES	PARAMETERS
Delcliffe Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - 125 mL Caro (yellow lid)	TP
	1 - 250 mL Caro	DOC, TN
	1 - 500 mL in house	UVT (UF)
	1 - TOC (2 bottles)	TOC
	1 - 1 L in house	Algae Density (May to November)
	1 - 4 L Caro	Chlorophyll a (May to November)

3rd Tuesday of every 3rd month Quarterly Sampling

Irrigation

SAMPLE SITE	BOTTLES	PARAMETERS
Goose Lake Intake	1 - PA	Bacterial (Most ProbableNumber)
	1 - 1 L Algae Density	in house - algae
	1 - 125 ml Caro (Yellow lid)	TP
	1 - 500 mL Caro	TN, DOC
	1 - 4 L Caro	Chlorophyll A
Goose Lake Shore	1 - 1 L Algae Density	Approximately start Mid June until September 30
	* Lake Observation visual / odor comments	

SEASONAL SOURCE sample if being used for potable water

SAMPLE SITE	BOTTLES	PARAMETERS
Coldstream Ranch Well 3 Prechlorination	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	*HPC*
	1 - Caro Bacterial	*Iron Related Bacteria (in house)*
	weekly	Bacterial (Most ProbableNumber)
	1 - Metals Caro	Manganese
	1 - 500 mL in house	Sulphate, Iron, Manganese

Annually

Sources	Kalamalka Lake Intake
	Duteau Creek Intake
Seasonal Source	Coldstream Ranch Well 1 (Prechlorination)

Bi-Annually (January/July)

Distribution	PRV 2
	Allenby PS

Every 5 Years (2024, 2029 etc)

Irrigation	Goose Lake Intake
	Coldstream Ranch Well 3
	Deer Creek Intake Pond
Emergency Source	Antwerp Springs PH 2

Comprehensive Sampling

Kalamalka Lake:

every 2 years (2021, 2023 etc):

Herbicides & Pesticides: June

Fuels: August

Annually

VOC's : July

Groundwater:

every 5 years (2019, 2024 etc):

Herbicides & Pesticides, Fuels: July

VOC's : July **(Annually)**

SOURCES

SAMPLE SITE	BOTTLES	PARAMETERS
Kalamalka Lake Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	SRB (sulfur reducing bacteria) IRB (Iron Related Bacteria)
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - Cyanide	
	1 - 125 mL Caro (Yellow lid)	TP
	1 - TOC Caro (2 bottles)	TOC
	1 - VOC Caro (2 bottles)	VOC
	1 - 1 L Caro	
	1 - 4 L Caro	Chlorophyll a
	(June) 2 - 40 ml amber glass vials preserved with Na2S2O3 (THM Vials)	Herbicides (2023, 2025, 2027 etc)
	(June) 2 - 1 L amber Caro*	Pesticides (2023, 2025, 2027 etc)
	(August) 2 - 1 L amber Caro	Fuel Scan (HEPL/LEPL) (2023, 2025, 2027 etc)

Annually — Comprehensive Sampling

Duteau Creek Intake	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - 500 mL in house	Iron
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - Cyanide	
	1 - 125 mL Caro (Yellow lid)	TP
	1 - TOC Caro (2 bottles)	TOC
	1 - 1 L Caro	
	1 - 4 L Caro	Chlorophyll a

Duteau Creek Intake: Ensure Dissolve Aluminum is on the CoC

Distribution

3rd Tuesday in January and July — Bi-Annually - January and July

Site and Water Trax #	Bottles	Parameters
PRV 2 Should reflect Duteau distribution water	1 - Caro Baterial	Total Coliform, E.Coli
	1 - PA	PA (MPN if Cl2 <0.20)
	1 - 500 mL in house	Colour (true)
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - 125 mL Caro (Yellow lid)	TP
	1 - Cyanide	Cyanide
	1 - TOC (2 bottles)	TOC
	1 - 1 L Caro	
Allenby PS Note: Should reflect Kal distribution water	1 - Caro Baterial	Total Coliform, E.Coli
	1 - PA	PA (MPN if Cl2 <0.20)
	1 - 500 mL in house	Colour (true)
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - 125 mL Caro (Yellow lid)	TP
	1 - Cyanide	Cyanide
	1 - TOC (2 bottles)	TOC
	1 - 1 L Caro	

Annually Comprehensive Sampling

Outback - Annual (July)

Site and water trax #	Bottles	Parameters
Outback Intake	1 - Caro Baterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - 125 mL Caro (Yellow lid)	TP
	1 - Cyanide	Cyanide
	1 - TOC	TOC
	1 - 1 L Caro	
	1 - 4 L Caro	chlorophyll a
	1 - 1 L in house	Algae Density

Delcliffe - Annual

NOTE: Delcliffe Intake: call operator to meet so they can turn the raw water on

NOTE: Please take a Chlorine at the raw before taking a sample to ensure there is not chlorine

Site and water trax #	Bottles	Parameters
Delcliffe Intake	1 - Caro Baterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	Bacterial (Most Probable Number)
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - 125 mL Caro (Yellow lid)	
	1 - Cyanide	Cyanide
	1 - TOC	TOC
	1 - 1 L Caro	
	1 - 500 mL in house	UVT (UF)
	1 - 4 L Caro	chlorophyll a
	1 - 1 L in house	Algae Density

Annually		Comprehensive Sampling
Seasonal Irrigation Source - annually (Well #3 can be used as an emergency potable source)		
Coldstream Ranch Well 3 (Replace Well #1; drilled in Fall/Winter 2019)	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - Caro Bacterial	HPC
	1 - Caro Bacterial	Iron Reducing Bacteria
	1 - Caro Bacterial	Sulfur Reducing Bacteria
	1 - PA	Bacterial (Most ProbableNumber)
	1 - 500 mL in house	Sulphate and Iron
	1 - Cyanide	
	1 - 125 mL Caro (Yellow lid)	
	1 - 125 mL Metals Caro	
	1 - 40 mL mercury glass metals	
	1 - 1 L Caro	
	1 - VOC Caro (2 bottles)	VOC's
	1 - 250 mL amber bottles (NaHSO4)	Fuel Scan (HEPL/LEPL) (2021, 2023, 2028 etc)
	2 - 40 ml amber glass vials preserved with Na2S2O3 (THM Vials)	Herbicides (2021, 2023, 2028 etc)
	2 - 1 L amber Caro*	Pesticides (2021, 2023, 2028 etc)

Note: Palfrey is shut off during the winter. Please contact DoC a couple days prior to turn on for the December and March samples.
NOTE: Contact DCWTP a few days prior to sampling to let them

THM's, HAA's & TOCs

(Mar, Jun, Sept, Nov)

Site		WaterTrax #	Most common Source	March, June, September, Decemember
DCWTP Post Treatment	entry point	23E7C	Duteau	THM, HAA, PA, TOC
Palfrey Drive SS	mid point	5ED7	Duteau	THM, HAA, PA
Golfview SS	end point	358A8	Duteau	THM, HAA, PA
Sunpeaks Reservoir SS	end point	229C3	Duteau	THM, HAA, PA
MHWTP Post Treatment	entry point	2427B	Kal	THM, HAA, 200 ml PA (duplicate), TOC
Tavistock Reservoir SS	end point	264EB	Kal	THM, HAA, PA
Longspoon Reservoir SS	end point	270F1	Kal	THM, HAA, PA
Allenby PS	mid point	280F5	Kal	THM, HAA, PA

Each site:		1 - PA
		1 - PA (200 ml) duplicate (DCWTP Post Treatment)
		2 - THM Bottles
		2 - HAA's
	DCWTP & MHWTP	2 - TOC bottles

***Note - be sure Outback THM's are completed March, June, September and November**

Duplicates:

November 19th 2020 **Dup 4A** **MHWTP Post Treatment**

January 2019	Extra THM sampling Foothills Outflow, McMechanan PS, Sunpeaks This is to assist in determining if the mixer put into Foothills reservoir in December 2018 is helping reduce THMs
January 2018	Removed perchlorate because there were very few detectable results
December 2017	For 2018 switched from Longspoon PH to Longspoon Reservoir as reservoir has longer retention time and is after re-chlorination at Longspoon PS. The PS sample site was before re-chlorination.
November 2017	Extra sample at Brewer to check if the mixer in Antwerp is working. The mixer in Antwerp Reservoir was installed Aug/Sept 2017
Nov/Dec 2017	Removed Ravine and Middleton Reservoirs from site of interest sampling and added in Grey Rd after chlorination if possible (March and September). Sampling Grey Rd and Brewer Rd SS before and after UV at DCWTP to determine if improvement after UV. Added McMechan PS (up to Foothills) and Foothills outlet to determine THM and HAAs in Foothills area. These will be completed in March and September.
January 2016	Removed Brewer Rd SS from regular THM sampling and added it Site of Interest sampling dates instead (March and August). Also added Ravine Res and Middleton Res to Site of Interest sampling for 2017. These sites are not regular sample sites and will be relooked at the end of 2017. Perchlorate has been added for 2017 to the eight regular sites in March (low flow) and August (high flow) to investigate if there are any concerns regarding hypo by-products.
December 2016	Added Brewer Rd SS to THM sampling in September 2016. Will continue to monitor this site in 2017 for the chlorine management program. Re-look at this site at the end of 2017. Removed Stepping Stones SS and added Golf View SS for 2017. Stopped sampling for bromate, chlorate, chlorite in 2017

	Added Bromate, Chlorite, and Chlorite analysis to THM sampling for 2016. One bottle for each site that gets analyzed at AGAT. Review for 2017 if will continue.	
February 2016	NOTE: these are sent to AGAT, therefore you must get the bottles and preservatives prior to sampling.	
	These samples must be dropped off at Purolator by 4:30.	
January 26, 2015	Renee and Dale had a meeting DCWTP, Palfrey or Ponderosa, Sunpeaks, Stepping Stones (Golf once in), Longsppon PS, Tavistock, MHTP, Allenby	
Changes January 12, 2015	**Duteau**	sunpeaks instead of foothill
		Golfview (new site) or Steppingstones or O'Keefe
	Kalamalka	Tavistock and Longspoon
	removed HPC from all sites - have enough data 4 years of data (since 2011)	
	changed foothills to SunPeaks - Foothills can be either source or reservoir or distribution and right after chlorination	
December 12, 2014	changed Stepping Stones to highland - stepping stones tends to freeze and will only run for 2 minutes at a time and can't turn down pressure	
	changed Kokanee to Longspoon PS	
	changed city hall to Tavistock	
June 2014	removed BX Park (Foothills is Duteau now) removed Old Kamloops Road (Duteau mainly) added City Hall for Kalamalka Did not add Anderson Way (on Kal only 60% of the time)	

Reactive Phosphate and Iron Sampling Program

RDNO Operator Sampling	Frequency	Parameters	Comments
DCWTP Post Treatment	3X/Week	DCWTP Lab: Reactive Phosphate, Alkalinity	Reservoir

DCWTP operators analyze and enter these results to WaterTrax

DoC Sampling	Frequency	Parameters	Comments
Noble Canyon Road Hydrant	monthly	GVW Lab: Reactive Phosphate & Iron	Week 3 (added January 2021)
Aberdeen Road SS	weekly	GVW Lab: Reactive Phosphate & Iron	Week 1, 2, 3 & 4 (added March 5, 2019)

CoV Sampling	Frequency	Parameters	Comments
Golfview SS	Monthly	GVW Lab: Reactive Phosphate & Iron	Week 1 (added January 2021)
Sunpeaks Reservoir SS	Monthly	GVW Lab: Reactive Phosphate & Iron	Week 3 (added January 2021)

October 4th - Zinc orthophosphate online. It will be an odd year for sampling as with Duteau system is a lot smaller with the headgates project. Dosing will be somewhat intermittent depending how low the flows out of Duteau are the same as UV.
RDNO ops will test for reactive phosphate downstream of injection as normal.
(as per email fwd from Tricia from Dustin on October 5, 2022 at 2:37 pm)

Older information

Base Line Samples	Parameters: orthophosphate Zinc
Foothills	5-Dec-13
Ponderosa	5-Dec-13
PRV #2	19-Feb-13, 16-Jul-13, 4-Dec-13
Bessette	10-Dec-13

2019:
9007 Aberdeen Road will be sampled for two projects:
Chlorine Residual and Mangement Project
Orthophosphate Corrosion Inhibitor Project

Orthophosphate Notes:

October 14, 2020: Zinc orthophosphate dosing started at Duteau WTP for the season. Dosing at start will occur at 5.0mg/L and will be adjusted to achieve a 1.4-1.6mg/L reactive phosphate concentration in the water. There is a plan to fix a leak on Duteau reservoir outlet the UV plant will be bypassed in November for this. Dosing during this project will be moved to the front end of Duteau reservoir so that the switch to bypass will still have ortho injection. We do not expect to see any significant reactive phosphate in the system for a couple of days. Last year we were able to move towards optimizing dose working with Keiko with results from the distribution system, hopefully we can do that again.

May 12, 2020: Zinc Orthophosphate dosing finished for the low flow 2019/2020 season

March 30, 2020: Zinc Orthophosphate sampling on additional Kal sites stopped with the exception of Longspoon Crt SS and Anderson Way SS. Ortho is no longer being detected in significant amounts at the discontinued sites and conductivity at these sites indicateds it is completely Kal water now. Longspoon and Anderson Way still have significant levels of ortho being detected and conductivity is showing a blend of Kal/Duteau still so these sites will continue to be sampled for Ortho.

November 19, 2019: Kalamalka Lake was shut down for flood midigation at Kal PH. Duteau has been throughout the whole system so it was decided to see how ortho/iron is through the Kal distrubtion. CoV started sampling in December 2019 and will continue in 2020 until it has been decided to end the sampling. The WQ team will re-asses every couple of months.

September 30, 2019: DCWTP started dosing Zinc Orthophosphate.

January 2, 2019: Zinc Orthophosphate is now being used again, new ortho was getting plugged. Removed zinc and alkalinity from sampling - Zinc was not detected throughout they system and alkalinity did not change throughout the system. Removed 2018 distribution sites - Golf View, PRV#1. Will continue sampling PRV#2 monthly during zinc ortho application to ensure it is getting through the system (190102 CH)

January 11, 2019 Duteau UV and Orthophosophate are back online as of 3pm. Free chlorine residual leaving the plant will be up approx. 0.2 ppm higher than it has been while UV was offline

Dustin Heidt email
January 2, 2019 We switched back to Zinc orthophosphate from the trial Orthophosphate we were using on Dec 31st. The trial product is proving difficult to inject consistently

Dustin Heidt email
January 2, 2019 As of 8am this morning we are bypassing the UV plant at Duteau for work in the UV outlet chamber. This means chlorine residual will be a bit low 1.6mg/l leaving the plant from 1.9mg/l but we are working on getting this back up to a target of 1.9 (this will take a day). Zinc Orthophosphate will be offline until the work is complete. Wildstone (onsite contractor) is hoping to finish by this Friday but it may push into next week.

Dustin Heidt email
December 13, 2018 Orthophosphate is back online as of this afternoon. It is now dosing from the UV building which means it does not need to make it through our reservoir before seeing it in the system. We will start testing for reactive phosphate again, but this is still the new trial product so there is no Zinc to test for.

Dustin Heidt email
December 4, 2018 We are making progress on the Ortho dosing skid in the new UV plant, right now we are going through a 5 day running exercise with water. Possibly next week if we can get the product through the mud and ice to the new plant we could start injecting again.

December 2018: Stopped sampling for Zinc. Testing new ortho product which is not zinc ortho. (181213 CH)

Dustin Heidt email
November 11, 2018 We have taken Orthophosphate offline as the new product is gelling in the injection line as it runs from Duteau Plant over to the reservoir. The new product has a high freezing point than the zinc orthophosphate but this should not be a problem when the new dosing location is up and running in the UV building.
Hopefully by early December we will be ready to go from that location where all of the injection system is within the building.

Dustin Heidt email
October 24, 2018 As of Oct 24th we are injecting Orthophosphate into the front end of Duteau Reservoir. It will be dosed at 5mg/l until we see reactive phosphate through the distribution system and then reduced to a dose to achieve a target of 1.5 mg/L reactive phosphate leaving the reservoir. We do not expect to see Ortho in the distribution system until early next week as it typically takes a week to fill the sample lines and get through the reservoir.
This year we are trialing a new product, ClearHIB-4 Orthophosphate rather than MCT 5071 Zinc Orthophosphate. Chemical supplier testing on our water and references from other systems using ClearHIB-4 suggest it should work well for our system. Once we see the reactive phosphate in the system it will be good to know if we are seeing any water quality changes from previous years. We can relatively easily switch back to the product we were using in previous years if necessary. The primary reason for this change is cost savings.

April 22, 2018 - DCWTP final day of Ortho injection. Reservoir outlet pH around 6.85 now but cannot dose caustic to back end of reservoir until dosing line re-established due to UV construction project. Probably at least 2 weeks away.

January 2018 - Added PRV #1 and PRV #2 to WQ monthly sampling for ortho and zinc project, coinciding with aluminum and monthly sampling.
- Removed Bessette from DOC Sampling

January 3, 2018 - Switched out Stepping Stones for Golf View SS, added Kal Secondary, added alkalinity and zinc to all distribution sites for 2018 to determine water chemisty (not DCWTP).

November 27, 2017 - added Alkalinity to all distribution sites for 2018 to determine water chemistry. Check about Kal Secondary; changing Stepping Stones to Golf View SS

Oct 6, 2017 - DCWTP started injecting zinc orthophosphate into the front end of reservoir at a dose of 6 mg/L, once ortho levels are detected in the distribution, dosage will be reduced to achieve a target of 1.5 mg/L going forward. This is similar to previous years. An early doseage date due to caustic addition offline due to UV construction.

March 23, 2017 - DCWTP final day of Ortho injection. Switching back to caustic injection on reservoir outlet for pH control over next few weeks. DCWTP reservoir pH currently 7.2 so not a huge concern at this time.

Oct 24, 2016 - DCWTP started injecting zinc orthophosphate into the front side of the reservoir. It was seen at the back side of the reservoir Oct 28, 2016.

November 16, 2015 - DCWTP started injecting zinc orthophosphate into the front side of the reservoir

April 13, 2015 - DCWTP - the last of the zinc orthophosphate was pushed through the injection lines. As of Wednesday (April 15th) still seeing a bit of residual at the sample point off the outlet of the reservoir. Typically run a few totes of water through the dosing system before bringing caustic back online. As a result pH could be lower than normal in the distribution system over the next few days

January 9, 2014 - DCWTP started injecting zinc orthophosphate into the front side of the reservoir

October 15, 2014 - DCWTP started to inject zinc orthophosphate into the front side of the Duteau reservoir at a Dose of 5.0 mg/L

May 5, 2014 - DCWTP ran the last bit of Zinc Orthophosphate; orthophosphate analysis will continue until the end of May.

2019 - Removed Zinc and Alkalinity because there are no changes within the system when Zinc ortho is on compared to when its not on.
Added Lead to DCWTP for base line; added to Cosens Bay and Kal Secondary
Added 9007 Aberdeen for Cl2 management project and ortho project
Removed PRV#2 and Northcott/Venables SS

Sites:

Duteau Watershed

Haddo Weir
18 km Aberdeen Road Tributary (dry ~July 15)
Duteau Creek Bridge

Peizometers and moisture content probes - first week of the month

For Peizometers and moisture bring: SDI-12 Reader and Water Level Reader

For Duteau Bridge bring: pump, tubing and weight

Bi-weekly

Follow Watershed Schedule

Sites and water trax #	Bottles	Parameters
16 km Aberdeen Road Tributary	1 - PA	Bacterial (Most ProbableNumber)
18 km Aberdeen Road Tributary	1 - PA	Bacterial (Most ProbableNumber)
Haddo Weir	**1 - 200 ml PA (Duplicate)**	**Bacterial (Most Probable Number)**
Duteau Creek Bridge	**1 - 200 ml PA (Duplicate)**	**Bacterial (Most Probable Number)**

Monthly

Follow Watershed Schedule

Sites and water trax #	Bottles	Parameters
16 km Aberdeen Road Tributary	1 - PA	Bacterial (Most ProbableNumber)
18 km Aberdeen Road Tributary	1 - PA	Bacterial (Most ProbableNumber)
Haddo Weir	1 - Caro Baterial	Total Coliform, E.Coli
	1 - 200 ml PA (Duplicate)	**Bacterial (Most Probable Number)**
	1 - 125 ml Caro (Yellow lid)	TP
	1 - 125 ml Caro	TN
	1 - TOC Caro	TOC
	1 - 500 mL in house	Iron, Colour (true and apparent)
	1 - 1 L Algae Density *if odor is present	**Algae Density**
	1 - 4 L Chlorophyll-a Caro	Chlorophyll a
Duteau Creek Bridge	**1 - 200 ml PA (Duplicate)**	**Bacterial (Most Probable Number)**

Annuals - July

Sites and water trax #	Bottles	Parameters
16 km Aberdeen Road Tributary	1 - PA	Bacterial (Most ProbableNumber)
18 km Aberdeen Road Tributary	1 - PA	MPN
Haddo Weir	1 - Caro Bacterial	Total Coliform, E.Coli
	1 - PA	Bacterial (Most ProbableNumber)
	1 - 500 mL in house	Iron, Colour (true and apparent)
	1 - Metals Caro	
	1 - Metals Caro (glass)	
	1 - Cyanide (Purple lid)	
	1 - 125 ml Caro (Yellow lid)	
	1 - TOC Caro	TOC
	1 - 1 L Caro	
	1 - 1 L Algae Density *if odor is present	**Algae Density**
	1 - 4 L Caro	Chlorophyll a
Duteau Creek Bridge	1 - PA	Bacterial (Most ProbableNumber)
	1 - TOC Caro	TOC

2024 Instrument Maintenance Schedule						
Date	**Week**	**Instruments**		**Date**	**Week**	**Instruments**
Jan 1 - 5	4			Jul 1 - 5	2	pH, Conductivity
Jan 8 - 12	1			Jul 8 - 12	3	
Jan 15 - 19	2	pH, Conductivity		Jul 15 - 19	4	
Jan 22 - 26	3			Jul 22 - 26	1	
Jan 29 - Feb 2	4			Jul 29 - Aug 2	2	
Feb 5 - 9	1	pH, Conductivity, Turbidity		Aug 5 - 9	3	pH, Conductivity, Turbidity
Feb 12 - 16	2			Aug 12 - 16	4	
Feb 19 - 23	3			Aug 19 - 23	1	
Feb 26 - Mar 1	4			Aug 26 - 30	2	
Mar 4 - 8	1	pH, Conductivity		Sep 2 - 6	3	pH, Conductivity
Mar 11 - 15	2			Sep 9 - 13	4	
Mar 18 - 22	3			Sep 16 - 20	1	
Mar 25 - 29	4			Sep 23 - 27	2	
Apr 1 - 5	1	pH, Conductivity		Sep 30 - Oct 4	3	
Apr 8 - 12	2			Oct 7 - 11	4	pH, Conductivity
Apr 15 - 19	3			Oct 14 - 18	1	
Apr 22 - 26	4			Oct 21 - 25	2	
Apr 29 - May 3	1			Oct 28 - Nov 1	3	
May 6 - 10	2	pH, Conductivity, Turbidity		Nov 4 - 8	4	pH, Conductivity, Turbidity
May 13 - 17	3			Nov 11 - 15	1	
May 20 - 24	4			Nov 18 - 22	2	
May 27 - 31	1			Nov 25 - 29	3	
Jun 3 - 7	2	pH, Conductivity, **Pocket Colorimeter II**		Dec 2 - 6	4	pH, Conductivity
Jun 10 - 14	3			Dec 9 - 13	1	
Jun 17 - 21	4			Dec 16 - 20	2	
Jun 24 - 28	1			Dec 23 - 27	3	
				Pocket Colorimeter II - secondary standard check annually		

Attachment B: GVW Water Quality Deviation Response Plan

REGIONAL DISTRICT
NORTH OKANAGAN

Greater Vernon Water
Water Quality
Deviation Response and Notification Plan

Revised: March 6, 2025

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Introduction

Greater Vernon Water (GVW) in cooperation with Interior Health Authority (IHA) has developed this Water Quality Deviation Response and Notification Plan (Plan) which works in conjunction with the GVW Emergency Response Plan (ERP).

The objective of the Plan is to provide a tool to:

1) guide operations, management and IH in identifying associated risks to human health
2) assist in determining the response for each incident identified
3) determine the level of public communication needed when water quality results deviate from acceptable levels

The Plan takes a risk evaluation approach to combat potential water borne diseases posing an associated risk to human health. The Plan links varying degrees of water quality degradation with investigative and operational responses.

The participants understand and agree this Plan will change in response to new research, technology and the understanding of water quality issues. Further, not all situations are outlined within this Plan and deviations that may affect water quality should be discussed with Regional District of North Okanagan (RDNO) management

The participants also understand the purpose of this document is not to replace the need for discussion with RDNO management and Interior Health Authority (IHA) when needed. As per the water quality protocol ENG-GVW-OP03:

> *the Owner, in consultation with Interior Health, will be responsible for determining the level of notification requirement during Water Quality events, and*
>
> *the Owner will consult with the Operator prior to issuing a notification of a Water Quality event if deemed appropriate by the Owner.*

This plan focuses on acceptable water quality as defined by The *Drinking Water Protection Act* and the *Drinking Water Protection Regulation*.

As defined by IHA, GVW must communicate deviations to the Drinking Water Officer (DWO) or Medical Health Officer (MHO) as determined in conjunction with the DWO.

WATER QUALITY DEVIATION and NOTIFICATION

Drinking water notification is defined in the *Drinking Water Protection Act,* specifically, sections 12, 13, and 14. The levels of notification are:

- water quality advisory (WQA)
- boil water notice (BWN)
- do not use water notice

Triggers for drinking water notification or a deviation response are defined within *Drinking Water Protection Act and Regulation*. The triggers include but are not limited to:

- the presence of indicator bacteria, such as fecal coliform or *E.coli* in water samples
- treatment failure
- water main breaks or infrastructure works resulting in depressurization
- cross connections between potable and non-potable sources
- turbidity

Each of these triggers can lead to a deviation in water quality.

Levels of Deviation

Deviations are categorized based on the severity and type of deviation from established guidelines and standards:

1. **Minor Deviations**: These are deviations that do not pose an immediate health risk but may indicate that water quality is not meeting the desired standards. Examples include slight changes in taste or odor. Minor deviations are not discussed in this DRP but may be noted on the field worksheets by operators/RDNO staff.
2. **Moderate Deviations**: These deviations indicate a change that may affect water quality but may not pose an immediate health risk. Examples include slightly elevated levels of certain chemicals or minor treatment process issues. **The tables** below outline some of the **moderate changes** from acceptable levels in the GVW system. At this level of deviation, **an identified or potential health risk** to drinking water users is determined as moderate and an operational response and notification is to be generated. The intent of the notification is to advise the drinking water user of a change to water quality and actions the user may consider. The checklist located in **ERP - APPENDIX J** should be used to implement a notification.
3. **Major Deviations**: These are serious deviations where there **is an identified or potential health risk** to consumers. For example, the potential presence of harmful bacteria. **The tables** below outline some of the **major changes** from acceptable levels in the GVW system. An investigation and operational response is determined. GVW and/or IHA will determine the notification level. The checklist located in **ERP - APPENDIX J** should be used to implement notification.
4. **Critical Deviations**: These are the most severe deviations, indicating a situation where the water is unsafe for consumption or use. Immediate action is required to protect public health. Examples include widespread contamination or a complete breakdown of the water treatment system. Critical deviations are not specifically mentioned in this DRP. All responses in a Critical Deviation would be in consultation with IHA.

The public notification levels and their definitions (as defined by the Province - https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/drinking-water-quality/notices-boil-water-advisories) are as follows:

Levels of Notification – Adapted from IHA Website

Water Quality Advisory

A WQA is the lowest-level notification. A WQA is used in situations where the public health threat is modest, and actions can be taken to reduce the risks by ways other than requiring a BWN or do not use water notice.

Boil Water Notice

A BWN is used in situations where the public health threat is significant, and the nature of the threat is one that can be effectively addressed by boiling the water.

Do Not Use Water Notice

A do not use water notice is the highest-level notification. It is used in situations where a significant public health threat exists and the threat cannot be adequately addressed through a WQA or BWN.

WATER QUALITY DEVIATION RESPONSE GUIDE

This Plan is to provide direction for the operator, staff, supervisors, and management when water quality or operational parameters deviate from normal conditions.

The intent of the Plan is to assess water quality changes and to mitigate risk to human health. An assessment of potential risk to human health will determine the level of notification. GVW may assist operations on an appropriate operational response and action plan to return water quality to a normal state.

Operational Communications for Mission Hill and Duteau Water Treatment Plants

Tables 1-6 were developed to provide guidance for identification of a water quality deviation at the treatment plants. While these tables are meant as guides, it is understood that deviations are dealt with collaboratively.

The operator/supervisor should:

- Inform their immediate supervisor and assess the situation when water quality or operational parameters deviate from normal conditions.

- Follow the tables and if the deviation is:
  - Moderate - inform the call list below **within 24 hours** of the specific changes in water quality that occurred outside of acceptable levels.
  - Major - inform the call list below **immediately. If no response, try another contact or contact method using the contact list (ERP - Appendix H).**

  Call List Order:
  1. **Tricia Brett**
  2. **John Lord**
  3. **Zee Marcolin**

RDNO should:

- inform the DWO/MHO by phone, email, weekly reports, or monthly reports depending on the type of deviation.

Water Distribution Operators Guidance

Tables 7-11 were developed to assist operators who are operating the GVW distribution system. These tables and notes provide guidance for water quality deviation within the water distribution system.

The operator should:

- Inform RDNO and assess the situation when water quality or operational parameters deviate from normal conditions

- Follow the tables and if the deviation is:
  - Moderate - inform GVW **within 24 hours** of the specific changes in water quality that occurred outside of acceptable levels.
  - Major - inform GVW **immediately. If no response, try another contact or contact method using the contact list (ERP - Appendix H).**

Call List Order:

1. **Tricia Brett**
4. **John Lord**
5. **Zee Marcolin**

Note: After hours, call cell numbers FIRST - until you get a live RDNO voice. While RDNO has made an effort to ensure the calls are not affected by the do not disturb feature, please note many RDNO employees use *Do Not Disturb Mode* on work cellphones. To ensure a call goes through after work hours, **phone twice within 3 minutes**.

- Inform their immediate supervisor of the situation if they wish

RDNO should:

- Inform the DWO/MHO by phone, email, weekly reports, or monthly reports depending on the type of deviation.

Communication through the comment section on water quality worksheets is required.

All corrective actions and abnormal observations are to be recorded in the comments section of the water quality worksheets. Corrective actions include, but are not limited to: additional sampling, water main flushing, increased chlorine levels, inspect sample site, and investigation of possible cross connection. For further direction on water quality emergencies follow the ***Greater Vernon Water Emergency Response Plan***.

Tables 1 to **11** are intended as guidance as to what can trigger a deviation and indicate what may be the response. They are intended to support decision making and indicate critical points.

Table 1: Chlorine Treatment at the Treatment Plant

Deviation Type	**Conditions / Actions**					
	Kalamalka Lake - Mission Hill Water Treatment Plant (MHWTP)	Duteau Creek Water Treatment Plant (DCWTP)	Okanagan Lake Outback	Okanagan Lake Delcliffe	Well#1/3 Coldstream Ranch	Deep Antwerp #2 Emergency Well
Target	1.8-2.2 ppm for 483 PZ. 1.8- >2.20 ppm for 550 PZ.	1.9 ppm (set by distribution)	1.0 – 2.0 ppm	1.2 – 2.0 ppm	0.5 ppm	~0.5 ppm
Moderate Deviation	Free chlorine residual below 0.80 ppm at outflow analyzer to 483 PZ or 550 PZ from MHWTP	Free chlorine residual below 1.00 ppm at Post - UV outflow	Free chlorine residual below 0.50 ppm	Free chlorine residual below 0.50 ppm	Free chlorine residual below 0.25 ppm	Free chlorine residual below 0.25 ppm
Response	Discuss: - Why not achieving target - Whether or not notification - Look at distribution - Take 200 mL bacterial sample at plant outflow	- Monitor distribution chlorine - Take 200 mL bacterial sample at plant outflow	- Take 200 mL bacterial sample at reservoir outflow	- Take 200 mL bacterial sample at reservoir outflow and in distribution	- Is the source being used for drinking?	- Is the source being used for drinking?
Major Deviation Initiates Investigation	- Malfunction of chlorination - chlorine interruption and plant continues to run - Unchlorinated water in distribution	- Malfunction of chlorination - Unchlorinated water in distribution	- Free chlorine below 0.20 ppm at reservoir outflow to Outback strata	- Malfunction of chlorination - Unchlorinated water in distribution	- Chlorine interruption and well continues to run	- Chlorine interruption and well continues to run
Response	- Can the unchlorinated water be isolated to an area and flushed? - Untreated water into the distribution – notification to the public if needed	- Can the unchlorinated water be isolated to an area and flushed? - Untreated water into the distribution – notification to the public if needed. - Look at booster stations to isolate incident or to help with residuals	- Public notification if necessary	- Can the unchlorinated water be isolated to an area and flushed? - Untreated water into the distribution – notification to the public if needed	- Is the source being used for drinking?	- Is the source being used for drinking?

Table 2: Bacteria at Source

Deviation Type	**Conditions / Actions**					
	Kalamalka Lake Raw water Sample Station	Duteau Creek (untreated line at Headgates Cl2 bldg.)	Okanagan Lake Outback Lake station	Okanagan Lake Delcliffe Lake Station	Well #1 at Coldstream Ranch	Deep Antwerp # 2 Emergency Well
Moderate Deviation	>20 *E.coli* bacteria per 100 mL >50 Total Coliform per 100 mL	>20 *E.coli* bacteria per 100 mL >200 Total Coliform per 100 mL	>20 *E.coli* bacteria per 100 mL >50 Total Coliform per 100 mL	>20 *E.coli* bacteria per 100 mL >50 Total Coliform per 100 mL	>1 *E.coli* bacteria per 100 mL	>1 *E.coli* bacteria per 100 mL
Response	Monitor the situation as an increase in bacteria counts may indicate a contamination event.					
Major Deviation Initiates Investigation	>50 *E.coli* bacteria per 100 mL in consecutive samples >200 Total Coliform per 100 mL in consecutive samples	>50 *E.coli* bacteria per 100 mL in consecutive samples >200 Total Coliform per 100 mL in consecutive samples	>50 *E.coli* bacteria per 100 mL in consecutive samples >200 Total Coliform per 100 mL in consecutive samples	>50 *E.coli* bacteria per 100 mL in consecutive samples >200 Total Coliform per 100 mL in consecutive samples	>1 *E.coli* bacteria per 100 mL in consecutive samples	>1 *E.coli* bacteria per 100 mL in consecutive samples
Response	May indicate watershed or groundwater contamination event. ***Inform Operations***					

Table 3: Turbidity after Treatment

Deviation Type	**Conditions / Actions**					
	Kalamalka Lake - Post Mission Hill WTP	Duteau Creek WTP - Post UV	Okanagan Lake Outback Booster Station – Post UV	Okanagan Lake – Delcliffe	Deep Antwerp #2 – Before Chlorination	Well #3 Coldstream Ranch
Moderate Deviation ***Trended on a 24 hour average***	> 3 NTU (Table 6)	>1 NTU	> 1 NTU	> 1 NTU	> 1 NTU	> 1 NTU
Response	- Confirm online monitoring accuracy. - Turbidity follows Operational Guideline (Table 6). - Notify Manager-Water Quality	- Confirm online monitoring accuracy. - Notify Manager-Water Quality	- Confirm online monitoring accuracy. - Notify Manager-Water Quality	- Confirm online monitoring accuracy. - Notify Manager-Water Quality	- Confirm online monitoring accuracy. - Notify Manager-Water Quality	- Confirm online monitoring accuracy. - Notify Manager-Water Quality
Major Deviation **Initiates Investigation** ***Trending or Greater than 30 minutes***	> 5 NTU	> 5 NTU	> 5 NTU	> 5 NTU	> 1 NTU	> 1 NTU
Response	Discussion with Water Quality Team					

Table 4: UV Disinfection

Deviation Type	**Conditions / Actions**		
	Mission Hill Water Treatment Plant	Duteau Creek Water Treatment Plant	Okanagan Lake Outback Booster Station
Moderate Deviation ***Trended on a 24 hour average***	Off- spec water over 10 minutes	Off- spec water over 10 minutes	<90 watts/m^2 under normal flow conditions
Response	- MHWTP UV Transmissivity follows Operational Guideline (Table 6). - Notify Manager-Water Quality	- Notify Lead Water and Supply Operator. - Notify Manager-Water Quality	- Consider restricting flow to bring dose back within UV reactor specifications. - Notify Manager-Water Quality
Major Deviation ***Upward Trending or Greater than 30 minutes***	Malfunction	Malfunction	UV Failure
Response	Discussion with Water Quality Team		

Table 5: DAF Treatment Only

Deviation Type	**Conditions / Actions**
	Duteau Creek Water Treatment Plant
Moderate Deviation	Off-spec water over 10 minutes
Major Deviation	– Primary treatment bypass and turbidity <5 NTU blended water at reservoir – WQA – Bypass with turbidity >5 NTU – BWN – Water Quality Manager to discuss both situations with IHA

Table 6: MHWTP Turbidity and UV Response

	Water Quality Parameters		**Operational Response**
Condition	Turbidity at Mission Hill *24 hour average*	UV Transmissivity	Chlorine Residual (leaving Mission Hill)
1	<1.0 NTU	>86%	Based on water quality set points
2	>1.0 NTU but <3.0 NTU	>86%	0.2 mg/L higher than condition 1 set points*
3	>1.0 NTU but <3.0 NTU	<86%	Moderate Deviation
4	>3.0 NTU and rising	Any UVT	Moderate Deviation
5	>5.0 NTU	Any UVT	Major Deviation, follow Response Plan

Notes:

- *If water quality parameters are moving from those outlined in condition 1 to those outlined in condition 2, residual should be raised by 0.2 mg/L unless residual has already been elevated due to an earlier event.
- The "Decision Tree" also includes the following scenarios that are relevant to our source but may not be covered above:
  - Has the turbidity level exceeded the level for which the system has been designed or validated (e.g., system designed to operate effectively for turbidity levels ≤3.5 NTU but the current turbidity level is 4 NTU)?
  - Have there been failures in the treatment train? For example:
    - Power outage
    - Existing treatment outcomes from chemical disinfection cannot be maintained (e.g., loss of chlorine residual)
    - Decrease in UV dose or lamp failure
    - Decrease in UV transmittance (the amount of light passing through the water)

Table 7: Chlorine in Distribution

Deviation Type	**Conditions / Actions**	**Conditions / Actions**
	Duteau and Kalamalka Water System	Delcliffe Water System
Moderate Deviation	Free chlorine residual below 0.20 mg/L at sampling point	Free chlorine residual below 0.20 mg/L at sampling point
Response	- A bacterial sample should be taken at the water quality monitoring site. - If a positive bacterial result occurs, corrective actions should be taken. - Actions could include flushing, increasing chlorine levels, inspect sample site, and investigate possible cross-connection.	- A bacterial sample should be taken at the water quality monitoring site. - If a positive bacterial result occurs, corrective actions should be taken. - Actions could include flushing, increasing chlorine levels, inspect sample site, and investigate possible cross-connection.
Major Deviation Initiates Investigation	Free chlorine residual below 0.20 ppm in **high** volume mains (300 mm and larger) and reservoirs	Free chlorine residual below 0.20 ppm in **reservoir**
Response	– Take 200 mL bacterial sample. – If positive bacterial sample, occurs corrective actions should be taken. – Actions could include additional sampling, water main flushing, increasing chlorine dosing, issuing a WQA or BWN. – Call IHA if needed.	– Take 200 mL bacterial sample. – If all bacterial samples are negative, dose reservoir and issue a WQA. – If positive, issue a BWN and dose reservoir. – Call IHA if needed.

Table 8: Bacteria in the Distribution System

Deviation Type	**Conditions / Actions**	**Conditions / Actions**
	Total Coliform	Escherichia coli (*E.coli*)
Target	0 Total Coliform per mL	0 *E.coli* per mL
Moderate Deviation	- Presence of Total Coliform on consecutive samples - >10 Total Coliform bacteria per 100 mL on one sample - More than one (1) sample site from a set of samples having presence of Total Coliform on a given sampling date	
Response	- Check other parameters and note if there are changes in turbidity, pH, temperature or conductivity that could relate to change in the source or distribution water and report to water quality - Corrective action(s) refers to but is not limited to additional sampling, water main flushing, increase chlorine levels, inspect sample site, and investigate possible cross-connection	
Major Deviation Initiates Investigation	- More than three (3) samples from a set of samples having presence of Total Coliform on a given sampling date - The third consecutive sample refers to 1) initial sample, 2) re-sample to verify, 3) re-sampled after corrective action has been completed - More than 10% based on a minimum of 10 samples show presence of Total Coliforms - A third consecutive sample confirmed by a certified lab of Total Coliform count or MPN	Presence of *E.coli* bacteria
Response	- Trigger an investigation and type of advisory discussion between RDNO Management and IHA - Trigger an investigation and resample - Trigger an investigation and potential water quality advisory or boil water notice - Check other parameters such as chlorine residual, pH, temperature and conductivity and report to water quality	- Immediately notify IHA - Trigger an investigation and potential WQA or BWN - Note if there is a low chlorine level or other abnormal parameter. Re-sample as soon as possible to confirm presence of E.coli bacteria - Discussion with Management and IHA regarding a BWN

Table 9: Turbidity in the Distribution System

Deviation Type	**Conditions / Actions** Within the Distribution System – Reservoir / Water Main
Moderate Deviation	- Turbidity is suspicious (Turbidity is significantly different than the post WTP value)
Response	- Make note if flushing is occurring in the area or other activities that may affect turbidity. - Make note of Turbidity leaving the treatment plant. - Check other parameters such as chlorine residual, pH, temperature and conductivity and record. - Take a 200 mL bacterial sample.
Major Deviation **Initiates Investigation** ***Trending or Greater than 30 minutes***	- Turbidity in the distribution notably higher than other sites or > 5 NTU unless flushing is occurring.
Response	- Check other parameters such as chlorine residual, pH, temperature and conductivity and report to water quality. - Call RDNO to report a deviation and note if related to the distribution water, maintenance or construction. - Take corrective actions that could include the following: flushing and investigating possible cross connection. - Take a 200 mL bacterial sample.

Table 10: Moderate Deviation Break or Water Quality Event

	Type 1 Break	**Responsibility**
Definition	• Positive pressure >20 PSI maintained during break and repair. • No signs of contamination intrusion.	
Steps:	1. Isolate and repair break following AWWA C651-23. 2. Flush water of concern out of pipe following AWWA C651-23 Flushing – 5.5.3.1 3. Verify chlorine residual, turbidity, pH, conductivity values align with pre break levels or nearby levels of the distribution system. 4. Report break to RDNO within 24 hours.	Operator

Table 11: Major Deviation Break or Water Quality Event

	Type 2 Break	Type 3 Break or Power Loss	Type 4 Break	Responsibility
Definition	• Positive pressure >20 PSI maintained until a controlled shutdown occurs. • No sign of contamination intrusion.	• Loss of pressure (<20 PSI) at the break site or within the system prior to shutdown of area. • Possible contamination at site or via cross connection.	• Loss of pressure (<20 PSI) at break site and/or widespread depressurization in the system. • Probable or actual contamination at site or via cross connection	
Steps	1. Contact RDNO Staff. Confirmation of contact is required. State expected affected area.			Operator
	2. Isolate area and preform controlled shutdown. 3. Repair break following AWWA C651-23 protocols. 4. Return water to service and flush following AWWA C651-23 Flushing – 5.5.3.2. Flush all possible contaminated water from the system. Notify RDNO staff if flushing did not occur.	2. Isolate area around break. 3. Repair break following AWWA C651-23 protocols. 4. Return water to service and flush following AWWA C651-23 Flushing – 5.5.3.3. Flush all possible contaminated water from the system. Notify RDNO staff if flushing did not occur.	2. Isolate area around break and depressurized area. 3. Repair break following AWWA C651-23 protocols. 4. Return water to service and flush following AWWA C651-23 Flushing – 5.5.3.3. Flush all possible contaminated water from the system. Notify RDNO staff if flushing did not occur.	Operator
	5. Determine alert level: • Water Quality Advisory if adequate flushing. • Boil Water Notice if adequate flushing not preformed.	5. Determine alert level: • Water Quality Advisory if adequate flushing. • Boil Water Notice if adequate flushing not preformed.	5. Boil Water Notice	RDNO Staff
	6. Delineate affected area with appropriate alert sandwich boards as designated by RDNO staff. If after hours, place generic “Water Quality Event” signs. 7. Record chlorine residuals, pH, conductivity, temperature and turbidity after flushing to ensure values are back to normal ranges. Deliver sheet to lab. 8. Take 1 bacterial sample from at least 1 site if adequate flushing occurred. Take 2 samples at least 24 hours apart from at least 1 site if adequate flushing did not occur. Larger areas may require additional sample sites to delineate entire area. 9. Document Incident and actions taken and report to RDNO.	6. Delineate affected area with appropriate alert sandwich boards as designated by RDNO staff. If after hours, place generic “Water Quality Event” signs. 7. Record chlorine residuals, pH, conductivity, temperature and turbidity after flushing to ensure values are back to normal ranges. Deliver sheet to lab. 8. Take 1 bacterial sample from at least 1 site if adequate flushing occurred. Take 2 samples at least 24 hours apart from at least 1 site if adequate flushing did not occur. Larger areas may require additional sample sites to delineate entire area. 9. Document Incident and actions taken and report to RDNO.	6. Delineate affected area with Boil Water Notice sandwich board signs. 7. Record chlorine residuals, pH, conductivity, temperature and turbidity after flushing to ensure values are back to normal ranges. Deliver sheet to lab. 8. Take 2 samples at least 24 hours apart from at least 1 site. Larger areas may require additional sample sites to delineate entire area. 9. Document Incident and actions taken and report to RDNO.	Operator