Lake Country
Life. The Okanagan Way.

Water Operations
2016 Annual Report

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DISTRICT OF LAKE COUNTRY

Water Operations Annual Report - 2016

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LAKE COUNTRY
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1. 2016 Overview

The following is intended to inform and summarize 2016 data collections, observations, and work completed by District of Lake Country staff with regards to water operations and water quality.

Water operations highlights include the continuation of the Universal Water Metering project, cleaning and inspections of the Oyama Creek intake and Vernon Creek intake, and the installation of agriculture water meters on Vernon Creek source.

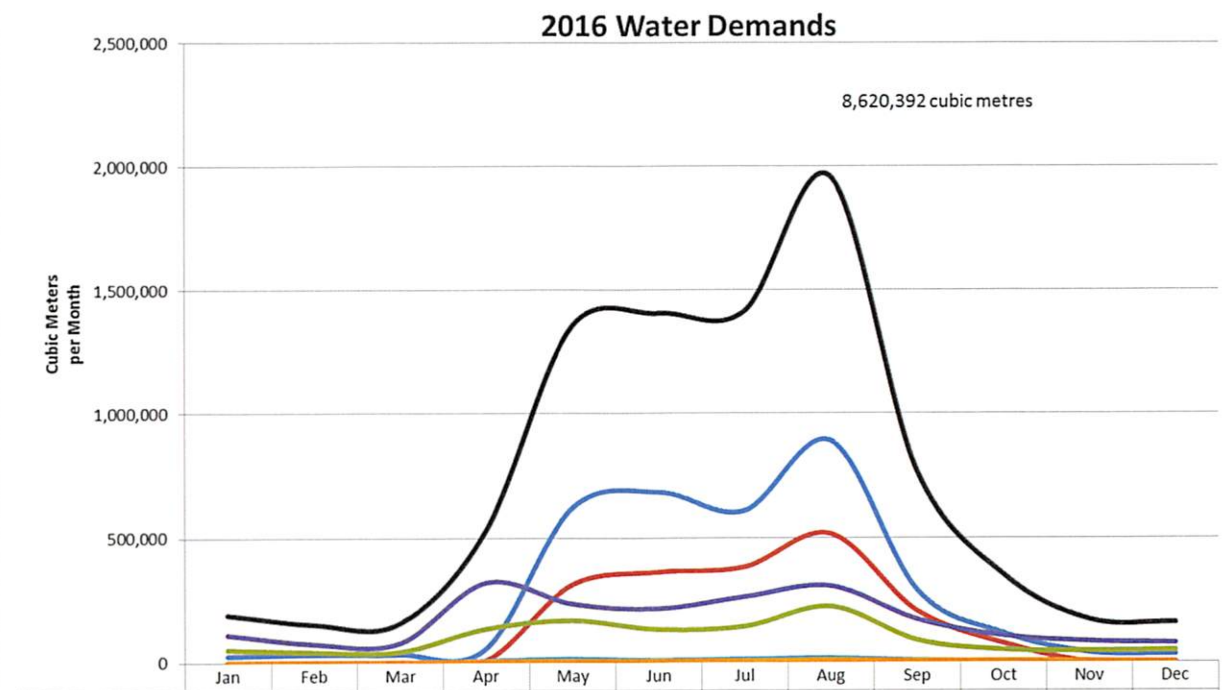
1.1 Systems Descriptions and Classification

The District of Lake Country is a growing municipality with an approximate population of 14,000 people. Not all of these 14,000 residents are connected to the District's regulated water systems. The primary upland sources regulated by the District include the reservoirs at Beaver Lake, Crooked Lake, Oyama Lake, and Damer Lake. The lower elevation reservoirs are Okanagan Lake (3 separate intakes) and Kalamalka Lake.

Infrastructure within the District owned water systems includes 6 storage dams, 9 reservoirs, 6 chlorine injection systems, 8 pump houses, 3 pressure boosting stations, 35 pressure reducing stations, 77 pressure reducing valves, more than 400 hydrants and approximately 200 km of water distribution mains.

1.2 Water Demands

Each water source or water system within the District has varying levels of consumption demand. The primary factors that affect demand are the total number of connections to the water system and the type of water connection. Residential, commercial, industrial, institutional, seasonal irrigation and agricultural connections are all different types of customers connected to the different water systems. Total water use among the different sources and water systems in 2016 was 8,620,392 cubic meters (see Figure 1 for water consumption by source).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beaver Lake	26,061	33,324	33,049	56,203	618,815	683,005	608,448	890,592	290,376	116,055	38,187	31,545
Oyama Lake	0	0	0	8,352	312,423	362,715	382,580	516,532	206,401	75,244	0	0
Kalamalka Lake	51,484	42,374	43,518	135,421	168,585	132,223	143,753	223,842	88,261	49,067	44,590	47,423
Okanagan Lake	111,384	74,880	78,624	321,048	235,872	216,216	263,016	306,072	172,224	105,768	83,304	76,752
Lake Pine	1,390	1,401	1,893	6,626	13,828	7,619	11,487	15,369	6,774	4,294	2,250	1,509
Coral Beach	1,254	1,513	1,531	2,672	4,853	5,103	5,571	6,173	4,817	2,588	2,652	1,617
Total	191,573	153,492	158,615	530,322	1,354,376	1,406,881	1,414,855	1,958,580	768,853	353,016	170,983	158,846

Figure 1. ***Graph of 2016 water demands with all sources.***

Figure 1 **Analysis:**

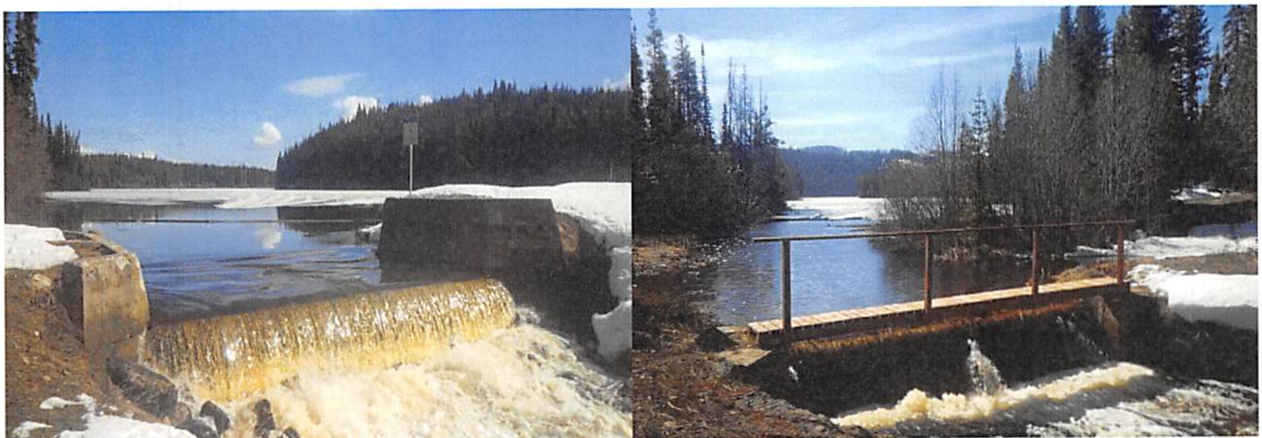
- 2016 was an average water consumption year with an average year's consumption being 8.6 million cubic meters.
- Zero consumption on Oyama Creek source occurred during low consumption months. This is because during low consumption months, traditional Oyama Lake customers are supplied with Kalamalka Lake water.
- Large increases on the Okanagan Lake supply and Kalamalka Lake supply in spring.
    - During the spring freshet the water flowing from the upland waters tends to have increased particulate in the water due to snow melt. This contributes to a period of increased turbidity and color on these water sources. Therefore the District supplies Kalamalka Lake water to the typical Oyama Creek customers and Okanagan Lake water to the typical Beaver Lake customers during spring freshet. The Okanagan Lake and Kalamalka Lake source typically exhibits higher drinking water quality characteristics than the Oyama and Beaver Lake sources.
- With unseasonably warm temperatures beginning in early April, water consumption was set to be record high but heavy rainfall from May through July slowed usage drastically. Typical summer temperatures returned in July and August which correlates to the usage peak seen in Figure 1.

1.3 Water Sources

The District 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

See appendix H for source area map.

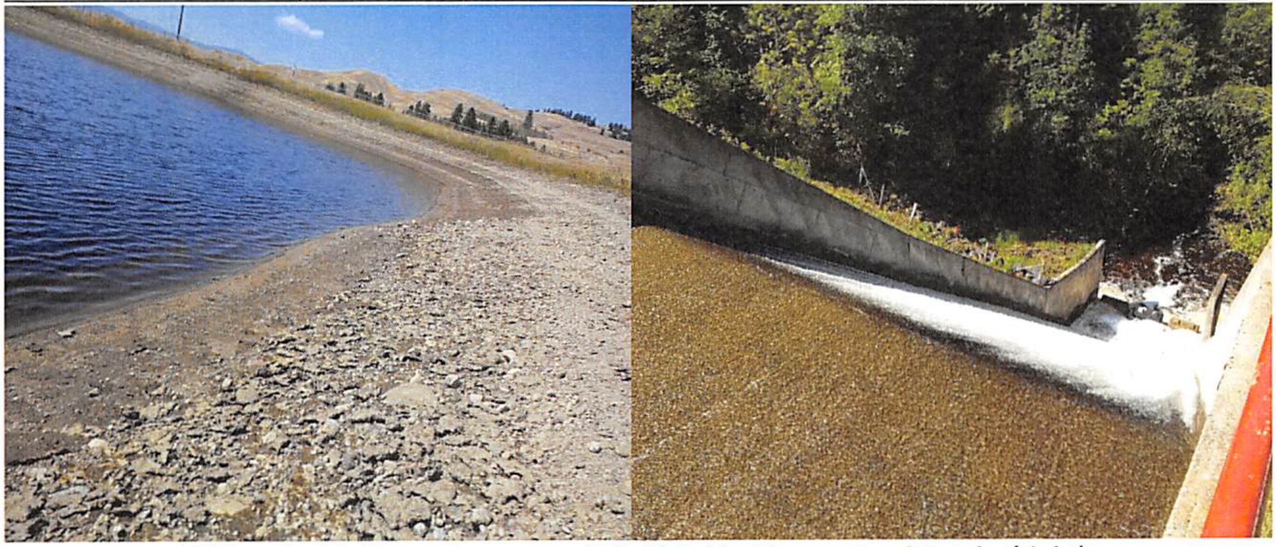


Crooked Lake dam spillway (left) and Oyama Lake dam spillway (right).

The Oyama Lake snow pack for 2016 was very high. February through to the beginning of April showed the largest volumes of snow recorded in the last 5 years. The water equivalence was nearly double that of 2015 at the end of February with volumes of 95 mm and 174 mm for 2015 and 2016, respectively. To see the historical snow survey data for Oyama Lake please visit the *BC River Forecast Centers website*, under manual snow survey data, number 2F19.

See Appendix F for 2016 Oyama and Beaver Lake level and Discharge.

During spring freshet and heavy rain events, large quantities of water flow though both Beaver Lake and Oyama Lake sources, commonly causing large spikes in turbidity and colour. When water quality becomes compromised due to rapid increased flows, the District switches upland source customers (Beaver and Oyama Lake) to lower elevation sources (Okanagan and Kalamalka Lake).



Eldorado drinking water reservoir (left) fed by Vernon Creek Intake (right).

1.4 Cross Connection Control Program (CCCP)

The Universal Metering program along with the installation of testable backflow prevention devices on seasonal irrigation connections reached 98% completion in 2016. The majority of seasonal irrigation connections, primarily for agricultural use in the District, were inspected and fitted with the appropriate cross connection control device, with the remainder to be completed in 2017. Risks encountered with domestic services were also addressed at this time.

Dependent on the business type, any new business license issued by the District will be subject to an inquiry as to the use of water for that business. If warranted, a cross connection inspection will be completed.

Table 1. *Status of cross connection control program noting the severity of hazards and the number of those that were surveyed as being compliant.*

Hazards	Quantity	Not Surveyed	Surveyed	Vacant	Compliant
High	40	3	37	0	33
Medium	88	12	76	0	62
Low	90	14	76	0	64
Totals	218	29	189	0	159

1.5 Annual Operations Summary

Annual operational duties that are completed by District staff:

- Service installation and repairs
- Collection and analysis of water sampling
- Upland dam inspections
- Maintain and clean all reservoir, chlorination, and pumping facilities
- Water main flushing
- Air valve maintenance
- Pressure reducing valve maintenance
- Hydrant maintenance
- Line valve maintenance
- Main line leak repairs
- Seasonal irrigation turn on & off
- Respond to customer complaints and inquiries

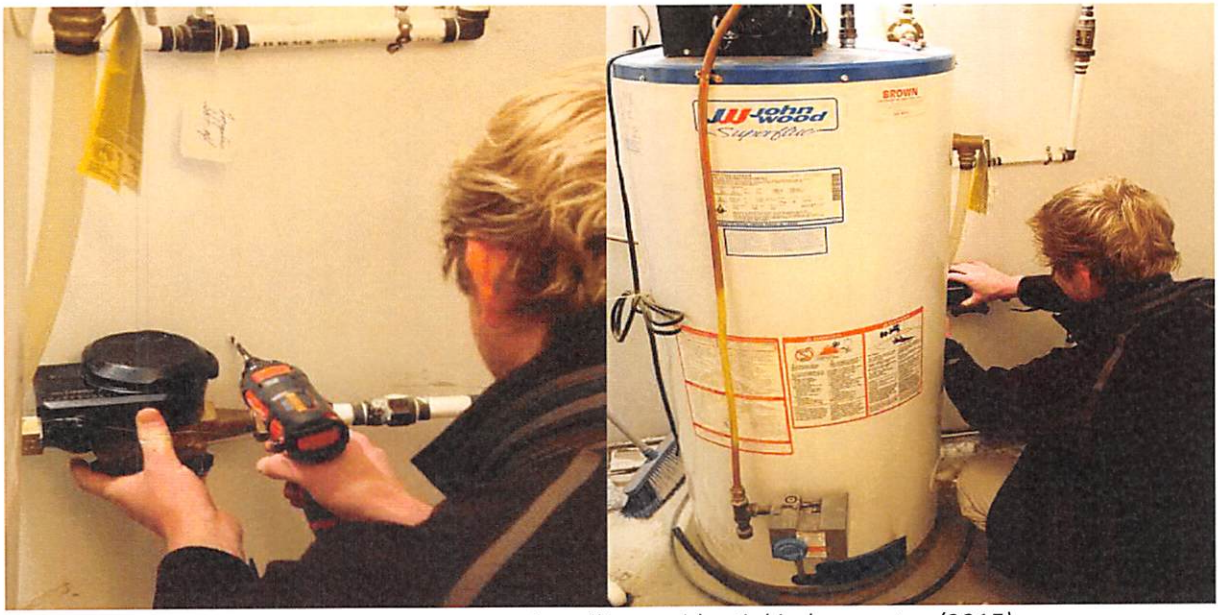
1.5.1 2016 Operations Project Highlights:

Universal Metering Program

The installation phase on the Universal Metering project continued from 2014 and reached 98% completion by the end of 2016. This project accounts for 2000 residential installations and upgrades to over 800 existing metered accounts so they are compatible with the new system. It also encompasses the installation of agricultural meters which neared completion in Winfield, Okanagan Centre, and Carr's Landing areas in 2016. The remaining domestic and agricultural installations will be completed in early 2017.

The District's Water plan remained the same in 2016, with a water **SAFE** vision of providing water that is **S**ustainable and **A**ffordable **F**or community and **E**nvironment. The project's primary objective is to have water consumption meters installed on all domestic, agricultural and industrial, commercial and institutional (ICI) service connections that are connected to a District water source. Metering will help to ensure water supplies are safe and sustainable as a whole.

Neptune Meter and Apollo Backflow installed (left) and District installing a Meter and Backflow unit (right)



Neptune Meter contractor installing residential indoor meter (2015)

Dam and Reservoir Inspections

Weekly and daily inspections of Upland Dams (Beaver, Crooked, Oyama, and Damer) were completed by the District. All inspection reports outlined the conditions of the dams and reservoirs as well as any maintenance recommendations.

The provincial inspector, Mike Norsworthy, completed a dam audit on Damer/Oyama Lake.

2016 also included the cleaning and inspection of the Coral Beach reservoir. There were no issues with any of the hardware or infrastructure.

1.6 Capital Works Improvements

The District of Lake Country continues to progress towards the goal of sustainable and affordable water following projects outlined in the Water Master Plan. Project 2 (Universal Metering) reached 98% completion in 2016 and will be completed in early 2017. Project 3, regarding Lower Lakes Water Quality Improvements, was next to be completed but was delayed and replaced by Project 4, Eldorado Treated Water Reservoir. The engineering and design phase of the Eldorado treated Water Reservoir began in 2016 with an anticipated start date of June 1, 2017 and is set to be completed March 31, 2018.

Due to the primary objective of supplying high quality water to domestic customers, the Eldorado Improvements took precedence over the Lower Lakes Improvements. The Eldorado reservoir is supplied with Vernon Creek water from the Beaver Lake source. This water source is susceptible to elevated turbidity and microbiological contamination, especially during freshet. The design of the Eldorado Treated Water Reservoir will increase treated water storage volumes and provide greater chlorine contact time for better disinfection.

Three key structures are involved with the completion of the Eldorado Improvements project. The Eldorado Treated Water Reservoir, Eldorado Low Lift Booster Station, and Glenmore Road Booster Station.

The Eldorado Treated Water Reservoir is a 6,000 m^3 storage reservoir. It will be located next to the existing Eldorado Raw Water Reservoir. The Eldorado Low Lift Booster Station is required to pump water from the current raw water reservoir up to the new treated reservoir.

The Glenmore Road Booster Station facilitates staffs ability to pump Okanagan Lake water into the Beaver Lake Water System. This is important during spring freshet when increased turbidity in Vernon Creek causes that source to become compromised. This new booster station replaces an existing booster station. The new booster station will have greater pumping capacity and greater operation redundancy.

1.7 Emergency Response Plan

The DLC has developed an Emergency Response Plan (ERP) that is updated annually (or more often as required). This report is seperate from the Annual Water Operations Report. Both the ERP and Annual Water Operations Report are provided to IHA annualy in June.

2. DISTRIBUTION WATER QUALITY SUMMARY

2.1 Water Chemistry background

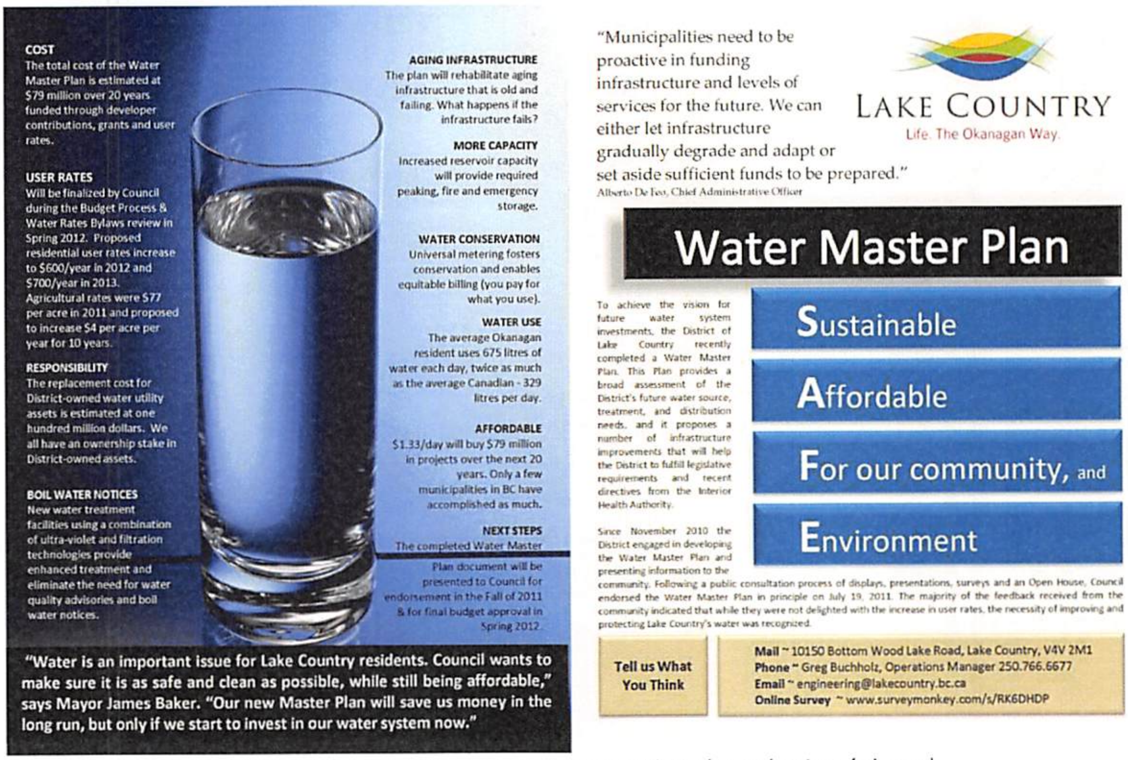
This section provides a review of the water quality testing performed in 2016 for the District of Lake Country's (DLC) water sources. Overall bacteriological and water chemistry results show that the District's drinking water is safe to drink. However, some parameters exceeded the maximum acceptable concentrations under the *Guidelines for Canadian Drinking Water Quality* (GCDWQ). The District's two main upland drinking water reservoirs (Beaver and Oyama Lakes and their creek sources where our intakes are located (Vernon and Oyama Creeks) exceeded the GCDWQ for colour and turbidity. Both Beaver and Oyama sources exceeded the THM guidelines. Such results are common throughout the Okanagan wherever water is sourced from highland watersheds.

Vernon Creek covered in snow (above).

Source water from these watersheds is high in organic matter which causes colour issues and elevated disinfectant by-products. Turbidity is naturally occurring in some areas and can be compounded by human activities that occur above our intakes, such as recreation, cattle ranching and logging. The DLC is working towards treatment (as outlined in our Water Master Plan) and at present our primary form of disinfection is chlorination.

Water purveyors are responsible for providing potable water to their users under the BC's Drinking Water Protection Act. In November 2012 the Province released version 1.1. for Drinking Water Treatment Objective (microbiological) for surface water supplies in British Columbia (BC Drinking water objectives). The BC Drinking water objectives provide an overview of the *framework towards achieving goals for drinking water treatment of pathogens in surface water supply systems in BC and for a general reference for assessing progress towards updating or improving existing water supply systems*. This general overview was developed using the BC's Drinking Water Protection Act, the Drinking Water Protection Regulation, and objectives in the GCDWQ. It will be used as a general reference for assessing progress towards updating or improving existing water supply systems. The treatment objectives ensure the provision of microbiologically-safe drinking water. It provides minimum performance target for water suppliers to treat water to produce microbiologically-safe drinking water addressing enteric viruses, pathogenic bacteria, Giardia cysts and Cryptosporidium oocysts. This continues to follow 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 until (NTU) of turbidity
- No detectable E.coli, fecal coliform and total coliforms



*Water **Master Plan** concept promotional marketing (above).*

The District has addressed these concerns in our Water Master Plan and we remain in discussions with IHA regarding the implementation and challenges of meeting these requirements

The DLC's distribution sites are monitored throughout the year for water chemistry, (free and total chlorine, turbidity, temperature, pH and conductivity) and for the presence of bacteria (total coliforms and E.coli).

Chlorine is the disinfectant used for all of the District sources. Free and total chlorine are measured to ensure a residual is maintained throughout the distribution systems. The Kalamalka Lake source also utilizes ultraviolet water treatment radiation as a secondary form of disinfection. Ultraviolet operations log sheets are contained in Appendix I.

Turbidity (a measure of the amount of particulate matter suspended in water) can harbour microorganisms protecting them from disinfection, therefore increasing the chlorine demand. In the Canadian Drinking Water Guideline (GCDWQ) the maximum allowable concentration for turbidity in water distribution systems has been set at 1 NTU.

Temperature and pH affect the strength of the disinfectant. The potable water temperature should be less than 15 °C for palatability and to inhibit growth of nuisance organisms. GCDWQ for pH ranges between 6.5 and 8.5.

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. There is no GCDWQ for apparent colour however the aesthetic objective in the GCDWQ for true colour is <15 TCU.

2.2 Bacteriological Background

The District of Lake Country (DLC) in cooperation with the Interior Health Authority, Okanagan Service Area (IHA) has developed a Water Quality Monitoring and Reporting Plan. It includes the criteria set by the Province to ensure standards for the monitoring the delivery of safe drinking water are being met. The bacteriological water quality monitoring requirements that DLC follows measure against the Guidelines for Canadian Drinking Water Quality (GCDWQ) and the *Drinking Water Protection Act (DWPA) and Regulations (DWPR).* Drinking Water Samples are collected on a weekly basis within each DLC Water System. Each water source is monitored for physical, chemical, and biological parameters. All membrane filtration microbiological samples are sent to an accredited and licensed laboratory for analysis. Additionally, samples are analyzed 'in-house' with presence absence tests (P/A) for further measurement against the GCDWQ and for use in assessing trends, standards and emerging issues. The required numbers of monthly samples are detailed in the DWPR Schedule B (Table 1) and the District of Lake Country Water Quality and Monitoring Plan; Frequency of Monthly bacteriological tests (Table 2). All weekly Total coliform and E.coli results from raw water sources and throughout the distribution system (this includes both membrane filtration and Presence-Absence) are compiled and submitted to the Drinking Water Officer assigned to DLC, Coral Beach and Lake Pine water systems. Results that do not meet the water quality standards in The DWPR, Schedule A **(Table 3)** are immediately reported to the Drinking Water Officer.

Table 1: 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 2: Frequency of Monthly bacteriological tests: Membrane Filtration (MF) and Presence-Absence (P/A)

System/Source	MF Distribution # samples required per mo.	MF Raw Water # samples recommended per mo.	P/A	Total MF Distribution and Raw	Distribution Bacteriological/ Chlorine test sites:
DLC Water System: Beaver Lake source : Est. Population 4,000	4	4	2	8	15*
DLC Water System: Okanagan Lake source : Est. Population: 4,000	4	4	2	8	11**
DLC Water System: Oyama Lake source: Est. Population 636	4	4	2	8	6
DLC Water System: Kalamalka Lake source: Est Population 614	4	4	2	8	5
Coral Beach Water System: Okanagan Lake source Est Population 124	4	4	2	8	2
Lake Pine Water System: Okanagan Lake source Est Population 173	4	4	2	8	4**
*includes Camp Rd. Reservoir (offline until required) **includes at least 2 reservoirs					

Table 3: 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 naturally occurring in the environment and generally are not harmful. However, their presence is an indicator for the presence of other types of disease-causing organisms. The presence of these bacteria is a sign that there may be problems with the water treatment, or the water distribution system.

Escherichia coli, (E.coli) is a bacterium that is always present in the intestines of humans and other animals and whose presence in drinking water would indicate fecal contamination of the water. Most strains of E.coli do not cause illness in healthy humans, although some strains do cause cramps and diarrhea. One particular strain named O157:H7 produces a powerful toxin that can cause severe illness. The maximum acceptable concentration (MAC) of *E.coli* in public, semi-public, and private drinking water systems is zero detectable per 100 mL.

At the time the samples are analyzed, the lab estimates the general bacterial population from background colony counts. Background bacteria are used as a general measure of the bacterial population present in a drinking water system or in the raw source water. Under ideal growth conditions, the background bacteria may increase and are indicators of the potential growth of coliforms. Initial counts are not reportable under our Permit to Operate. However, in order to identify problem areas and in aiming to provide good water quality within the distribution systems, all events are recorded and reported with follow-up sampling and, when necessary, flushing to provide fresh water to the site. 308 MF bacteriological samples were collected and analyzed at Caro Environmental Labs in Kelowna for total coliforms and E.coli. Additionally 171 P/A tests were analyzed (in-house). The P/A tests determine if total coliforms are present or absent from the sample but do not provide counts should the test be positive. P/A tests are collected on alternate weeks from the MF samples. The P/A tests provide quick feedback on the bacteriological quality of the water during the week that MF samples are not collected. Should a P/A be positive, additional bacteriological testing and further water chemistry testing occurs. At no time was E.coli detected in any DLC distribution systems.

In 2016 four samples were Positive for Total Coliforms. Three of the five bacteriological samples collected at the Coral Beach south end sampling site were positive for total coliforms and all were negative for E.coli. Presence Absence samples collected at the same time were negative. It was determined that a leak at the top of the yard hydrant sample site was the cause of intermittent positive total coliform counts; this leak was repaired. One sample on the Okanagan Lake source, Jardine pump station was positive for 1 total coliforms and no E.coli. Bacteriological sampling the following day were negative for total coliforms and E.coli. Appendix A contains a summary of positive total coliform results from each water system.

For all sources, any water chemistry parameters that are recorded daily through supervisory control and data acquisition (SCADA) and are not included in the data below. The monitoring of source and distribution water is conducted weekly rotating sampling through all sites as set out in the District of Lake Country Water Quality Monitoring and Reporting Plan.

Distribution water quality results are in tables 4 -9 below for District of Lake Country Water System (Beaver Lake Source (Table 4), Okanagan Lake source (Table 5), Oyama Lake Source (Table 6) Kalamalka Lake Source (Table 7) Coral Beach Water System (Table 8) and the Lake Pine Water System (Table 9). The list of sample sites for each distribution system is located in Appendix B.

2.3 Beaver Lake Source

Table 4. 2016 Annual Distribution Water Chemistry Results: District of Lake Country Water System; Beaver Lake Source (*All data reported from weekly water quality monitoring using hand-held equipment).*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.01	0.06	0.18	2	6.5	59
MAX	5.01	3.96	7.4	19	7.9	127
AVERAGE	1.37	1.34	1.28	12	7.0	73
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max) ≤ 5 NTU AO***	***15*** ***AO***	***6.5-8.5*** ***AO***	

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.

Water chemistry equipment (residual chlorine and turbidity meters) at Eldorado Balancing Reservoir (above).

2.4 Okanagan Lake Source

Table 5. 2016 Annual Distribution Water Chemistry Results: District of Lake Country Water System; Okanagan Lake Source (*All data reported from weekly water quality monitoring using hand-held equipment).*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.01	0.02	0.25	5	7.4	162
MAX	4.41	5.10	3.05	17	8.4	389
AVERAGE	0.85	0.92	0.50	10	8.0	287
WQ Guidelines *Aesthetic objective (AO)*			*1 (max)* ≤ 5 NTU AO	***15*** *AO*	***6.5-8.5*** *AO*	

It should be noted that there may be occasion where the distribution water sampled is a mixture of both sources (Okanagan Lake water mixed into Beaver distribution) and variation from the norm occurs within the data.

2.5 Oyama Lake Source

Table 6. 2016 Annual Distribution Water Chemistry Results: District of Lake Country Water System; Oyama Lake Source (*All data reported from weekly water quality monitoring using hand-held equipment).*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.13	0.27	0.53	6	6.2	48
MAX	4.14	5.16	3.58	20	7.1	68
AVERAGE	2.59	2.89	1.12	13	6.6	56
WQ Guidelines *Aesthetic objective (AO)*			***1 (max)*** **≤ 5 NTU** **AO**	***15*** ***AO***	***6.5-8.5*** ***AO***	

Occasionally the distribution water sampled is a mixture of both sources (Oyama Lake and Kalamalka Lake) and variation from the norm occurs within the data.

2.6 Kalamalka Lake Source

Table 7. 2016 Annual Distribution Water Chemistry Results: District of Lake Country Water System; Kalamalka Lake Source (*All data reported from weekly water quality monitoring using hand-held equipment).*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.05	0.19	0.29	4	7.7	332
MAX	2.82	3.20	2.2	16	8.5	448
AVERAGE	1.29	1.52	0.74	10	8.2	398
WQ Guidelines *Aesthetic objective (AO)*			***1 (max)*** **≤ 5 NTU** **AO**	***15*** ***AO***	***6.5-8.5*** ***AO***	

2.7 Coral Beach Water System

Table 8. 2016 Annual Distribution Water Chemistry Results: Coral Beach Water System; Okanagan Lake Source ***(All data reported from weekly water quality monitoring using hand-held equipment).***

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.56	0.08	0.29	6	7.4	281
MAX	2.56	2.52	1.57	15	8.4	734
AVERAGE	1.16	1.30	0.54	11	8.0	339
WQ Guidelines *Aesthetic objective (AO)*			*1 (max)* ≤ 5 NTU AO	***15*** *AO*	***6.5-8.5*** *AO*	
Conductivity of 734 verified by Caro Labs unknown why this measurement was higher than normal.						

2.8 Lake Pine Water System

Table 9. 2016 Annual Distribution Water Chemistry Results: Lake Pine Water System; Okanagan Lake Source ***(All data reported from weekly water quality monitoring using hand-held equipment).***

	Chlorine mg/L	Chlorine mg/L	NTU	Temp °C	pH	µS/cm
MIN	0.05	0.18	0.25	5	7.6	284
MAX	4.18	4.38	0.87	17	8.2	330
AVERAGE	1.26	1.47	0.42	12	7.9	305
WQ Guidelines *Aesthetic objective (AO)*			*1 (max)* ≤ 5 NTU AO	***15*** *AO*	***6.5-8.5*** *AO*	

Distribution water quality can vary for numerous reasons. These include: seasonal changes to water demand, timing of sampling following system flushing or use of hydrant, or mixing of water sources. The last circumstance is only applicable to Beaver/Okanagan Lake customers and Oyama/Kalamalka Lake customers. Under normal operating procedures Beaver Lake and Okanagan Lake sources do not mix. However, should Beaver Lake source water experience an undesirable water quality event (i.e. high turbidity that occurs during freshet), and if the system demands are within an operational range, we will supplement or switch Beaver Lake source customers with Okanagan Lake water. For customers on the Oyama source this has been the third season that they have been supplied with Kalamalka Lake source during the non-irrigation season (approximately Oct through May). At no time are the Beaver or Oyama sources mixed into Okanagan or Kalamalka source distribution systems. If this were ever to occur it would be under a water emergency situation with the appropriate Water Quality Advisory Notification issued. It is not unusual in any of the distribution systems for free chlorine to read trace levels at dead ends or through low use areas. The free and total chlorine levels are closely monitored. If chlorine levels are low or turbidity is elevated chlorine dosing may be increased and/or flushing of distribution lines may occur. Follow-up sampling confirms residuals and turbidity levels.

2.9 Water Quality Advisory and Boil Water Notice

The following sources throughout 2016 were on a **Water Quality Advisory (WQA)**:

- Beaver Lake (District of Lake Country Water System)
- Oyama Lake (District of Lake Country Water System)

The advisories on Beaver and Oyama Sources will remain in effect until infrastructure upgrades are made to improve water quality and reliability.

Notice to customers on the Oyama and Beaver sources as to when their water supplies will be switched over or supplemented with an alternate water source of better water quality does not occur. The DLC will continue to supply customers with the best water quality possible and normal operations includes the switching and supplementing of alternate sources when possible. Notification would occur in a situation where there is a lower water quality event (such as a Water Quality Advisory condition).

Effective March 31st, 2006, Interior Health (IH) launched a Turbidity Notification Campaign wherein IHA required purveyors to issue a Water Quality Advisory when turbidity exceeds 1 NTU, and to contact Interior Health as the turbidity approaches 5 NTU to discuss enhanced notification (i.e. a Boil Water Notice). Reminder notifications are sent to customers annually through water bills inserts as well as posted on the DLC web page and through our social media as is required. Regardless whether a source is on an Advisory or not, the distribution systems on all sources are regularly monitored as per the IHA approved Water Quality Monitoring and Reporting Plan.

2.10 Service Disruptions

Under normal operating conditions many water utilities frequently experience minor disruptions due to various reasons such as repairs to leaks, water main breaks, seized valves or installation of new infrastructure. In 2016 water operations crew responded to approximately 15 service repairs and 3 water main breaks.

Two temporary BWN's specific to localized areas were required.

April 21 – 25: On Thursday April 21 an 8" valve failure occurred at the corner of Pretty and Middleton Roads. The water was shut off and all downstream users from this point were out of water. In conjunction with the Interior Health Authority a Boil Water Notice (BWN) for these customers was issued. In addition to following all requirements in the DLC's Deviation Response plan, all customers affected were hand delivered the BWN with explaining the reason of the water outage and that the BWN would remain in effect until Tuesday April 26th. DLC water operations staff worked all day to repair the break, flush the lines and restore water to customers by 4:30 pm. DLC staff also worked on the weekend to test water quality and collect Bacteriological samples so that the BWN could be removed on Monday April 25th. Rescind Notices were posted via our Deviation Response Plan protocols in addition to DLC staff hand-delivering to the affected businesses.

On September 22nd a broken service line during construction across from Lakewood mall, required water to be shut off while operations crew repaired and flushed the line. Boil Water Notices were hand delivered to the customers affected at the Lakewood Mall, trailer court and Daycare centre. Following bacteriological sampling and adequate chlorine and turbidity results meeting the requirements of Interior Health, the BWN was lifted the morning of Sunday September 25^{th}. All affected customers were hand delivered the notices.

All other mainline breaks at this site (across from the Lakewood Mall) were repaired by DLC operations staff. Positive pressure was maintained throughout these procedures with minimal interruption to customers. Lines were flushed to reduce any impact from fluctuating flows following the repair and sampling confirmed good water quality.

Most of the repairs required in 2016 were completed with little disruption and as quickly as possible. Regular service was restored within the day and public health and safety was not compromised. In circumstances where public health and safety are at risk due an interruption in water distribution services, the District reports the notable events to Interior Health Authority (IHA) and documented in the Monthly Water Quality Reports under *Notable Events*. With the exception of an emergency repair or break, customers are provided advanced notice. When this is not possible, customers in the affected area are advised and notifications are left on the doors of the residents.

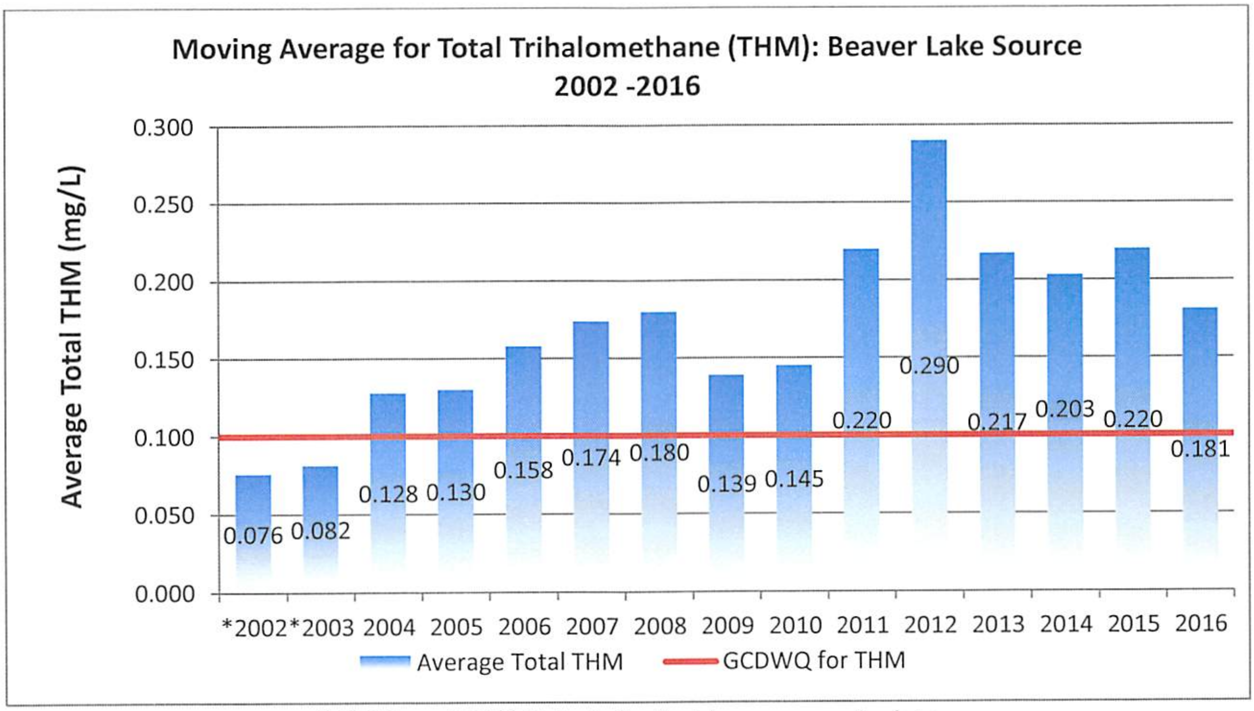
2.11 Trihalomethanes (THM's)

Trihalomethanes (THM's) are a by-product of the water disinfection process. They form when natural organic matter (i.e. decaying vegetation commonly found in lakes and reservoirs) reacts with the chlorine used to treat the water. This reaction produces organic chlorites that include suspected carcinogenic "disinfection by-products," the most common of which are THM's.

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

Trihalomethane analysis in the DLC Water System, Oyama and Beaver Lake sources had running averages that exceeding the CDWG. All THM results displayed at a running average are detailed in Figures 2-7.

Figure 2. 2002-2016 Moving Average of Total Trihalomethane (THM) Results for DLC Water System: Beaver Lake Source.



** 2002 and 2003 Data is limited to one sample date.*

Figure 3. 2006-2016 Moving Average of Total Trihalomethane (THM) Results for DLC Water System: Okanagan Lake Source.

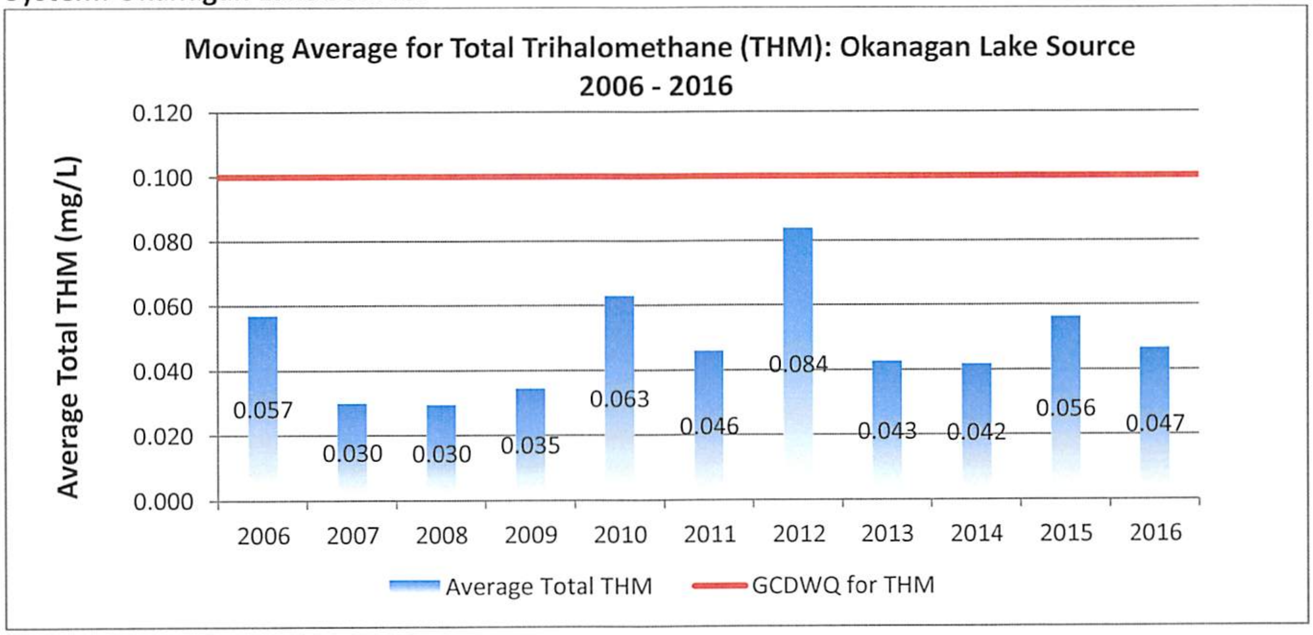
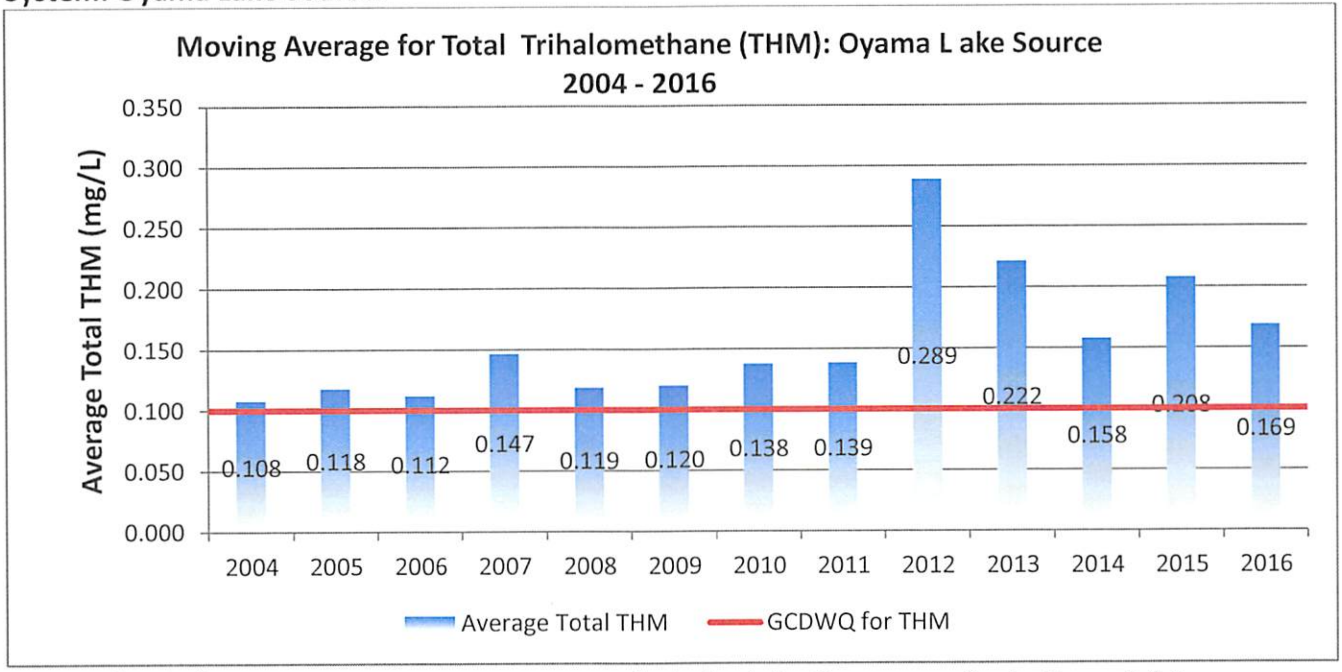
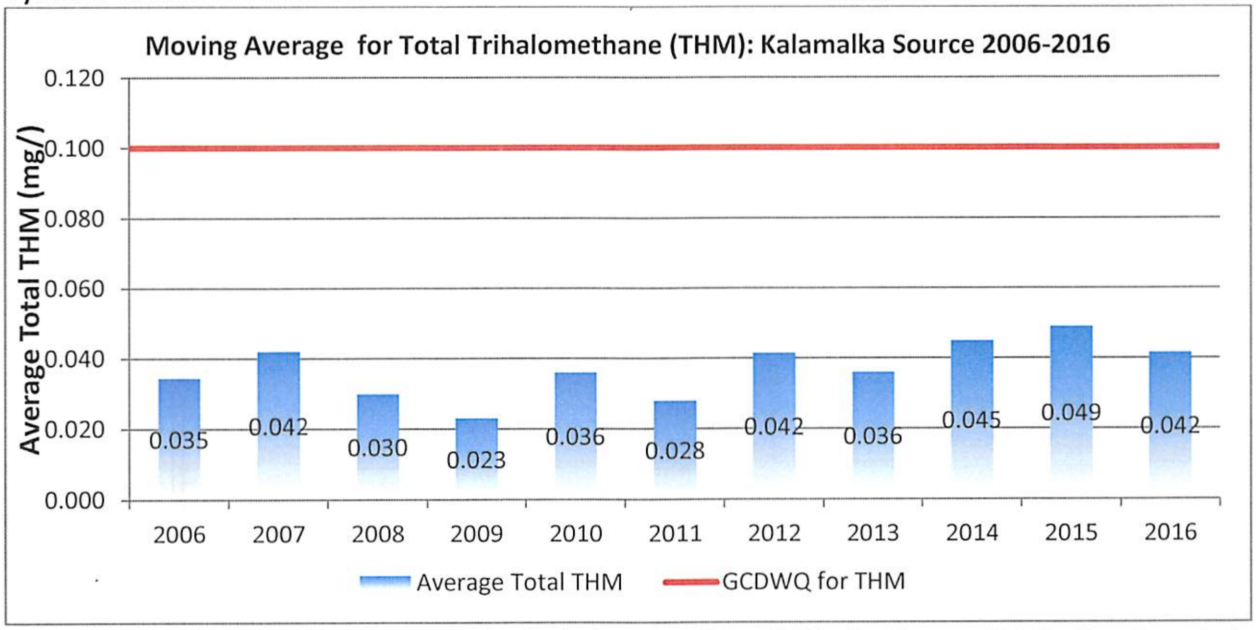


Figure 4. 2004-2016 Moving Average of Total Trihalomethane (THM) Results for DLC Water System: Oyama Lake Source.



Range of Sampling on Oyama source now occurs only during irrigation season due to the switch to Kalamalka Lake source approximately Oct through May. 2013 onwards samples reduced from four to two.

Figure 5. 2004-2016 Moving Average of Total Trihalomethane (THM) Results for DLC Water System: Kalamalka Lake Source.



Range of Sampling on Kal source now also includes sampling wiithin the Oyama distribution lines during non- irrigation season when the Kalamalka Lake source is the primary supply (approximately October through May). For years of 2013 onwards samples increased to four annually.

Figure 6. 2004-2016 Moving Average of Total Trihalomethane (THM) Results for Coral Beach Water System: Okanagan Lake Source.

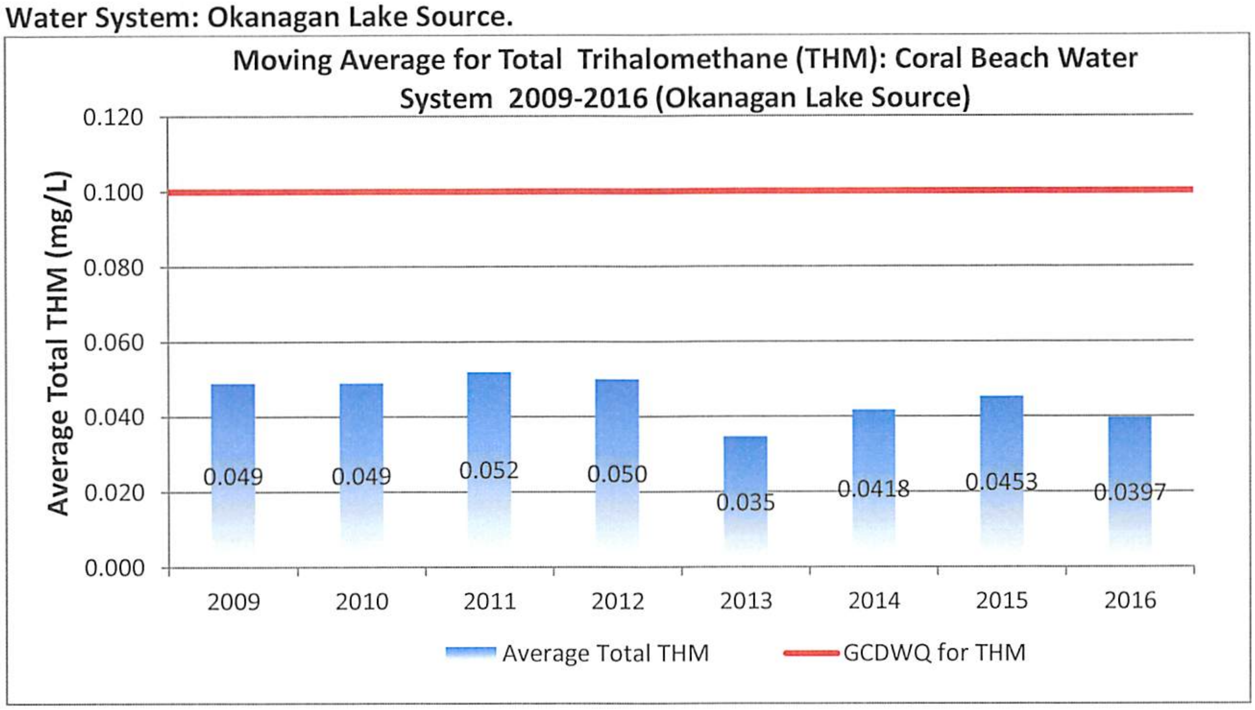
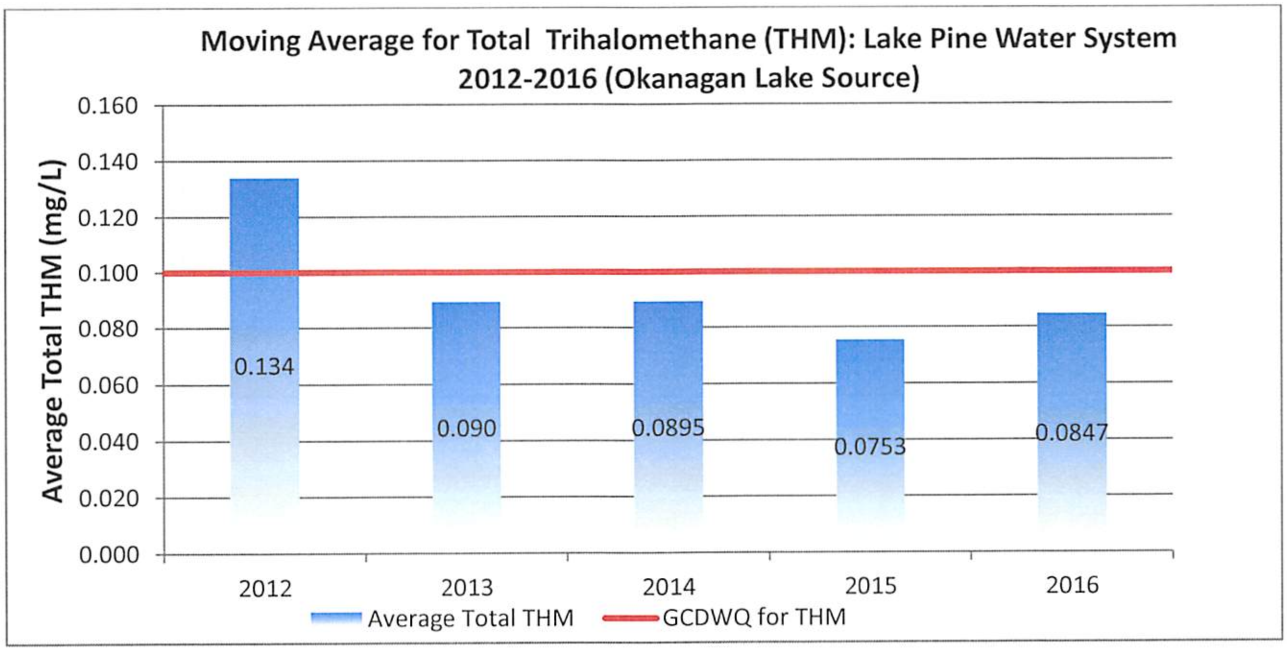


Figure 6. 2004-2015 Moving Average of Total Trihalomethane (THM) Results for Lake Pine Water System: Okanagan Lake Source.



3. Instrument Calibration and Quality Control

Prior to sampling, field instruments are checked against standards to ensure accuracy. All equipment is regularly maintained and calibrated as required prior to use in the field. Annually, a representative from Hach Services personally attends the DLC to inspect, recalibrate and re-certify water quality hand-held equipment. 2016 certification was obtained for all water quality monitoring field equipment. On-line Water Quality monitoring equipment is verified weekly using the hand-held water quality equipment maintained and calibrated as per manufacture directions and certified by an outside agency as scheduled in the automated operational maintenance program.

4. Giardia Performance Monitoring: CT calculations

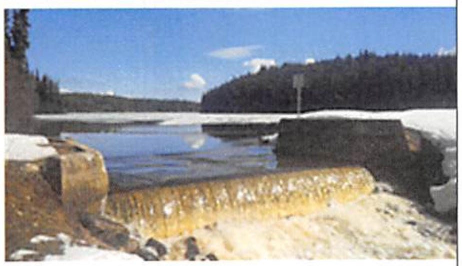
Beaver Lake Source

Chlorine is the primary disinfectant used on the Beaver Lake source and in order to be effective, it must have adequate contact time (CT) with microorganism to inactivate them. Various factors can affect CT values, such as pH, temperature, strength of disinfectants and types of organisms. The CT table that the DLC uses was developed by IHA specifically for the Beaver Lake source at the Glenmore pressure reducing Station (PR6), with the assumption that we are aiming to inactivate both Giardia lamblia (a single-celled parasite that causes intestinal infection) and viruses. Therefore the objective of giardia performance monitoring is to achieve a 3 log inactivation of giardia which is 99.9% deactivation which also provides the required 4 log inactivation of viruses. This PR station on Seaton Road has been working relatively well for collecting CT data. However, due to confined space and inadequate set up within that station this dedicated sample site was instead installed outside of the station and is subject to freezing in winter. Other than two occasions in 2016 when this site was sampled all CT requirements were met. On May 17TH 98.19% inactivation with triple chlorine concentration and 100% inactivation the following sample day. On

July 27th 92.87% inactivation with triple chlorine concentration within the following two hours achieving 100% inactivation. The CT spreadsheet is located in Appendix C. When Okanagan Lake source water is the primary source or supplemental source to Beaver Lake customers giardia performance contact time (CT) is not calculated. As such, there are no calculations for April 2016.

5. 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 water quality parameters that will provide adequate measurement of chemical and physical water quality against the CDWG as per Conditions on Permit and recommendations in Oyama and Vernon Creek Watersheds Source Water Assessment. Annually, comprehensive tests are collected at all intakes and nutrient testing occurs as budget permits during high and low flow seasons or as required. The DLC continually modifies parameters sampled to provide sufficient baseline data for future water treatment.

Raw Water Data from intakes and pump stations are located in Tables 10 through 16 (below). Comprehensive tests were collected as follows:

- Beaver Lake source: Vernon Creek Intake (Table 11)
- Okanagan Lake Source: Okanagan Lake Pump Station (Table 12)
- Oyama Lake source: Oyama Creek Intake (Table 13)
- Kal Lake source: Kal Pump Station (Table 14)
- Coral Beach Water System
- Okanagan Lake Source: Coral Beach Pumphouse (Table 15)
- Lake Pine Water System
- Okanagan Lake Source: Lake Pine Pumphouse (Table 16)

Subsequent comprehensive tests are planned for 2017. Comprehensive reports are located in Appendix D.

Oyama Lake Dam Spillway

Results are stored electronically and undergo verification prior to monthly and annual reporting to ensure quality controlled data. The data is used to characterize the quality of raw water intakes, monitor levels of physical, chemical and biological changes occurring in raw drinking water, establish trends in drinking water quality, identify and track the occurrence of concerns such as increased turbidity, positive bacteriological results or changes in nutrient loading. As well provide background data for future additional forms of disinfection and water treatment plant(s), assess and report on the state of the DLC's distribution and raw water quality.

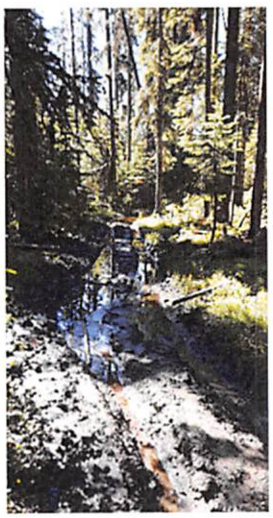
Table 10. District of Lake Country Water System, 2016 Raw Water, Beaver Lake Source: Vernon Creek Intake/Eldorado Reservoir. All data reported from weekly water quality monitoring using hand-held equipment.

weekly sampling and on-line water quality eqiupment verification	[1] *Hardness* *mg/L as* CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF EColi CFU/100 ml	[3] % of samples less than 10 Ecoli/100mL (N=52)
MIN	40	0.40	1.6	7.0	55	24	<1	<1	86%
MAX	80	2.52	17	8.3	96	75	380	23	
AVERAGE	69	1.25	9	7.6	68	39	40 samples		
WQ Guidelines			*15*	*6.5-8.5*			*<1*	*<1*	
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*AO*		*AO*	*MAC*	*MAC*	

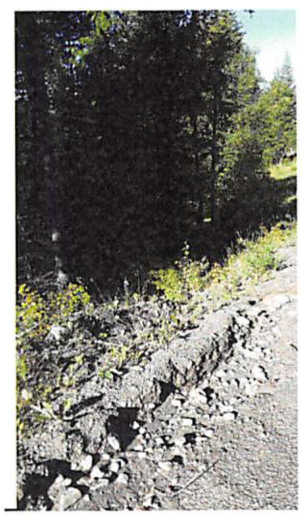
1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts calcium carbonate concentration as follows: soft, 0 to <60 mg/L; medium hard, 60 to <120 mg/L; hard, 120 to < 180 mg/L; and very hard, 180 mg/L and above

2 Turbidity is reported as weekly equipment verification and not SCADA

3 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL



On July 17th a turbidity event occurred on the Beaver Lake Source following an intense rain storm event. Water operations staff quickly switched to the Okanagan Lake source. This changeover was only possible due to the immediate reduction of flows and ongoing wet weather over the following few days. On further investigation staff found many sections on the Beaver Lake road above the second cattle guard that had areas of substantial water erosion where sedimentation and high turbid water were draining to the Vernon Creek side. Many of the drainage structures were filled. The Ministry of Transportation and Infrastructure's roads maintenance contractors were advised and asked to remediate this situation. Turbidity continued to elevate as each rain event occurred over the next 48 hrs.

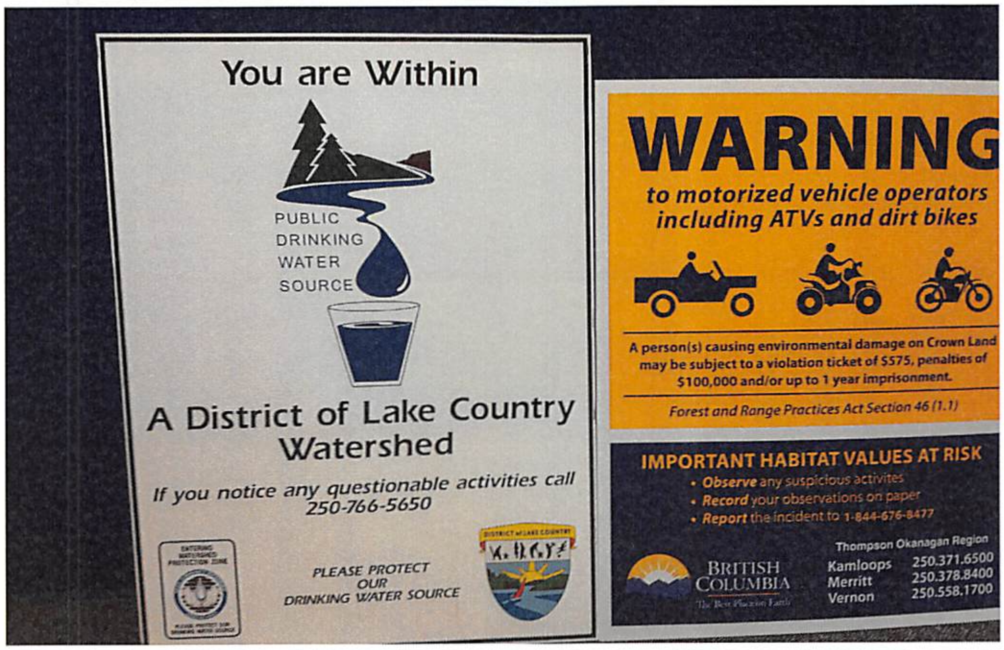


It was also discovered that below the Dam a mud bogging area was discovered that also had very high potential for delivery of sediments to the creek. Many pictures of this area were taken and the site reported to the Natural Resource Sector of the Province both verbally and officially through their web based submission process.

DLC operators flushed the intake pond and cleaned screens until July 21st when the turbidity was less than 5NTU down from 100NTU and we could operate as normal again.
Water chemistry and bacteriological samples prior to the switch back showed low (normal) counts. A Boil Water Notice was adverted due to the quick response of the staff, the long days of work to clean the intake pond and the rains subsiding after day two.

Following this process we have received warning signage from the Province indicating the offence and fines associated with motorized vehicle damage in sensitive areas. These will be posted with the DLC watershed information signage at this site. A person(s) causing environmental damage on Crown Land may be subject to a violation ticket of $575, penalties of $1000,000 and/or up to 1 year imprisonment. Unless the off road activities are reported in process or with substantiated evidence of the offender charges cannot be processed.

The drainage investigations in the high vulnerability areas directly along the creek, Beaver Lake Road and the unsanctioned off road activities below our intake all appear to be cumulative impact from sources of sediment that are contributing to high turbidly in our drinking water source.



If you notice questionable activities in our Community Watersheds report the incident to: **1-844-676-8477.**

Table 11. District of Lake Country Water System, 2016 Raw Water, Okanagan Lake Source: Okanagan Lake Intake. All data reported from weekly verification of on-line monitoring equipment using hand-held water quality equipment.

weekly sampling and on-line water quality eqiupment verification	[1] Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UVTransmittance @ 254 nm unflitered	[3] % of samples less than 10 E.coli/100mL (N=30)
MIN	140	0.25	5	7.5	257	<5	<1	<1	86	100%
MAX	160	2.30	10	8.4	301	<5	110	1	88	
AVERAGE	153	0.42	7	8.1	277	<5	32 SAMPLES		87	
WQ Guidelines			*15*	*6.5-8.5*			*<1*	<1		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*AO*		*AO*	*MAC*	*MAC*		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA

3 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Table 12. District of Lake Country Water System, 2016 Raw Water Oyama Creek Intake. All data reported from weekly verification of on-line monitoring equipment using hand-held water quality equipment.

weekly sampling and on-line water quality eqiupment verification when Oyama Creek online	[1] Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	[3] % of samples less than 10 E.coli/100mL (N=21)
MIN	40	0.5	2.9	7.0	41	36	25	<1	58%
MAX	60	4	17.6	8.4	76	120	1700	130	
AVERAGE	44	1.1	11.4	7.5	55	51	29 samples		
WQ Guidelines			*15*	*6.5-8.5*			*<1*	*<1*	
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*AO*		*AO*	*MAC*	*MAC*	

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

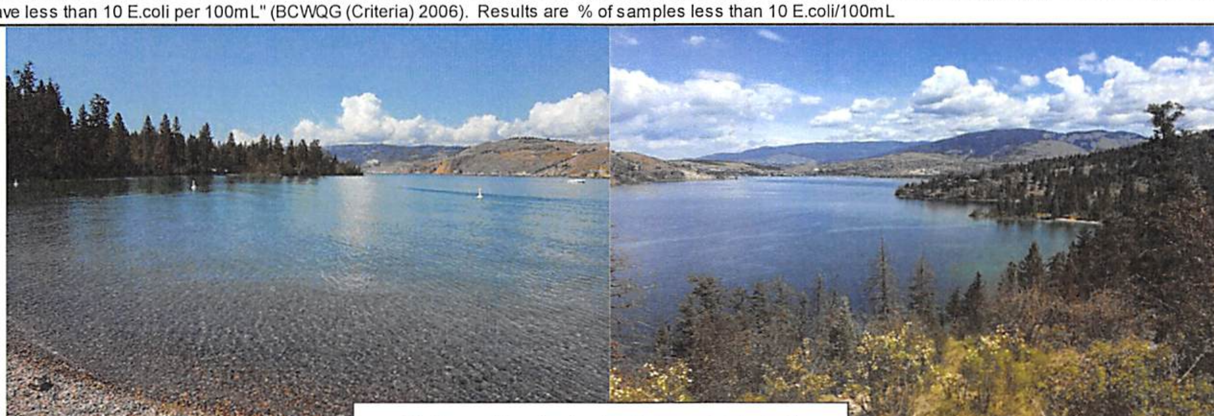
Table 13 District of Lake Country Water System, 2016 Raw Water Kalamalka Lake Intake. All data reported from weekly verification of on-line monitoring equipment using hand-held water quality equipment.

weekly sampling and on-line water quality eqiupment verification	[1] Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UVTransmittance @ 254 nm unflitered	[3] % of samples less than 10 E.coli/100mL (N=46)
MIN	200	0.25	6	7.8	366	<5	<1	<1	85	100%
MAX	220	3.33	15	8.8	428	<5	90	3	91	
AVERAGE	217	0.85	9	8.2	388	<5	51 Samples		90	
WQ Guidelines			*15*	*6.5-8.5*			*<1*	<1		
Aesthetic objective (AO)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*AO*		*AO*	*MAC*	*MAC*		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL



Kalamalka Lake (left) and (right).

Table 14. Coral Beach Water System, 2016 Raw Water Coral Beach Intake (Okanagan Lake source). All data reported from weekly verification of on-line monitoring equipment using hand-held water quality equipment.

weekly sampling and on-line water quality eqiupment verification	[1] Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UVTransmittance @ 254 nm unflitered	[3] % of samples less than 10 E.coli/100mL (N=49)
MIN	120	0.27	6	7.7	260	<5	<1	<1	32	100%
MAX	160	0.82	20	8.5	305	5	3	2	89	
AVERAGE	140	0.45	12	8.1	273	-	51 Samples		78	
WQ Guidelines			*15*	*6.5-8.5*			*<1*	<1		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*AO*		*AO*	*MAC*	*MAC*		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

2 Turbidity is reported as weekly equipment verification and not SCADA.

3 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

Table 15. Lake Pine Water System, 2016 Raw Water Lake Pine Intake (Okanagan Lake source). All data reported from weekly verification of on-line monitoring equipment using hand-held water quality equipment.

weekly sampling and on-line water quality eqiupment verification	[1] Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UVTransmittance @ 254 nm unflitered	[3] % of samples less than 10 E.coli/100mL (N=46)
MIN	140	0.20	8	7.4	264	<5	<1	<1	85	
MAX	160	0.58	15	8.3	339	<5	41	3	88	100%
AVERAGE	145	0.35	12	8.0	287	<5	44 Samples		86	
WQ Guidelines			*15*	*6.5-8.5*			*<1*	<1		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*AO*		*AO*	*MAC*	*MAC*		

1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts 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

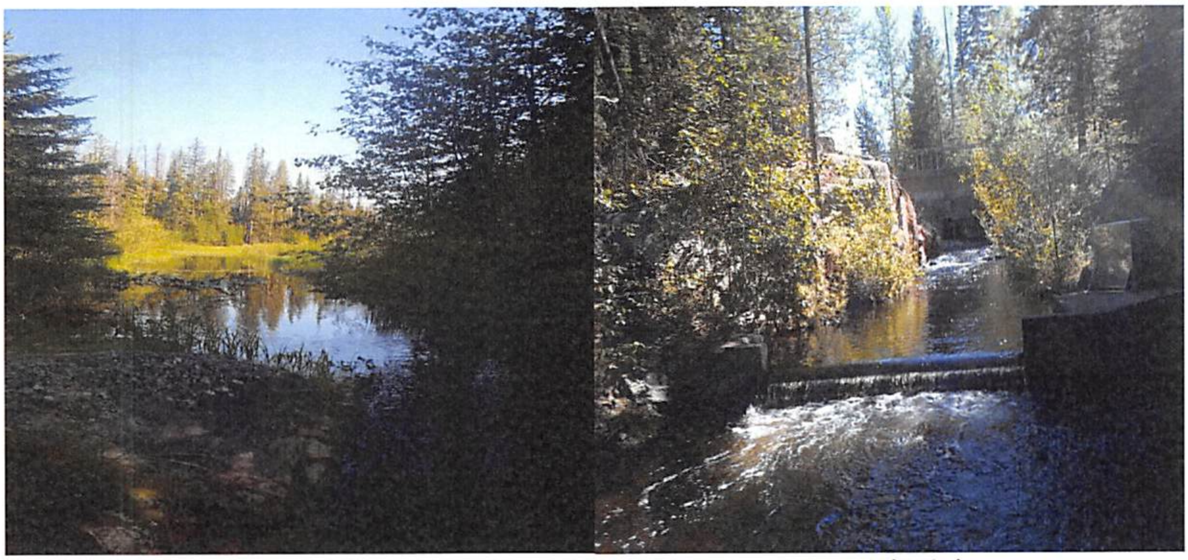
2 Turbidity is reported as weekly equipment verification and not SCADA.

3 According to the criteria set out by the BC Water Quality Guidelines (BCWCG) for a system using disinfection only to treat drinking water, "90% of samples should have less than 10 E.coli per 100mL" (BCWQG (Criteria) 2006). Results are % of samples less than 10 E.coli/100mL

5.1 Raw Water Reservoirs/Intakes

The District 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 intake
4. Kalamalka Lake (1) deep water intake



Oyama Lake downstream dam (left) and Oyama Creek (right).

The Oyama and Vernon Creek watersheds together encompass approximately 141.1 km2. Together, the two community watersheds supply the DLC with approximately 65% of their source water. Both watersheds are dependent on upland storage reservoirs that rely on snow pack for annual water regeneration and supply needs.

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

The District's two main upland drinking water reservoirs (Beaver and Oyama Lakes) and creek sources (Vernon and Oyama Creeks) exceeded the GCDWQ for colour and turbidity. Such results are common throughout the Okanagan wherever water is sourced from highland watersheds.

Source water from these watersheds is high in organic matter which causes colour issues and elevated disinfectant by-products. Turbidity is naturally occurring in some areas and can be compounded by human activities that occur above our intakes, such as recreation, cattle ranching and logging.

The water quality monitoring of these reservoirs may increase or decrease in response to varying water quality conditions and to provide adequate baseline data for future water treatment. Results are stored electronically and undergo verification prior to monthly and annual reporting to ensure quality controlled data. The data is used to characterize the raw water quality from our upland drinking water reservoirs, monitor levels of physical, chemical and biological changes occurring in raw drinking water, establish trends in drinking water quality, identify and track the occurrence of concerns such as increased turbidity, positive bacteriological results or changes in nutrient loading, provide background data for future additional forms of disinfection and water treatment plant(s) and to assess and report on the state of the DLC's distribution and raw water quality.

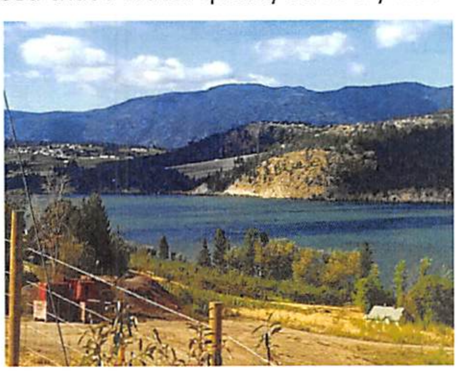
Beaver Lake Dam Intake

Algal blooms and other aquatic growth in our drinking water reservoirs can occur at various time throughout the year. Aquatic anomalies are assessed, under the direction of an aquatic biologist; samples are collected and sent for analysis.

The Eldorado balancing reservoir is monitored regularly and operations staff continues with on-going measures to control aquatic organism growth which includes the operation of the water as a balancing reservoir and the periodic removal of accumulated sediments. In 2016 this worked well and there were no major events that required additional control measures. There were no observed algae incidents on Oyama Lake or Oyama Creek.

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. The information obtained defines the physical and biological impact at the DLC'S existing intakes; accumulates baseline water chemistry for future additional water treatment; provides information on the ideal depth of intakes for the best water quality; shows fluctuations in nutrients and algae production; and the implications of changes for water resources. This research is evaluated and re-directed on an annual basis.

As with previous years, late July Kalamalka Lake began to Marl and we saw the beautiful blue and turquoise green colours (pictures below). With this crystallization of calcium carbonate we also see a slight increase with this inorganic turbidity source. With very low bacterial counts and our chlorine maintained at adequate levels this did not cause additional problems other than regular cleaning and maintenance of equipment at our chlorination/UV facility. IHA was aware of this increased turbidity trending and has advised that a water quality advisory was not required.



Marling: Kalamalka Lake in late July (left) & (right).

6. Watershed Management

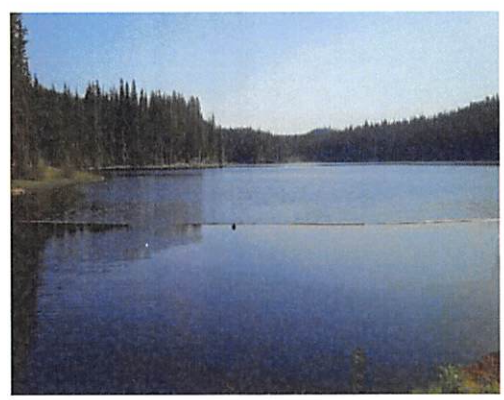
The DLC supplies domestic and irrigation water for the communities of Oyama, Winfield, Okanagan Centre, and Carr's Landing. Sixty five (65%) percent of the water delivered to the Lake Country communities originates from the Oyama and Vernon Creek watersheds.

Infrastructure within these watersheds was constructed approximately 100 years ago for irrigation, but in the 1970's the systems were updated, and evolved to become a major domestic water supply. As the service population continues to expand, there has been a significant increase on the demands of these watersheds. Both the Oyama and Vernon Creek watersheds are multi-use and have numerous ongoing activities (e.g. forestry, range, recreation, etc.). 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.

In 2010 the DLC secured an Okanagan Basin Water Board Water Quality and Conservation Grant that provided us with the substantial financial support to complete Watershed Source Water Assessment Plans. The DLC meets annually with stakeholders to review the plan, the intentions and recommendations/action items that were completed and other actions that have occurred or are required. The DLC also continues to collaborate with stakeholders (Forestry, Ranchers etc.) on other various occasions throughout the year to address matters as they arise. In 2015, the DLC fulfilled the second watershed related requirement of condition on permit to produce an implementation plan.

Watershed Source Water Assessment Plans:

2010 Oyama and Vernon Creek Source Water Assessment (Watershed Protection Plan)]
2010 Source to Tap Assessment South Kalamalka Lake Intake (DLC water system)
2010 Source to Tap Assessment of the Okanagan lake Intake (DLC water system)
2015 Source Water Assessment and implementation Plan: Oyama and Vernon Creek



Damer Lake (above).

The purpose of the Source to Tap Assessments on the DLC distribution systems Kalamalka and Okanagan Lake sources were to conduct research and compile known data for use in identifying the DLC'S intake strengths, liabilities and planning for water quality protection and improvement. One of the most important recommendations in these assessments was the identification of an Intake Protection Zone. This zone defines the area where the intake should take precedence over every other use of consideration. It also defines the areas of land and water where special care must be taken in the use and handling of potential contaminants to prevent them from accidently entering the lake and affecting the intake.

The Watershed Protection plan for the Oyama and Vernon Creek watersheds promotes sustainable management of our ecosystems through collaborative efforts of all stakeholders. The most valuable management tool from this plan is the identification of the various vulnerability zones that indicate the potential for risk to water quality. When considering any high risk activities within our community watershed, these high risk areas are the first to be evaluated for potential impacts of the activities along with the associated levels of risk. These activities may include forestry management, sports and/or recreational and mining activities.

Throughout the process of completing these plans, stakeholder involvement was a key component to ensuring a broad range of aspects were considered. The goal for stakeholders is to be aware of the vulnerability zones and to recognize the recommendations specific to them when planning further watershed activities.

The Oyama and Vernon Creek Source Water Assessment (SWA) was completed in 2010 as a condition on permit and prepared by Ecoscape Environmental Consultants Ltd. with input from all stakeholders.

Follow up meetings are for stakeholders to share their past accomplishments and current activities in the watershed. Overall, there is an appreciation and recognition our watersheds are multipurpose and it takes and overall effort to help protect the water while also sustainably maintaining resources for all users. Stakeholders are encouraged to bring forward their questions with an understanding that we want to maintain trust in this environment. As we continue to understand more of each stakeholder's processes and various regulations involved in their activities, recommendations can more often be dealt with through collaborative efforts. We recognize water is vitally important; however, we are all impacting the watershed regardless of what our activities are, we all have rights to be in the watersheds and we all have room for improvement.

The Source Water Assessment continues to play an important role in the management and planning in our community watersheds. In 2016 a specific stakeholder meeting to follow up on identified risks and actions in the SWA was not held. However, throughout 2016 there were various meetings (and continuous communications) either on a one-to one basis or in group settings with the Ministry of Agriculture, Ministry of Forest Lands and Natural Resource Operations, forestry licensees, range tenure holders, private lease lot cabin and resort owners, Okanagan Basin Water Board, Central Okanagan Regional District and the Ministry of Transportation and Infrastructure are among some of the parties the DLC worked with in 2016 respecting watershed activities. DLC staff also maintain other connections through involvement with several of the above-mentioned in various watershed related organizations some of which are the Okanagan Basin Water Board (OBWB), Okanagan Water Stewardship Council, BC Water Supply Association, Public Advisory Group for Sustainable Forest Management, OBWB and source protection and wetland committee.

We continue to improve our collaboration with the SWA stakeholders group, striving to implement recommendations and recognizing improvements as we move forward. Our watersheds are multipurpose, multijurisdictional and cumulatively we are all making an impact. All stakeholders have a responsibility to recognize this and use best practices maintaining sustainable resources for all users.

The DLC continued the joint work with Greater Vernon Water/North Okanagan Regional District (RDNO) and the Ministry of Environment to acquire water quality data on Kalamalka Lake. Data collected from 2016 sampling season was compiled and updated into the Kalamalka Lake Water Quality Study, Microflora, Water Chemistry & Thermal Profiles Report. The 2016 sampling season began in May and continued monthly into the fall; this marks the 18th year of collaboration on this comprehensive study.

6.1 Range Management

The Okanagan Shuswap District Range Program's annual meeting took place in the spring at the District of Lake Country. This year the meeting was expanded to include purveyors and ranchers within the Central Okanagan Regional District (DLC, Glenmore Ellison Irrigation District, Black Mountain Irrigation District, West Kelowna, South East Kelowna Irrigation District and Regional District North Okanagan (RDNO), Greater Vernon Water. There were over 40 people in attendance including stakeholders that presented information on watershed recreation sites and trails, timber licencees (Tolko, West Bank First Nations and BC Timber Sales) and research from UBCO, Range Branch and Ministry of Agriculture. Following this meeting the FLNRO Range Program facilitator provided minutes with action items to be addressed in the upcoming operating season.

Overall, the discussions this year focused on collaboration among local gov't, ranchers, Ministries within FLNRO), UBCO research and the new recreation sites and trails being developed. Again during 2016 the concern remained of the impact for (non-sanctioned and unknown but authorized) recreational activities in our watershed.

The meeting was quite large and for the DLC it is not the forum for individual discussions and specific updates with range use permit holders in our community watersheds. The DLC connects with ranchers (and others) throughout the year working to maintain open lines of communication with updates on projects, opportunities or situations that either party should be aware of.

Current Researchers/Projects in DLC and neighboring Community Watersheds:

- UBCO Research, Dr. Deborah Roberts, UBCO March 31, 2016 completed for FLNRO: Verifying Best Management Practices (BMPs) for Livestock Grazing in Community Watersheds in the Okanagan Valley
- UBCO 2016 initiated: Vulnerable distance to drinking water intakes for activities
- FLNRO: Managing Natural Range Barriers under the Forests and Range Practices Act
- Ministry of Agriculture Silvopasture project
- MAY 2016, Persistence of Cryptosporidium parvum in Bovine Feces During Summer and Winter Exposure, Thesis by Keith Trizin

6.2 Forestry

Harvest activities in our community watershed continue to remain substantially decreased from previous years of major harvest and Mountain Pine Beetle salvage. The two major licencees in our watersheds, Tolko and BC Timber Sales again maintained low profile for harvest operations in 2016. Ongoing communications were maintained through staff involvement with the Sustainable Forest Management Plans, Public Advisory Group and direct contact as necessary.

Major Licencees in our community watersheds are well aware of our Watershed Protection Plan and the DLC has requested it be used as a planning tool when developing harvest plans. Harvest/site plans are reviewed by DLC staff and recommendations are provided as needed to address issues such as access (cattle and unsanctioned motorized vehicle activities), wild fire management, drainage concerns, and rehabilitation of roads to decrease the amount of non-status roads accumulating in our community watersheds.

Small Scale Salvage is a program that is regulated and operates through the Province. Private companies can apply for a small scale salvage licencee through the Ministry of Forest Lands and Natural Resources (MFLNR) These smaller operations apply to the MFLNR, harvest small volumes of timber that would otherwise not have been harvested and/or to address forest health objectives. Small scale salvage operations do not follow Forest Stewardship Plans or belong to a certification process such as Sustainable Forest Management Plan (SFMP) The SFMP includes a set of values, objectives, indicators and targets that address environmental, economic and social aspects of forest management... (excerpt extracted from Sustainable Forest Management Plan). Both major Licencees in the DLC'S community watershed adhere to this plan. It is the responsibility of the small scale salvage operator and the Province to ensure that best management practices are being followed.

As with major licencees, when small scale salvage operations occur in DLC'S watersheds, DLC staff review the referral for comment/recommendations and remind or provide the applicant a copy of our Watershed Protection Plan highlighting the importance of recognizing our vulnerability zones and properly planning and working within these zones . The DLC's highest concerns are within high vulnerability zones regardless of type of the proposed activity. The DLC continues to express concern with the Province authorizing approval for small scale salvage logging in high vulnerability zones (commonly within a major licensee's Lakeshore protection).

In early 2016 the Small Scale Salvage Program (SSSP) met with all participants (Licensees, contractors, professionals and purveyors (DLC and RDCO) to review changes in the SSSP *Manual effective May 2016.* The amendments do not directly address current ongoing issues within the community watersheds however; a new commitment to the responsibilities for SSS clients, such as electronic submissions of applications and documents will enable DLC staff to more clearly identify areas and respond to site in future applications.

For applications within Lakeshore Management zones the SSSP has been requesting the licensee follow Best Management practices and ensure appropriate cattle barriers are put in place after harvest. SSSP also advised they will monitor the logging during harvest and on completion to ensure adherence to the salvage plan. This is important when working in high vulnerability (i.e. lakeshore management zones) and of significant improvement over past Ministry protocol.

The Okanagan Shuswap District advises they will not regularly track ECA (equivalent Clear Cut Area) and rely on the comments from Major Licensee's to identify related issues in their feedback. The ECA not only can impact water quality but importantly it can influence water quantity (timing and volume). The DLC will continue requesting updates and address this information gap in our watershed implementation plans.

Access and roads appears to remain unchanged as the SSSP are currently reviewing the road use exemption to strengthen wording around maintenance and rehabilitation of roads. Currently, if trails into blocks appear to be left in such a way that ATV access might be an issue, SSSP informed the DLC they would try to work with the licensee to ensure restricted access. The SSSP advised they will continue to work with DLC if we observe and report SSS activities having a negative impact on roads and drainage.

The most significant improvement in SSSP planning is their agreement to now use the DLC vulnerability zone mapping in their future planning.

APPENDIX A – SUMMARY OF POSITIVE BACERIOLOGICAN RESULTS IN DISTRIBUTION

	Total coliforms CFU/100 mL	E.coli CFU/100 mL	presence Absense (total coliforms)	presence Absense (E.coli)	sample date	Number of TC/E.coli Samples	Number of P/A samples
District of Lake Country Water System:							
Beaver Lake Source (WQA)	none detected in distribtuion system					51	37
Okanagan Lake Source	none detected in distribtuion system					59	27
Jardine	1	<1			30/Aug/16		
Oyama Lake Source	none detected in distribtuion system					26	13
Kalamalka Lake Source	none detected in distribtuion system					57	34
Coral Beach Water System: Okanagan Lake Source						60	31
Coral Beach South End	1	<1			8/Aug/16		
Coral Beach South End	1	<1			10/Aug/16		
Coral Beach South End	1	<1			30/Aug/16		
Coral Beach South End			1	<1	1/Sep/16		
Lake Pine Water System: Okanagan Lake Source	none detected in distribtuion system					55	29
					TOTAL:	*308*	*171*

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	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
Vernon Creek Intake **RAW**	Beaver Lk		x									x											
Eldorado **RAW**	Beaver Lk		x			x		x															
Eldorado Reservoir/ chlorination facility	Beaver Lk					x				x		x	x										
Artella	Beaver Lk		x		x											x							
Breakwater	Beaver Lk							x								x							x
Camp Rd Shop	Beaver Lk		x		x										x				x		x		
Camp Rd Reservoir (off line)	Beaver Lk		x							x					x			x					
Cooney Drain	Beaver Lk	x	x								x					x					x		
Mulbery	Beaver Lk	x	x				x								x								
Dewar Park	Beaver Lk		x		x											x							x
Fire Admin Building	Beaver Lk		x		x										x								
Jammery	Beaver Lk			x					x														x
Long	Beaver Lk		x		x											x							x
Middleton Rd (Future)	Beaver Lk		x												x						x		
McCreight	Beaver Lk		x		x											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							
Pixton	Beaver Lk			x							x					x							x
Pow Rd PRV Stn	Beaver Lk		x							x					x								
PR2	Beaver Lk			x	x										x								
PR6 Vernon Ck	Beaver Lk		x							x				x						x	x		
Williams	Beaver Lk		x		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	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
Arena	Ok Lk			x											x				x			x	
Clement	Ok Lk		x					x								x					x	x	
Copper Hill	Ok Lk		x		x											x					x		
Jardin Pump Stn	Ok Lk		x						x						x								
Lower Lakes Reservoir	Ok Lk		x			x				x					x								
McCoubrey	Ok Lk		x				x								x								
Ok Bio Fuels (Jim Bailey Rd)	Ok Lk		x		x																		
Ok Lk Intake **RAW**	Ok Lk		x							x		x										x	
Ok Lk Pump Stn/chlorination facility	Ok Lk					x				x		x	x										
PR6 Ok Lk	Ok Lk	x	x							x					x						x		
Ponderosa pumphouse	Ok Lk		x							x		x				x							
Ponderosa PRV stn	Ok Lk		x							x					x								
Ottley Rd (off Stubbs)	Ok Lk		x				x							x						x			
Upper Lakes Reservoir	Ok Lk		x					x															
Upper Zone (Future)	Ok Lk		x																		x		

District of Lake Country Water System: Oyama Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	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								
Oyama Rd S	Oyama Lk	x	x				x									x	x	x			x		
Oyama Rd N	Oyama Lk		x				x									x	x	x			x		
Oyama Lk/Hayton Rd	Oyama Lk			x												x	x		x				
Oyama Creek Intake **RAW**	Oyama Lk		x									x											
Oyama Reservoir	Oyama Lk		x							x			x									x	
Ribbleworth	Oyama Lk		x				x								x							x	
Sawmill Rd at Middlebench (Future)	Oyama Lk			x							x				x							x	
Talbot Rd Booster Stn (future)	Oyama Lk			x				x								x							
5410 Todd Rd. (summer: First customer Spring (Sawmill online): could be either from Sawmill or from reservoir)	Oyama Lk		x							x				x	x	x							
Oyama Creek intake/Chlorination Facility - Chlorinator post reservoir	Oyama Lk					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	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
B-2 Reservoir	Kal			x				x							x								
Cornwall/ Sheldon	Kal	x	x				x								x		x				x		
Evans	Kal		x				x									x					x		
Kal Lk Intake **RAW**	Kal		x							x		x											
Kal Pump Stn	Kal		x			x				x			x	x						x			
Maclaren	Kal		x		x		x								x						x		
Sawmill Rd Booster (Future)	Kal		x												x	x							
Oyama Creek Chlorination Facility (distribtuion water fromKal Source (Sawmill) to Oyama reservoir)	Kal					x						x	x										
Old Oyama Pumphouse	Kal			x						x		x			x								x
Teddy Bear (seasonal)	Kal		x							x						x			x				x

Coral Beach Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	BacT/Water Chemistry	Free Ci2/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 South End	CB Ok Lk	x	x		x											x					x		

Appendix B (continued)

Lake Pine Water System: Okanagan Lake Source

MATRIX: Water Quality Sampling Sites, Criteria,Purpose, Type of sample Station	Source	THM	BacT/Water Chemistry	Free Ci2/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: dosing Booster/Lower Res	LP Ok Lk					x				x			x	x						x			
Lake Pine Booster/Lower Res	LP Ok Lk		x			x				x			x	x						x			
Lake Pine Lower Res	LP Ok Lk		x				x							x									
Lake Pine PR Stn.	LP Ok Lk	x	x													x					x		
Lake Pine Upper Reservoir	LP Ok Lk		x							x					x								

Appendix C – 2016 Giardia Performance Monitoring

DATE Jan	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
1	6.90	2.00	14.00	1.80	3318.3	205.9	16.1	0.11	100.00	409124	1843	222	30.7
2	6.90	2.00	14.00	2.50	4608.8	216.3	21.3	0.12	100.00	409125	1844	222	30.7
3	6.90	2.00	14.00	2.10	3871.4	210.8	18.4	0.11	100.00	409126	1844	222	30.7
4	6.90	2.00	14.00	2.50	4608.8	216.3	21.3	0.12	100.00	409127	1844	222	30.7
5	6.90	2.00	14.00	1.87	3447.4	207.1	16.6	0.11	100.00	409128	1844	222	30.7
DATE Feb	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
1	7.20	2.60	10.00	2.10	5419.9	226.7	23.9	0.09	100.00	409124	2581	159	43.0
2	7.25	2.80	10.00	2.03	5239.2	226.6	23.1	0.09	100.00	409125	2581	159	43.0
4	7.10	2.90	14.00	2.00	3687.0	212.3	17.4	0.12	100.00	409127	1844	222	30.7
5	7.20	2.70	14.00	1.99	3668.6	223.3	16.4	0.12	100.00	409128	1844	222	30.7
10	7.10	2.90	14.00	2.01	3705.5	212.4	17.4	0.12	100.00	409133	1844	222	30.7
11	7.04	2.80	14.00	2.40	4424.5	214.7	20.6	0.12	100.00	409134	1844	222	30.7
15	6.98	2.80	14.00	2.90	5346.3	215.9	24.8	0.12	100.00	409138	1844	222	30.7
16	6.98	2.70	15.00	3.00	5162.0	218.5	23.6	0.13	100.00	409139	1721	238	28.7
17	7.00	2.70	15.00	3.16	5437.3	221.9	24.5	0.13	100.00	409140	1721	238	28.7
18	6.98	2.71	13.00	2.90	5757.6	217.2	26.5	0.11	100.00	409141	1985	206	33.1
19	7.00	3.40	13.00	2.20	4367.9	200.2	21.8	0.10	100.00	409142	1985	206	33.1
22	6.98	3.70	13.00	1.99	3951.0	191.7	20.6	0.10	100.00	409145	1985	206	33.1
24	7.00	3.50	13.00	2.10	4169.4	197.4	21.1	0.10	100.00	409147	1985	206	33.1
29	6.90	3.50	12.00	2.00	4301.8	188.6	22.8	0.09	100.00	409152	2151	190	35.8
DATE March	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
1	6.98	3.70	12.00	1.99	4280.0	191.7	22.3	0.09	100.00	409124	2151	190	35.8
2	7.00	3.80	12.00	1.80	3871.4	189.0	20.5	0.09	100.00	409125	2151	190	35.8
3	7.02	4.00	12.00	1.45	3118.6	181.8	17.2	0.08	100.00	409126	2151	190	35.8
4	7.08	4.00	12.00	1.10	2365.8	178.5	13.3	0.08	100.00	409127	2151	190	35.8
8	7.09	4.80	13.00	1.21	2402.3	171.9	14.0	0.09	100.00	409131	1985	206	33.1
10	7.15	5.00	13.00	1.13	2243.4	171.7	13.1	0.09	100.00	409133	1985	206	33.1
16	7.10	5.00	12.00	1.20	2581.0	170.0	15.2	0.08	100.00	409139	2151	190	35.8
21	7.20	5.00	14.00	1.10	2027.9	174.2	11.6	0.09	100.00	409144	1844	222	30.7
22	7.15	5.00	12.00	1.13	2430.5	171.7	14.2	0.08	100.00	409145	2151	190	35.8
23	7.50	5.80	12.00	0.56	1204.5	166.2	7.2	0.08	100.00	409146	2151	190	35.8
24	7.40	5.80	13.00	0.65	1290.5	163.9	7.9	0.08	100.00	409147	1985	206	33.1
30	7.30	6.60	14.00	0.85	1567.1	155.7	10.1	0.08	100.00	409153	1844	222	30.7
DATE MAY	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
2	7.02	10.80	280.00	1.21	111.5	110.4	1.0	1.20	99.91	409125	92	4439	1.5
3	6.70	11.40	260.00	1.88	186.6	99.8	1.9	1.01	100.00	409126	99	4122	1.7
4	6.60	10.10	177.00	1.59	231.8	102.3	2.3	0.70	100.00	409127	146	2806	2.4
9	6.80	11.90	318.00	1.70	138.0	98.8	1.4	1.22	99.99	409132	81	5041	1.4
10	6.80	11.80	284.00	1.43	130.0	96.9	1.3	1.07	99.99	409133	91	4502	1.5
11	6.98	11.80	180.00	1.71	245.2	106.8	2.3	0.75	100.00	409134	143	2853	2.4
12	6.80	11.80	233.00	1.95	216.0	101.6	2.1	0.92	100.00	409135	111	3694	1.8
16	6.75	13.30	270.00	1.80	172.1	88.7	1.9	0.93	100.00	409139	96	4280	1.6
17	6.80	12.40	270.00	0.48	45.9	79.0	0.6	0.83	98.19	409140	96	4280	1.6
18	6.83	13.80	267.00	1.57	151.8	86.6	1.8	0.90	100.00	409141	97	4232	1.6
19	7.80	13.00	252.00	2.03	207.9	136.0	1.5	1.33	100.00	409142	102	3995	1.7
24	6.96	11.60	192.00	1.51	203.0	105.5	1.9	0.78	100.00	409147	134	3044	2.2
25	6.67	12.80	265.00	1.25	121.7	84.2	1.4	0.86	100.00	409148	97	4201	1.6
26	6.97	12.50	213.00	1.43	173.3	98.7	1.8	0.81	100.00	409149	121	3376	2.0
30	6.86	11.60	130.00	2.56	508.3	109.8	4.6	0.55	100.00	409153	199	2061	3.3
31	6.93	12.30	154.00	2.48	415.7	107.0	3.9	0.64	100.00	409154	168	2441	2.8

Appendix C – 2016 Giardia Performance Monitoring (continued)

DATE June	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
2	6.79	13.90	247.00	1.79	187.0	86.3	2.2	0.83	100.00	409125	104	3915	1.7
3	6.60	13.70	276.00	1.98	185.2	82.3	2.2	0.88	100.00	409126	94	4375	1.6
6	6.80	17.10	439.00	1.72	101.1	69.0	1.5	1.17	100.00	409129	59	6959	1.0
7	7.00	17.10	410.00	1.85	116.5	75.4	1.5	1.20	100.00	409130	63	6499	1.0
8	6.91	17.40	340.00	1.69	128.3	70.4	1.8	0.93	100.00	409131	76	5390	1.3
9	6.91	16.20	343.00	2.32	174.6	80.2	2.2	1.07	100.00	409132	75	5437	1.3
10	7.45	17.40	201.00	2.07	265.8	88.8	3.0	0.69	100.00	409133	128	3186	2.1
13	6.80	13.40	125.00	2.94	607.0	96.7	6.3	0.47	100.00	409136	206	1982	3.4
14	7.32	13.60	118.00	2.04	446.2	110.0	4.1	0.50	100.00	409137	219	1871	3.6
15	6.96	13.50	157.00	2.03	333.7	96.7	3.5	0.59	100.00	409138	164	2489	2.7
16	7.15	13.00	246.00	1.27	133.2	100.3	1.3	0.96	99.99	409139	105	3900	1.7
20	6.57	12.50	168.00	3.56	546.9	96.5	5.7	0.63	100.00	409143	154	2663	2.6
21	6.98	13.30	213.00	1.95	236.3	98.2	2.4	0.81	100.00	409144	121	3376	2.0
22	7.17	13.70	213.00	1.35	112.0	97.2	1.2	1.17	99.97	409145	83	4930	1.4
23	6.99	13.70	237.00	1.49	162.3	92.1	1.8	0.85	100.00	409146	109	3757	1.8
27	7.13	14.90	256.00	0.90	90.7	82.9	1.1	0.82	99.95	409150	101	4058	1.7
28	7.20	16.10	336.00	1.52	116.8	84.7	1.4	1.10	99.99	409151	77	5326	1.3
29	7.10	16.00	412.00	1.71	107.1	83.6	1.3	1.33	99.99	409152	63	6531	1.0
30	7.19	16.90	445.00	1.47	85.3	79.4	1.1	1.37	99.94	409153	58	7054	1.0
DATE JULY	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
4	6.85	15.20	292.00	2.08	183.8	82.6	2.2	0.93	100.00	409127	88	4629	1.5
5	6.85	13.20	173.00	3.24	483.4	101.4	4.8	0.68	100.00	409128	149	2742	2.5
6	6.94	13.40	130.00	1.29	256.1	90.3	2.8	0.45	100.00	409129	199	2061	3.3
7	6.82	14.10	149.00	0.82	142.0	76.6	1.9	0.44	100.00	409130	173	2362	2.9
11	6.85	15.20	80.00	0.64	206.5	69.2	3.0	0.21	100.00	409134	323	1268	5.4
12	6.93	15.60	99.00	1.32	344.1	77.4	4.4	0.30	100.00	409135	261	1569	4.3
13	6.86	15.90	160.00	1.69	272.6	76.6	3.6	0.47	100.00	409136	161	2536	2.7
14	6.96	15.70	216.00	1.99	237.8	82.8	2.9	0.69	100.00	409137	119	3424	2.0
18	7.45	13.00	86.00	0.70	210.1	102.5	2.1	0.34	100.00	409141	300	1363	5.0
19	8.03	9.60	25.00	0.67	691.7	157.6	4.4	0.15	100.00	409142	1032	396	17.2
20	7.63	10.80	28.00	0.86	792.7	131.2	6.0	0.14	100.00	409143	922	444	15.4
21	6.83	14.70	201.00	3.52	452.0	91.8	4.9	0.72	100.00	409144	128	3186	2.1
25	6.84	16.30	363.00	1.82	129.4	74.7	1.7	1.05	100.00	409148	71	5754	1.2
26	6.78	17.30	355.00	1.68	122.1	67.3	1.8	0.93	100.00	409149	73	5627	1.2
27	7.40	17.50	356.00	0.35	25.4	66.4	0.4	0.92	92.87	409150	73	5643	1.2
27	6.96	17.70	356.00	3.68	266.8	79.0	3.4	1.09	100.00	409150	73	5643	1.2
28	6.97	17.70	358.00	1.44	103.8	68.9	1.5	0.96	100.00	409151	72	5675	1.2
29	6.80	18.20	350.00	2.02	149.0	65.5	2.3	0.89	100.00	409152	74	5548	1.2
DATE AUG	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
1			327.00		0.0	0.0	#DIV/0!	0.00	#DIV/0!	409124	79	5184	1.3
2	7.65	16.70	277.00	3.00	279.5	105.9	2.6	1.14	100.00	409125	93	4391	1.6
3	6.83	16.60	205.00	3.10	390.3	79.0	4.9	0.63	100.00	409126	126	3250	2.1
4	6.87	16.80	282.00	2.78	254.4	77.8	3.3	0.85	100.00	409127	92	4470	1.5
8	6.58	16.90	380.00	2.20	149.4	66.5	2.2	0.98	100.00	409131	68	6024	1.1
9	7.00	16.70	350.00	2.70	199.1	82.1	2.4	1.11	100.00	409132	74	5548	1.2
10	6.90	16.60	280.00	2.56	236.0	78.9	3.0	0.86	100.00	409133	92	4439	1.5
12	6.93	17.10	361.00	2.48	177.3	76.7	2.3	1.07	100.00	409135	71	5723	1.2
15	6.90	18.00	366.00	3.02	213.0	73.4	2.9	1.04	100.00	409138	71	5802	1.2
16	7.00	18.20	362.00	2.68	191.1	73.9	2.6	1.04	100.00	409139	71	5738	1.2
17	6.79	18.70	360.00	2.36	169.2	64.5	2.6	0.90	100.00	409140	72	5707	1.2
18	7.11	18.10	368.00	2.44	171.1	76.5	2.2	1.09	100.00	409141	70	5834	1.2
19	6.93	17.20	364.00	3.10	219.8	78.8	2.8	1.11	100.00	409142	71	5770	1.2
22	7.63	16.80	291.00	3.18	282.1	105.3	2.7	1.19	100.00	409145	89	4613	1.5
23	7.38	16.50	298.00	3.20	277.2	98.4	2.8	1.14	100.00	409146	87	4724	1.4
24	6.93	16.00	299.00	3.20	276.2	86.0	3.2	1.00	100.00	409147	86	4740	1.4
25	7.51	15.10	358.00	3.00	216.3	112.6	1.9	1.56	100.00	409148	72	5675	1.2
26	7.04	16.00	314.00	3.18	261.4	89.7	2.9	1.09	100.00	409149	82	4978	1.4
29	6.92	16.50	282.00	3.28	300.2	83.1	3.6	0.91	100.00	409152	92	4470	1.5
30	7.32	16.70	302.00	3.20	273.5	95.0	2.9	1.11	100.00	409153	85	4787	1.4
31	6.88	16.80	303.00	3.22	274.3	79.9	3.4	0.94	100.00	409154	85	4803	1.4

Appendix C – 2016 Giardia Performance Monitoring (continued)

DATE SEPT	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
1	6.99	16.50	290.00	3.60	320.4	86.6	3.7	0.97	100.00	409124	89	4597	1.5
2	6.81	15.70	228.00	5.01	567.1	89.6	6.3	0.79	100.00	409125	113	3614	1.9
6	6.92	13.80	263.00	4.40	431.8	104.7	4.1	1.07	100.00	409129	98	4169	1.6
12	7.17	13.40	265.00	2.11	205.5	106.1	1.9	1.09	100.00	409135	97	4201	1.6
14	6.90	12.70	265.00	3.06	298.0	106.2	2.8	1.09	100.00	409137	97	4201	1.6
19	6.94	12.70	263.00	3.90	382.7	111.8	3.4	1.14	100.00	409142	98	4169	1.6
28	6.99	12.40	264.00	3.40	332.4	114.0	2.9	1.17	100.00	409151	98	4185	1.6
30	7.10	12.20	265.00	3.50	340.9	121.1	2.8	1.24	100.00	409153	97	4201	1.6
DATE OCT	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
5	7.10	13.40	148.00		0.0	0.0	#DIV/0!	0.00	#DIV/0!	409128	174	2346	2.9
7	7.10	11.00	40.00	3.30	2129.3	130.5	16.3	0.20	100.00	409130	645	634	10.8
11	7.30	9.00	40.00	1.64	1058.2	145.4	7.3	0.23	100.00	409134	645	634	10.8
12	7.00	10.00	45.00	3.98	2282.7	138.5	16.5	0.24	100.00	409135	574	713	9.6
13	7.20	8.70	30.00	1.60	1376.5	142.6	9.7	0.17	100.00	409136	860	476	14.3
17	7.25	8.50	24.00	1.16	1247.5	140.3	8.9	0.13	100.00	409140	1075	380	17.9
19	7.30	8.60	20.00	1.35	1742.2	145.2	12.0	0.11	100.00	409142	1291	317	21.5
26	6.95	8.50	14.00	1.20	2212.3	125.9	17.6	0.07	100.00	409149	1844	222	30.7
27	7.30	9.50	20.00	1.33	1716.4	136.1	12.6	0.11	100.00	409150	1291	317	21.5
31	7.20	9.50	35.00	0.75	553.1	120.4	4.6	0.16	100.00	409154	737	555	12.3
DATE NOV	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
1	7.10	9.50	17.00	0.65	986.8	113.5	8.7	0.07	100.00	409124	1518	269	25.3
3	7.20	9.50	20.00	1.44	1858.3	132.8	14.0	0.10	100.00	409126	1290	317	21.5
4	7.18	8.40	14.00	0.80	1474.8	130.2	11.3	0.07	100.00	409127	1844	222	30.7
7	7.10	9.30	14.00	1.30	2396.6	127.7	18.8	0.07	100.00	409130	1844	222	30.7
9	7.00	8.50	14.00	1.30	2396.6	129.9	18.5	0.07	100.00	409132	1844	222	30.7
14	7.00	8.00	14.00	0.88	1622.3	126.8	12.8	0.07	100.00	409137	1844	222	30.7
15	7.10	7.90	14.00	1.16	2138.5	138.3	15.5	0.08	100.00	409138	1844	222	30.7
16	7.00	7.90	15.00	1.32	2271.3	135.7	16.7	0.08	100.00	409139	1721	238	28.7
17	7.70	6.90	17.00	1.71	2596.2	195.4	13.3	0.13	100.00	409140	1518	269	25.3
22	7.30	6.90	18.00	1.00	1433.9	156.2	9.2	0.11	100.00	409145	1434	285	23.9
23	6.50	7.00	12.00	0.92	1978.8	112.1	17.6	0.05	100.00	409146	2151	190	35.8
24	6.60	7.00	12.00	0.86	1849.7	115.6	16.0	0.05	100.00	409147	2151	190	35.8
28	6.30	6.82	13.00	1.01	2005.3	105.8	18.9	0.05	100.00	409151	1985	206	33.1
29	6.30	6.80	14.00	0.88	1622.4	103.8	15.6	0.06	100.00	409152	1844	222	30.7
31	6.30	6.80	14.00	0.80	1474.9	102.3	14.4	0.06	100.00	409154	1844	222	30.7
DATE DEC	pH (highest)	TEMP C (lowest)	FLOW L/s	Free Cl PR6	CT achieved	CT Req'd	CTa/CTr	Free Cl Req'd	% Inactivation	TOT. VOL. USGAL	TIME (mins)	FLOW Usgpm	TIME (hrs)
5	7.20	5.50	11.00	0.80	1877.0	160.4	11.7	0.07	100.00	409128	2346	174	39.1
6	7.00	4.20	11.00	1.00	2346.3	168.3	13.9	0.07	100.00	409129	2346	174	39.1
8	6.95	3.20	11.00	0.55	1290.5	161.7	8.0	0.07	100.00	409131	2346	174	39.1
12	7.00	3.50	11.00	0.85	1994.4	172.4	11.6	0.07	100.00	409135	2346	174	39.1
13	7.00	3.50	11.00	0.80	1877.1	170.8	11.0	0.07	100.00	409136	2346	174	39.1
14	6.94	3.30	11.00	3.30	7742.9	209.3	37.0	0.09	100.00	409137	2346	174	39.1
15	6.95	2.70	11.00	3.30	7743.0	219.1	35.3	0.09	100.00	409138	2346	174	39.1
19	7.10	2.50	11.00	0.58	1360.9	181.3	7.5	0.08	100.00	409142	2346	174	39.1
20	7.10	2.50	11.00	0.60	1407.8	182.2	7.7	0.08	100.00	409143	2346	174	39.1
21	7.00	2.50	11.00	1.62	3801.1	203.5	18.7	0.09	100.00	409144	2346	174	39.1
22	7.00	2.50	11.00	1.40	3284.9	199.1	16.5	0.08	100.00	409145	2346	174	39.1
23	6.95	2.60	11.00	1.25	2933.0	190.7	15.4	0.08	100.00	409146	2346	174	39.1
24	6.95	2.50	12.00	2.50	5377.2	213.1	25.2	0.10	100.00	409147	2151	190	35.8
25	6.95	2.50	12.00	1.60	3441.4	199.3	17.3	0.09	100.00	409148	2151	190	35.8
26	6.95	2.50	13.00	1.90	3772.3	204.5	18.4	0.10	100.00	409149	1985	206	33.1
27	6.95	2.50	13.00	1.50	2978.1	197.4	15.1	0.10	100.00	409150	1985	206	33.1
28	6.95	2.50	12.00	2.50	5377.2	213.1	25.2	0.10	100.00	409151	2151	190	35.8
29	6.95	2.50	12.00	3.00	6452.7	219.0	29.5	0.10	100.00	409152	2151	190	35.8
30	6.95	2.50	11.00	2.50	5866.1	213.1	27.5	0.09	100.00	409153	2346	174	39.1
31	6.95	2.50	12.00	2.50	5377.3	213.1	25.2	0.10	100.00	409154	2151	190	35.8

Appendix D – Comprehensive Test Results

2016 Comprehensive Results							
Distribution Source		Beaver	Okanagan	Lake Pine	Coral Beach Source	Oyama	Kalamalka
Site		VERNON CREEK Intake	OK Pump House	LAKEPINE Pump House	CORAL BEACH Pump House	OYAMA CREEK Pump House	KALAMALKA Pump House
Date		16-May-16	18-May-16	18-May-16	18-May-16	16-May-16	17-May-16
Anions							
Chloride	mg/L	0.92	4.95	6.03	5.10	0.36	8.58
Chloride (AO)	mg/L	≤250	≤250	≤250	≤250	≤250	≤250
Fluoride	mg/L	<0.10	0.20	0.21	0.19	<0.10	0.32
Fluoride (MAC)	mg/L	1.5	1.5	1.5	1.5	1.5	1.5
Nitrogen, Nitrate as N	mg/L	0.038	0.082	0.159	0.028	0.018	0.080
Nitrate (MAC)	mg/L	10	10	10	10	10	10
Nitrogen, Nitrite as N	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrite (MAC)	mg/L	1	1	1	1	1	1
Sulphate	mg/L	2.7	30.4	32.9	30.4	3.2	51.2
Sulphate (AO)	mg/L	≤500	≤500	≤500	≤500	≤500	≤500
General Parameters							
Alkalinity (total)	mg/L	26	113	116	111	23	153
No current guidelines							
True Colour	CU	**47**	<5	<5	<5	**48**	<5
True Colour (AO)	CU	<15	≤15	≤15	≤15	≤15	≤15
Conductivity	uS/cm	61	287	301	286	54	412
No current guidelines							
Cyanide	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cyanide (MAC)	mg/L	0.2	0.2	0.2	0.2	0.2	0.2
pH	pH units	7.13	7.77	7.80	7.79	6.99	7.98
pH (AO)	pH units	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
Turbidity	NTU	**1.60**	0.20	0.27	0.48	0.73	**4.65**
Turbidity Guideline	NTU	<1	<1	<1	<1	<1	<1
Trans. 254 nm (unfiltered)	%T	42.7	86.4	86.8	86.3	40.1	88.2
No current guidelines							
Calculated Parameters							
Hardness (mg/L as $CaCO_3$)	mg/L	30.6	127	134	148	25.3	197
No current guidelines							
Total Dissolved Solids/TDS	mg/L	33.2	165	174	173	29.5	243
TDS (AO)	mg/L	≤500	≤500	≤500	≤500	≤500	≤500
Total Recoverable Metals							
Aluminium (total)	mg/L	0.15	<0.05	<0.05	<0.05	0.09	<0.05
Aluminium (OG)	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Antimony (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony (MAC)	mg/L	0.006	0.006	0.006	0.006	0.006	0.006
Arsenic (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01	0.01
Barium (total)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium (MAC)	mg/L	1	1	1	1	1	1
Beryllium (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
No current guidelines							
Boron (total)	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Boron (MAC)	mg/L	5	5	5	5	5	5
Cadmium (total)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cadmium (MAC)	mg/L	0.005	0.005	0.005	0.005	0.005	0.005
Calcium (total)	mg/L	7.9	34.6	36.2	40.7	6.6	43.8
No current guidelines							
Chromium (total)	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Cobalt (total)	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
No current guidelines							

Appendix D – Comprehensive Test Results (continued)

2016 Comprehensive Results							
Distribution Source		Beaver	Okanagan	Lake Pine	Coral Beach Source	Oyama	Kalamalka
Site		VERNON CREEK Intake	OK Pump House	LAKEPINE Pump House	CORAL BEACH Pump House	OYAMA CREEK Pump House	KALAMALKA Pump House
Date		16-May-16	18-May-16	18-May-16	18-May-16	16-May-16	17-May-16
Total Recoverable Metals cont.							
Copper (total)	mg/L	0.005	<0.002	0.012	<0.002	0.002	<0.002
Copper (AO)	mg/L	≤1	≤1	≤1	≤1	≤1	≤1
Iron (total)	mg/L	**0.31**	<0.10	<0.10	<0.10	0.17	0.11
Iron (AO)	mg/L	≤0.3	≤0.3	≤0.3	≤0.3	≤0.3	≤0.3
Lead (total)	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01	0.01
Magnesium (diss.)	mg/L	2.6	9.9	10.6	11.2	2.2	21.3
No current guidelines							
Manganese (total)	mg/L	0.011	<0.002	0.003	<0.002	0.007	0.017
Manganese (AO)	mg/L	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05	≤0.05
Mercury (total)	mg/L	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Mercury (MAC)	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Molybdenum (total)	mg/L	<0.001	0.004	0.005	0.005	<0.001	0.006
No current guidelines							
Nickel	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
No current guidelines							
Phosphorus	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
No current guidelines							
Potassium (total)	mg/L	1.1	2.7	2.8	3.1	1.4	5.5
No current guidelines							
Selenium (total)	mg/L	<0.002	<0.005	<0.005	<0.005	<0.002	<0.005
Selenium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05	0.05
Silicon	mg/L	7	<5	<5	<5	5	<5
No current guidelines							
Silver	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
No current guidelines							
Sodium (total)	mg/L	2.0	12.7	14.1	14.3	2.0	19.5
Sodium (AO)	mg/L	≤200	≤200	≤200	≤200	≤200	≤200
Uranium (total)	mg/L	<0.0002	0.0022	0.0044	0.0025	<0.0002	0.0031
Uranium (MAC)	mg/L	0.02	0.02	0.02	0.02	0.02	0.02
Vanadium (total)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
No current guidelines							
Zinc (total)	mg/L	<0.04	0.81	0.08	0.05	<0.04	<0.04
Zinc (AO)	mg/L	≤5	≤5	≤5	≤5	≤5	≤5

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 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.

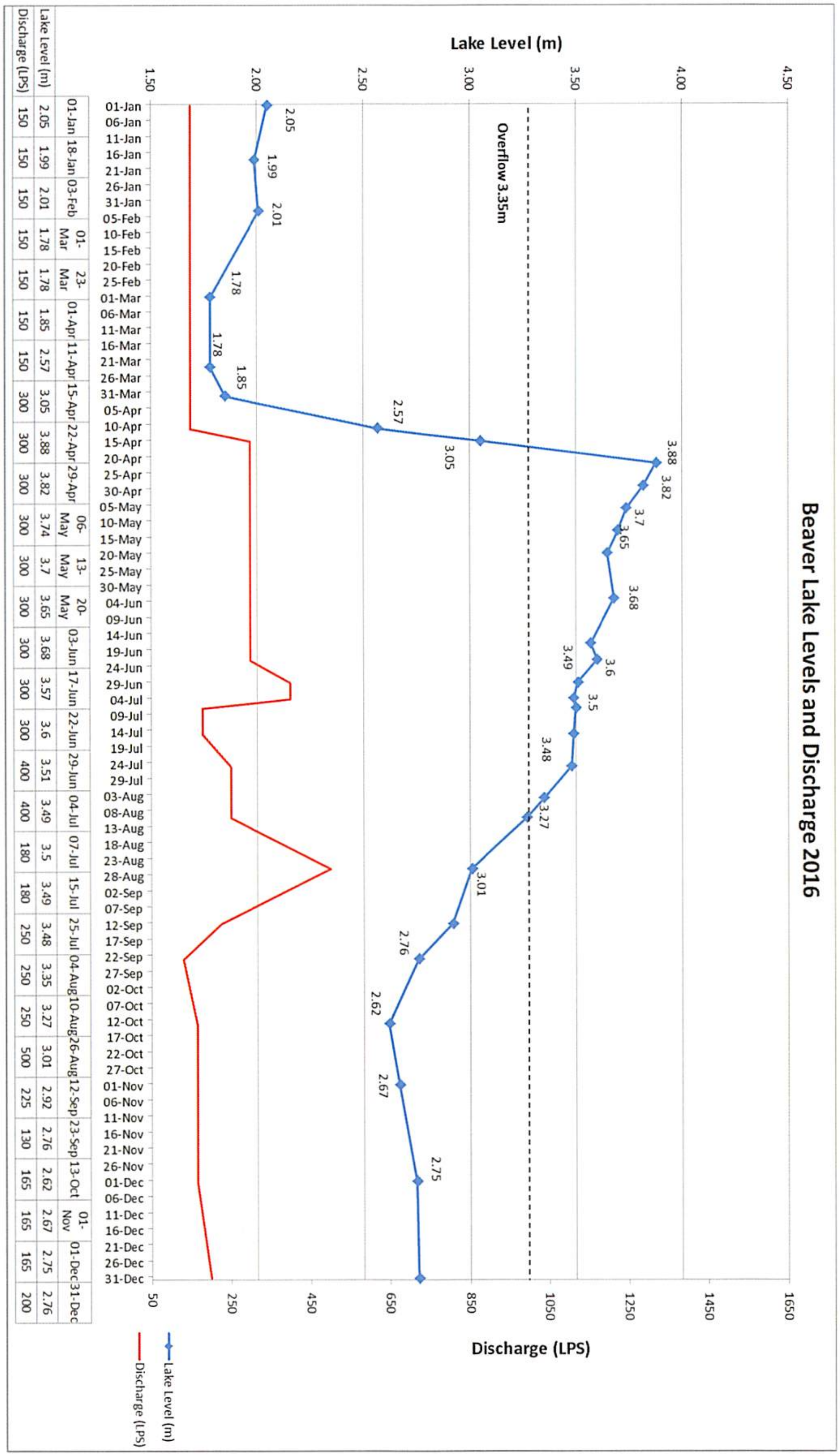
Appendix E – Nutrient Sampling Upland Drinking Water Reservoirs

2016 Nutrients				
Site		BEAVER	OYAMA	DAMER
Date		7-Jul-2016	7-Jul-2016	7-Jul-2016
Anions				
Nitrate as N	mg/L	<0.010	<0.010	<0.010
Nitrate (MAC)	mg/L	10	10	10
Nitrite N	mg/L	<0.010	<0.010	<0.010
Nitrite (MAC)	mg/L	1	1	1
Phosphate, as P	mg/L	<0.01	<0.01	<0.01
No current guidelines				
Sulfate	mg/L	2.3	1.6	< 1.0
Sulfate (AO)	mg/L	≤ 500	≤ 500	≤ 500
General Parameters				
Alkalinity, Total as CaCO3	mg/L	22	17	23
No current guidelines				
Alkalinity,Phenolphthalein as CaCO3	mg/L	<1	<1	<1
No current guidelines				
Alkalinity, Bicarbonate as CaCO3	mg/L	22	17	23
No current guidelines				
Alkalinity, Carbonate as CaCO3	mg/L	<1	<1	<1
No current guidelines				
Alkalinity, Hydroxide as CaCO3	mg/L	<1	<1	<1
No current guideline				
Ammonia as N	mg/L	0.118	0.062	0.088
No current guidelines				
Total Organic Carbon	mg/L	10.1	10.6	17.0
No current guidelines				
Dissolved Organic Carbon	mg/L	10.0	10.5	16.8
No current guidelines				
Chlorophyll-a	ug/L	0.9	2.3	1.5
No current guidelines				
Colour, True	CU	49	69	120
Colour(AO)	CU	≤15	≤15	≤15
Nitrogen, Total Kjeldahl	mg/L	0.34	0.38	0.59
No current guidelines				
Phosphorus, Total as P	mg/L	0.014	0.019	0.187
No current guidelines				
TDS	mg/L	64	44	64
TDS (AO)	mg/L	≤ 500	≤ 500	≤ 500
TSS	mg/L	<2	<2	<2
No current guidelines				
Calculated Parameters				
Hardness, Total as CaCO3	mg/L	30.4	17.1	25.5
No current guidelines				
Nitrate+ Nitrite as N	mg/L	<0.010	<0.010	<0.010
No current guidelines				
Total Nitrogen	mg/L	0.344	0.384	0.586
No current guidelines				
Organic Nitrogen	mg/L	0.226	0.322	0.498
No current guidelines				

2016 Nutrients				
Site		BEAVER	OYAMA	DAMER
Date		7-Jul-2016	7-Jul-2016	7-Jul-2016
Dissolved Metals (No current guidelines for dissolved metals)				
Total Dissolved Aluminium	mg/L	0.37	<0.05	0.11
Total Dissolved Antimony	mg/L	<0.001	<0.001	<0.001
Total Dissolved Arsenic	mg/L	<0.005	<0.005	<0.005
Total Dissolved Barium	mg/L	<0.05	0.06	0.06
Total Dissolved Beryllium	mg/L	<0.001	<0.001	<0.001
Total Dissolved Bismuth	mg/L	<0.001	<0.001	<0.001
Total Dissolved Boron	mg/L	0.07	0.13	0.11
Total Dissolved Cadmium	mg/L	<0.0001	<0.0001	<0.0001
Total Dissolved Calcium	mg/L	9.1	4.1	5.5
Total Dissolved Chromium	mg/L	<0.005	<0.005	<0.005
Total Dissolved Cobalt	mg/L	<0.0005	<0.0005	<0.0005
Total Dissolved Copper	mg/L	<0.002	<0.002	0.003
Total Dissolved Iron	mg/L	0.13	0.12	0.23
Total Dissolved Lead	mg/L	<0.001	<0.001	<0.001
Total Dissolved Lithium	mg/L	<0.001	0.001	0.002
Total Dissolved Magnesium	mg/L	1.8	1.7	2.8
Total Dissolved Manganese	mg/L	0.004	0.005	0.016
Total Dissolved Mercury	mg/L	<0.00002	<0.00002	<0.00002
Total Dissolved Molybdenum	mg/L	<0.001	<0.001	<0.001
Total Dissolved Nickel	mg/L	<0.002	<0.002	0.002
Total Dissolved Phosphorus	mg/L	0.4	<0.2	<0.2
Total Dissolved Potassium	mg/L	1.0	1.2	1.6
Total Dissolved Selenium	mg/L	<0.005	<0.005	<0.005
Total Dissolved Silicon	mg/L	<5	<5	<5
Total Dissolved Silver	mg/L	<0.0005	<0.0005	<0.0005
Total Dissolved Sodium	mg/L	2.3	2.5	2.9
Total Dissolved Strontium	mg/L	0.04	0.03	0.03
Total Dissolved Sulfur	mg/L	<10	<10	<10
Total Dissolved Tellurium	mg/L	<0.002	<0.002	<0.002
Total Dissolved Thallium	mg/L	<0.0002	<0.0002	<0.0002
Total Dissolved Thorium	mg/L	<0.001	<0.001	<0.001
Total Dissolved Tin	mg/L	<0.002	<0.002	<0.002
Total Dissolved Titanium	mg/L	<0.05	<0.05	<0.05
Total Dissolved Uranium	mg/L	<0.0002	<0.0002	<0.0002
Total Dissolved Vanadium	mg/L	<0.01	<0.01	<0.01
Total Dissolved Zinc	mg/L	<0.04	<0.04	<0.04
Total Dissolved Zirconium	mg/L	<0.001	<0.001	<0.001

Glossary of Terms, GCDWQ:	
<	Less than. Reported when result is less than the reported detection
≤	Less than or equal to. Reported when result is less or equal to the
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,

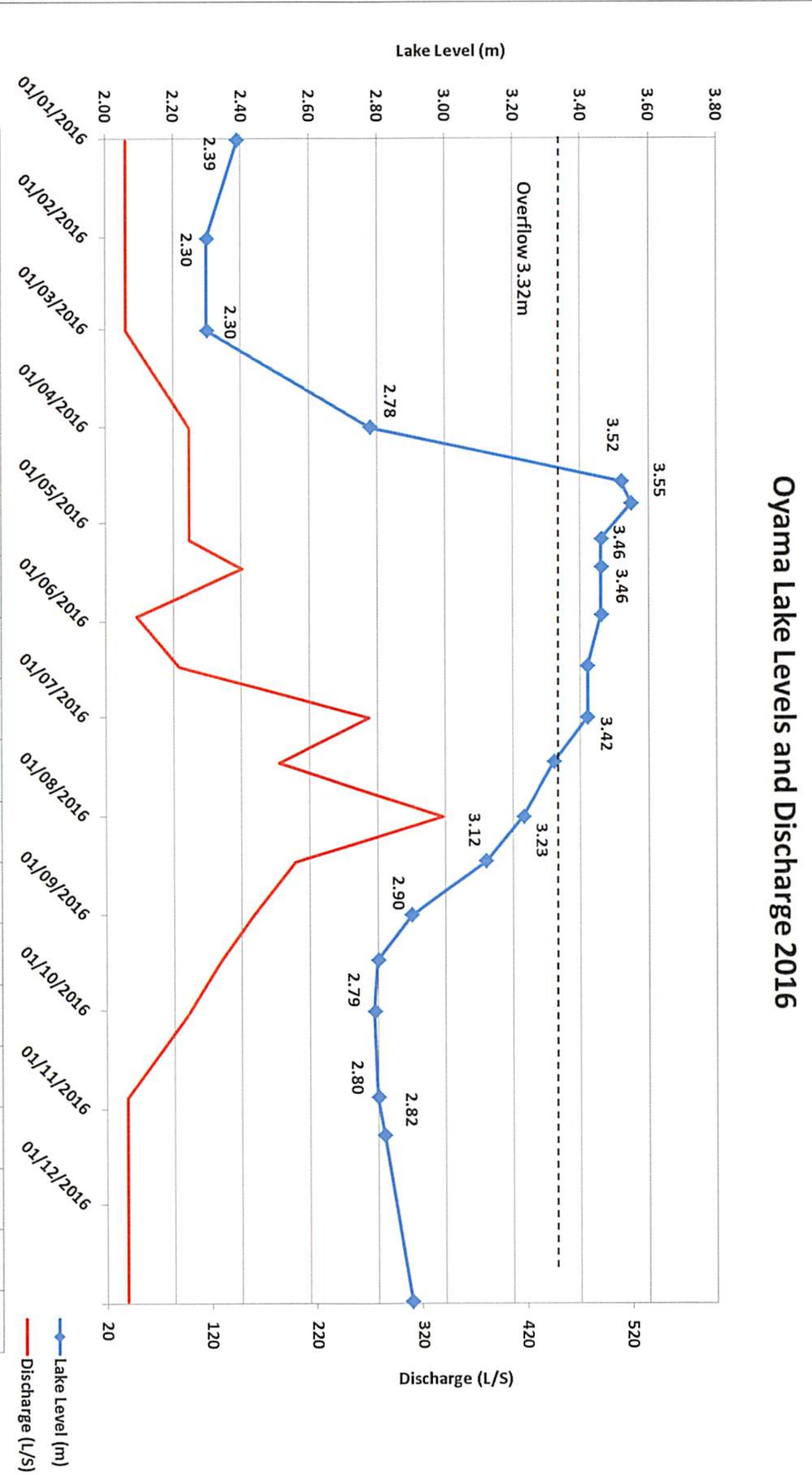
APPENDIX F – BEAVER & OYAMA LAKE LEVELS AND DISCHARGE



	01-Jan	18-Jan	03-Feb	01-Mar	23-Mar	01-Apr	11-Apr	15-Apr	22-Apr	29-Apr
Lake Level (m)	2.05	1.99	2.01	1.78	1.78	1.85	2.57	3.05	3.88	3.82
Discharge (LPS)	150	150	150	150	150	150	150	300	300	300

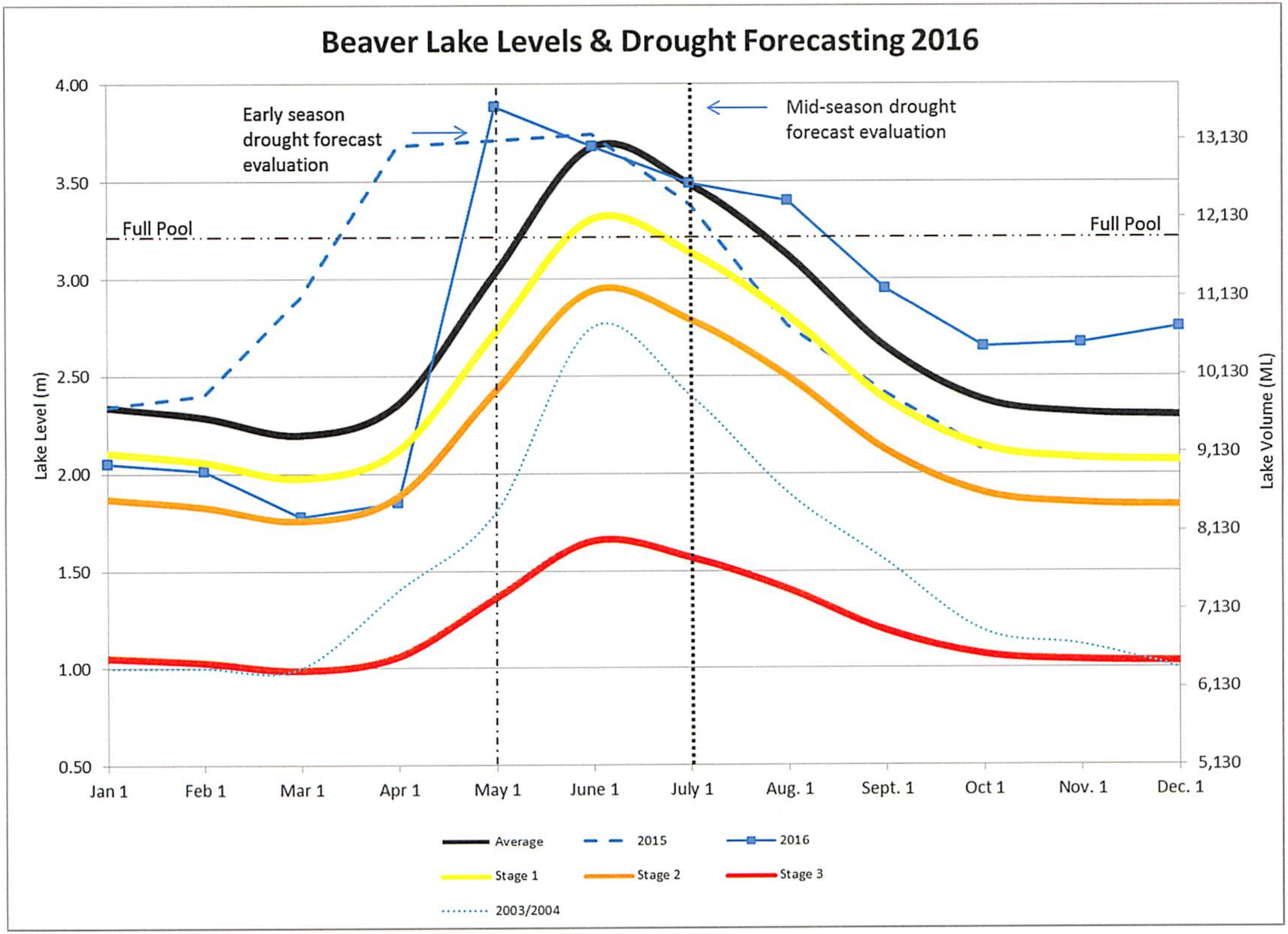
	06-May	13-May	20-May	03-Jun	17-Jun	22-Jun	29-Jun	04-Jul	07-Jul	15-Jul
Lake Level (m)	3.74	3.7	3.65	3.68	3.57	3.6	3.51	3.49	3.5	3.49
Discharge (LPS)	300	300	300	300	300	300	400	400	180	180

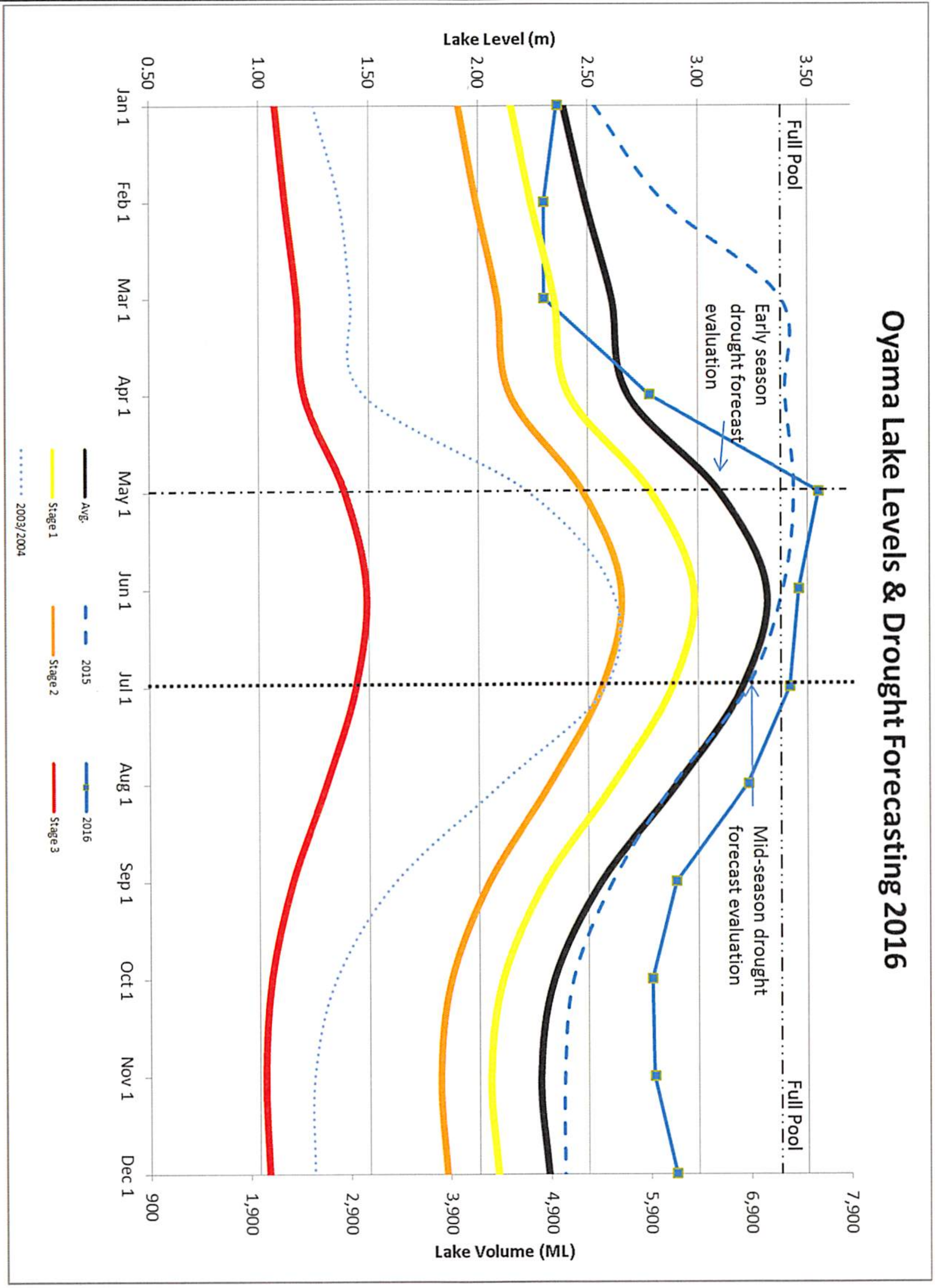
	25-Jul	04-Aug	10-Aug	26-Aug	12-Sep	23-Sep	13-Oct	01-Nov	01-Dec	31-Dec
Lake Level (m)	3.48	3.35	3.27	3.01	2.92	2.76	2.62	2.67	2.75	2.76
Discharge (LPS)	250	250	250	500	225	130	165	165	165	200



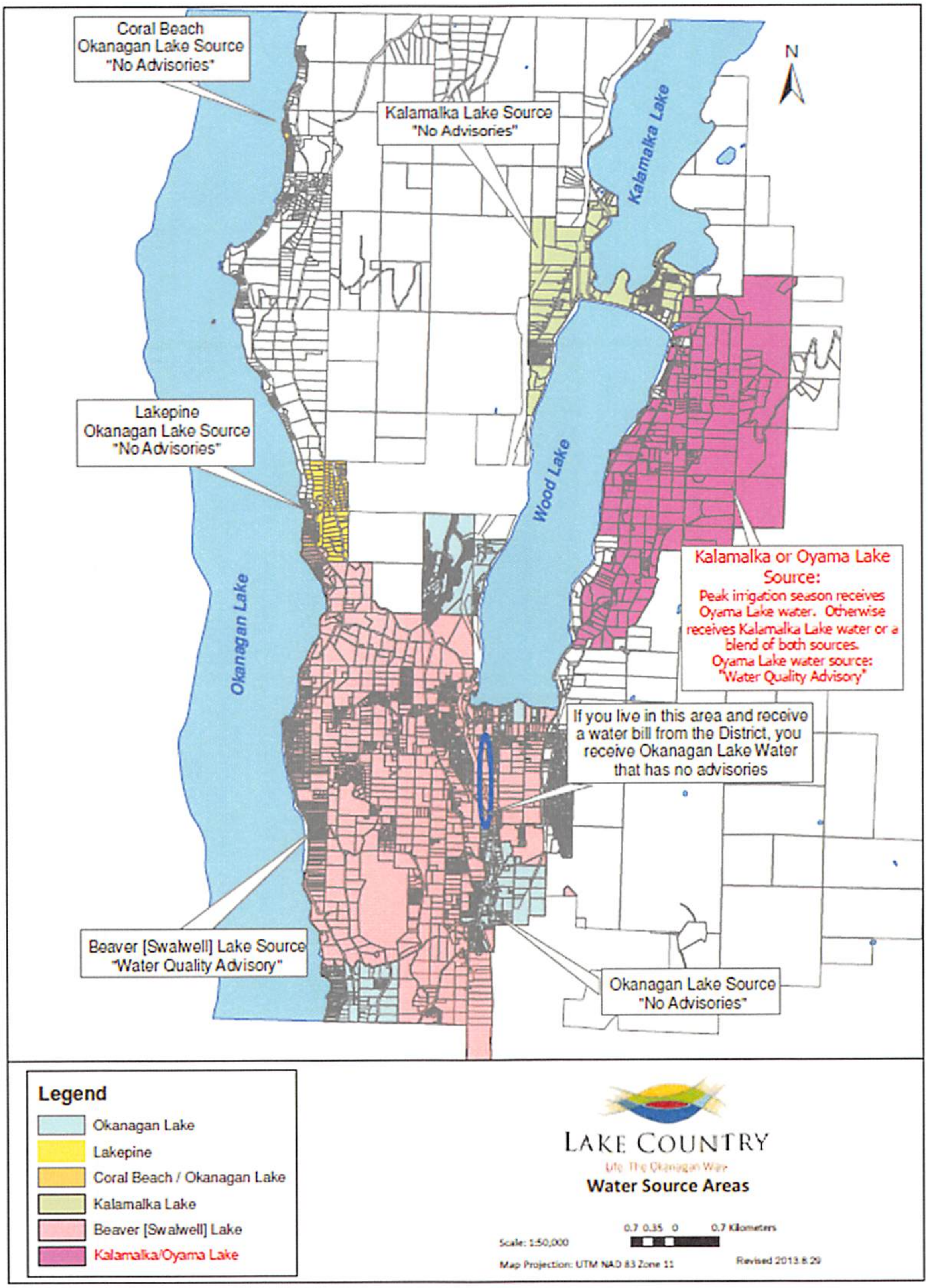
	1-Jan-16	1-Feb-16	1-Mar-16	1-Apr-16	18-Apr-16	25-Apr-16	6-May-16	15-May-16	30-May-16	15-Jun-16	1-Jul-16	15-Jul-16	1-Aug-16	15-Aug-16	1-Sep-16	15-Sep-16	1-Oct-16	28-Oct-16	9-Nov-16	31-Dec-16
Lake Level (m)	2.39	2.30	2.30	2.78	3.52	3.55	3.46	3.46	3.46	3.42	3.42	3.32	3.23	3.12	2.90	2.80	2.79	2.80	2.82	2.90
Discharge (L/S)	40	40	40	100	100	100	100	150	50	90	270	185	340	200	160	130	100	40	40	40

APPENDIX G - DROUGHT FORECAST FOR BEAVER AND OYAMA LAKES




Oyama Lake Levels & Drought Forecasting 2016
Lake Level (m)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
Full Pool
Full Pool
Early season drought forecast evaluation
Mid-season drought forecast evaluation
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1
7,900
6,900
5,900
4,900
3,900
2,900
1,900
900
Lake Volume (ML)
Avg.
2015
2016
Stage 1
Stage 2
Stage 3
2003/2004

APPENDIX H – 2016 SOURCE AREA MAP



APPENDIX I – KALAMALKA UV STATION LOG SHEETS

January 2016

JANUARY 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	1070	JR	1730392	2157926	401/402	21.6	119.6	108.5	66.3	4.07	39	91.8	4.3	2.5
2	0840	JR	1730573	2155767	401/402	73	124.6	114.1	62.9	4.16	38	91.6	4.5	2.5
3	0830	JR	1732347	2155776	401/402						Ø	91.8		
4	930	RDB	1733957	2156303	401/402	71	173	194	63	4.37	39	93.3	6.0	3.9
5					401/402									
6	1605	JR	1734438	2156108	401/402	69	122	113	66.5	4.06	39	91.8	4.3	2.5
7	1015	AMR	1736202	2158219	401/402									
8					401/402									
9	0830	PM			401/402	66	122	110	63.2	3.95	39.44	91.4		
10	950	PM	1738003	2161430	401/402	67	120.4	111	62.3	4.07	37.76	91.4		
11	0920	PM	1739825	2161892	401/402						-	90.4		
12	1020	PM	1740318	2163634	401/402	72	178.4	201	63.8	4.27	39.4	94		
13	1015	PM	1741391	2163808	401/402	72	174	199	63.3	4.37	39.2	94		
14	400	RDB	1742357	2164911	401/402	72	178	199	63	4.33	37.7	94	6.1	3.0
15	0850	JR	1742598	2166251	401/402						Ø	91.8		
16	1130	JR	1742821	2167217	401/402	69	121.3	102.1	62.9	4.14	37	92.1	4.3	2.5
17	1145	JR	1744053	2168313	401/402	68.1	125.9	112.9	63.5	4.08	39	91.9	4.3	2.5
18	1050	JR	1744223	2169326	401/402						Ø	92.1		
19	900	RDB	1744283	2171445	401/402									
20	900	RDB	1745736	2171849	401/402	67	134	105	62	4.08	39	93.6	4.3	3.5
21		JR	1745980	2173113	401/402	66.1	121.1	101.2	62.6	4.03	39	91.8	4.3	2.5
22	1200	RDB	1746801	2173847	401/402	70	173	197	62	4.34	39	93	6.0	3.9
23	930	RDB	1748355	2174041	401/402									
24	1000	RDB	1749135	2175497	401/402									
25	1030	RDB	1750879	2175861	401/402	71	175	199	63	4.36	39	90.8	6.0	3.9
26	0900	JR	1751142	2176142	401/402	70	124.6	107.1	64.5	4.07	39.6	91.5	4.3	2.5
27	830	RDB	1751313	2177764	401/402									
28	830	RDB	1753916	2178072	401/402	59	101	63	57	3.89	38	91.7	3.7	1.7
29	1145	JR	1753100	2179442	401/402	70.3	121.1	105.5	64.7	4.06	39	91.8	4.3	2.6
30					401/402									
31					401/402									
JANUARY					401/402									

February 2016

FEBRUARY 2016 DAY	TIME	Chk'd	FLOW Totalizer 401 (m3)	Totalizer 402 (m3)	Running Reactor	Lamp Intensity 1 (W/m2)	2 (W/m2)	3 (W/m2)	Dosage UV SP (W/m2)	Validated Log	Flow (LPS)	UVT %	Power Bank 1 (KWH)	Bank 2 (KWH)
1	1200	J.R.	1756152	2180751	401/402						ø	92.1		
2	830	ROB	1756471	2180921	401/402	90	79	99	70	4.2	39	91.7	3.8	1.8
3	1445	J.R.	1758068	2181104	401/402						ø	91.8		
4					401/402									
5	1115	J.R	1760372	2181755	401/402	89.0	77.2	96.5	69.5	4.17	39.16	91.8	3.7	1.8
6	0950	J.R	1761358	2181981	401/402						ø	91.0		
7	1115	J.R.	1761732	2182190	401/402	88.9	78.2	95.7	70.1	4.18	39	91.6	3.7	1.8
8	0115	J.R	1762913	2183567	401/402									
9	1130	ROB	1763847	2183741	401/402									
10					401/402									
11	1210	J.R.	1765273	2186022	401/402						ø	91.8		
12	1000	ROB	1765454	2186380	401/402	62	102	61	54	4.23	39	95.52	3.7	1.7
13					401/402									
14					401/402									
15	1155	J.R	1768521	2188350	401/402	89.8	80.1	98.6	71.2	4.21	39.35	91.9	3.7	1.8
16	0945	J.R	1768985	2188519	401/402						ø	91.9		
17	1150	J.R.	1769336	2190051	401/402						ø	91.8		
18	1230	J.R.	1770955	2190299	401/402	61.6	105.6	63.9	58.5	3.96	38	92	3.8	1.7
19	1045	ROB	1771130	2190695	401/402	61	105	64	58	3.92	39	92.6	3.7	1.7
20					401/402									
21					401/402									
22	0900	J.R	1772736	2193519	401/402	60.8	103.5	62.5	57.3	3.94	38	91.9	3.7	1.7
23	1230	J.R	1772936	2194953	401/402						ø	91.6		
24	1540	J.R	1774195	2195501	401/402						ø	91.8		
25	1055	J.R	1775101	2195678	401/402	88.9	85.9	97.7	71.3	4.36	39.8	92.6	3.7	1.8
26	1020	J.R.	1776107	2195858	401/402	89.1	86.7	98.8	71.8	4.35	39.7	92.3	3.7	1.8
27					401/402									
28					401/402									
29	1130	ROB	1777987	2198866	401/402	73	127	108	67	4.09	39	91.3	4.3	2.4
30					401/402									
31					401/402									
FEBRUARY					401/402									

March 2016

MARCH 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	1515	J.R	1778161	2199449	401/402									
2	1030	RDB	1779777	2199483	401/402									
3	1320	J.R.	1779959	2200559	401/(402)	59.9	102.3	62.5	57.6	3.98	39.7	92.1	3.7	1.7
4	0915	J.R	1780125	2201316	401/402						Ø	91.9		
5	915	RDB	1781631	2201492	401/402									
6	930	RDB	1781806	2201855	401/(402)	73	127	109	67	4.05	3.9	90.8	4.3	2.5
7	930	J.R	178269	2202269	401/402						Ø	91.5		
8	1500	RDB			401/402									
9	1020	J.R.	1783789	2203773	(401)/402	98.2	82.9	99.7	72.8	4.28	38	91.6	3.8	1.8
10	900	RDB	1784028	2205263	(401)/402	95	79	90	70.	4.35	38	91.5	3.8	1.8
11	1530	J.R	1785280	2205478	401/402						0	91.6		
12	0950	J.R	1785872	2205654	(401)/402	97.6	81.7	99	72	4.22	39	91.8	3.8	1.8
13	0850	J.R	1785970	2207253	401/402						Ø	91.6		
14	1000	J.R	1786988	2207627	(401)/402	95.6	79.7	98.6	70.6	4.22	39	91.9	3.8	1.8
15	0920	J.R.	1787785	2207598	401/402						Ø	91.6		
16	0940	J.R.	1787966	2209146	401/402						Ø	91.8		
17	830	RDB	1789770	2209544	401/402									
18	530	MRM	1790833	2210095	(401)/402	97.5	83.5	88.9	71.8	4.36	37	92.5	3.8	1.8
19	8:00	MRM	1792495	2210280	401/402									
20					401/402									
21	1145	J.R.	1792600	2211067	401/(402)	59.5	103.5	63.7	58.5	3.81	39	91.8	3.7	1.7
22	830	RDB	1792778	2212231	401/402									
23	830	RDB	1794304	2212400	401/402									
24	1030	J.R.	1794488	2213330	401/(402)	59.9	104.3	66.6	58.6	3.82	39	91.8	3.7	1.7
25					401/402									
26					401/402									
27					401/402									
28					401/402									
29	1120	J.R.	1798278	2216734	401/(402)	59.8	103.9	66.2	58.3	3.87	38	91.6	3.8	1.7
30	0320	J.R	1798663	2217622	401/(402)	70.1	124	106.9	69.6	4.03	39	91.3	4.3	2.5
31	1240	J.R	1798662	2218702	401/402						Ø	91.8		
MARCH					401/402									

April 20106

APRIL 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	0945	J.R.	1800 707	1218827	401/402	58	101.6	62.4	54.3	4.0	38.1	91.9	3.8	1.7
2	1015	J.R	1801875	2219 091	401/402	92	76	89.9	67.9	4.26	38	92.0	3.7	1.8
3	1020	J.R	1802 159	2 219 6[illegible]	401/402	56.5	99.6	61.4	54.4	3.89	39.6	91.7	3.8	1.7
4	1525	J.R	1802 349	2221680	401/402						0	91.8		
5	0930	J.R	1803 492	222168[illegible]	401/402						0	91.8		
6	0855	J.R	1806 171	2222568	401/402	69.5	124.6	107.5	65.6	4.04	39.8	91.7	4.3	2.5
7	12:34	MCC	1804480	2223966	401/402	95.0	77.2	92.4	69.4	4.17	39.8	91.5	3.8	1.8
8	12:34	MCC	1806395	2224163	401/402	–	–	–	–	–	0	90.6	–	–
9	7:30	MCC	1806592	2225781	401/402	–	–	–	–	–	0	89.7	–	–
10	7:30	MCC	1808095	2225985	401/402	92.7	76.7	90.6	70.7	4.05	39	91.7	3.7	1.8
11	0930	J.R.	1810 315	222[illegible] 989	401/402	91.8	76.9	88.9	69.6	4.16	39	91.4	3.7	1.8
12	1030	J.R.	1812 060	2226 121	401/402	93.8	77.5	84.7	69.1	4.2	39.2	91.4	3.7	1.8
13	1130	J.R.	1814 239	2226 353	401/402						0	92.1		
14	1420	J.R	1814 312	2228655	401/402	94.6	80.4	90.7	71.5	4.2	38.9	91.4	3.7	1.8
15	1420	J.R	1814 445	2 231 57[illegible]	401/402	67	123	105.2	63.4	3.98	40	91.6	4.3	2.8
16	0740	J.R	1814478	2233 585	401/402	96	81.1	92.9	71.4	4.25	40	92.1	3.8	1.8
17	0820	J.R	1817354	2233790	401/402					/	0	91.8		
18	0840	J.R	1821 612	2233790	401/402	89.7	76.2	85.3	67.6	4.2	39	92.1	3.8	1.8
19	0930	Pm	1824114	2235547	401/402	141.8	267.4	187.6	112.9	4.7	38.7	91.2		
20					401/402									
21	1015	J.R.	1830 700	2243 030	401/402	157.1	137.3	155.9	130	3.92	85	91.7	5.4	2.9
22					401/402									
23					401/402									
24					401/402									
25	1030	RDS	1861001	2243324	401/402	313	192	202	174	4.11	96	90.4	7.7	3.9
26	930	MN	1865335	2244198	401/402	304	185	196	173	4.00	97	89	7.7	3.9
27					401/402									
28	0820	J.R.	1884 102	2247152	401/402	138.5	264.9	180.6	130.4	3.45	81.74	91.6	7.6	3.8
29	1100	RDS	1887364	2255677	401/402	133	260	175	146	3.39	94	88.3	7.6	3.7
30	1100	RDS	1888695	2263560	401/402	134	247	164	139	3.56	94	91.7	7.6	3.6
31					401/402									
APRIL					401/402									

May 2016

MAY 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	1100	ROB	1890615	2271335	401/402	149	136	139	128	3.99	83	91.9	6.1	2.9
2	1150	J.R.	1893285	2279432	401/402	127.4	254.1	169.5	126.1	3.78	95.19	92.3	7.6	3.7
3	1300	J.R.	1896539	2287456	401/402	156.8	139.4	148.3	131.6	3.91	84	91.8	6.0	2.9
4	1310	J.R.	1900187	2295532	401/402	128.9	250.8	166.8	115.3	3.98	80.2	91.9	7.6	3.7
5	1600	J.R.	1902607	2297579	401/402	170.6	191.2	200.8	153	4.16	86	91.6	7.9	3.7
6	1120	TF	1904067	2299089	401/402	166	170	152	136	4.19	84	57	6.0	2.8
7	0730	J.R.	1905646	2301247	401/402						0	96.8		
8	1000	J.R.	1907971	2304032	401/402						0	93.1		
9	1300	J.R.	1910790	2306655	401/402	117.9	133.3	141.2	126.9	3.93	84.3	91.8	6.1	2.9
10	1450	J.R.	1913559	2309148	401/402	18[illegible]	153.7	151.1	1[illegible]	4.0	88	91.7	5.9	2.8
11	1630	J.R.	1916366	2311692	401/402	154.6	160.9	166.6	137.1	3.9	83	91.8	6.1	2.9
12	1440	J.R.	1918619	2313765	401/402						0	91.6		
13	1400	ROB	1920997	2316328	401/402									
14					401/402									
15					401/402									
16	1100	J.R.	1931031	2323969	401/402	153.6	142.9	146.2	134.6	3.86	85	91.6	6.1	2.9
17	0950	J.R.	1933384	2327186	401/402						0	91.8		
18	0950	J.R.	1936930	2329319	401/402	187.8	158.7	146.1	136.4	4.03	86	91.9	6.0	2.8
19	1015	J.R.	1939835	2331864	401/402	152.6	161.7	145.6	133.6	3.99	84	91.4	6.0	2.9
20	1120	J.R.	1942310	2334298	401/402	148.3	132.2	136.8	127	3.91	82	91.2	6.0	2.9
21	9:30	TF	1944312	2336590	401/402	147	164	153	136	4.22	83	93	6.0	2.8
22	10:30	TF	1945817	2338040	401/402							95.9		
23	9:00	TF	1947338	2339628	401/402	138	131	134	126	3.90	82	92	6.0	2.9
24	10:00	TF	1949066	2341523	401/402	188	158	147	135	4.04	81	91	6.0	2.8
26	1300	ROB	1951416	2344577	401/402	197	163	150	138	4.07	85	92	5.9	2.8
26	1030	ROB	1956307	2350401	401/402						0			
27	9:00	MRM	1957983	2352061	401/402									
28	7:00	MRM	1959686	2353754	401/402									
29	1110	J.R.	1961501	2355543	401/402						0	91.8		
30	0855	J.R.	1962750	2356991	401/402						0	91.9		
31	0855	J.R.	1962750	2356991	401/402						0	91.6		
MAY					401/402									

June 2016

JUNE 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	1150	J.A	1965135	2359858	401/402						0	91.5		
2	0850	J.A	1968606	2361967	401/402						0	91.8		
3	0950	J.A	1970458	2365259	401/402						0	91.6		
4	0815	J.A	1973849	2367126	401/402						0	91.9		
5	0935	J.A	1977619	2370232	401/402	189.6	158.2	151.9	139	5.05	92.51	91.8	5.9	2.8
6	0945	J.A	1980938	2373787	401/402	146	137.3	135.6	133.2	3.87	88	91.9	6.0	2.9
7	1045	J.A	1984665	2377846	401/402	~~195~~	~~185~~				0	91.7		
8	800	ROB	1984627	2379742	401/402	195	185	186	160	4.39	88	93.4	7.7	3.9
9	1415	J.A	1992620	2385677	401/402	131.8	138.2	135.2	128.6	3.85	85.5	91.6	6.1	2.9
10	1130	ROB	1994764	2387274	401/402									
11	–	ROB	1995997	2388055	401/402	165	160	172	135	4.41	80	94.6	6.0	2.8
12	730	ROB	1996990	2389342	401/402						0	91.8		
13	730	ROB	1998258	2390610	401/402									
14	0730	J.A	1999163	2391682	401/402									
15	1000	J.A	2000253	2392326	401/402						0	91.5		
16	1100	ROB	2001669	2393889	401/402									
17	0920	J.A	2003785	2396098	401/402	206.6	190.9	172.2	155.5	5.16	89.01	91.6	7.9	5.0
18					401/402									
19					401/402									
20	1150	J.A	2010962	2400993	401/402						0	91.5		
21	0540	J.A	2012562	2402257	401/402						0	91.6		
22	0800	J.A	2014232	2404441	401/402						0	91.4		
23	800	ROB	2016331	2408243	401/402									
24	800	ROB	2017882	2409721	401/402									
25	600	[illegible]	2018769	2410663	401/402									
26	0800	J.A.	2019753	2411850	401/402	193.8	183.5	186.5	166.1	4.25	85.1	91.2	8.0	5.0
27	1140	J.A	2021852	2413932	401/402	200	190	195.8	164.9	4.29	84.75	91.2	8.0	5.0
28	0900	J.A.	2024196	2416603	401/402	160.3	153.7	165.7	142.4	4.08	86	91.4	5.9	2.8
29	0915	J.A.	2027226	2419066	401/402	166.6	160.1	172.8	166.8	4.19	86	91.9	6.0	2.8
30	1000	ROB	2030041	2425136	401/402									
31					401/402									
JUNE					401/402									

July 2016

JULY 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	8:45	TF	2031705	2430553	401/402	173	160	176	143	4.20	87	93	5.9	2.8
2	8:45	TF	2036501	2433272	401/402	200	184	185	160	4.28	89	92	7.7	3.9
3	9:30	TF	2042392	2434827	401/402	197	181	184	161	4.22	90	92	7.7	3.9
4	[illegible]	RoB	2043592	2440538	401/402	205	187	192	164	4.36	89	93	7.9	4.0
5	1210	J.R	2046217	2443427	401/402	173.9	115.7	178.7	149.8	4.17	81.16	91.6	6.1	3.0
6					401/402									
7	930	RoB		2447615	401/402									
8	10:00	TF	2046834	2450128	401/402							92.5		
9	800	RoB	2048305	2451660	401/402									
10	1030	RoB	2049609	2452905	401/402									
11	1100	RoB	2050471	2453733	401/402									
12	0845	J.R	2051365	2454613	401/402	–	–	–	–	–	0	91.8	–	–
13	800	RoB	2053600	2455534	401/402	141	130	137	121	3.93	80	91.7	5.9	3.0
14	1000	RoB	2054803	2457495	401/402									
15	1250	J.R	2056 487	2459436	401/402						0	91.5		
16	9:15	MRG	2057352	2460315	401/402			187	151.3					
17	7:00	MRG	2058595	2461303	401/402	184.2	152.6	~~175.5~~	~~157.3~~	4.33	78	91.9	7.7	4.2
18	1130	RoB	2060015	2462892	401/402	152	154	167	141	4.00	86	91.9	6.0	2.8
19	0750	J.R	2061015	2463680	401/402	132	124.9	131.4	121.4	3.91	83	91.8	5.8	3.0
20	0840	J.R	2062161	2464939	401/402						0	91.7		
21	0800	J.R	2063573	2467066	401/402						0	91.6		
22	830	RoB	2066801	2469634	401/402	183	170	186	153	4.25	97	94.2	7.5	4.1
23	8:45	TF	2070594	2473866	401/402	172	161	178	145	4.18	89	93	7.6	4.1
24	10:15	TF	2074138	2477689	401/402	182	173	187	155	4.20	97	93	7.5	4.1
25	0930	J.R	2077687	2480292	401/402						0	91.8		
26	1110	J.R.	2080208	2484464	401/402	160.1	142.2	156.8	149.6	4.2	91.24	91.6	5.9	2.8
27	0835	J.R	2080478	2491849	401/402	173.3	162.4	182.7	152	4.07	88.74	91.6	7.6	4.1
28	1100	J.R.	2082277	2496744	401/402	150.6	153.3	165.8	142	4.00	84.5	91.4	5.9	2.8
29	1315	J.R.	2086133	2501348	401/402	173.8	155.4	180.2	149	4.17	88.6	91.8	7.5	4.1
30	0850	J.R.	2092491	2501348	401/402	178	170.2	179.1	134.9	4.13	89.5	91.6	7.5	4.1
31	0850	J.R.	2096024	2504782	401/402						0	91.6		
JULY					401/402									

August 2016

AUGUST 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	0915	J.R.	2098451	2508354	401/402	193.6	204.0	225.9	171.8	4.22	88.6	91.6	7.8	3.8
2	1300	J.R	2102143	2511869	401/402	151.7	160.2	166.4	141.3	4.05	89.3	91.4	6.0	2.8
3	1230	J.R	2104103	2514593	401/402	170.5	164.9	171.4	149.5	4.14	86	91.6	7.7	4.1
4	~~1130~~	~~TF~~			401/402									
5	7:30	TF	2109480	2519066	401/402	177	171	179	152	4.23	86	92.7	7.6	4.1
6	8:30	TF	2116101	2524083	401/402	401/179	208	227	159	4.19	89	91.8	7.6	3.7
7	8:15	TF	2118410	2528837	401/402	186	207	220	162	4.14	91	91.0	7.9	3.8
8	12:45	TF	2122378	2533717	401/402	172	204	221	161	4.03	91	89.9	7.6	3.7
9	~~11:00~~	~~TF~~			401/402									
10	11:00	TF	2128064	2541407	401/402	177	212	228	164	4.07	90	89.6	7.7	3.7
11	0950	J.R.	2131878	2543789	401/402	183	217.4	232.2	163.3	4.18	86	91.6	7.2	3.8
12	0850	J.R	2134955	2546142	401/402						0	91.9		
13					401/402									
14					401/402									
15	1030	RoB	2143411	2556266	401/402	168	205	220	157	4.04	88	90.0	7.7	3.7
16	1045	J.R.	2150612	2556809	401/402	174.9	192.7	230.3	161.2	4.16	92.1	91.5	7.9	3.8
17	800	RoB	2150652	2564001	401/402	161	200	215	150	4.09	91	92.2	7.7	3.7
18	730	RoB	2157261	2564693	401/402	161	198	187	149	4.06	91	91.8	7.5	4.1
19	800	RoB	2159137	2570685	401/402	164	204	219	155	4.07	91	91.6		
20	1000	RoB	2167025	2571545	401/402	154	187	177	149	3.89	92	90.3	7.5	4.1
21	1630	RoB	2169402	2583810	401/402	157	188	182	147	4.00	86	90.	7.6	4.1
22	1345	J.R	2172456	2587162	401/402	165.1	217.9	225.0	152	4.09	89	91.4	7.8	3.8
23					401/402									
24	0911	J.R	2174515	2590569	401/402	166	207.3	192.2	149.3	4.2	89.8	91.8	7.6	4.1
25	0855	J.R.	2178479	2593256	401/402						0	91.4		
26	1100	J.R	2182142	2597277	401/402	158.3	194.6	182.5	147.7	3.98	89	96.2	7.5	4.1
27	0				401/402									
28	630	MRM	2188534	2602434	401/402	166.3	207	195.4	149	4.17	89	92	7.6	4.1
29	1020	J.R.	2192403	2605988	401/402						0	91.5		
30	0915	J.R.	2194695	2609622	401/402	165.3	208.4	194.3	150.9	4.1[illegible]	89.6	91.6	7.7	4.0
31	0945	J.R.	2198538	2612866	401/402	158.2	212	214.1	162.5	3.96	89.5	91.1	7.8	3.8
AUGUST					401/402									

September 2016

SEPTEMBER 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	830	ROB	2200931	2615935	401/402	160	200	188	147	4.08	84	90.7	7.6	4.1
2	0940	J.R	2202781	2618059	401/402	153.6	223	225.4	138.2	4.16	82	92.1	7.8	3.8
3	0730	J.R.	2204359	2619393	401/402						0	91.8		
4	0830	J.R	2205780	2620812	401/402						0	91.2		
5	1000	J.R.	2207187	2622250	401/402	144	218.2	220.5	134.8	4.05	84	91.9	7.9	3.8
6	1210	J.R.	2208994	2624390	401/402	163	210	195.1	149.8	4.09	83.2	90.4	7.7	4.2
7	1020	J.R.	2210461	2625831	401/402						0	90.3		
8	0940	J.R	2211824	26268[illegible]	401/402						0	91.6		
9	1130	ROB	2213094	2627694	401/402	163	211	197	148	4.13	81	90.4	7.7	4.2
10					401/402									
11		ROB	2215163	2628844	401/402									
12	1230	J.R.	2216326	2630809	401/402	150.1	218.7	219.8	131.5	3.97	84.7	91.2	7.9	3.8
13					401/402									
14	1430	ROB	2219601	2633882	401/402	134	213	216	128	3.93	85	92.3	7.9	3.8
15	0905	J.R.	2222005	2636069	401/402						0	91.4		
16	0930	J.R.	2224666	2639064	401/402	153.9	202.9	188.4	153.1	4.06	85	91.5	7.7	4.2
17					401/402									
18					401/402									
19	1500	J.R	2231420	2645371	401/402						0	91.9		
20	1430	J.R.	2232267	2646803	401/402						0	91.6		
21	600	ROB	2233393	2648266	401/402									
22	9:15	TF	2233953	2648949	401/402							91.7		
23	0930	J.R.	2234761	2649745	401/402						0	91.8		
24	10:00	TF	2235285	2650555	401/402							91		
25	9:30	TF	2236096	2651372	401/402							90.9		
26	1145	J.R	2237264	2651932	401/402						0	91.8		
27	1030	J.R.	2238538	2652824	401/402						0	91.9		
28	1350	J.R	2240230	2654311	401/402						0	91.8		
29	1300	J.R	2241324	2655741	401/402	145.2	191.0	171.9	136.0	3.98	85.3	91.4	7.7	4.2
30	1300	J.R	2242971	2657270	401/402	145.1	192.5	171.8	133.5	4.06	84	91.8	7.7	4.2
31					401/402									
SEPTEMBER					401/402									

October 2016

OCTOBER 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	1115	J.R	2244411	2658826	401/402						0	91.6		
2	1130	J.R	2246363	2660496	401/402	138.1	192.5	169.5	131.1	4.01	84.3	91.8	7.7	4.1
3	1250	J.R	2249480	2660651	401/402	180.4	221.6	243.3	161.2	4.27	85.9	91.4	7.9	3.8
4	1000	J.R	2251080	2662263	401/402	169	200.5	124.0	131.2	4.03	84	91.8	7.7	4.1
5					401/402									
6	1050	J.R	2254120	2665340	401/402						0	91.8		
7	930	ROB	2255694	2666587	401/402									
8	900	ROB	2257015	2666382	401/402	140	185	170	130	4.01	81	91.8	7.7	4.2
9					401/402									
10	1000	ROB	2258256	2671235	401/402	172	203	229	155	4.21	83	90.9	7.8	3.8
11					401/402									
12					401/402									
13	1340	J.R	2260161	2673118	401/402						0	91.9		
14	13:30	TF	2260562	2673569	401/402							92.3		
15					401/402									
16					401/402									
17					401/402									
18	930	ROB	2261450	2674618	401/402									
19	900	ROB	2261664	2674992	401/402									
20	1330	ROB	2262066	2675170	401/402									
21	1030	ROB	2262245	2675547	401/402									
22					401/402									
23					401/402									
24	1400	ROB	2263210	2676384	401/402									
25	830	ROB	2263385	2676475	401/402									
26		ROB	2263874	2677134	401/402	70	78	77	67	4.02	39	91.1	3.8	1.7
27	1000	ROB	2264540	2679003	401/402	67	84	91	63	4.01	39	91.3	4.2	2.6
28	900	TF	2265310	2679401	401/402							92.4		
29	1000	TF	2266311	2679580	401/402							93.7		
30	900	TF	2266311	2681151	401/402							91.9		
31	1100	ROB	2268029	2681337	401/402									
OCTOBER					401/402									

November 2016

NOVEMBER 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1	1200	ROB	2268215	2682866	401/402	76	80	82	68	4.21	39	92.3	3.7	1.7
2	1315	J.R	2268709	2683304	401/402	70.2	82.5	96.4	66.7	3.83	39.4	90.1	4.2	2.6
3	930	ROB	2270002	2683495	401/402									
4					401/402									
5		ROB	2271592	2685194	401/402	69	86	96	63	4.14	39	92.7	4.2	2.6
6	1230	ROB	2272363	2687041	401/402									
7	930	ROB	2273916	2687223	401/402									
8	1230	ROB	2275271	2687592	401/402									
9		ROB	2275461	2689035	401/402									
10					401/402									
11	1015	J.R	2275697	2689207	401/402	72.5	90.2	100.6	67.7	4.0	40	91.8	4.3	2.7
12	1100	J.R	2277251	2689384	401/402						0	92.1		
13	1120	J.R.	2277660	2690809	401/402						0	91.9		
14	1150	J.R.	2278626	2690991	401/402	70	87.0	97.9	63.0	4.13	40	92.1	4.2	2.6
15	1130	J.R	2279357	2691170	401/402						0	91.9		
16					401/402									
17	1515	J.R	2281005	2692876	401/402						0	91.2		
18	830	TF	2281179	2693060	401/402							91.4		
19	~~0400~~				401/402									
20					401/402									
21	0900	J.R.	2282995	2695996	401/402	69.7	72.6	77.2	66.9	4.01	39	91.1	3.7	1.6
22		ROB	2283569	2696684	401/402	66	82	92	64	3.97	39	91.4	4.2	2.6
23	830	ROB	2284714	2696533	401/402	70	73	76	65	4.06	37	91.1	38	1.7
24	0930	J.R	2284890	2698281	401/402						0	91.6		
25	8:30	[illegible]	2286659	2698630	401/402									
26	8:30	[illegible]	2286834	2700113	401/402									
27					401/402									
28					401/402									
29	1315	J.R	2288726	2701019	401/402	71.5	74.2	77.4	66.0	4.06	39.5	91.1	3.7	1.7
30					401/402									
31					401/402									
NOVEMBER					401/402									

December 2016

DECEMBER 2016			FLOW		Running Reactor	Lamp Intensity			Dosage		Flow	UVT	Power	
DAY	TIME	Chk'd	Totalizer 401 (m3)	Totalizer 402 (m3)		1 (W/m2)	2 (W/m2)	3 (W/m2)	UV SP (W/m2)	Validated Log	(LPS)	%	Bank 1 (KWH)	Bank 2 (KWH)
1			2294378	2702274	401/402	75	77	80	67	4.16	38	91.6	3.8	1.7
2	9:45	ROB	2295543	2703149	401/402	70	73	76	66	4.15	39	92.9	3.7	1.6
3					401/402									
4					401/402									
5	1215	J.A.	2292569	2705777	401/402						0	91.5		
6	1315	J.R	2293573	2705962	401/402	68.1	86.6	97.1	65.5	4.0	39	91.1	4.2	2.0
7					401/402									
8	1025	J.A.	2294	2707639	401/402	71	89.5	99.3	65.6	4.05	36	91.6	4.3	2.7
9		ROB	2295706	2707439	401/402	66	83	93	64	3.86	39	91.2	4.2	2.6
10	1150	J.R.	2295918	2708568	401/402						0	91.2		
11	1120	J.R	2296669	2709564	401/402						0	91.5		
12			2297950	2709748	401/402									
13	1025	J.A.	2298134	2710734	401/402	69.3	73.9	78.5	63.8	4.06	39.6	91.8	3.7	1.7
14	1310	J.R	2298481	2711691	401/402	68.5	86.9	96.6	62.9	4.02	39.2	91.4	4.3	2.6
15	1030	ROB	2299888	2711881	401/402									
16		ROB	2300076	2713406	401/402									
17					401/402									
18	1000	ROB	2301948	2713767	401/402									
19	1000	ROB	2302143	2715350	401/402									
20	1000	ROB	2303364	2715455	401/402	67	85	95	67	4.07	39	91.6	4.2	2.6
21	900	ROB	2305809	2715438	401/402									
22	0930	J.R.	2307825	2715661	401/402	71.0	76	79.0	66.4	4.12	38.1	91.8	3.8	1.7
23	1100	J.A	2307513	2717260	401/402						0	92.0		
24	9:20	TF	2307578	2717438	401/402	68	87	98	63	4.04	39	91.7	4.3	2.6
25	9:40	TF	2309384	2717613	401/402							91.8		
26	1015	J.A.	2309580	2719104	401/402						0	91.9		
27	1130	J.R.	2311077	2719295	401/402	67.7	82.6	98.2	63.1	4.04	37	91.8	4.2	2.6
28	0850	J.A	2311530	2719480	401/402						0	91.9		
29	1150	J.R	2311719	2721074	401/402						0	91.6		
30	0845	J.R	2313183	2721263	401/402									
31	0850	J.R.	2313371	2722005	401/402	69.7	74.7	78.8	65.7	4.05	39	91.6	3.2	1.4
DECEMBER					401/402									

APPENDIX J –ENVIRONMENTAL OPERATORS CERTIFICATION PROGRAM (EOCP) OPERATOR'S CERTIFICATION

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 with 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. This was an unexpected expense and time allocation; not all operators were in approved in 2016 to obtain certification. 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-I
Rob Witzke	1841	WD-II, CH
Patti Meger	4838	WT-I, CH, WD-I, T-I
Kiel Wilkie	6503	WD-III, CH
Tyler Friedrich	7697	WD-II, WT-I
Julius Rideg	6827	WD-I, CH, MWWT-OIT, WT-I
Mike Kristensen	8344	WD-I, WT-I