Water Operations

2023 Annual Report

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LAKE COUNTRY
Life. The Okanagan Way.

Contents

Water Operations

2023 Overview

The following is intended to inform and summarize 2023 data collections, observations, and work completed by DLC staff with regards to water operations and water quality.

Water operations highlights include:

- City of Kelowna System Separation
- Vernon Creek Intake Cleaning
- Okanagan Centre Watermain Replacement
- Intake Buoys
- 2023 Lake Country Wildfire
- Watermain Line Valve Improvements
- Fixed Meter Network
- Pump Servicing and Rebuilds
- Beaver Lake Water Treatment Plant (WTP) Bench Scale Pilot

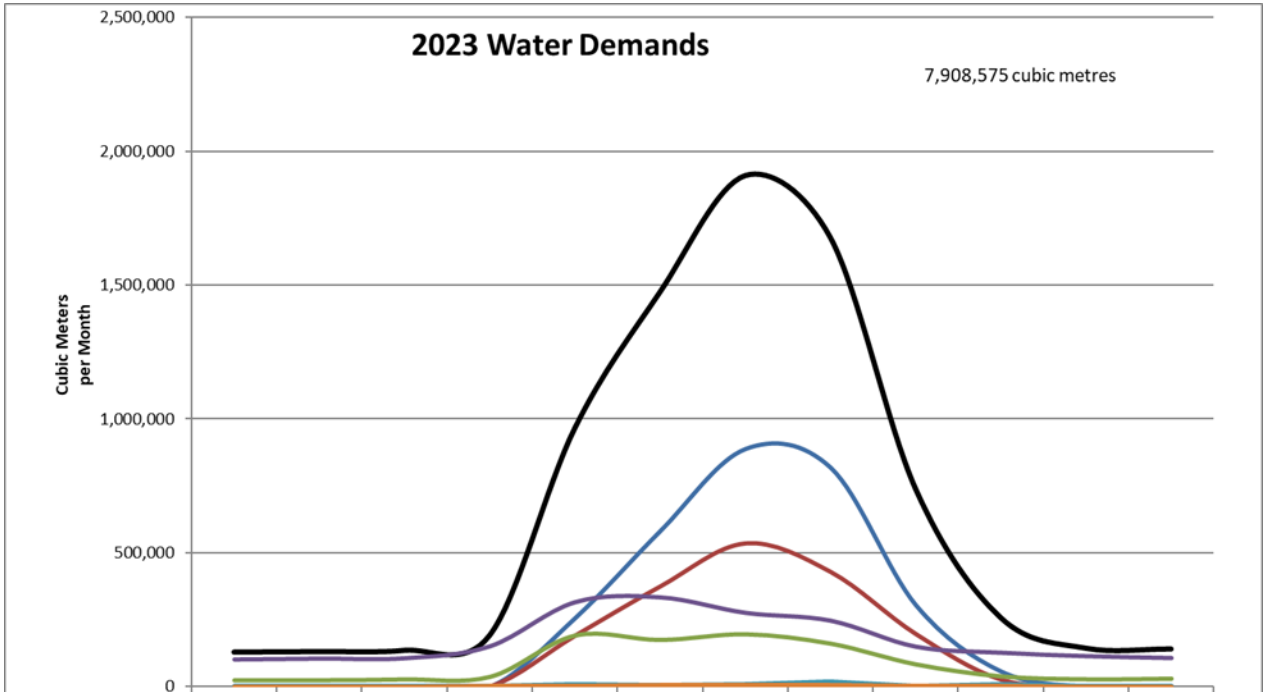
System Descriptions and Classification

The District of Lake Country (DLC) is a growing municipality with an approximate population of 15,000 people. Not all 15,000 residents are connected to the DLC's public water systems. The primary upland sources used by the DLC include Beaver Lake, Crooked Lake, Oyama Lake, and Damer Lake. The lower elevation water sources are Okanagan Lake (3 separate intakes) and Kalamalka Lake.

Infrastructure within the DLC owned water systems include 6 storage dams, 10 reservoirs, 6 chlorine injection systems, 9 pump houses, 2 UV disinfection systems, 6 pressure boosting stations, 41 pressure reducing stations, 85 pressure reducing valves, 514 hydrants, and approximately 200 km of water distribution mains.

Water Demands

The consumption demand of each source within the District varies according to the total number and types of connections serviced by each source. These connection types include residential, commercial, industrial, institutional, seasonal irrigation and agricultural. Total water usage among all District water systems in 2023 was 7,908,575m^3 (see Figure 1 for water consumption by source). Despite prolonged periods of zero precipitation over the summer, water demands in 2023 remained slightly below average.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total	130,440	132,335	136,991	193,076	966,757	1,474,797	1,909,557	1,678,313	740,456	258,885	144,922	142,046
Beaver Lake	0	0	0	0	256,360	581,258	887,175	817,114	304,801	57,396	0	0
Oyama Creek	0	0	0	0	189,713	374,162	534,954	427,976	195,672	25,045	0	0
Kalamalka Lake	24,328	24,458	27,550	37,003	189,859	173,397	194,592	159,840	83,278	38,777	28,050	30,185
Okanagan Lake	102,652	105,902	107,235	152,182	316,978	334,999	277,002	247,843	150,504	127,894	115,097	108,084
Lake Pine	2,736	1,422	1,361	2,752	9,910	6,468	10,067	20,127	2,611	8,525	1,119	2,935
Coral Beach	724	553	845	1,139	3,937	4,513	5,767	5,413	3,590	1,248	656	842

Figure 1. *2023 DLC water demands from each source reported as cubic meters per month.*

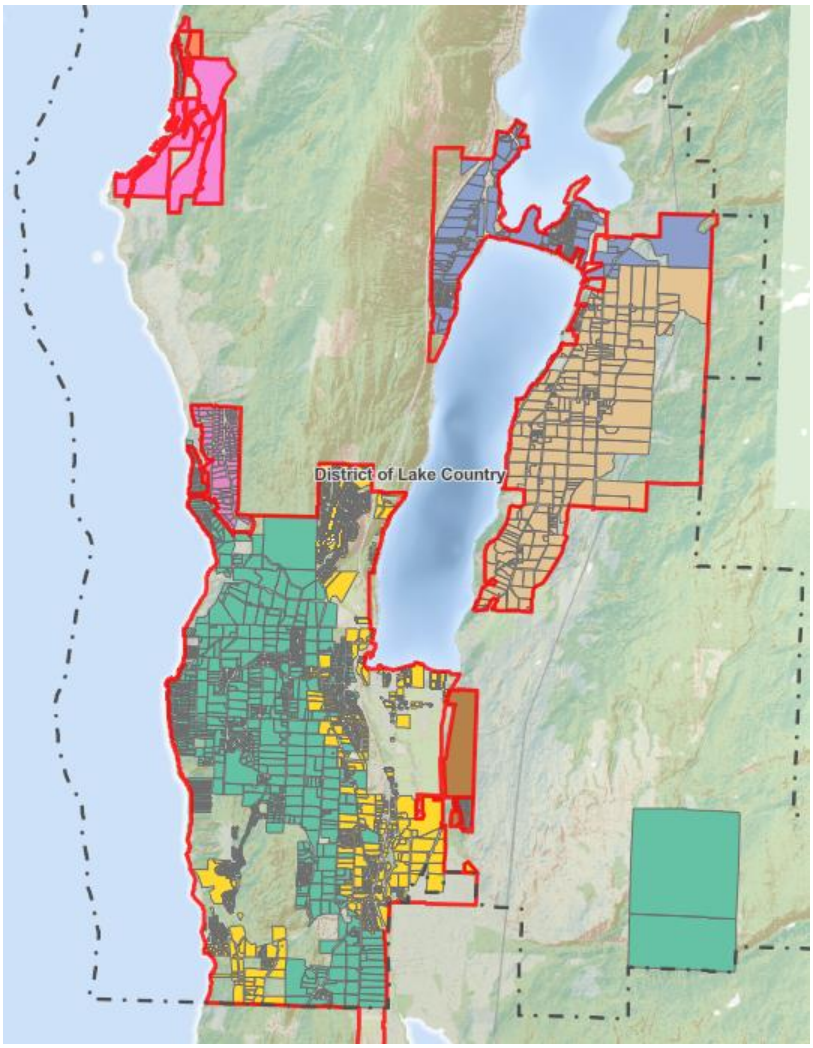
- *Zero demand months on the Oyama Lake source is due to the DLC supplying the Oyama Lake source with the Kalamalka Lake source during periods of low consumption.*
- *Zero demand months on Beaver Lake source is due to the DLC supplying the Beaver Lake source with Okanagan Lake source during periods of low consumption.*

Water Sources

The DLC uses and monitors four separate water sources:

1. Beaver Lake (Crooked Lake chain flows into Beaver Lake)
2. Oyama Lake (Damer Lake flows into Oyama Creek)
3. Okanagan Lake
4. Kalamalka Lake

To review a water source area map, go to: [MyWater Map vII (arcgis.com)]



2023 Snowpack

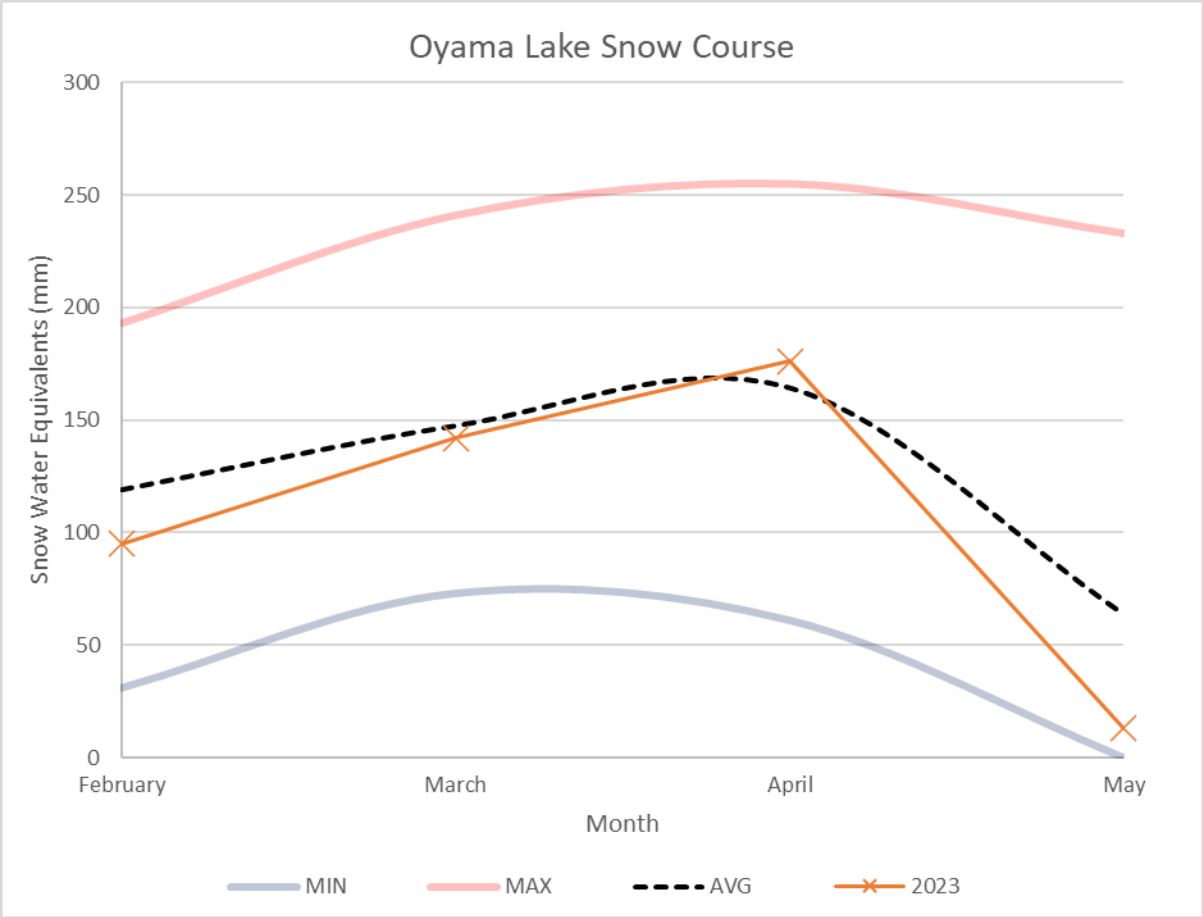


Figure 2. *2023 Oyama Lake Snowpack*

2023 was the fourth year the automated snow course was operational. The real time data that is collected from the automated weather station and was manually verified until 2023. The weather station records humidity, ambient temperature, snow depth, and snow water equivalents required for proper watershed management. Now that manual verification has confirmed accuracy, the automated snow course will reduce the need for DLC staff to travel to the upper elevation watershed during winter months, thereby reducing safety concerns. To see the historical snow survey data for Oyama Lake please visit the BC River Forecast Centers website, and search for the station ID "*2F19P*".

2023 Freshet & Releases

The March 31, 2023 snow pack results indicated a 25% higher than average snow depth with a water equivalent of 7% higher than average. District staff decided not to release water from Beaver Lake other than the required base flow as Beaver Lake was well below average for the time of year.

District staff decided to release approximately 200 L/s from Oyama Lake to maintain the current lake level at historic average for the time of year.

March of 2023 went on to be the driest on record which depleted the snow in the upland watershed earlier than normal. Beaver and Oyama Lakes both filled and spilled slightly.

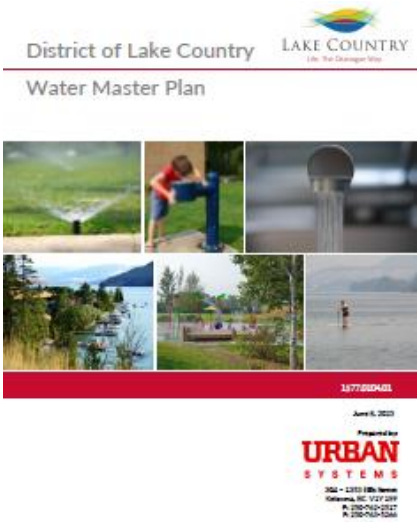
Cross Connection Control Program (CCCP)

Ensuring the integrity of our water supply system is paramount, and the District upholds this commitment by implementing robust protocols for managing backflow devices and ensuring regulatory compliance standards are met. Testing of known or required backflow prevention devices occurs in compliance with CSA Standard B64.10-11/B64.10.1-11 and amendments thereto. All new construction and businesses are required to meet or exceed DLC regulations related to Cross-Connection Control. Bylaw 984 (Water Rates & Regulations Bylaw) empowers staff to inspect and enforce cross-connection control requirements in the BC Building Code and CSA Group standards. The program has become an integral part of the DLC's multi-barrier approach to protecting our community's drinking water. Existing facility assessments continue to take place on a rotating scheduled basis to ensure that any changes in ownership/usage are captured by the CCC program and protection devices are installed where required. The Cross Connection Control Manager utilizes FAST software to monitor compliance efficiently, ensuring prompt response to any deviations from regulatory requirements.

As of 2023, the District effectively manages backflow devices across 826 properties in accordance with Water Rates & Regulation Bylaw 984. The following table delineates the distribution of properties by type:

	Properties	Backflow Devices
ICI	145	299
Residential	202	205
Agriculture	440	447
DLC Facilities	39	63
Total	**826**	**1014**

Water Master Plan



The updated Water Master Plan was approved by Council in 2023. The key initiative of the Water Master Plan was to prepare a strategy outlining what is required to support 20 years of growth within our community. This plan considers our communities needs, priorities, and abilities to fund desired improvements. Key considerations of the report look at how our community will manage climate change, infrastructure failure, changing regulations and water quality, growth related changes, funding requirements, and major changes to the watershed. A full copy of the report can be found on the District website.

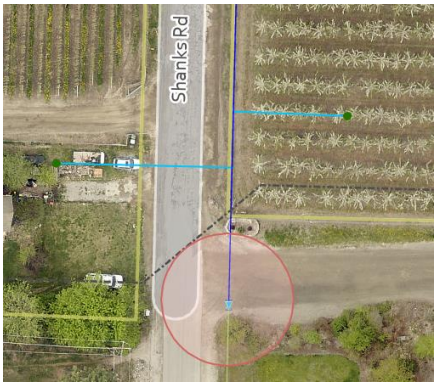
Annual Operations Summary

Annual operational duties that are completed by DLC staff:

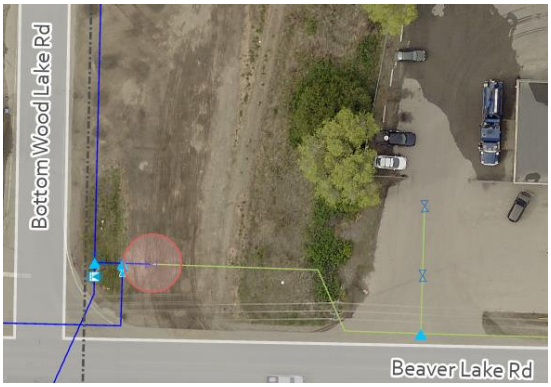
- Service installation and repairs
- Collection and analysis of water sampling
- Upland dam inspections and water releases
- Maintenance and cleaning of all reservoirs, chlorination, and pumping facilities.
- Air valve maintenance
- Meter installations, troubleshooting, reads and repairs
- Pressure reducing valve maintenance
- Hydrant maintenance
- Line valve maintenance
- Main line leak repairs
- Seasonal irrigation turn on and offs
- Responding to customer complaints and inquiries
- Cross connection control assembly testing
- Watermain flushing

City of Kelowna System Separation

In 2023, the District took steps to separate water infrastructure that was previously located within the City of Kelowna. Water mainline valves were installed at the District and City boundaries on both Shanks Rd and Beaver Lake Rd. These valves delineate ownership of the water distribution system between the municipalities.



Shanks Rd mainline valve location



Beaver Lake Rd mainline valve location

Vernon Creek Intake Cleaning

In January, DLC operations drained and cleaned the Vernon Creek intake pond. The intake is the start of the Beaver Lake distribution system. This large-scale project is performed every 5 years and takes several days to complete. Removing organic sediment from the pond ensures capacity for seasonal freshet and improves water quality.

Cleaning of the Vernon Creek intake pond

Dam Inspections and Maintenance

Inspections of the upland dams (Beaver, Crooked, Oyama, and Damer) are completed by DLC staff weekly when water levels are normal. Increased inspections occur when water levels increase. Dam maintenance is completed every fall by District staff. During dam maintenance in the fall of 2023 new rip rap was installed and extended coverage on the upstream face of the dam at Damer Lake.

Newly placed rip rap and graded dam crest at Damer Lake

Okanagan Centre Water Main

A development driven watermain installation initiated a 3-phase program to increase fire flows to the lower Okanagan Centre area back in 2020. In 2021, a new pressure reducing valve (PRV) station was constructed on Hare Road. In 2022, aging watermain was replaced and upsized along Hare Road and down Sixth Street. 2023 saw the final phase of the project with the replacement of aging watermain from Sixth Street to Maddock Avenue, between Fourth and Seventh Streets. Additionally, a preexisting PRV chamber was replaced with an above-ground PRV station; thereby eliminating a confined space hazard.

Directional drilling a portion of the new watermain (left) and the new PRV station (right).

Intake Buoys

District owned water intakes on Okanagan Lake and Kalamalka Lake were marked with yellow buoys to alert waterway users of their presence and avoid damage from boats anchoring.

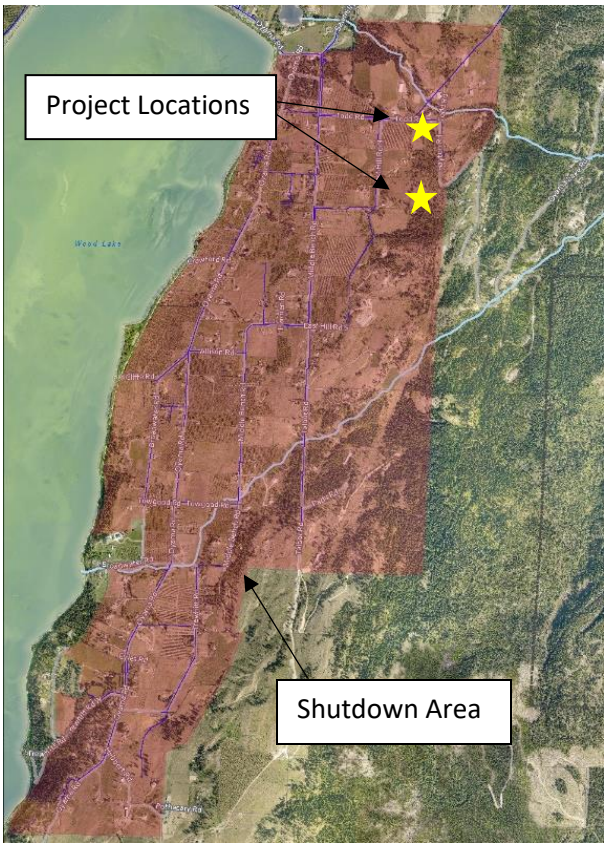
2023 Lake Country Wildfire

In August, the McDougall Creek wildfire jumped across Okanagan Lake igniting a wildfire within the District of Lake Country. While maintaining personal safety, utility crews were tasked with operating the water system during extreme demand. Operations became more challenging following the loss of communications to pump stations and reservoirs, as some radio towers were lost to the fire. With the increased risk of losing power to the Okanagan Lake pumphouse, Beaver Lake water was used to provide fire flows to the Okanagan Lake system. While peak water demand only lasted a couple of days, system restoration and post fire maintenance carried out for weeks.

Wildfire proximity to electrical kiosk (left) and Okanagan Lake reservoir (right)

Watermain Line Valve Improvements

In June, the Oyama Lake water system was shutdown to remove two aging watermain line valves from the transmission main. The majority of the work was performed along East Hill Rd and Todd Rd. Along with the installation of two new fire hydrants, small sections of aging watermain were also removed during the shutdown.



Reservoir Cleaning

The DLC uses a diving company to conduct reservoir inspections with an ROV unit as needed. In some instances, the DLC also uses divers to clean the reservoirs. When using a diver is not possible, the DLC operations crew will drain and clean the reservoir. In 2023 DLC staff cleaned, and inspected the Oyama Creek Reservoir, Lower Lake Pine Reservoir, and Coral Beach Reservoir.

Fixed Meter Network

Following the success of last years fixed water meter reading tower, two new reading towers were installed at the Wastewater Treatment Plant and the Upper Lake Pine Reservoir. Approximately 80% of all the District water meters are now able to be read from this one site. Installation of the meter reading network has both reduced operational hours required to manually read water meters each month and allowed DLC staff to provide enhanced, real-time customer service to residents who have inquiries about their water consumption or potential leaks. The long-term goal of the fixed meter reading network is to provide residents with their own means to access real-time water consumption data and leak alarm monitoring.

Pump Servicing and Rebuilds

During routine inspection, a leak was found on one of the 100HP pumps at the Glenmore Booster Station. Due to the importance of this equipment and severity of the leak, the pump end and motor were rebuilt by pump specialists. Operations took this opportunity for preventative maintenance to rebuild the other pump at this station.

Two split case pumps and motors were rebuilt at the Sawmill Booster station after routine maintenance found the pumps were not meeting their performance standards.

Okanagan Lake Pumphouse has three 750 HP vertical turbine pumps. In late 2022 one of the motors was sent out for repairs and servicing. With the pump out of service the operations staff used this opportunity to remove the pump and send it out to a third party for a complete overhaul.

Okanagan Lake Pumphouse, lifting the pump out (left) and lowering the serviced pump back in place (right).

Beaver Lake Water Treatment Plant (WTP) Bench Scale Pilot

In 2022, the District identified a multi-barrier treatment approach for the Beaver Lake water source. In 2023, the District initiated a Bench Scale Testing Plan to validate the proposed treatment processes and guide the subsequent design phase of the planned Beaver Lake water treatment plant. This testing program, conducted from April to September, aimed to account for seasonal variations in water quality and treatment parameters. It involved weekly sampling and monitoring of raw water quality to enhance the existing characterization of Beaver Lake water. Additionally, a series of jar tests and specialized testing were carried out, strategically scheduled in May, June, and September to capture various design water quality scenarios, such as freshet, a landslide event, and the more stable water conditions typically seen in the fall and winter.

Images 1& 2: Sample being collected for specialty testing after Landslide event.

Image 3: Jar Testing to evaluate coagulation chemistry.

Potable Water Emergency Response Plan

The DLC has a Potable Water Emergency Response Plan that is updated annually (or more often as required). The plan outlines operational response and communication procedures that are to be undertaken in an emergency event that may present health threats to people using the water system. Emergency events include, but are not limited to power outages, loss of supply, watermain breaks, and algae blooms. Both the Emergency Response Plan and Annual Water Operations Report are provided to IHA annually.

Beaver Lake Watershed Environmental Releases

In the fall of 2023, the Province once again requested the District to release water from Beaver Lake that exceeded the agreed-upon environmental flow regime. These additional releases were necessary to support the Kokanee spawning in middle-Vernon creek. While the importance of spawning and environmental releases is recognized, this practice is not considered sustainable given the constantly changing climate. The District is actively collaborating with the Province to establish a water management plan aimed at developing a sustainable approach to ensure environmental flows during periods of drought.

Water Quality

Regulatory and Resources

Water purveyors in British Columbia are mandated to supply potable water to their users in accordance with the BC's Drinking Water Protection Act. In 2012, the Province introduced BC Drinking water objectives for surface water supplies in British Columbia. These treatment objectives are designed to ensure the delivery of microbiologically safe drinking water. They establish minimum performance targets for water suppliers, focusing on the treatment of water to eliminate enteric viruses, pathogenic bacteria, Giardia cysts, and Cryptosporidium oocysts. This framework maintains adherence to the 4-3-2-1-0 treatment objectives.

- 4-log (99.99 percent) inactivation and/or removal of viruses,
- 3-log (99.9 percent) inactivation and/or removal of Giardia and *Cryptosporidia*,
- Two treatment processes for surface water
- Less than or equal to one nephelometric turbidity unit (NTU) of turbidity
- No detectable E.coli, fecal coliform and total coliforms

Water suppliers in British Columbia must develop and implement a plan to meet this standard. Meeting this objective significantly reduces risks to human health. Additionally, it is mandatory for water suppliers to transparently identify any risks associated with water supplies that do not meet these standards. This empowers the public to make informed decisions about any necessary additional steps to safeguard themselves, their families, and their guests.

The Oyama and Beaver Lake water treatment facilities solely employ chlorination and do not achieve the required 3-log (99.9 percent) inactivation and/or removal of Cryptosporidium. The health impacts stemming from exposure to certain Protozoa, such as Giardia and Cryptosporidium, vary depending on the individual's immune system. Consequently, the Oyama and Beaver Lake water sources are under a year-round water quality advisory. This advisory recommends that individuals with compromised immune systems boil the water for at least 1 minute before consumption. These concerns and risks have been addressed in our 2023 Water Master Plan (WMP), and ongoing discussions with IHA (Interior

Health Authority) regarding the challenges and implementation of meeting these standards persist. Customers who are immune-compromised or may serve water to such individuals are urged to register for the sensitive customer list through the District of Lake Country (DLC) at Engineering@lakecountry.bc.ca. This registration ensures that they receive timely notifications regarding any changes in water quality.

The DLC remains committed to advancing efforts towards achieving compliance with the drinking water treatment objectives.

Water Quality Testing

This section offers an overview of the water quality testing conducted in 2023 for the water sources of the District of Lake Country (DLC). Throughout the year, DLC's distribution sites undergo monitoring for water chemistry parameters such as free and total chlorine, turbidity, temperature, pH, and conductivity. Additionally, tests are conducted to detect the presence of bacteria, including total coliforms and E. coli.

Overall, the majority of water chemistry and bacteriological results indicate compliance with the Guidelines for *Guidelines for Canadian Drinking Water Quality* However, there are instances where certain parameters exceed the maximum acceptable concentrations

Vernon Creek covered in snow.

Instrument Calibration and Quality Control

Before collecting field data or verifying on-line equipment, field instruments undergo regular checks against standards to guarantee accuracy. They are maintained and calibrated as necessary prior to field use. Furthermore, a certified accredited agency (such as Hach) conducts annual inspections and provides certification for all water quality monitoring field equipment.

The online water quality monitoring equipment that uploads directly to Supervisory Control and Data Acquisition (SCADA) undergoes weekly verification using handheld water quality equipment. Additionally, the equipment is regularly maintained and calibrated according to manufacturer guidelines, with additional attention as necessary.

Water Chemistry

Turbidity, a measure of suspended particulate matter in water, occurs naturally in some areas and can be amplified by human activities upstream from our intake locations, such as recreation, cattle ranching, and logging. Elevated turbidity levels can create a favorable environment for microorganisms, shielding them from disinfection and thereby increasing the demand for chlorine. The Canadian Drinking Water Guideline (GCDWQ) establishes a maximum allowable concentration for turbidity in water distribution systems at 1 NTU.

Chlorine serves as the primary disinfectant for all DLC water sources. Both free and total chlorine levels are monitored to verify the effectiveness of the disinfection process and to maintain a residual throughout the distribution systems.

Ultraviolet (UV) water treatment works by inactivating pathogens in surface water (such as cryptosporidium, giardia lamblia and more) with UV radiation. The UV light radiation disrupts their DNA and disables their ability to replicate. UV disinfection provides no residual to prevent system regrowth. The Kalamalka and Okanagan Lake sources utilize ultraviolet water treatment as a secondary form of disinfection. Ultraviolet operations log sheets are contained in Appendix F

Temperature and pH levels can influence both the odor and taste of water, as well as affect the efficiency of the disinfection process. For optimal palatability and to deter the growth of nuisance organisms, the temperature of potable water should ideally be below 15°C. According to the Guidelines for Canadian Drinking Water Quality (GCDWQ), the pH of water should fall within the range of 7.0 to 10.5. Ensuring proper pH levels is essential for maximizing treatment efficacy, managing corrosion, and reducing leaching from distribution systems and plumbing components.

Conductivity (the ability of an aqueous solution to carry an electrical current) is used as a quick indicator of changes occurring in the natural waters.

Colour creates high disinfectant demands and is an indicator of potential increased dissolved organic matter which, when combined with chlorine, forms disinfectant by-products. The GCDWQ for true colour is <15 TCU.

Water Chemistry Results

For all sources, any water chemistry parameters recorded daily through supervisory control and data acquisition (SCADA) are not included in the data below. SCADA information is reported monthly to IHA. The monitoring of source and distribution water is carried out weekly, with sampling rotated through all sites as outlined in the District of Lake Country Water Quality Monitoring and Reporting Plan.

The chemistry of distribution water can fluctuate for various reasons. Seasonal shifts in water demand, the timing of sampling after system flushing or the use of hydrants, and the mixing of water sources can all contribute to these changes. It's common within a distribution system to detect trace levels of free chlorine in dead ends or low-use areas. Free and total chlorine levels are closely monitored, and if levels are low, or if turbidity and color are elevated, among other potential circumstances, actions are taken in accordance with our Interior Health-approved Potable Water Quality Emergency Response protocols.

The Beaver and Oyama sources frequently fell short of meeting pH range objectives of 7.0-10.5, whereas the lower elevation sources on Okanagan and Kalamalka generally remained within the specified range. Temperature across all systems fluctuates with changes in outdoor ambient temperature and raw water conditions. While annual averages across all systems comfortably remained below the 15 degrees guideline, some systems experienced peak summer temperatures that exceeded this threshold.

Distribution water quality results are in tables 1 -6 below for DLC Water Systems. The list of sample sites for each distribution system can be found in Appendix B

Beaver Lake Source

Table 1. *2023 Annual Distribution Water Chemistry Results: DLC Water System; Beaver Lake Source (All data reported from weekly water quality monitoring using hand-held equipment). It should be noted that occasionally the distribution water sampled is a mixture of both sources (Okanagan Lake mixed into Beaver distribution) and variation from the norm occurs within the data.*

Beaver Lake Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.13	0.28	0.29	9	6.0	70
MAX	3.20	2.7	5.25	21	8.0	200
AVG	1.25	1.19	1.42	16	6.9	83

Low chlorine is commonly detected at end of the line sites. When low chlorine or high turbidity occurs our standard deviation response plans are initiated. Follow up procedures may include further bacteriological sampling, flushing or other operational practices to improve water quality. At all times Bacteriological sampling was good and corrective measures as per our plan were followed.

Okanagan Lake Source

Table 2. *2023 Annual Distribution Water Chemistry Results: DLC Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Okanagan Lake Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.01	0.01	0.4	1	7.9	250
MAX	3.5	2.03	1.25	18	8.3	399
AVG	0.96	1.03	0.48	8	8.0	284

When low chlorine or high turbidity occurs our standard deviation response plans are initiated. Follow-up procedures may include further bacteriological sampling, flushing or other operational practices to improve water quality. At all times Bacteriological sampling was good and corrective measures as per our plan were followed.

Oyama Lake Source

Table 3. *2023 Annual Distribution Water Chemistry Results: DLC Water System; Oyama Lake Source (All data reported from weekly water quality monitoring using hand-held equipment). Occasionally the distribution water sampled is a mixture of both sources (Oyama Lake and Kalamalka Lake) resulting in data variations within the data. Oyama water source is typically online mid-May through mid-October (mixing of sources in the Oyama reservoir occurs for a short time following the switch).*

Oyama Lake Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.42	0.58	0.42	10	6.0	51
MAX	4.90	5.4	2.23	21	7.0	76
AVG	2.40	2.82	0.96	16	6.2	58

Kalamalka Lake Source

Table 4. *2023 Annual Distribution Water Chemistry Results: DLC Water System; Kalamalka Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Kalamalka Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.10	0.24	0.22	1	7.9	400
MAX	3.50	3.8	1.50	15	8.4	439
AVG	1.29	1.48	0.89	8	8.1	402

Coral Beach Water System

Table 5. *2023 Annual Distribution Water Chemistry Results: Coral Beach Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Coral Beach (OK Lake) Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH (sU)	Conductivity (uS/cm)
MIN	0.24	0.35	0.22	1	7.1	288
MAX	1.64	1.83	1.75	16	8.4	362
AVG	0.83	0.98	0.55	11	8.0	308

Lake Pine Water System

Table 6. *2023 Annual Distribution Water Chemistry Results: Lake Pine Water System; Okanagan Lake Source (All data reported from weekly water quality monitoring using hand-held equipment).*

Lake Pine (OK Lake) Water System	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Turbidity (NTU)	Temp (°C)	pH	Conductivity (uS/cm)
MIN	0.19	0.25	0.15	4	7.8	283
MAX	2.80	3.1	0.89	17	8.1	355
AVG	1.00	1.15	0.36	10	8	319

Bacteriological Regulations and Results

DLC adheres to bacteriological water quality monitoring standards outlined in the Guidelines for Canadian Drinking Water Quality (GCDWQ) and the *Drinking Water Protection Act (DWPA)* and *Regulations (DWPR).* Chlorine, either in gas or hypochlorite form, is employed across all DLC water sources for disinfection against waterborne pathogens, with chlorine residuals monitored in the distribution lines. In addition, ultraviolet (UV) disinfection is implemented on the Kalamalka and Okanagan Lake sources. For UV system deviations from specifications, refer to Appendix F.

Drinking water samples are collected weekly within each DLC Water System to monitor physical, chemical, and biological parameters. Membrane filtration microbiological samples undergo analysis at an accredited laboratory. Additionally, 'in-house' analysis with Presence-Absence tests (P/A) is conducted to further assess compliance with the GCDWQ and identify trends and emerging issues.

The required number of monthly samples is outlined in the DWPR Schedule B (Table 7) and the DLC Water Quality and Monitoring Plan; Frequency of Monthly bacteriological tests (Table 8). Weekly Total coliform and E. coli results from raw water sources and throughout the distribution system, including both membrane filtration and Presence-Absence tests, are compiled and submitted to the assigned Drinking Water Officer.

Any results failing to meet water quality standards outlined in the DWPR, Schedule A (Table 9), are promptly reported to the Drinking Water Officer, triggering implementation of corrective actions according to the DLC's Potable Water Emergency Response Plan.

Table 7: *Schedule B – Frequency of Monitoring Samples for Prescribed Water Supply Systems* (*section 8).*

Population Served by the Prescribed Water Supply System:	**# Samples per month:**
less than 5,000	4
5,000 to 90,000	1 per 1,000 of population
more than 90,000	90 plus 1 per 10,000 of population in excess of 90,000

Table 8: *Frequency of monthly bacteriological tests: Membrane Filtration (MF) and Presence-Absence (P/A)*

System/Source	**MF Distribution # samples required per mo.**	**P/A**	**Total MF Distribution and Raw**	**Distribution Bacteriological/Chlorine test sites:**
DLC Water System: Beaver Lake source : Est. Population 3,000	4	2	8	15*
DLC Water System: Okanagan Lake source : Est. Population: 6,000	6	2	8	14**
DLC Water System: Oyama Lake source: Est. Population 625	4	2	8	5
DLC Water System: Kalamalka Lake source: Est Population 750	4	2	8	5
Coral Beach Water System: Okanagan Lake source Est Population 130	4	2	8	2
Lake Pine Water System: Okanagan Lake source Est Population 198	4	2	8	3**
• * Includes Camp Rd. Reservoir (Offline unless required) • ** Includes 2 reservoirs				

Table 9: *Schedule A - Water Quality Standards for Potable Water (sections 2 and 9) DWPR*

Parameter:	**Standard:**
Escherichia coli (*E.coli*)	No detectable Escherichia coli (*E.coli*) per 100 ml
Total coliform bacteria:	
(a) 1 sample in a 30 day period	No detectable total coliform bacteria per 100 ml
(b) more than 1 sample in a 30 day period	At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml

Coliform bacteria are typically harmless but serve as indicators for potential presence of harmful organisms, signaling issues with water treatment or distribution systems. Escherichia coli (E.coli), found in the intestines of humans and animals, suggests fecal contamination if present in drinking water. While most strains do not affect healthy individuals, certain strains like O157:H7 can cause severe illness. BC's Drinking Water Protection Regulation sets a maximum acceptable concentration (MAC) of none detectable per 100 mL for E.coli in drinking water systems.

Background colony counts estimate the general bacterial population in drinking water systems or raw source water when samples are analyzed. Exceeding acceptable levels of Total coliforms or E. coli triggers the Potable Water Quality Emergency Response Plan. Events are documented and reported to identify problem areas, with follow-up sampling and flushing conducted as necessary to maintain water quality in distribution systems.

In 2023, 323 membrane filtration (MF) bacteriological samples were collected and analyzed at Caro Analytical Services (CARO) in Kelowna for total coliforms and E.coli. Additionally, 155 P/A tests were analyzed in-house. The summary of the bacteriological results is in **Appendix A.** P/A tests determine the presence or absence of total coliforms in the sample but do not quantify coliform counts in case of a positive result. These tests are conducted on alternate weeks from the MF samples. In the event of a positive P/A test, additional bacteriological and water chemistry testing is carried out. E.coli was not detected in any DLC distribution systems throughout this period.

Durning the extreme hot weather throughout July and August on 9 occasions, Total Coliform samples were detected in 3 distribution systems (Okanagan, Coral Beach and Lake Pine). Although weather conditions were considered to be a contributing factor the lab performed microbial analysis beyond the maximum holding time (24 hours) on four separate occasions. All sites were resampled confirming no total coliforms. E. coli was not detected within any distribution system in 2023. Summary results can be found in **Appendix A.**

Lead

Under the Drinking Water Protection Act (DWPA), drinking water supply systems in BC are responsible for monitoring water they deliver to verify it is within acceptable limits for lead and other metals. The Guidelines for Canadian Drinking Water Quality (GCDWQ) suggest:

> *The GCDWQ maximum acceptable concentration (MAC) for total lead in drinking water is 0.005 mg/L (5 µg/L), based on a sample of water taken at the tap and using the appropriate protocol for the type of building being sampled. These guidelines further state that every effort should be made to maintain lead levels in drinking water as low as reasonably achievable.*

Most drinking water supply systems in BC typically have lead levels well below 5 µg/L. Lead is typically absent in water leaving treatment plants but may leach from pipes and fixtures within buildings, homes, or service lines connecting homes to water mains. Recent advancements in testing now allow laboratories to measure lead levels below 0.001 mg/L (1 part per billion). Although recent testing detected very low lead levels in various systems, these results lack consistency and are measured in parts per billion (ppb), well below guideline thresholds. Testing and assessment will continue in the 2023 sampling program. Since 1989, the BC Plumbing Code has restricted the use of lead in plumbing. The amount of lead released into water depends on plumbing materials used, water corrosiveness, and the duration water sits in the plumbing.

Schools have been advised to conduct water sampling to ensure lead levels are within safe limits. IHA collaborates directly with these facilities on monitoring efforts, and DLC has not received any reports of elevated lead levels in schools or daycares within our communities.

Building owners are responsible for assessing their plumbing systems and taking necessary actions to minimize lead exposure. A plumber can assist in identifying any lead-containing plumbing components in your home, including the service line on your property.

To evaluate corrosion risks within the community, DLC samples water for indicators of corrosivity, including the presence of lead. The results of lead testing can be found in Table 10.

Further information can be found at

BC Health Link: Lead in Drinking Water, the Guidelines for Canadian Drinking Water Quality and Caro Analytical Services for in-home testing.

Table 10: 2023 Lead Sampling Results for Raw water intakes and distribution sources.

	SYSTEM	DATE	RESULTS	GCDWQ
Vernon Creek Raw	Beaver (Vernon Ck)	7/11/2023	<0.00020	0.005
Vernon Creek Raw	Beaver (Vernon Ck)	8/1/2023	<0.00020	0.005
Vernon Creek Raw	Beaver (Vernon Ck)	9/19/2023	<0.00020	0.005
Cooney	Beaver (Vernon Ck)	7/11/2023	<0.00020	0.005
Cooney	Beaver (Vernon Ck)	9/19/2023	<0.00020	0.005
Pow	Beaver (Vernon Ck)	7/11/2023	<0.00020	0.005
Pow	Beaver (Vernon Ck)	9/19/2023	<0.00020	0.005
Okanagan Lake Raw	Okanagan Lake	1/24/2023	<0.00020	0.005
Okanagan Lake Raw	Okanagan Lake	4/17/2023	<0.00020	0.005
Okanagan Lake Raw	Okanagan Lake	7/14/2023	<0.00020	0.005
Glenmore Booster	Okanagan Lake	1/23/2023	<0.00020	0.005
Glenmore Booster	Okanagan Lake	4/24/2023	<0.00020	0.005
Glenmore Booster	Okanagan Lake	7/13/2023	<0.00020	0.005
Glenmore Booster	Okanagan Lake	9/18/2023	<0.00020	0.005
Lakes Upper Reservoir	Okanagan Lake	1/23/2023	0.00180	0.005
Lakes Upper Reservoir	Okanagan Lake	4/20/2023	<0.00020	0.005
Lakes Upper Reservoir	Okanagan Lake	7/13/2023	0.00046	0.005
Lakes Upper Reservoir	Okanagan Lake	9/18/2023	0.00039	0.005
Oyama Creek Raw	Oyama Creek	7/10/2023	<0.00020	0.005
Oyama Creek Raw	Oyama Creek	8/2/2023	<0.00020	0.005
Oyama Creek Raw	Oyama Creek	9/19/2023	<0.00020	0.005
Oyama Creek	Oyama Creek	7/10/2023	0.00154	0.005
Oyama Creek	Oyama Creek	9/19/2023	0.00056	0.005
Kalamalka Raw	Kalamalka Lake	1/25/2023	<0.00020	0.005
Kalamalka Raw	Kalamalka Lake	4/20/2023	<0.00020	1.005
Kalamalka Raw	Kalamalka Lake	7/10/2023	<0.00020	2.005
Kalamalka Raw	Kalamalka Lake	8/3/2023	<0.00020	3.005
Kalamalka Raw	Kalamalka Lake	9/19/2023	<0.00020	4.005
Ribbleworth	Kalamalka Lake	7/10/2023	<0.00020	0.005
Ribbleworth	Kalamalka Lake	9/19/2023	0.00022	0.005
Cornwall	Kalamalka Lake	1/25/2023	<0.00020	0.005
Cornwall	Kalamalka Lake	4/20/2023	<0.00020	0.005
Cornwall	Kalamalka Lake	7/10/2023	0.00030	0.005
Cornwall	Kalamalka Lake	9/19/2023	0.00028	0.005
Coral Beach Raw	Okanagan (Coral Beach)	1/23/2023	<0.00020	0.005
Coral Beach Raw	Okanagan (Coral Beach)	4/17/2023	<0.00020	0.005
Coral Beach Raw	Okanagan (Coral Beach)	7/12/2023	0.00083	0.005
Coral Beach Raw	Okanagan (Coral Beach)	8/4/2023	<0.00020	0.005
Coral Beach Raw	Okanagan (Coral Beach)	9/18/2023	<0.00020	0.005
Coral Beach Raw	Okanagan (Coral Beach)	11/14/2023	0.00020	0.005
CB - South End	Okanagan (Coral Beach)	1/23/2023	<0.00020	0.005
CB - South End	Okanagan (Coral Beach)	4/17/2023	<0.00020	0.005
CB - South End	Okanagan (Coral Beach)	7/12/2023	<0.00020	0.005
CB - South End	Okanagan (Coral Beach)	9/18/2023	<0.00020	0.005
Lake Pine Raw	Okanagan (Lake Pine)	1/23/2023	0.00052	0.005
Lake Pine Raw	Okanagan (Lake Pine)	4/17/2023	0.00024	0.005
Lake Pine Raw	Okanagan (Lake Pine)	7/12/2023	0.00036	0.005
Lake Pine Raw	Okanagan (Lake Pine)	8/4/2023	0.00062	0.005
Lake Pine Raw	Okanagan (Lake Pine)	9/18/2023	0.00039	0.005
Lake Pine Raw	Okanagan (Lake Pine)	11/14/2023	0.00054	0.005
Lake Pine PR Station	Okanagan (Lake Pine)	1/23/2023	<0.00020	0.005
Lake Pine PR Station	Okanagan (Lake Pine)	4/17/2023	<0.00020	0.005
Lake Pine PR Station	Okanagan (Lake Pine)	7/12/2023	<0.00020	0.005
Lake Pine PR Station	Okanagan (Lake Pine)	9/18/2023	<0.00020	0.005

Water Quality Advisories and Boil Water Notices

IHA mandates water purveyors to issue a Water Quality Advisory when turbidity exceeds 1 NTU and to contact Interior Health when turbidity approaches 5 NTU for potential enhanced notification, such as a Boil Water Notice. Currently, two of the DLC sources are under a Water Quality Advisory (WQA). Quarterly reminder notifications are distributed to customers through water bill inserts, and information is posted on the DLC website, social media channels, and local newspapers as required. Irrespective of Advisory status, regular monitoring of all distribution systems on DLC sources is conducted in accordance with the IHA-approved Water Quality Monitoring and Reporting Plan.

The following sources were on a **Water Quality Advisory (WQA**) in 2023:

- Beaver Lake Water Source (ongoing even if source switched to Okanagan Lake)
- Oyama Lake Water Source (ongoing even if source switched to Kalamalka Lake)
- Coral Beach May 9 – June 19
- Okanagan Lake Customers switch to Beaver Lake Source August 18 - 25

Beaver and Oyama Sources are currently under Water Quality Advisories (WQA) due to fluctuating turbidity and the absence of multibarrier treatment. These advisories will persist until infrastructure upgrades improve water quality and reliability. Despite transitioning customers in these systems to low-turbidity sources of Okanagan and Kalamalka Lakes during the low-flow (non-irrigation) season, the WQA's are regulated to remain in effect. In 2022, Beaver Lake Source was switched over early for the first time.

LAKE COUNTRY

REMINDER

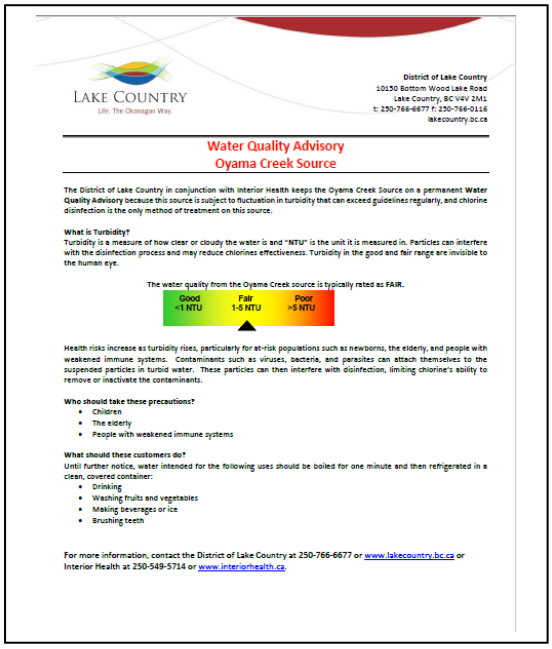
Water Quality Advisory

Sources: Beaver Lake (Vernon Creek)

"Interior Health recommends that children, the elderly, people with weakened immune systems and anyone seeking additional protection drink boiled water or a safe alternative until further notice. For these at-risk populations, water intended for drinking, washing fruits or vegetables, making juice or ice, or brushing teeth should be boiled for one minute."

What is Turbidity?

Good <1 NTU | Fair 1-5 NTU | Poor >5 NTU



LAKE COUNTRY

District of Lake Country
10150 Bottom Wood Lake Road
Lake Country, BC V4V 2M1
t: 250-766-6677 f: 250-766-0116
lakecountry.bc.ca

Water Quality Advisory
Oyama Creek Source

The District of Lake Country in conjunction with Interior Health keeps the Oyama Creek Source on a permanent Water Quality Advisory because this source is subject to fluctuation in turbidity that can exceed guidelines regularly, and chlorine disinfection is the only method of treatment on this source.

What is Turbidity?

Turbidity is a measure of how clear or cloudy the water is and "NTU" is the unit it is measured in. Particles can interfere with the disinfection process and may reduce chlorines effectiveness. Turbidity in the good and fair range are invisible to the human eye.

The water quality from the Oyama Creek source is typically rated as FAIR.

Good <1 NTU | Fair 1-5 NTU | Poor >5 NTU

Health risks increase as turbidity rises, particularly for at-risk populations such as newborns, the elderly, and people with weakened immune systems. Contaminants such as viruses, bacteria, and parasites can attach themselves to the suspended particles in turbid water. These particles can then interfere with disinfection, limiting chlorine's ability to remove or inactivate the contaminants.

Who should take these precautions?

- Children
- The elderly
- People with weakened immune systems

What should these customers do?

Until further notice, water intended for the following uses should be boiled for one minute and then refrigerated in a clean, covered container:

- Drinking
- Washing fruits and vegetables
- Making beverages or ice
- Brushing teeth

For more information, contact the District of Lake Country at 250-766-6677 or www.lakecountry.bc.ca or Interior Health at 250-549-5714 or www.interiorhealth.ca.

Vernon Creek Water Quality Event – June 24, 2023, to June 28, 2023

On June 24, 2023, a storm event occurred in the Beaver Lake watershed resulting in poor water quality at the intake on Vernon Creek. A Do Not Irrigate Order was released for the Winfield-Okanagan Centre Water System from June 26, 2023, to June 28, 2023, due to limited clean water reserves during the poor water quality event.

Timeline of Events:

SAT, JUN 24

Evening – A localized storm event occurs in the upper watershed. No rainfall in the valley bottom.

20:00 – Operations receives a high turbidity alarm at the raw water inlet at the Eldorado site
Response: Operations bypasses the Eldorado raw water balancing reservoir sending raw water back into Vernon Creek.

22:00 – Water Quality Technician measures a turbidity of 176 NTU at the Eldorado Hydro Plant (raw water inlet).
Response: Operations opens the gate at Beaver Lake dam to flush out high turbidity water from Vernon Creek.

SUN, JUN 25

07:00 – Operations assess water quality at the Vernon Creek Intake Pond, *see image 2*. Turbidity measured at 90 NTU in the pond. Turbidity of water entering the pond is 7 NTU.
Response: Operations begins to exchange the water in the pond by drawing down and refilling pond with lower turbidity water from incoming creek.

13:00 – Operations was able to decrease turbidity in the intake pond to 11-12 NTU after exchanging water.

Evening – Another localized storm event occurs in the upper watershed. No rainfall in the valley bottom. Turbidity begins to increase.

MON, JUN 26

06:00 – Operations assess the water quality at the Vernon Creek Intake Pond. Turbidity measured at 70 NTU. Eldorado raw water balancing reservoir at 25%, Eldorado treated water reservoir at 65%, and current system demand 200-320 l/s . Remaining water storage at Eldorado is expected to be depleted by the afternoon without action.

08:30 – District Staff meet to evaluate options and determine a Do Not Irrigate Order is necessary, rather than introducing the high turbidity water into the water system.

09:30 – Response: District releases a Do Not Irrigate Order . Operations begin turning off irrigation valves.

12:30 – All irrigation connections are turned off. Okanagan Lake water is now supplying all the Winfield-Okanagan Centre Water System and starting to fill the Eldorado Treated Water Reservoir.

WED, JUN 28

08:00 – Raw water turbidity is in an acceptable range and water is fed into the Eldorado raw water balancing reservoir

18:00 – Raw water balancing reservoir is filled and the Do Not Irrigate Order is rescinded

FRI, JUN 30

09:00 – District staff survey Vernon Creek and determine the most probable cause to be two sloughing events, *see image 3 and image 4.*

Key Factors Leading to Do Not Irrigate Order:

Introducing the poor-quality water into the distribution system would result in:

- The issuance of a Boil Water Notice for the Winfield-Okanagan Centre Water System.
- Damage to the districts infrastructure and privately owned irrigation systems and plumbing.
- An additional 2-3 day delay in supplying clean water to residents due to the requirement to flush out the entire system of turbid water.

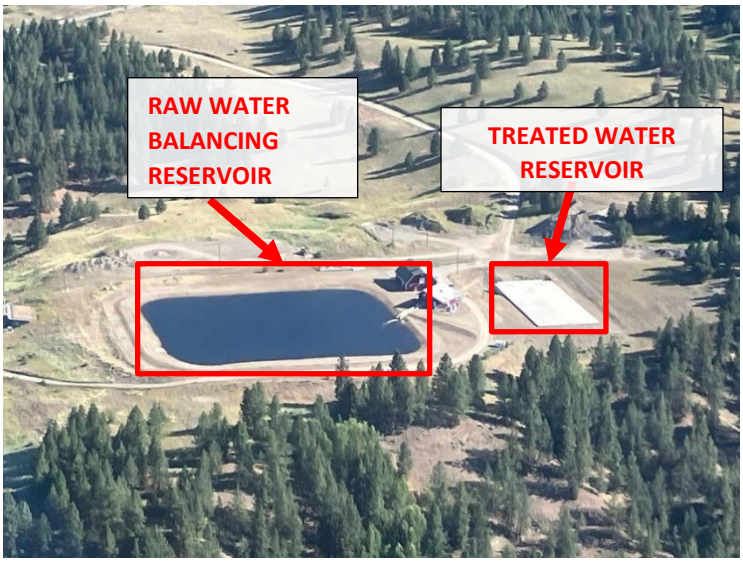


Image 1: Eldorado site (taken June 30, 2023).

Image 2: Intake Pond Sunday morning.

Image 3: Larger sloughing site in watershed.

Image 4: Smaller sloughing site in watershed.

Coral Beach:

The Coral Beach Water System was on a WQA for approximately 6 weeks while the north-west end of Okanagan Lake experienced a heavy freshet that carried a large amount of debris into the lake. This created an increase in turbidity (cloudiness) rising above 1NTU but <5NTU at the Coral Beach intake. This rise and fluctuating turbidity resulted in a precautionary Water Quality Advisory being issued.

Okanagan Lake:

In August, the McDougal Creek Wildfire from the mountain on the East side above and within the City of West Kelowna and Westbank First Nations, it jumped Okanagan Lake into the DLC area, prompting a wildfire response at the south end of our border along Okanagan Lake near Okanagan Centre. During this event, Okanagan Lake was placed on a Water Quality Advisory (WQA) on August 18th, with hundreds of people under evacuation orders and alerts. We switched to our reliable upland Vernon Creek (Beaver Lake) source as a precaution due to the fire's proximity to the Okanagan Lake pumphouse, potentially disrupting service delivery.

The District of Lake Country developed a plan following Interior Health Authority (IHA) guidance and our own diligence to ensure drinking water safety post-fire, including potential impacts to raw water quality from both the Okanagan and Vernon (Beaver) distribution systems.

The objective was to sample and assess both distribution systems following the wildfire event, despite structural losses. After a physical assessment confirmed no contamination and positive pressure was maintained throughout and after the event, all sampling results met satisfactory guidelines. This included additional samples taken after subsequent rain and wind events in the following weeks.

Once all bacteriological and water chemistry results returned with acceptable levels and stable operational conditions resumed, the Okanagan Lake source was reinstated, and the WQA was lifted on August 25th.

Oyama Watershed high bacteriological E. coli counts in Raw Water Source:

The DLC responded to a high E. coli event in the Oyama Creek raw water source over the month of July. At this time turbidity levels were also steadily increasing, posing concerns for disinfection efficiency and potential implementation of a Boil Water Notice for the community. DLC took immediate steps to investigate the watershed. Within the highest vulnerability zones (downstream of dams to our drinking water intake), multiple sensitive areas had drainage structures that were overwhelmed and no longer functioning properly. When road drainage systems are broken, it can lead to materials being deposited into drinking water sources. While site-specific evidence of E. coli contamination was not found during this sampling, all identified and potential sites contribute to cumulative impacts on water quality at our intake.

The DLC engaged with MOF, including Roads and Range and BC Timber Sales, to provide verification of structure failure and to discuss maintenance and infrastructure permits for all sites. Follow-up measures and timelines for corrective actions were promptly managed and mitigated by all parties involved.

As per our Potable Water Quality Emergency Response Plan with IHA, ongoing water quality results and remedial actions were reported, with our Regulatory Health Officer copied for oversight.

Disinfectant By-Products:

Under the Guidelines for Guidelines for Canadian Drinking Water Quality: Haloacetic acids (HAAs) Guidelines for Canadian Drinking Water Quality: Haloacetic acids (HAAs) are disinfectant by-products formed when chlorine used in water treatment reacts with natural organic matter. Chlorine's use in treatment has significantly reduced waterborne diseases by killing or inactivating most microorganisms. Most Canadian water treatment plants utilize chlorine for direct treatment and to maintain residual chlorine in distribution systems to prevent bacterial regrowth. Despite by-product risks, disinfection is crucial for public health as it reduces overall health risks compared to consuming untreated water.

Elevated levels of HAA's and THM's are commonly present in chlorinated water sourced from upper elevation drinking water reservoirs. These disinfectant by-products are prevalent in the Okanagan due to high natural organic matter content. In contrast, lower levels of disinfectant by-products, turbidity and organics are found in lakes in our lower elevation sources such as Okanagan and Kalamalka Lakes. Monitoring for deviations in water quality at our deep-water intakes is rigorous following flooding years. It often takes multiple seasons before changes in water chemistry are detected post-flooding event.

Haloacetic Acids (HAAs)

Total haloacetic acids (HAAs) comprise monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. The maximum acceptable concentration (MAC) for total HAAs in drinking water is 0.08 mg/L (80 µg/L), determined based on a locational running annual average from at least quarterly samples taken in the distribution system.

DLC adheres to GCDWQ standards for HAA testing, conducting minimum quarterly monitoring and sampling at intermediary sites. Additional sample points for HAA testing are established on large water systems (Oyama, Beaver, and Okanagan), particularly in areas with the highest HAA formation potential. These sites are characterized by extended disinfectant retention times and are typically located at re-chlorination sites or at the far end of the distribution system.

Analysis of haloacetic acids in the DLC Water System in 2023 revealed that Oyama and Beaver Lake sources exceeded the annual HAA averages specified in the GCDWQ. Detailed results, including running averages for each site and distribution totals, are presented in Tables 11 - 16

Table 11. **Beaver Lake Source** 2023 Average Total HAA data collected and calculated as per the GCDWQ.

Vernon Creek (Beaver Lake) Source HAA guideline <0.080 mg/L			
	Cooney Drain	**Pow Rd PRV**	
Total Haloacetic Acid	HAA		HAA
Date	mg/L	Date	mg/L
7/11/2023	0.241	7/11/2023	0.213
9/19/2023	0.192	9/19/2023	0.203
Quarterly Site Annual Average	0.217		0.208
Total Quarterly Annual Average			**0.212**

Table 12. **Okanagan Lake Source** 2023 Average Total HAA data collected and calculated as per the GCDWQ.

Okanagan Lake Source HAA guideline <0.080 mg/L					
	Glenmore Booster	Lake Upper Reservoir		Pow	
Total Haloacetic Acid	HAA		HAA	Date	mg/L
Date	mg/L	Date	mg/L		
1/23/2023	0.043	1/23/2023	0.062		
4/24/2023	0.026	4/20/2023	0.060	4/24/2023	0.046
7/13/2023	0.029	7/13/2023	0.046		
9/18/2023	0.032	9/18/2023	0.061		
Quarterly Site Annual Average	0.033		0.058		**0.046**
Total Quarterly Annual Average					**0.046**

Table 13. **Kal Lake Source** 2023 Average Total HAA data collected and calculated as per the GCDWQ.

Kalamalka Lake Source HAA guideline <0.080 mg/L			
	Cornwall	Ribbleworth Drain	
Total Haloacetic Acid	HAA	HAA	
Date	mg/L	Date	mg/L
1/25/2023	0.032	1/25/2023	0.046
5/20/2023	0.037	4/20/2023	0.038
7/10/2023	0.022		
9/19/2023	0.023		
Quarterly Site Annual Average	**0.029**		**0.043**
Total Quarterly Annual Average			**0.036**

`		
Date	**Sheldon/Cornwall**	**Ribbleworth Drain**
1/28/2022	0.0299	0.0276
3/29/2022	0.0343	0.0303
8/9/2022	0.0244	
12/19/2022	0.0338	0.0553
Quarterly Site Annual Average	0.031	0.038
Quarterly Site Annual Average		**0.034**

Table 14. **Oyama Lake Source** 2023 Average Total HAA data collected and calculated as per the GCDWQ.
Note: Oyama Source only online during irrigation season and quarterly annual samples are not possible

Oyama Lake Source HAA guideline <0.080 mg/L			
	Easthill	Ribbleworth Drain	
Total Haloacetic Acid	HAA		HAA
Date	mg/L	Date	mg/L
7/10/2023	0.219	7/10/2023	0.244
9/19/2023	0.250	9/19/2023	0.279
Quarterly Site Annual Average	0.235		0.262
Total Quarterly Annual Average			**0.248**

Table 15. **Coral Beach Water System** (Okanagan Lake Source) 2023 Average Total HAA data collected and calculated as per the GCDWQ.

Coral Beach Okanagan Lake Source HAA guideline <0.080 mg/L	
Total Haloacetic Acid	HAA
Date	mg/L
1/23/2023	0.004
4/17/2023	0.053
7/12/2023	0.025
9/18/2023	0.040
Quarterly Site Annual Average	**0.031**

Coral Beach Okanagan Lake Source HAA guideline <0.080 mg/L	
Date	**South End**
1/26/2022	0.0335
3/29/2022	0.0394
8/8/2022	0.0312
12/19/2022	0.0393
Total Quarterly Annual Average	**0.036**

Table 16. **Lake Pine Water System** (Okanagan Lake Source) 2023 Average Total HAA data collected and calculated as per the GCDWQ.

Lake Pine Okanagan Lake Source HAA guideline <0.080 mg/L	
Total Haloacetic Acid	HAA
Date	mg/L
1/23/2023	0.041
4/17/2023	0.041
7/12/2023	0.054
9/18/2023	0.047
Quarterly Site Annual Average	**0.046**

Trihalomethanes (THM's)

The maximum acceptable concentration (MAC) for trihalomethanes (*includes the total of chloroform, bromodichloromethane, dibromochloromethane and bromoform*) in drinking water is 0.100 mg/L (100 µg/L). Compliance is determined based on a locational running annual average, with samples taken at least quarterly at the point in the distribution system with the highest potential THM levels**.**

In accordance with the Guidelines for Canadian Drinking Water Quality (GCDWQ), the DLC conducts minimum quarterly monitoring and sampling for THMs, with additional sampling points established in areas of highest THM formation potential, such as sites with extended disinfectant retention times or at the farthest reaches of the distribution system.

Analysis conducted in 2023 revealed that the annual THM averages from the Oyama and Beaver Lake sources exceeded the GCDWQ. Additionally, there was one instance in the Lake Pine water system where a quarterly average exceeded guidelines, and two instances in the Okanagan source post re-chlorination at the Upper Lake Reservoir, while still maintaining overall quarterly average within compliance. Detailed THM results, including running averages for each site and distribution totals, are provided in Tables 17-22

Table 17. Beaver Lake Source 2023 Average Total THM values relative to the GCDWQ. Beaver source only online during irrigation season and quarterly annual samples are not possible. Offline distribution samples are reported under Okanagan Lake.

Vernon Creek (Beaver Lake) Source THM guideline <0.100mg/L			
	Cooney Drain	**Pow Rd PRV**	
Total Trihalomethane	THM		THM
Date	mg/L	Date	mg/L
7/11/2023	0.241	7/11/2023	0.17
9/19/2023	0.199	9/19/2023	0.126
Quarterly Site Annual Average	0.220		0.148
Total Quarterly Annual Average			**0.184**

Table 18. DLC Okanagan Lake source 2023 Average Total THM values relative to the GCDWQ. Includes sites within Beaver distribution lines during switch over (i.e. non-irrigation season approximately October – May).

Okanagan Lake Source THM guideline <0.100 mg/L					
Glenmore Booster		**Lake Upper Reservoir**		**POW**	
Total Trihalomethane	THM		THM		THM
Date	mg/L	Date	mg/L	Date	mg/L
1/23/2023	0.070	1/23/2023	0.073		
4/24/2023	0.066	4/20/2023	0.109	4/20/2023	0.064
7/13/2023	0.075	7/13/2023	0.103		
9/18/2023	0.041	9/18/2023	0.070		
Quarterly Site Annual Average	0.063		0.089		0.064
Total Quarterly Annual Average					**0.072**

Table 19. Oyama Lake Source 2023 Average Total THM data collected and calculated as per the GCDWQ. Note: Oyama Source only online during the irrigation season and quarterly annual samples are not possible. Offline distribution samples are reported under Kalamalka Lake.

Oyama Lake Source THM guideline <0.100 mg/L			
	Easthill	**Ribbleworth Drain**	
Total Trihalomethane	THM		THM
Date	mg/L	Date	mg/L
7/10/2023	0.114	7/10/2023	0.120
9/19/2023	0.106	9/19/2023	0.195
Quarterly Site Annual Average	0.110		0.158
Total Quarterly Annual Average			**0.134**

Table 20. Kalamalka Lake source 2023 Average Total THM values relative to the GCDWQ. Kalamalka sampling includes sites within Oyama distribution lines during switchover (i.e. non-irrigation season approximately October – May).

Kalamalka Lake Source THM guideline <0.100 mg/L		
	Cornwall	**Ribbleworth**
Total Trihalomethane	THM	THM
Date	mg/L	mg/L
1/25/2023	0.064	0.093
4/20/2023	0.097	0.052
7/10/2023	0.030	
9/19/2023	0.057	
Quarterly Site Annual Average	**0.062**	**0.072**
Total Quarterly Annual Average		**0.067**

Table 21. Coral Beach System (Okanagan Lake source) 2023 Average Total THM values relative to the GCDWQ.

Coral Beach Okanagan Lake Source THM guideline <0.100 mg/L	
Total Trihalomethanes	THM
Date	mg/L
1/23/2023	0.080
4/17/2023	0.064
7/12/2023	0.047
9/18/2023	0.082
Quarterly Site Annual Average	**0.068**

Table 22. Lake Pine System (Okanagan Lake source) THM data collected in 2023. Average Total THM values relative to the GCDWQ.

Lake Pine Okanagan Lake Source THM guideline <0.100 mg/L	
LP PR Station	
Total Trihalomethanes	THM
Date	mg/L
1/23/2023	0.086
4/17/2023	0.048
7/12/2023	0.104
9/18/2023	0.091
Quarterly Site Annual Average	**0.082**

Source Water Sampling

The DLC draws water from four main primary drinking water reservoirs:

1. Beaver Lake (Crooked Lake chain flows into Beaver Lake) - upland source with a downstream intake on Vernon Creek.
2. Oyama Lake (Damer Lake flows into Oyama Creek) - upland source with a downstream intake on Oyama creek
3. Okanagan Lake (3) deep water intakes
4. Kalamalka Lake (1) deep water intake

Oyama Lake near earth fill dam (left) and Oyama Creek (right)

The combined area of the Oyama and Beaver Lake watersheds is approximately 141.1 km² and is located within the traditional and ancestral territory of the Syilx Okanagan People. These two community watersheds collectively provide the DLC with approximately 60-65% of its source water. Both watersheds rely on upland storage reservoirs, which are replenished annually by snowpack, to meet their water regeneration and supply requirements.

The DLC draws water from intakes both on Vernon and Oyama Creeks. In addition to monitoring and sampling at these intakes, the DLC also analyzes raw water from our upland drinking water reservoirs. These reservoirs have samples collected for other water quality parameters that would provide adequate measurement of chemical and physical water quality against the CDWG as per Conditions on Permit and recommendations in 2010 Oyama and Vernon Creek Source Water Assessment. Comprehensive reports (parameters tested at the drinking water intakes) are in Appendix C .

and the result for nutrient sampling (upland drinking water reservoirs (Beaver and Oyama)) is contained in Appendix D.

Source water from these watersheds has high organic content, leading to coloration problems and increased disinfectant by-products. Turbidity, naturally present in certain areas, can be exacerbated by human activities like recreation, cattle ranching, and logging upstream of our intakes.

Monitoring of reservoir water quality may intensify or diminish based on fluctuating conditions to establish sufficient baseline data for future water treatment needs.

Beaver Lake at Dam outflow

Source Sampling (Raw Water)

Raw Water Sampling occurs at intakes, upland drinking water reservoirs, and at deep water intake pump stations.

Crooked Lake (left) Beaver Lake Dam (middle) and Vernon Creek (right)

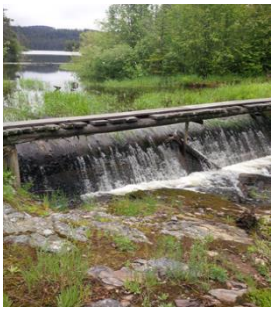
At raw water intakes, we analyze key water quality parameters to gauge chemical and physical water quality, comparing against GCDWQ and recommendations from Oyama and Vernon Creek Watersheds Source Water Assessment. Comprehensive tests are conducted annually at all intakes, with nutrient testing performed as necessary. The DLC adjusts sampled parameters continuously to establish adequate baseline data for future water treatment.

The DLC's main upland drinking water reservoirs, Beaver and Oyama Lakes (sourced from Vernon and Oyama Creeks), exceeded GCDWQ physical parameters for color. Similar results are common throughout the Okanagan region where water is drawn from upper watersheds.

All results are tabulated in the comprehensive reports in **Appendix D.**

Raw Water Data from intakes and pump stations are in Tables 23 through 28 (below). Data is collected from each source from the following sites:

- Beaver Lake source: Vernon Creek Intake (Table 23)
- Okanagan Lake Source: Okanagan Lake Pump Station (Table 24)
- Oyama Lake source: Oyama Creek Intake (Table 25)
- Kalamalka Lake source: Kalamalka Pump Station (Table 26)
- Okanagan Lake Source: Coral Beach Pump House (Table 27)
- Okanagan Lake Source: Lake Pine Pump House (Table 28)



Oyama Lake Dam Spillway

Table 23. *2023 Raw Water, Beaver Lake Source: Vernon Creek Intake/Eldorado Reservoir. (Data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)) when source was On-line.*

Beaver Lake Source: Vernon Creek/Eldorado Reservoir								
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL
MIN	40	0.60	2	6.9	47	27	135	2
MAX	60	21.87	19	7.9	92	95	5,120	52
AVG	50	2.42	13	7.3	66	44	**21 Samples**	
WQ Guidelines			15	7.0-10.5			<1	<1
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**

Table 24. *2023 Raw Water, Okanagan Lake Source: Okanagan Lake Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)).*

Okanagan Lake Source: Okanagan Intake									
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL	**UV Transmittance @ 254 nm unfiltered** %
MIN	140	0.20	4.00	7.3	271	<5	<1	<1	84
MAX	140	1.02	9.30	8.3	291	5	2,100	<1	86
AVG	140	0.36	6.33	7.9	278	5	**41 Samples**		86
WQ Guidelines			15	7.0-10.5			<1	<1	
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**	

Table 25. *2023 Raw Water Oyama Creek Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)). Oyama source on-line during irrigation season only.*

Oyama Lake Source: Oyama Creek Intake								
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL
MIN	40	0.37	10	7.0	46	36	172	<1
MAX	60	1.30	17	7.8	63	98	5,290	348
AVG	50	0.77	13	7.3	52	52	**24 Samples**	
WQ Guidelines			15	7.0-10.5			<1	<1
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**

Table 26. *2023 Raw Water Kalamalka Lake Intake. (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO)).*

Kalamalka Lake Source: Kalamalka Intake									
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL	**UV Transmittance @ 254 nm unfiltered** %
MIN	200	0.23	4	7.3	383	<5	<1	<1	90
MAX	200	1.77	14	8.4	414	<5	37	2	91
AVG	200	0.82	7	8.1	400	5	**45 Samples**		90
WQ Guidelines			15	7.0-10.5			<1	<1	
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**	

Table 27. *Coral Beach Water System, 2023 Raw Water Coral Beach Intake (Okanagan Lake source). (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO).*

Okanagan Lake Source: Coral Beach Intake									
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL	**UV Transmittance @ 254 nm unfiltered** %
MIN	140	0.21	1	7.4	227	<5	<1	<1	1
MAX	160	2.08	12	11.0	299	5	9,080	2	88
AVG	150	0.55	8	8.1	268	5	**46 Samples**		74
WQ Guidelines			15	7.0-10.5			<1	<1	
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**	

Table 28. *Lake Pine Water System, 2023 Raw Water Lake Pine Intake (Okanagan Lake source). (All data reported from weekly water quality monitoring using hand-held equipment other than True colour and Bacteriological (CARO).*

Okanagan Lake Source: Lake Pine Intake									
Weekly sampling & online water quality equipment verification	**Hardness** mg/L As CaCO3	**Turbidity** NTU	**Temp** Deg C	**pH**	**Conductivity** uS/cm	**True Color** TCU	**Total Coliforms** CFU/100mL	**E.Coli** CFU/100mL	**UV Transmittance @ 254 nm unfiltered** %
MIN	140	0.11	5	7.6	277	<5	<1	<1	84
MAX	140	0.85	13	8.8	310	7	1,550	5	86
AVG	140	0.42	10	8.0	286	5	**40 Samples**		85
WQ Guidelines			15	7.0-10.5			<1	<1	
Aesthetic Objective (AO) Maximum Allowable Concentration (MAC)	**Acceptable**	**1 (max) ≤5 NTU AO**	**AO**	**OG**			**MAC**	**MAC**	

Below are tables for all DLC water sources containing raw water chemistry data collected throughout the year and analyzed by Caro Analytical. This monthly average data serves as operational guidance and ongoing baseline information for understanding our water sources as we progress towards filtration exclusion and/or filtration.

Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) measurements gauge natural organic materials in the water, acting as precursors for disinfection by-products and potentially reducing UV disinfection effectiveness. Ultraviolet Transmissivity (UVT), measured as a percentage, indicates the amount of ultraviolet light at 254 nanometers (nm) that can penetrate 10 mm of water. Total Suspended Solids (TSS) represent unfiltered waterborne particles exceeding 2 microns in size. True color reflects color measurement before filtration, with an Aesthetic Objective in GCDWQ of less than or equal to 15 True color units.

Table 29. 2023 Beaver Lake Water Source - Monthly average water chemistry analysis.

	PARAMETER	UNITS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOCBER	NOVEMBER	DECEMBER
BEAVER LAKE (VC INTAKE)	TOC	mg/L	OFF LINE OKANAGAN LAKE SOURCE PRIMARY SUPPLY				12.80	8.22	10.10	9.44	8.47	6.18	OFF LINE OKANAGAN LAKE SOURCE PRIMARY SUPPLY	
	DOC	mg/L					12.00		8.34	8.30	7.71			
	TURBIDITY	NTU					5.62	1.84	2.44	1.76	0.95			
	TSS	mg/L					5.8	24.0	3.0	<2.0	2.4	<2.0		
	TRU	Co-Pt					95	53	37	35	32	21		

Table 30. 2023 Okanagan Lake Water Source - Monthly average water chemistry analysis

	PARAMETER	UNITS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOCBER	NOVEMBER	DECEMBER
OKANAGAN LAKE	TOC	mg/L	4.58	4.61	4.73	4.55	4.30	3.80	5.08	4.88	5.17	4.28	5.92	5.13
	DOC	mg/L		4.58	4.61	4.14	3.93	3.66	4.67	4.37	4.34	3.54	4.71	4.06
	UVT	/cm^-1	85.80	86.40	86.10	86.20	86.00	86.50	85.20	85.80	86.10	86.40	85.50	85.60
	TURBIDITY	NTU	0.30	0.34	0.32	0.35	1.02	0.51	0.53	0.40	0.40	0.46	0.34	0.45
	TSS	mg/L	<2.0	<5.0	<2.0	<2.0	<2.0	<2.0	<2.0	<3.3	<2.0	<2.0	<2.0	<2.0
	TRU	Co-Pt	<5	<5	<5	<5	<5	6	6	5	<5	<5	6	<5

Table 31. 2023 Oyama Lake Water Source - Monthly average water chemistry analysis

	PARAMETER	UNITS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOCBER	NOVEMBER	DECEMBER
OYAMA LAKE	TOC	mg/L	OFF LINE KALAMALKA LAKE PRIMARY SUPPLY				15.80	9.78	13.20	10.90	12.40	10.20	OFF LINE KALAMALKA LAKE PRIMARY SUPPLY	
	DOC	mg/L					13.90	9.68	10.20	10.00	11.00	9.46		
	TURBIDITY	NTU					0.60	0.87	1.16	1.07	1.30	1.10		
	TSS	mg/L					2.0	2.0	3.0	2.0	3.4	2.0		
	TRU	Co-Pt					98	50	45	42	49	45		

Table 32. 2023 Kalamalka Lake Water Source. Monthly average water chemistry analysis

	PARAMETER	UNITS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOCBER	NOVEMBER	DECEMBER
KALAMALKA LAKE	TOC	mg/L	4.52		4.35	4.06	3.44	4.99	4.96	4.30	3.80	4.36	5.14	
	DOC	mg/L	3.76		4.16	3.77	3.38	4.11	4.67	4.23	3.77	4.14		
	UVT	/cm^-1	89.8		90.7	89.9	89.6	89.7	90.1	89.7	89.8	89.6	90.5	
	TURBIDITY	NTU	0.40	0.40	0.60	0.32	0.65	1.10	1.64	1.77	1.56	1.33	0.60	0.30
	TSS	mg/L	2.0		2.0	2.0	2.2	2.4	2.4	2.0	2.0	2.0	2.0	
	TRU	Co-Pt	<5		<5	<5	<5	<5	<5	<5	<5	<5	<5	

Table 33. 2023 Coral Beach (Okanagan Lake Water Source) - Monthly average water chemistry analysis

	PARAMETER	UNITS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOCBER	NOVEMBER	DECEMBER
CORAL BEACH (OKANAGAN LAKE)	TOC	mg/L	4.53		4.74	4.90	5.99	4.25	4.82	4.79	4.39		6.28	5.15
	DOC	mg/L	4.48		4.44	4.52		4.05	4.62	4.28	4.18		6.18	4.34
	UVT	/cm^-1	87.6	86.0	88.3	85.6	84.4	86.6	86.5	85.6	85.9		85.1	86.1
	TURBIDITY	NTU	0.40	0.70	0.30	0.44	2.08	0.71	0.60	0.51	0.40	0.66	0.52	0.40
	TSS	mg/L	2.0	4.5	2.0	2.0	3.3	2.0	2.0	3.2	2.0		2.0	2.0
	TRU	Co-Pt	5	5	5	5	5	5	5	5	5		5	5

T**able 34.** 2023 Lake Pine (Okanagan Water Source) - Monthly average water chemistry analysis

	PARAMETER	UNITS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOCBER	NOVEMBER	DECEMBER
LAKE PINE (OKANAGAN LAKE)	TOC	mg/L	4.48		5.03	4.36			4.69	4.58	4.83	4.20	5.68	5.48
	DOC	mg/L	4.01		4.62	4.14			4.65	4.30	3.65		5.48	5.10
	UVT	/cm^-1	86.1	86.1	84.6	85.6		85.3	84.6	84.8	84.3	85.9	85.2	85.9
	TURBIDITY	NTU	0.40	0.22	0.85	0.55	0.69	0.60	0.45	0.45	0.43	0.40	0.40	0.50
	TSS	mg/L	3.3	2.0	2.0	2.0		2.0	2.0	3.3	2.0	2.0	2.0	2.0
	TRU	Co-Pt	5	5	7	5		5	5	5	5	5	5	5

Algae

Although the DLC lacks water intakes on Wood Lake, we include it within our continuous monitoring program alongside Kalamalka Lake. In 2023, Wood Lake experienced algae blooms, but these did not affect our Kalamalka Lake intake. We maintain frequent sampling at the Kalamalka Lake intake with algae monitoring spring through November increasing as needed should conditions change. Samples consistently met acceptable drinking water standards.

If any observed or reported condition necessitates further action, we will follow the DLC's Potable Water Quality Emergency Response Plan and share results with IHA as needed. In 2021, the Province launched an Algae Watch Website (https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/algae-watch) . Algae Watch is an educational program for citizen science data gathering. The goal is to help people recognize, identify and report algae blooms in B.C. lakes.

Watershed Management

The DLC provides domestic and irrigation water for Oyama, Winfield, Okanagan Centre, and Carr's Landing communities. Sixty-five percent (65%) of Lake Country's water originates from the Oyama and Beaver Lake watersheds.

Under the BC Government's Action Plan for Safe Drinking Water, the primary responsibility for protecting drinking water from land-use activities lies with the agency responsible for approving those activities. This can create complex governance that makes addressing source water concerns a significant challenge.

Infrastructure in the Oyama and Beaver lake watershed was initially built for irrigation approximately a century ago and was later upgraded in the 1970s to serve as a major domestic and agricultural water supply. Both watersheds are multi-use and host various ongoing activities such as forestry, range, and recreation. Under the BC Government's Action Plan for Safe Drinking Water, the primary responsibility for protecting drinking water from land-use activities rests with the agency approving those activities, leading to complex governance and significant challenges in addressing source water concerns.

The DLC collaborates with stakeholders, such as forestry and ranching communities, to address issues and maintain partnerships on watershed protection plans and source-to-tap assessments. This ongoing collaboration involves working with multi-level governance, land tenures, stakeholders, and primary partners to address emerging issues and uphold partnerships. Throughout the years, including 2023, the DLC has maintained close cooperation with these stakeholders to ensure the effective management and protection of our local watersheds.

Source to Tap Assessments

The Source to Tap Assessments conducted on the DLC distribution systems' Kalamalka and Okanagan Lake sources aimed to gather data for identifying intake strengths, weaknesses, and planning for water quality protection and enhancement. A crucial recommendation from these assessments was the establishment of an Intake Protection Zone. This zone prioritizes intake use over other considerations and delineates areas where special precautions are needed to prevent potential contaminants from reaching the lake and impacting the intake.

Kalamalka & Wood Lake Monitoring

Since 1998, when a taste and odour complaint occurred on Kalamalka Lake, the DLC, Greater Vernon Water/North Okanagan Regional District and the Ministry of Environment have partnered to acquire water quality data on this source. This data is crucial for understanding physical and biological impacts at the existing DLC intake, establishing baseline water chemistry, optimizing the intake depth, monitoring nutrient and algae levels, and anticipating water resource changes. This research is evaluated and re-directed on an annual basis. This ongoing collaboration marks the 24th year of comprehensive study.

In 2023, the DLC focused on assessing potential impacts from past flooding, high-water levels, and climate change, including wildfires' particulates and activities of photosynthetic organisms. Response time delays following previous events are typical, as particulates need time to accumulate and decompose at deep-water depths.

Watershed Protection Plans

The Source Water Assessments for the Oyama and Vernon Creek watersheds promote sustainable ecosystem management through collaboration. The key management tool from this plan is identifying vulnerability zones that indicate potential water quality risks. High-risk areas are evaluated first for potential impacts from activities like forestry, recreation, and mining.

Partnerships and Stakeholder involvement was crucial in considering all aspects of the 2010 Source Water Assessment plan. All involved in land activities must be aware of vulnerability zones and follow recommendations when planning in the watershed.

The Source Water Assessment remains vital for managing our community watersheds. In the fall of 2023, the DLC hosted a meeting with key stakeholders, including representatives from WLRS, MOF, regional and local government, OBWB, recreational users, and land lease/permit holders (forestry, recreation, and range). We aim to build a stronger relationship with First Nations, particularly OKIB, for partnership planning in these watersheds. Unfortunately, the timing was not favorable, and their representatives (ONA) were unable to attend this year.

As it had been some time since our last meeting, we used this opportunity to develop a Terms of Reference (TOR) and reintroduce the various partners. The discussion focused on improving relationships and developing partnerships for managing these watersheds. Some action items were identified, and some of the partnerships had already begun working on achieving some of those goals before the end of the year.

Regardless of annual meeting, DLC staff maintain communication with key partners and stakeholders throughout the year. Staff participate in watershed-related conferences, respond to Provincial watershed related initiatives, attend seminars, and are involved in key organizations such as the Okanagan Basin Water Board and the BC Water Supply Association.

Our watersheds are multipurpose and multi-jurisdictional, with all activities contributing to cumulative environmental impacts. All activities require best practices to maintain sustainable resources for all.

Off Road Vehicle

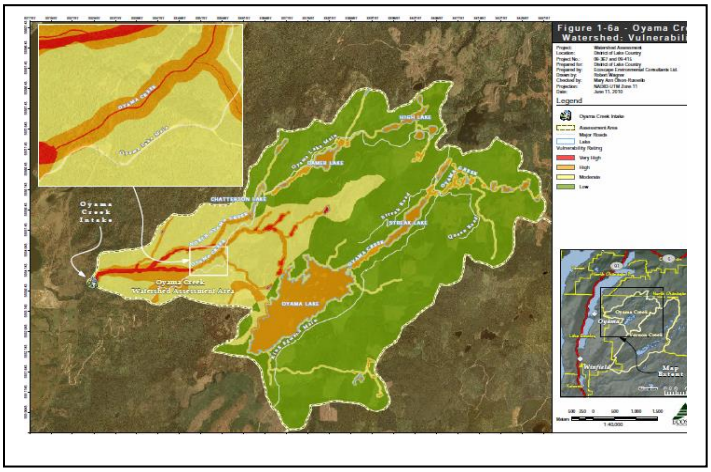
In 2023, our community watersheds again experienced significant motor vehicle traffic and unsanctioned activities, causing environmental harm. Many vehicles parked or camped illegally, creating fires and dumping garbage. Lease lot resorts reported high interest from people wanting to access drinking water reservoirs. Large amounts of garbage and debris, including abandoned and burnt vehicles, were left in the forest and roadside.

Illegal activities, especially motorized vehicle use near intake areas, risk soil disturbance and new drainage pathways, increasing particulates in our water source. Fortunately, despite hot and dry conditions, no forest fires were caused by these activities.

If you notice questionable activities in our Community Watersheds **Report All Poachers and Polluters** (RAPP) Violations to the Conservation Officer Service 24-hour **hotline: 1-877-952-7277**. or #7277 on the TELUS Mobility Network Additionally, you can register complaints online through RAPP

Range Management

The Okanagan Shuswap District Range Program's annual meeting was held in the spring. The DLC collaborated with range agrologists to create a forum for ranchers to connect with local and regional government, IHA, and major licensees. The goal is to stay connected, share changes in grazing plans, notable events and provide updates on harvesting plans and legislation changes. *All range use holders, major licensees, and the Small-Scale Salvage Program (SSSP) have agreed to use the DLC vulnerability zone mapping in their planning and development process.*



Forestry

Tolko and BC Timber Sales are the two major Licensees in our watersheds. Both Tolko and BCTS have opted out of the public advisory group and pursue certification through the Sustainable Forestry Initiative (SFI). This process excludes public input and consultation in developing and reporting targets

and indicators, unlike the previous Sustainable Forest Management Public Advisory Group that included public consultation. The DLC must make a concerted effort to stay informed about Major Licensee activities.

Major Licensees in our community watersheds are aware of our Watershed Protection Plan, and they have committed to using the vulnerability layer as a planning tool for developing harvest plans. Tolko and BCTS have agreed to annual meetings to update on harvesting and other activities in our watersheds. Additionally, DLC staff review harvest and site plans, offering recommendations to address issues such as access (cattle and unsanctioned motorized vehicles), wildfire management, drainage concerns, and road rehabilitation to minimize non-status roads.

Both Beaver and Oyama watersheds contain several existing and planned Tolko and BCTS harvest blocks that the DLC monitors closely. All proposed harvesting activities in these watersheds fall within high and very high vulnerability zones, situated directly below our dams' outflows and above our drinking water intakes. We maintain active involvement to understand how Licensees will manage access while safeguarding both immediate and long-term water quality and supply.

In 2023, Tolko and BCTS harvested sites directly below the outflow of Beaver and Oyama Lake Dams and above our drinking water intakes which are areas within the highest vulnerability zones of these community watersheds. The DLC has informed both Licensees of the risks and potential consequences of activities in these zones. We require block walks with our experts and the Licensees for all sensitive areas. Field trips and extensive discussions, including a review of Watershed Assessments and input from subject matter experts hired by the DLC. We maintain ongoing engagement with regulatory authorities and the Province, seeking their input as needed on referrals and sensitive watershed plans from major Licensees. This process remains active and continuous.

The Small Scale Salvage Program (SSSP) is regulated by the Province, allowing private companies to apply for licenses through the Ministry of Forests. These licenses enable harvesting of small volumes of timber for forest health purposes or salvaging timber that would otherwise remain unharvested. SSSP operations are independent of Forest Stewardship Plans (FSP) and certification processes. The DLC has requested referrals from the Province for all SSSP activities in our community watersheds but has not received any referrals in the past five years.

Wildfire Planning

The potential for a catastrophic wildfire in our community watershed is a significant concern. A wildfire in the Beaver or Oyama watersheds could severely degrade water quality. Post-fire floods and landslides often follow the first storm event (or freshet) and continue for decades, jeopardizing both water quality and quantity.

The DLC has acknowledged wildfire as a major risk to our community and has established a communication process with the BC Wildfire Service (BCWS) during the wildfire season.

In 2022, we received the final report on Reducing Wildfire Risk in our Community Watersheds. Neighboring stakeholders on the Aberdeen Plateau, supported by FESBC funding, partnered to mitigate wildfire risks to our water resources. The DLC recognizes that long-term plans involve collaboration with indigenous neighbors, the Province, and our adjacent watersheds (RDNO) among other key stakeholders to safeguard our communities and essential infrastructure from wildfire devastation.

Photos by Frontline Operations in the 2019-2021: Reducing Wildfire Risk to the Okanagan Basin Water Supply – Aberdeen Plateau Report. *A low intensity surface fire typical of discontinuous fuels in an open stand as compared to a crown fire associated with dense, continuous fuels resulting from fire exclusion.*

Wildfire reduction planning and mitigation measures in community watersheds outside of the wildland urban interface are not directly managed by the Province. Provincial funding for wildfire reduction planning and operations is provided to the Forest Enhancement Society of BC (FESBC) and dispersed through process grants. These grants are dependent on a variety of factors including the collaboration and consent of stakeholders and First Nations. In 2022 we had an opportunity to collaborate with OKIB for this funding resource to implement the next phases of planning and prescription within the Aberdeen Plateau of the Syilx territory from Beaver Lake watershed through to the Duteau community watershed.

In 2023 this collaboration continued with the DLC and RDNO with OKIB including discussions with the Ministry of Forests (MOF) on initial planning and long-term funding security for our watersheds. Under FESBC consideration our intent is to continue with a potential multi-year project with several proposals that would provide wildfire resiliency measures to protect water, infrastructure, and cultural heritage values throughout these watersheds.

Appendices:

Appendix A – Summary of Positive Bacteriological Results in Distribution

Lake Country Water System & Source	Total Coliforms CFU/100mL	E. Coli CFU/100mL	Presence Absence (Total Coliforms)	Presence Absence (E. Coli)	Number of TC/E.Coli Samples	Number of P/A Samples
Beaver Lake Source (WQA)	All Total Coliforms and E.coli non-detect				19	20
Okanagan Lake Source	Positive Total Coliforms: All E.coli non-detect				117	27
Ottley July 19	1	<1				
**Ottley Aug 10*	1	<1				
Kalamalka Lake Source	All Total Coliforms and E.coli non-detect				55	27
Oyama Lake Source (WQA)	All Total Coliforms and E.coli non-detect				24	14
Coral Beach (Okanagan Lake Source)	Positive Total Coliforms: All E.coli non-detect				54	24
CB PH July 18	2	<1				
**CB PH Aug 4*	1	<1				
**CB PH Aug 10*	1	<1				
CB S-end Aug 4	1	<1				
Lake Pine (Okanagan Lake Source)	Positive Total Coliforms: All E.coli non-detect				54	28
PRV July 19	1	<1				
**PH Aug 4*	2	<1				
				Total	**323**	**140**

* indicate all dates the lab performed micorbial analysis after the holding time (24 hours) even when samples were logged into the lab just hours after sampling.

Appendix B – District of Lake Country Sampling Sites

District of Lake Country Water System: Beaver Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Frost Free Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Vernon Creek Intake **RAW**	Beaver Lk			x									x											
Eldorado **RAW**	Beaver Lk			x			x		x															
Eldorado Balancing Reservoir	Beaver Lk			x			x				x													
Eldorado Reservoir chlorination facility (reservoir inlet & outlet)	Beaver Lk						x				x		x	x										
Camp Road Works Yard	Beaver Lk			x												x				x		x		
Camp Rd Reservoir (off line)	Beaver Lk			x	x						x					x			x					
Chase Rd future	Beaver Lk			x	x						x													
Cooney Drain	Beaver Lk	x	x	x								x					x					x		
Glenmore Booster Station	Beaver Lk			x			x				x				x									
Mulbery	Beaver Lk			x				x								x								
Lakestone Beacon Hill PRV	Beaver Lk			x							x													
Hare Road PRV	Beaver Lk			x							x													
Long	Beaver Lk			x				x									x							
McCreight	Beaver Lk			x		x											x	x				x		
Monte Carlo	Beaver Lk			x				x								x								
Nighthawk	Beaver Lk			x		x											x	x	x					
North View/Chase	Beaver Lk			x				x									x	x						
Nygren	Beaver Lk			x				x									x							
Pow Rd PRV Stn	Beaver Lk	x	x	x								x				x								
PR2	Beaver Lk			x	x	x										x								
Shanks Road (Future site)	Beaver Lk			x													x					x		
Williams	Beaver Lk			x		x		x									x	x	x					

District of Lake Country Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Frost Free Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Ok Lk Intake **RAW**	Ok Lk			x							x		x										x	
Ok Lk Pump Stn/chlorination facility	Ok Lk						x				x		x	x										
UV Treatment Facility	Ok Lk						x																	
Copper Hill	Ok Lk			x		x											x					x		
4th Street (future site)																						x		
Glenmore Booster Station	Ok Lk		x	x			x				x				x									
Jardine	Ok Lk			x						x						x								
Kelwin	Ok Lk				x						x						x							
Lakes Lower Reservoir (cell 1)	Ok Lk			x			x				x					x								
Lakes Upper Reservoir	Ok Lk			x					x															
Lakes Upper Zone (Shoreline Park)	Ok Lk			x																		x		
Lake Stone Benchlands	Ok Lk			x				x									x							
Future site: Lake Stone original development	Ok Lk			x					x															
McCoubrey	Ok Lk			x				x								x								
Roberts Road PRV	Ok Lk			x												x								
Oceola PRV	Ok Lk			x							x						x							
Ottley Rd (off Stubbs)	Ok Lk			x				x							x									
Ponderosa pumphouse	Ok Lk			x				x									x							
Ponderosa PRV stn	Ok Lk			x							x					x								
Woodsdale Lift Stn	Ok Lk			x		x											x							

District of Lake Country Water System: Oyama Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Easthill	Oyama Lk	x	x	x		x		x								x								
Oyama Rd S	Oyama Lk	x		x				x									x	x	x					
Oyama Rd N	Oyama Lk			x				x									x	x	x					
Oyama Lk/Hayton Rd	Oyama Lk				x												x	x		x				x
Oyama Creek Intake **RAW**	Oyama Lk			x									x											
Oyama Reservoir	Oyama Lk			x							x			x									x	
Oyama Creek intake/Chlorination Facility - Chlorinator post reservoir	Oyama Lk						x						x	x										
5410 Todd Rd. (Oyama: First customer Fall (Sawmill online: Kal) could be either from Sawmill or from reservoir	Oyama Lk			x							x				x	x	x							

District of Lake Country Water System: Kalamalka Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Irvine B-2 Reservoir	Kal				x				x							x						x		
Cornwall/ Sheldon	Kal	x	x	x				x								x		x						
Evans	Kal			x				x									x							
Kal Lk Intake **RAW**	Kal			x							x		x											
Kal Pump Stn	Kal			x			x				x			x	x						x			
Sawmillpump station	Kal			x							x					x								
Oyama Creek Chlorination Facility (distribtuion water fromKal Source (Sawmill) to Oyama reservoir)	Kal						x						x	x										

Coral Beach Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Coral Beach Intake **RAW**	CB Ok Lk			x			x						x										x	
Coral Beach Pump Stn	CB Ok Lk						x				x			x	x						x			
Coral Beach Pump Stn (distrib sample site)	CB Ok Lk			x					x					x	x									
Coral Beach Reservoir (Future)	CB Ok Lk			x												x						x		
Coral Beach North End (Future)	CB Ok Lk				x																	x		
Coral Beach South End	CB Ok Lk	x	x	x		x											x					x		

Lake Pine Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	HAA	BacT/Water Chemistry	Free Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Lake Pine Intake RAW	LP Ok Lk			x					x														x	
Lake Pine chlorination facility	LP Ok Lk		x				x				x			x	x									
Lake Pine Booster/Lower Res	LP Ok Lk		x	x			x				x			x	x						x			
Lake Pine PR Stn.	LP Ok Lk	x		x													x					x		
Lake Pine Upper Reservoir	LP Ok Lk			x							x					x								
Lake Pine Road (Future)	LP Ok Lk																					x		
Moberly South (Future Site)	LP Ok Lk																x							

2023 Water Potability Test (aka Comprehensive Results)							
Distribution Source		**Beaver**	**Oyama**	**Kal lake**	**Coral Beach**	**Lake Pine**	**Okanagan Lake**
Site		Vernon Creek Intake	Oyama Creek Pump House	Kalamalka Pump House	Coral Beach Pump House	Lakepine Pump House	Okanagan Lake Pump House
Date		05-Jul-23	04-Jul-23	04-Jul-23	06-Jul-23	07-Jul-23	06-Jul-23
Anions							
Chloride	mg/L	1.36	0.18	10.80	6.10	6.18	5.53
Chloride (AO)	mg/L	250	250	250	250	250	250
Fluoride	mg/L	<0.10	<0.10	0.23	0.20	0.17	0.21
Fluoride (MAC)	mg/L	1.5	1.5	1.5	1.5	1.5	1.5
Nitrogen, Nitrate as N	mg/L	<0.01	<0.01	<0.01	0.06	0.01	0.08
Nitrate (MAC)	mg/L	10	10	10	10	10	10
Nitrogen, Nitrite as N	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite (MAC)	mg/L	1.0	1.0	1.0	1.0	1.0	1.0
Sulphate	mg/L	3.10	2.00	50.00	30.30	33.20	30.30
Sulphate (AO)	mg/L	500	500	500	500	500	500
General Parameters							
Alkalinity (total)	mg/L	44.20	29.30	187.00	132.00	143.00	141.00
No current guidelines							
Total Organic Carbon	mg/L	10.10	15.40	4.99	5.15	5.48	5.75
No current guidelines							
Dissolved Organic Carbon	mg/L	8.34	13.90	4.67	4.62	5.10	5.04
No current guidelines							
True Colour	CU	**48.00**	**83.00**	<5.00	<5.00	<5.00	6.40
True Colour (AO)	TCU	15	15	15	15	15	15
Conductivity	uS/cm	62	47	413	280	288	278
No current guidelines							
Cyanide	mg/L	<0.0020	0.0020	<0.0020	0.0024	0.0026	0.0071
Cyanide (MAC)	mg/L	0.2	0.2	0.2	0.2	0.2	0.2
pH	pH units	**6.91**	**6.75**	8.08	7.95	7.99	8.00
pH (OG)	pH units	7 - 10.5	7 - 10.5	7 - 10.5	7 - 10.5	7 - 10.5	7 - 10.5
Turbidity	NTU	**1.52**	0.81	0.53	0.73	0.26	0.32
Turbidity Guideline	NTU	>5 =BWN	>5 =BWN	>5 =BWN	>5 =BWN	>5 =BWN	>5 =BWN
	NTU	>1 =WQA	>1 =WQA	>2 =WQA	>1 =WQA	>1 =WQA	>1 =WQA
Trans. 254 nm (unfiltered)	% T			90.60	86.50	87.40	86.50
No current guidelines. Note the lab did not report for Beaver and Oyama Lake sources							
Trans. 254 nm (unfiltered)	nm			90.60	86.50	87.40	86.50
No current guidelines. Note the lab did not report for Beaver and Oyama Lake sources							
Calculated Parameters							
Hardness (mg/L as CaCO3)	mg/L	30.1	21.5	187.0	113	128	112
No current guidelines see glossary below							
Total Dissolved Solids/TDS	mg/L	36.60	26.00	254.00	166.00	169.00	163.00
TDS (AO)	mg/L	500	500	500	500	500	500

2023 Water Potability Test (aka Comprehensive Results)							
Distribution Source		**Beaver**	**Oyama**	**Kal lake**	**Coral Beach**	**Lake Pine**	**Okanagan Lake**
Site		Vernon Creek Intake	Oyama Creek Pump House	Kalamalka Pump House	Coral Beach Pump House	Lakepine Pump House	Okanagan Lake Pump House
Date		05-Jul-23	04-Jul-23	04-Jul-23	06-Jul-23	07-Jul-23	06-Jul-23
Total Recoverable Metals							
Aluminium (total)	mg/L	**0.11**	0.04	0.01	0.01	0.01	0.01
Aluminium (OG)	mg/L	0.1	0.1	0.1	0.1	0.1	0.1
Antimony (total)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Antimony (MAC)	mg/L	0.00600	0.00600	0.00600	0.00600	0.00600	0.00600
Arsenic (total)	mg/L	<0.0005	<0.0005	0.0009	<0.0005	0.0005	<0.0005
Arsenic (MAC)	mg/L	0.010	0.010	0.010	0.010	0.010	0.010
Barium (total)	mg/L	0.01	0.01	0.03	0.02	0.02	0.02
Barium (MAC)	mg/L	2.0	2.0	2.0	2.0	2.0	2.0
Boron (total)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron (MAC)	mg/L	5.0	5.0	5.0	5.0	5.0	5.0
Cadmium (total)	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Cadmium (MAC)	mg/L	0.007	0.007	0.007	0.007	0.007	0.007
Calcium (total)	mg/L	7.43	5.57	42.90	28.40	34.20	28.40
No current guidelines							
Chromium (total)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium (MAC)	mg/L	0.050	0.050	0.050	0.050	0.050	0.050
Cobalt (total)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
No current guidelines							
Copper (total)	mg/L	0.0013	0.0012	0.0012	0.0007	0.0049	0.0006
Copper (MAC)	mg/L	2.000	2.000	2.000	2.000	2.000	2.000
Iron (total)	mg/L	0.21	0.09	<0.01	<0.01	<0.01	<0.01
Iron (AO)	mg/L	0.3	0.3	0.3	0.3	0.3	0.3
Lead (total)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Lead (MAC)	mg/L	0.005	0.005	0.005	0.005	0.005	0.005
Magnesium (diss.)	mg/L	2.80	1.85	19.20	10.20	10.40	9.93
No current guidelines							
Manganese (total)	mg/L	0.00878	0.00507	0.00149	0.00067	0.00105	0.00059
Manganese (MAC)	mg/L	0.12	0.12	0.12	0.12	0.12	0.12
Mercury (total)	mg/L	<0.000040	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Mercury (MAC)	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Molybdenum (total)	mg/L	0.00039	0.00016	0.00492	0.00337	0.00364	0.00328
No current guidelines							

2023 Water Potability Test (aka Comprehensive Results)							
Distribution Source		**Beaver**	**Oyama**	**Kal lake**	**Coral Beach**	**Lake Pine**	**Okanagan Lake**
Site		Vernon Creek Intake	Oyama Creek Pump House	Kalamalka Pump House	Coral Beach Pump House	Lakepine Pump House	Okanagan Lake Pump House
Date		05-Jul-23	04-Jul-23	04-Jul-23	06-Jul-23	07-Jul-23	06-Jul-23
Total Recoverable Metals							
Nickel	mg/L	0.0009	0.0011	<0.0004	0.0004	0.0005	<0.0004
No current guidelines							
Potassium (total)	mg/L	1.04	1.01	5.03	2.50	2.53	2.44
No current guidelines							
Selenium (total)	mg/L	<0.0005	<0.0005	0.0099	<0.0005	<0.0005	<0.0005
Selenium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Sodium (total)	mg/L	2.51	2.28	19.30	12.20	12.80	11.30
Sodium (AO)	mg/L	200	200	200	200	200	200
Strontium (total)	mg/L	0.04	0.04	0.49	0.28	0.30	0.27
Strontium (MAC)	mg/L	7	7	7	7	7	7
Uranium (total)	mg/L	0.000045	0.000053	0.003060	0.002460	0.003110	0.002450
Uranium (MAC)	mg/L	0.020	0.020	0.020	0.020	0.020	0.020
Zinc (total)	mg/L	<0.004	<0.004	<0.004	<0.004	0.004	<0.004
Zinc (AO)	mg/L	3.000	3.000	3.000	3.000	3.000	3.000

Glossary of Terms, GCDWQ:	
<	Less than. Reported when result is less than the reported detection limit
≤	Less than or equal to. Reported when result is less or equal to the reported detection limit
AO	Aesthetic objective. Refer to GCDWQ
MAC	Maximum acceptable concentration. Refer to GCDWQ
OG	Operational guidance values. Refer to GCDWQ
TCU	True color unit. Color referenced against a platinum cobalt standard
NTU	Nephelometric turbidity unit
uS/cm	Microsiemens per centimeter
Hardness	The degree of hardness of drinking water may be classified in terms of its calcium carbonate

2023 Nutrients			
Site		OYAMA	BEAVER
Date		27-Nov-23	17-Aug-23
Anions			
Nitrogen (Nitrate as N)	mg/L	0.05	<0.01
Nitrate (MAC)	mg/L	10	10
Nitrogen (Nitrite as N)	mg/L	<0.01	<0.01
Nitrite (MAC)	mg/L	1	1
Phosphate (as P)	mg/L	0.01	<0.01
No current guidelines			
Sulfate	mg/L		
Sulfate (AO)	mg/L	500	500
General Parameters			
Alkalinity, Total (as CaCO3)	mg/L	21.10	21.60
No current guidlines			
Alkalinity,Phenolphthalein (as CaCO3)	mg/L	<1.00	<1.00
No current guidelines			
Alkalinity, Bicarbonate (as CaCO3)	mg/L	21.40	30.10
No current guidelines			
Alkalinity, Carbonate (as CaCO3)	mg/L	<1.00	<1.00
No current guidelines			
Alkalinity, Hydroxide (as CaCO3)	mg/L	<1.00	<1.00
No current guidelines			
Ammonia (as N)	mg/L	0.06	<0.05
No current guidelines			
Total Organic Carbon	mg/L	11.30	10.20
No current guidelines			
Dissolved Organic Carbon	mg/L	0.05	<0.01
No current guidelines			
Chlorophyll-a	ug/L	<1.00	<1.00
No current guidelines			
Colour, True	**TCU**	**47.00**	**40.00**
Colour (AO)		15	15
Nitrogen, Total Kjeldahl	mg/L	0.40	0.51
No current guidelines			
Phosphorus, Total (as P)	mg/L	0.05	0.01
No current guidelines			
TDS	mg/L		
TDS (AO)	mg/L	500	500
TSS	mg/L	<2.00	<2.00
No current guidelines			
Calculated Parameters			
Hardness, Total (as CaCO3)	mg/L	20.30	22.60
No current guidelines			
Nitrate+ Nitrite (as N)	mg/L	0.0463	<0.0100
No current guidelines			
Total Nitrogen	mg/L	0.45	0.51
No current guidelines			
Organic Nitrogen	mg/L	0.34	0.51
No current guidelines			

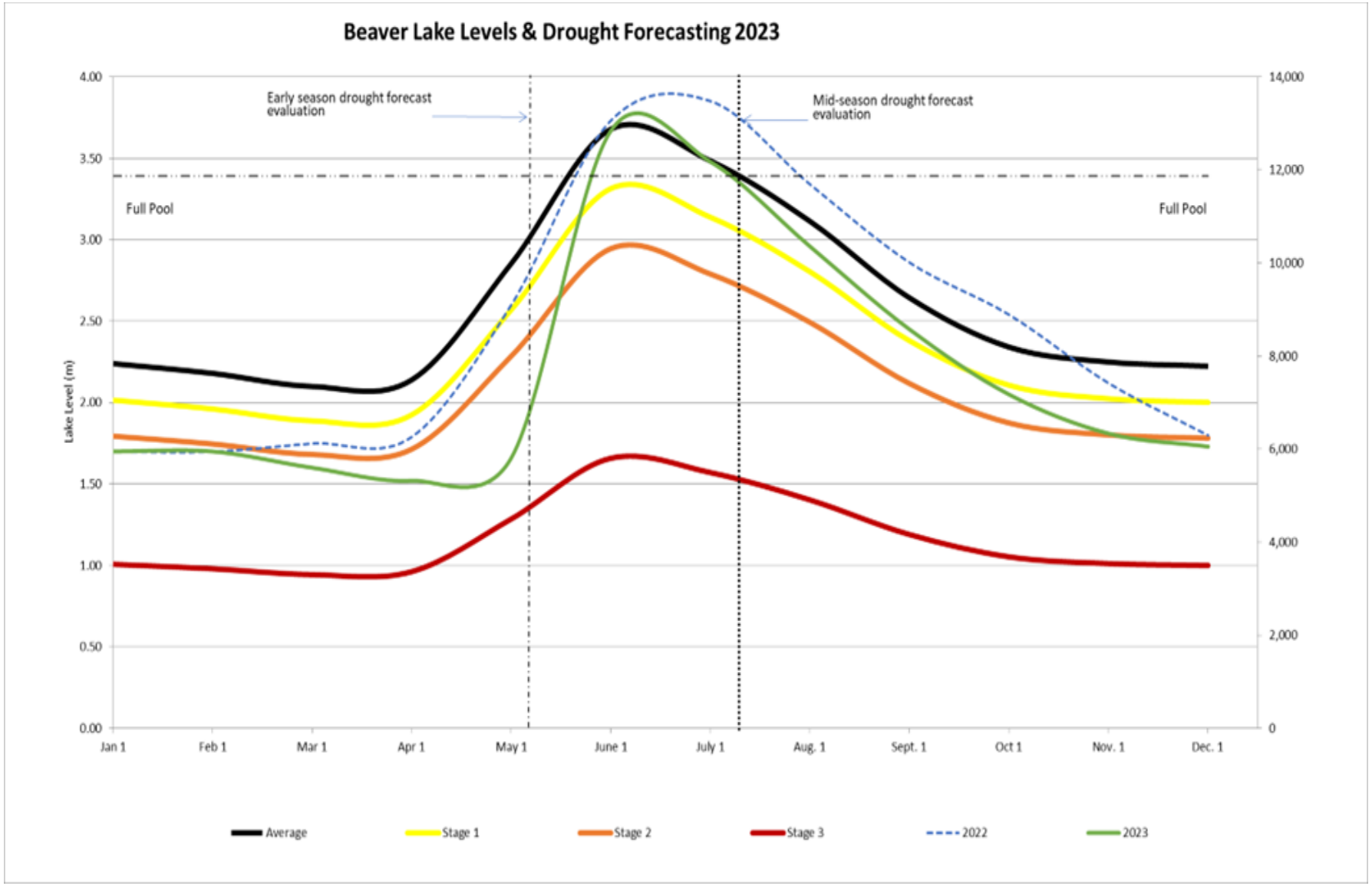
2023 Nutrients			
Site		OYAMA	BEAVER
Date		27-Nov-23	17-Aug-23
Metals			
Total Dissolved Aluminium	mg/L	0.02	0.04
Total Recoverable Aluminium	mg/L	0.02	0.03
Aluminium (OG)	mg/L	0.1	0.1
Total Dissolved Antimony	mg/L	<0.0002	<0.0002
Total Recoverable Antimony	mg/L	<0.0002	<0.0002
Antimony (MAC)	mg/L	0.006	0.006
Total Dissolved Arsenic	mg/L	<0.0005	<0.0005
Total Recoverable Arsenic	mg/L	<0.0005	<0.0005
Arsenic (MAC)	mg/L	0.01	0.01
Total Dissolved Barium	mg/L	0.0074	0.0055
Total Recoverable Barium	mg/L	0.0073	0.0056
Barium (MAC)	mg/L	2	2
Total Dissolved Beryllium	mg/L	<0.00010	<0.00010
Total Recoverable Beryllium	mg/L	<0.00010	<0.00010
No current guidelines			
Total Dissolved Bismuth	mg/L	<0.00010	<0.00010
Total Recoverable Bismuth	mg/L	<0.00010	<0.00010
No current guidelines			
Total Dissolved Boron	mg/L	<0.05	<0.05
Total Recoverable Boron	mg/L	<0.05	<0.05
Boron (MAC)	mg/L	5	5
Total Dissolved Cadmium	mg/L	<0.000010	<0.000010
Total Recoverable Cadmium	mg/L	<0.000010	<0.000010
Cadmium (MAC)	mg/L	0.005	0.005
Total Dissolved Calcium	mg/L	5.17	6.13
Total Recoverable Calcium	mg/L	4.95	6.23
No current guidelines			
Total Dissolved Chromium	mg/L	<0.00050	<0.00050
Total Recoverable Chromium	mg/L	<0.00050	<0.00050
Chromium (MAC)	mg/L	0.05	0.05
Total Dissolved Cobalt	mg/L	<0.00010	<0.00010
Total Recoverable Cobalt	mg/L	<0.00010	<0.00010
No current guidelines			
Total Dissolved Copper	mg/L	0.00139	0.00200
Total Recoverable Copper	mg/L	0.00101	0.00098
Copper (AO)	mg/L	2	2
Total Dissolved Iron	mg/L	0.20	0.08
Total Recoverable Iron	mg/L	0.23	0.10
Iron (AO)	mg/L	0.3	0.3

2023 Nutrients			
Site		OYAMA	BEAVER
Date		27-Nov-23	17-Aug-23
Metals Continued			
Total Dissolved Lead	mg/L	<0.00020	<0.00020
Total Recoverable Lead	mg/L	<0.00020	<0.00020
Lead (MAC)	mg/L	0.005	0.005
Total Dissolved Lithium	mg/L	0.00072	0.00100
Total Recoverable Lithium	mg/L	0.00069	0.00051
No current guidelines			
Total Dissolved Magnesium	mg/L	1.79	1.83
Total Recoverable Magnesium	mg/L	1.82	1.71
No current guidelines			
Total Dissolved Manganese	mg/L	0.04	0.00
Total Recoverable Manganese	mg/L	0.04	0.00
Manganese (MAC)	mg/L	0.12	0.12
Total Dissolved Mercury	mg/L	<0.000040	<0.000010
Total Recoverable Mercury	mg/L	<0.000010	<0.000010
Mercury (MAC)	mg/L	0.001	0.001
Total Dissolved Molybdenum	mg/L	0.00013	0.00017
Total Recoverable Molybdenum	mg/L	0.00016	0.00018
No current guidelines			
Total Dissolved Nickel	mg/L	0.00116	0.00100
Total Recoverable Nickel	mg/L	0.00107	0.00064
No current guidelines			
Total Dissolved Phosphorus	mg/L	<0.05	<0.05
Total Recoverable Phosphorus	mg/L	<0.05	<0.05
No current guidelines			
Total Dissolved Potassium	mg/L	1.10	0.89
Total Recoverable Potassium	mg/L	1.05	0.83
No current guidelines			
Total Dissolved Selenium	mg/L	<0.00050	<0.00050
Total Recoverable Selenium	mg/L	<0.00050	<0.00050
Selenium (MAC)	mg/L	0.05	0.05
Total Dissolved Silicon	mg/L	3.40	3.20
Total Recoverable Silicon	mg/L	3.10	3.20
No current guidelines			
Total Dissolved Silver	mg/L	<0.000050	<0.000050
Total Recoverable Silver	mg/L	<0.000050	<0.000050

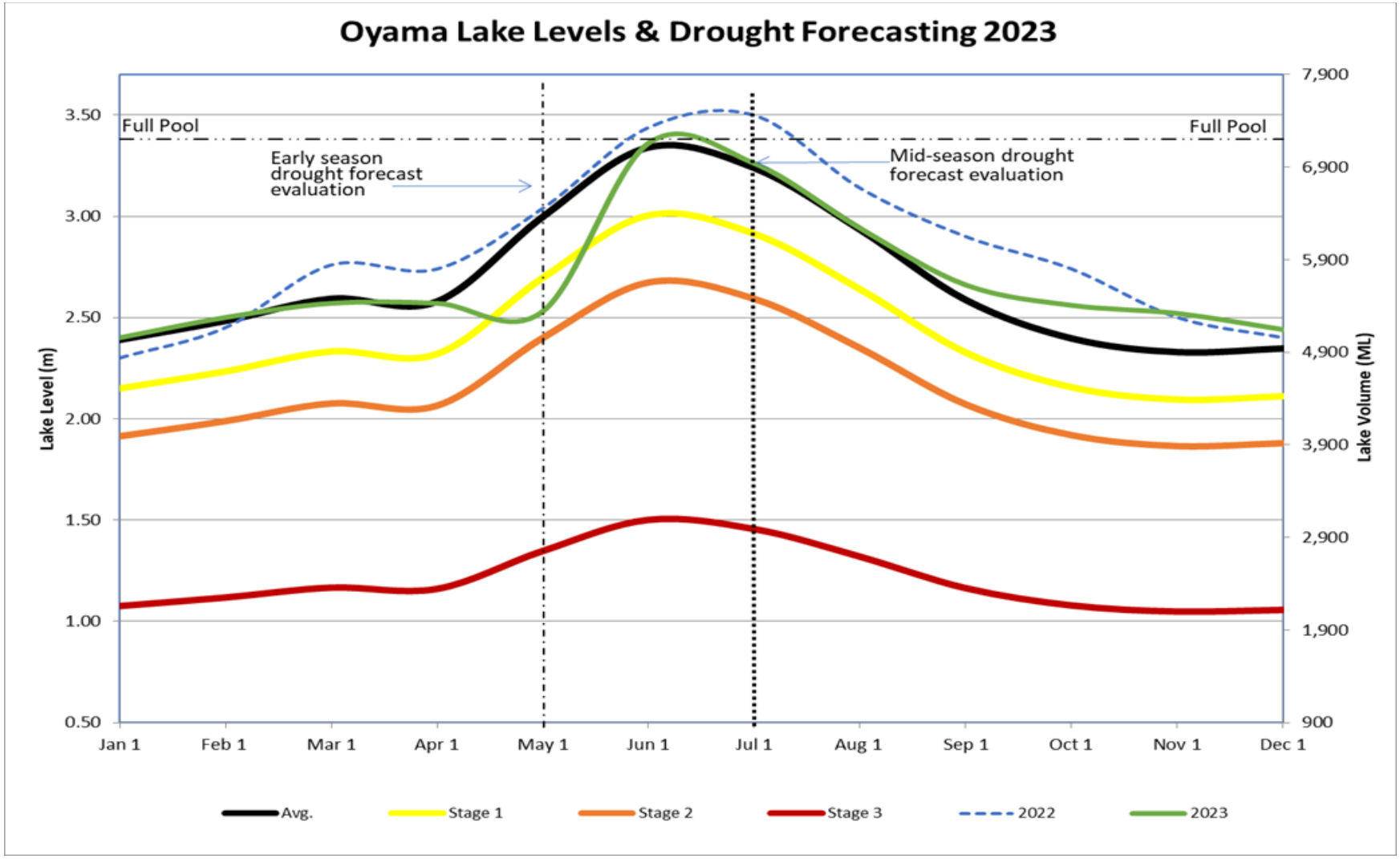
2023 Nutrients			
Site		OYAMA	BEAVER
Date		27-Nov-23	17-Aug-23
Metals Continued			
No current guidelines			
Total Dissolved Sodium	mg/L	2.38	2.57
Total Reocoverable Sodium	mg/L	2.26	2.05
Sodium (AO)	mg/L	200	200
Total Dissolved Strontium	mg/L	0.04	0.04
Total Recoverable Strontium	mg/L	0.04	0.04
No current guidelines			
Total Dissolved Sulfur	mg/L	<3.00	<3.00
Total Recoverable Sulfur	mg/L	<3.00	<3.00
No current guidelines			
Total Dissolved Tellurium	mg/L	<0.00050	<0.00050
Total Recoverable Tellerium	mg/L	<0.00050	<0.00050
No current guidelines			
Total Dissolved Thallium	mg/L	<0.000020	<0.000020
Total Recoverable Thallium	mg/L	<0.000020	<0.000020
No current guidelines			
Total Dissolved Thorium	mg/L	<0.00010	<0.00010
Total Recoverable Thorium	mg/L	<0.00010	<0.00010
No current guidelines			
Total Dissolved Tin	mg/L	<0.00020	<0.00020
Total Recoverable Tin	mg/L	<0.00020	<0.00020
No current guidelines			
Total Dissolved Titanium	mg/L	<0.01	<0.01
Total Recoverable Titanium	mg/L	<0.01	<0.01
No current guidelines			
Total Dissolved Uranium	mg/L	0.000028	0.000026
Total Recoverable Uranium	mg/L	0.000033	0.000035
Uranium (MAC)	mg/L	0.02	0.02
Total Dissolved Vanadium	mg/L	<0.00500	<0.00500
Total Recoverable Vanadium	mg/L	<0.00500	<0.00500
No current guidelines			

2023 Nutrients			
Site		OYAMA	BEAVER
Date		27-Nov-23	17-Aug-23
Metals Continued			
Total Dissolved Zinc	mg/L	<0.0040	<0.0040
Total Recoverable Zinc	mg/L	<0.0040	<0.0040
Zinc (AO)	mg/L	5	5
Total Dissolved Zirconium	mg/L	0.00051	0.00056
Total Recoverable Zirconium	mg/L	0.00049	0.00054
No current guidelines	mg/L		
Glossary of Terms, GCDWQ:			
<	Less than. Reported when result is less than the reported detection limit		
≤	Less than or equal to. Reported when result is less or equal to the reported		
AO	Aesthetic objective. Refer to GCDWQ		
MAC	Maximum acceptable concentration. Refer to GCDWQ		
OG	Operational guidance values. Refer to GCDWQ		
TCU	True color unit. Color referenced against a platinum cobalt standard		
NTU	Nephelometric turbidity unit		
uS/cm	Microsiemens per centimeter		
Hardness	The degree of hardness of drinking water may be classified in terms of its calcium carbonate concentration as follows: soft, 0 to <60 mg/L; medium hard, 60 to <120 mg/L; hard, 120 to < 180 mg/L; and very hard, 180 mg/L and above.		

Appendix E – Drought Forecast for Beaver Lake & Oyama Lake



Appendix E continued – Drought Forecast for Beaver Lake & Oyama Lake



Appendix F – UV system off spec water

The configuration and design of the UV system at Kalamalka Lake does not automatically permit off spec water to pass into the distribution system. For this facility to operate outside of validated conditions (i.e., 5% off spec) the system would need to be manually adjusted to bypass the UV reactor setting to operate outside of the spec conditions. This did not occur.

Appendix G – Environmental Operators Certification Program (EOCP)

The EOCP Board of Directors, with the approval of the Ministry of Health, recently changed the water treatment facility definition. As such, since our chlorination facilities are method of *primary disinfection*, to produce potable water, they are now classified as water treatment facilities.

According to the EOCP, primary disinfection can include chlorination and ultraviolet of which we utilize alone or combined in our facilities. With this new definition, Operators are now required to update their certification to include water treatment. With the EOCP and Ministry of Health changing our facility classifications to Water Treatment facilities, Section 12 of the BC Drinking Water Protection Regulation requires that our operators now must now also obtain Water Treatment Certification through the EOCP. All operators now are also required to accumulate operator experience toward Water Distribution and Water Treatment certification.

Name	Certification No.	Level
Mike Mitchell	1839	WD-IV, CH, WT-II
Patti Meger	4838	WT-I, CH, WD-II
Kiel Wilkie	6503	WD-III, CH
Tyler Friedrich	7697	WD-III, WT-I
Mike Kristensen	8344	WD-II, WT-I, CH
Krista Winram	1001349	WD-I, CH
Evan Kemp	8114	WWT-III, WWC-I, CH, WT-II
Kyle Barker	Pending	WD-I
Eddie Maher	1001145	WD-I