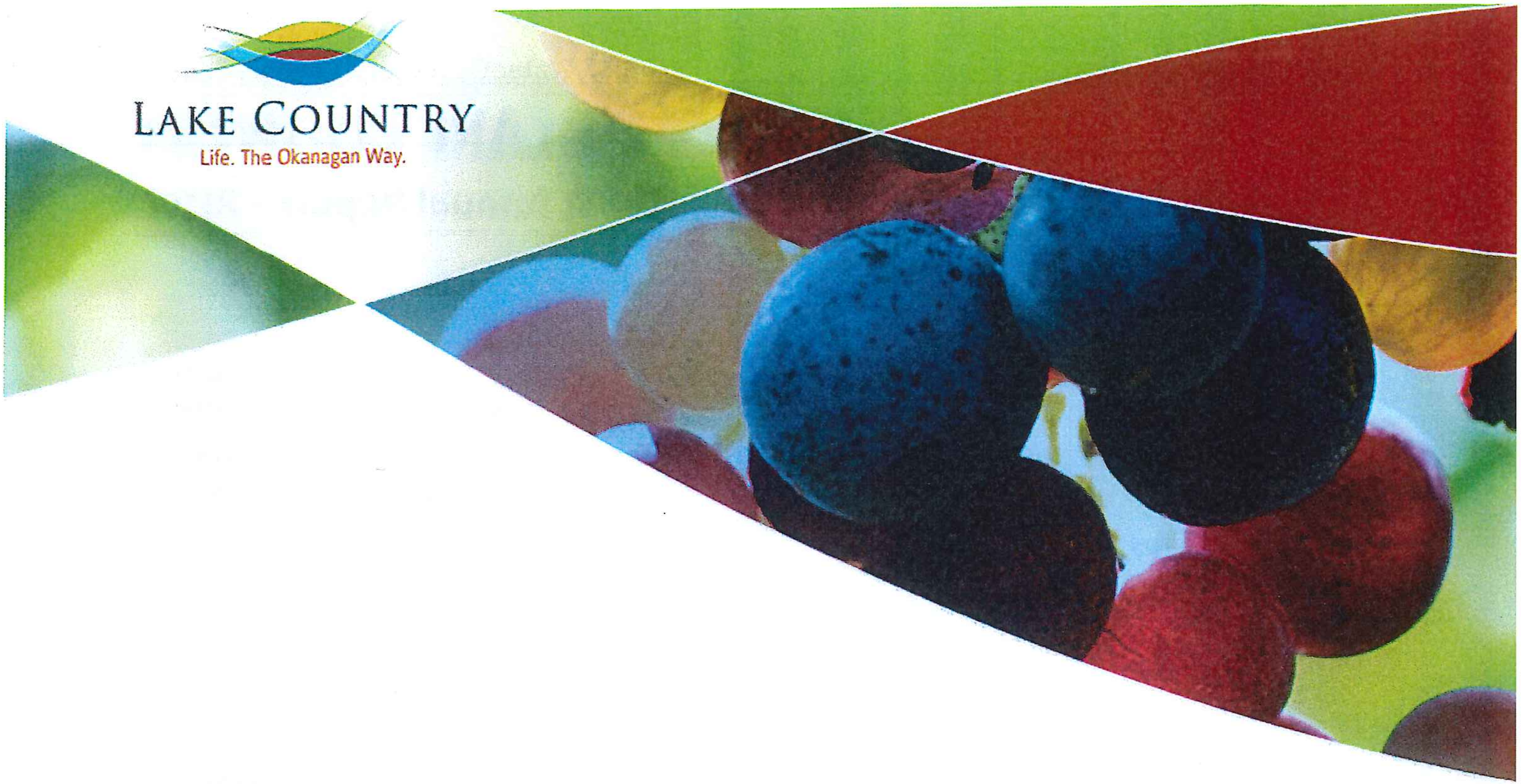
LAKE COUNTRY
Life. The Okanagan Way.



Water Operations
2017 Annual Report

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DISTRICT OF LAKE COUNTRY

Water Operations Annual Report - 2017

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Water Sources and Operations

2017 Overview

The following is intended to inform and summarize 2017 data collections, observations, and work completed by District of Lake Country staff with regards to water operations and water quality.

Water operations highlights include:

- Total completion of the Universal Water Metering project
- Implementation of a metered rate structure for all customers
- Okanagan Centre Rd. East Service Renewal Project
- Eldorado Treated Reservoir construction
- Camp Road Public Works Shop Improvements
- Flooding restoration works and repair – Oyama Creek Intake

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: 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, 36 pressure reducing stations, 79 pressure reducing valves, more than 400 hydrants, and approximately 200 km of water distribution mains.

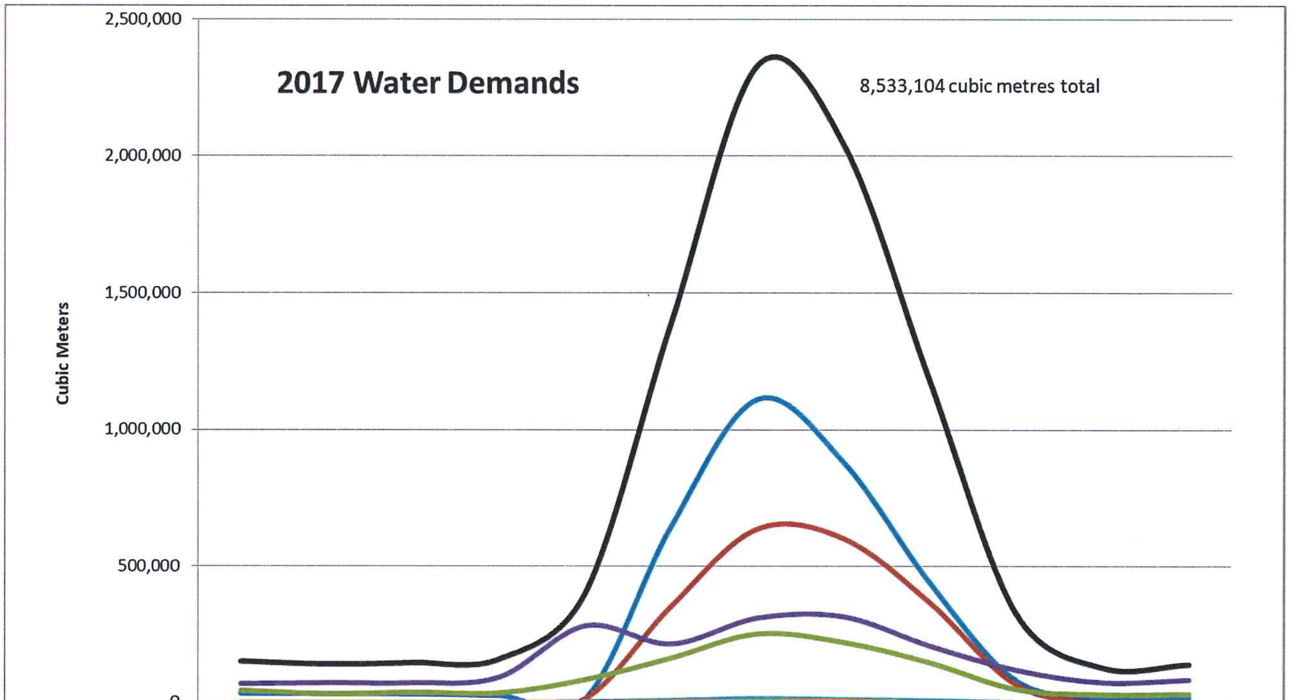
Water Demands

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 the different types of customers connected to the different water systems. Total water use among the sources and water systems in 2017 was 8,533,104 cubic meters (see Figure 1 for water consumption by source).

Water demand in 2017 was slightly below the 6 year average of 8.8 million cubic meters. Large increases in Okanagan Lake and Kalamalka Lake demand is seen in spring. This is due to the tendency of upland reservoirs to have an increase in particulates in the water from spring freshet. Creek flows increase and carry with them soil and organic matter. This inevitably leads to an increase in turbidity and colour each spring, therefore Beaver Lake and Oyama Lake Customers are supplied with Okanagan Lake and Kalamalka Lake water, respectively. The Okanagan Lake and Kalamalka Lake source typically exhibits higher quality drinking water characteristics than the Oyama and Beaver Lake sources.

The 2017 record setting flood waters carried enormous amounts of debris through Vernon Creek and Oyama Creek, leading to the upland reservoirs to be kept offline slightly longer than previous years. Water use was restricted to domestic use only from May 8th to May 17th, and then limited irrigational use until May 30th, when upland sources were useable.

Rapid onset of summer weather in June led to a sharp increase in demand, peaking at above average total demand in late July. 2017 set the record in Kelowna for least summer precipitation and hottest July and August on record, with 74 days of no measurable amount of precipitation. With Lake Country feeling the same drought effects, water restriction were put in place in September.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beaver Lake	33,954	32,836	32,170	26,271	13,847	646,190	1,111,840	876,467	439,317	83,626	19,786	20,761
Oyama Lake	0	0	0	0	14,916	353,093	637,129	600,312	367,338	68,294	0	0
Kalamaka Lake	45,319	32,489	37,951	36,230	85,066	164,218	253,100	221,544	147,649	50,701	31,503	33,179
Okanagan Lake	69,433	72,949	72,949	94,043	282,128	216,210	311,132	315,527	209,179	121,289	75,586	85,254
Lake Pine	1,613	1,465	1,515	1,586	3,342	8,439	16,442	11,826	8,533	2,286	1,350	1,532
Coral Beach	1,807	1,428	1,619	1,887	1,934	4,695	5,549	6,521	2,455	1,250	694	562
Total	152,126	141,167	146,204	160,017	401,233	1,392,845	2,335,192	2,032,196	1,174,471	327,446	128,919	141,288

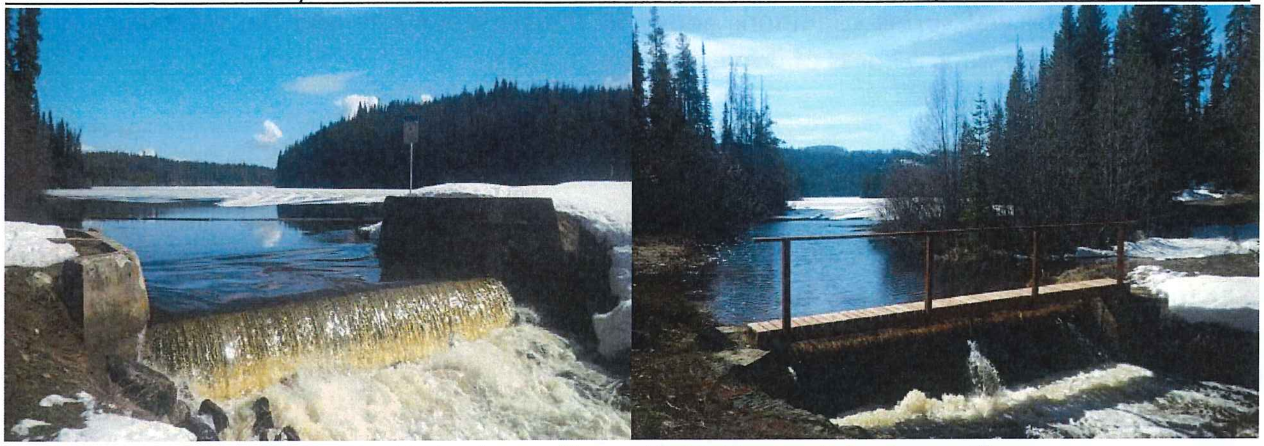
Figure 1. *2017 DLC water demands from each source reported as cubic meters per month. Zero demand on the Oyama lake source is due to traditional Oyama source customers switched to Kalamalka lake source during low consumption months.*

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 G for source area map.



Left: Crooked Lake dam spillway. Right: Oyama Lake dam spillway.

The Oyama Lake snow pack for 2017 was an average level. February and March measurements were below mean values but April and May values were slightly above. The water equivalence of the highest measured value in 2017 was 182 mm, at the beginning of April. 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 E 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).

2017 Flooding

The immense upland flow, in April and May of 2017, increased lower reservoirs to above 200-year flood levels. Heavy precipitation in the fall of 2016 saturated soils and filled upland reservoirs, reducing the amount of storage for spring snowmelt. Unusual winter weather followed; high snow levels accumulating at lower elevations, while higher elevations had a below average snowpack.

Finally, abnormally wet spring conditions added to the perfect storm and the following months would surpass all previous records of flooding in the Okanagan.

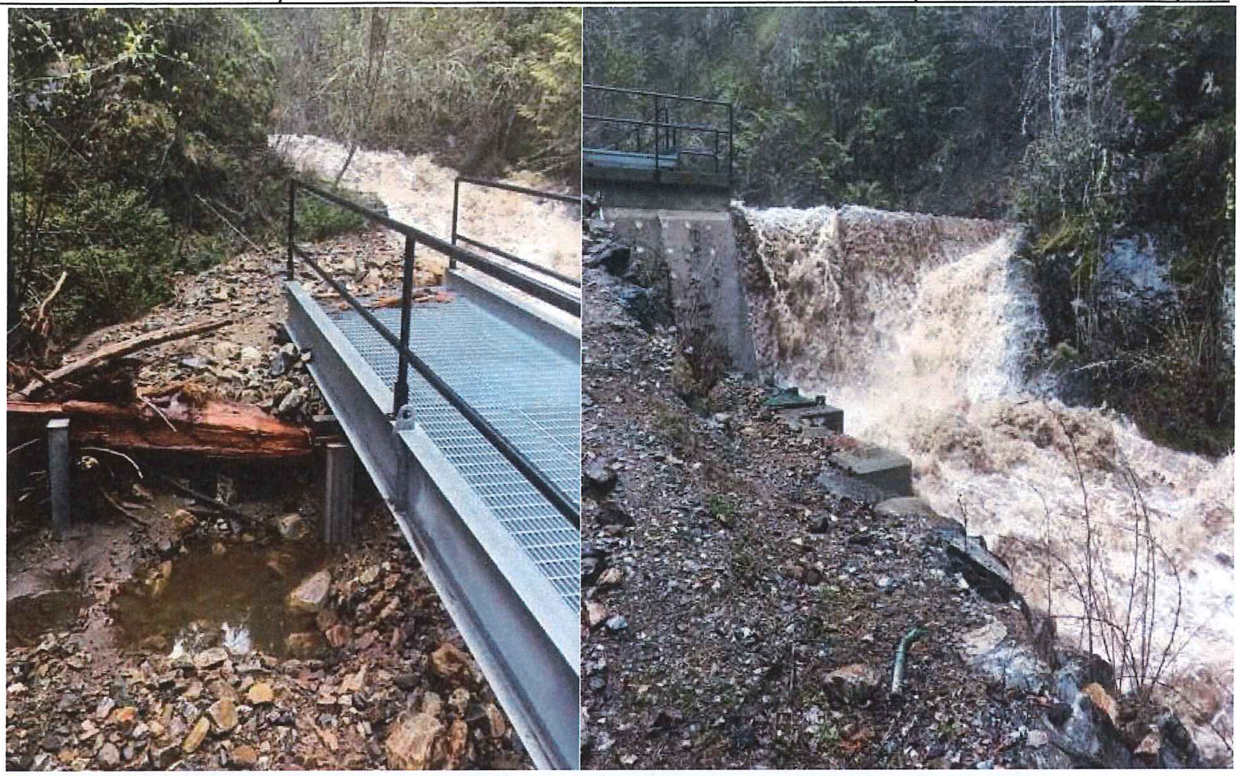
Vernon Creek Intake

The upland intakes experienced significant damage during a large rain event on May 5th and 6th that combined with the lower snow melt. The massive flows contained large amounts of debris including large boulders and trees. The Vernon Creek intake, which was cleaned the previous year, was filled to approximately 50% with rocks and sediment. Further down Vernon Creek large amounts of wood debris substantially blocked the creek, rerouting the waters over the Eldorado reservoir overflow spillway. This completely destroyed the spillway channel and also buried the overflow piping outlet structure in approximately 2 meters of gravel. In May of 2017, the creek was set back into its original flow channel and the Eldorado overflow spillway was restored. This work was completed as per Dobson Engineering Ltd. recommendations.

Left: Vernon Creek spillway during high flows. Right: Eldorado overflow outlet structure uncovered but still full of sediment.

Oyama Creek Intake

Oyama Creek intake was also filled with debris during this high flows flood event. Due to this, District staff constructed a temporary dam directly below the existing intake and diverted water into the headworks of the Oyama Creek water system. The make-shift dam was maintained throughout the summer, sufficiently meeting water demands of Oyama Creek customers. The Oyama Creek intake was cleaned out in November of 2017.

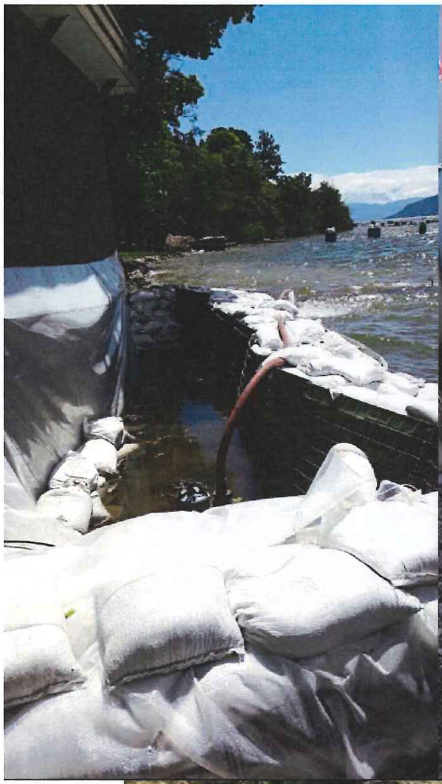


Left: Oyama Creek intake filled with debris. Right: High flows spilling over Oyama Creek intake.

Left: Construction of temporary dam directly below debris filled Oyama Creek intake. Right: Damage to the spillway caused by the extreme flows.

Intakes along Okanagan Lake

Okanagan Lake reached a record setting maximum level of 343.25 m, 77 cm above full pool. The District of Lake Country has three pump houses located on Okanagan Lake; Lake Pine pump house, Coral Beach pump house, and Okanagan Lake pump house, all of which were impacted by the flooding. Lake Pine and Coral Beach pump houses had sandbag dams built to protect the buildings. In front of the Okanagan Lake pump house soil erosion exposed foundation and other issues with breakwater wall. Immediate actions were erosion mitigation measures with large rip rap was used to re-armoured preventing further wave erosion under the structure.



Top left: Flood protection at Lake Pine pump house. Top right: Sandbag dam at Coral beach pump house. Bottom: re-armouring the Okanagan Lake pump house.

Cross Connection Control Program (CCCP)

The Universal Metering program along with the installation of testable backflow prevention devices on seasonal irrigation connections reached completion in 2017. The majority of seasonal irrigation connections, primarily for agricultural use in the District, were inspected and fitted with the appropriate cross connection control device. 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	39	2	37	0	33
Medium	94	12	82	0	73
Low	89	12	77	0	65
Totals	222	26	196	0	171

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

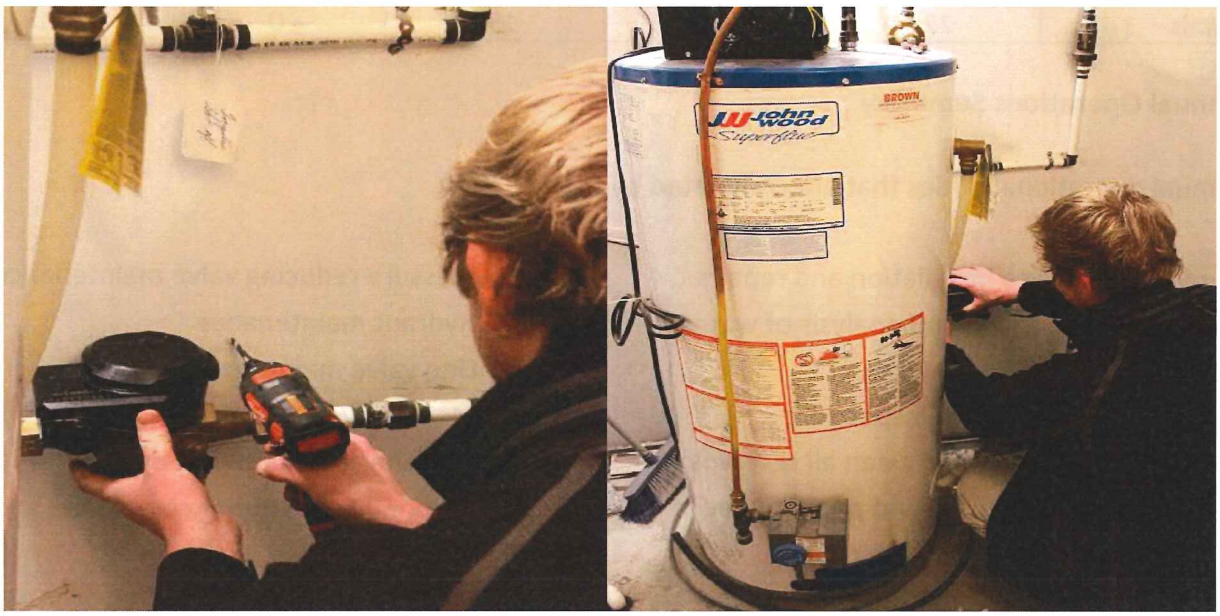
2017 Operations Project Highlights

Universal Metering

The installation phase on the Universal Metering project continued from 2014 and reached 98% completion by the end of 2016. This project accounted for greater than 2000 residential meter installations and upgrades to over 800 existing metered accounts so they are compatible with the new reading system. It also encompasses the installation of agricultural water meters. The remaining agricultural installations were completed in early 2017.

In 2017 the District implemented a metered rate structure for all customers.

Left: High Volume Ultrasonic Meter and Backflow installed. Right: District installing a Meter and Backflow unit.



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 Beaver Lake.

2017 also included the cleaning and inspection of the Coral Beach reservoir. There were no issues noted.

Okanagan Centre Road East Service Renewal

From June to September 2017 District operations staff completed approximately 100 residential service line renewals along Okanagan Centre Road East. This work consisted of connecting new service lines to properties private water lines, removal of the old service lines, and removal of any unused irrigation standpipes fronting the property. Many of the old service lines were over 40 years old and found to be in a state of imminent failure.

Water operators working along Okanagan Centre Road East

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) was completed in 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. Project 4 is currently under construction with a completion date in the summer of 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.

Eldorado Treated Water Reservoir and Glenmore Booster Station Project

In 2017 the District began construction of the Eldorado Treated Water Reservoir and Glenmore Booster Station Project. This project consists of three new key infrastructure components.

6,000 Cubic Metre Concrete Reservoir

- Provides greater time for chlorine to react and disinfect water prior to entering the distribution system
- Provides greater storage for fire protection
- Provides a clear water storage tank for future water treatment facility

Low Lift Pump Station

- Conveys water from the raw water balancing reservoir to the treated water reservoir

Glenmore Booster Station

- Replaces an existing undersized booster station
- Interconnects the Beaver Lake water source and the Okanagan Lake water source, allowing District staff to use either source in both systems as needed

Treated reservoir construction at Eldorado

Camp Road Public Works Yard

Camp Road Public Works Yard was renovated in 2017 to include outside covered storage areas and three additional bays for extra shop space. The additional space was needed due to an increase in staff and equipment. The District of Lake Country's Water division and Roads division both share the Camp Road Public Works Yard. This upgrade was a vital addition and was necessary to create more organizational space.

Left: Camp Rd. Shop three bay addition. Right: Outside covered storage addition.

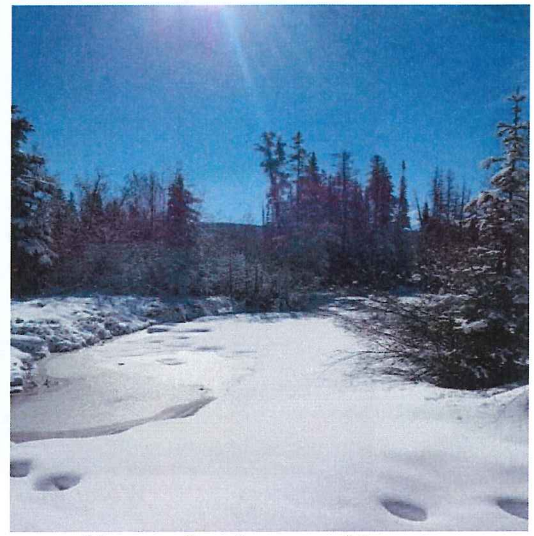
Emergency Response Plan

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 annually in June.

DISTRIBUTION WATER QUALITY

Water Chemistry background

This section provides a review of the water quality testing performed in 2017 for the District of Lake Country's (DLC) water sources. Overall bacteriological and water chemistry results show that the majority of samples meet the *Guidelines for Canadian Drinking Water Quality* (GCDWQ); however, some parameters exceeded the maximum acceptable concentrations. The District's two main upland drinking water reservoirs (Beaver and Oyama Lake) and their creek sources where our intakes are located (Vernon and Oyama Creek) 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.

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. 2017 was exceptional during the freshet flooding as major road washouts occurred on Beaver Lake Road and within old forestry cut blocks, all washing into Vernon creek and ultimately settling in our drinking water intake, Beaver Lake. 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; further details page 13 Capital Works.

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 H.

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 7.0 and 10.5.

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.

The pH is the measure of acidity or basicity of an aqueous solution. It is an Aesthetic Objective (AO) now set at 7.0- 10.5 (prior to 2017 was 6.5-8.5). pH is important to maximize treatment effectiveness, control corrosion and reduce leaching from distribution system and plumbing components CDWQG .

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 2) and the District of Lake Country Water Quality and Monitoring Plan; Frequency of Monthly bacteriological tests (Table 3). 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 4)** are immediately reported to the Drinking Water Officer.

Table 2: *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 3: *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 4: *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) are 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. In 2017 283 MF bacteriological samples were collected and analyzed at Caro Environmental Labs in Kelowna for total coliforms and E.coli. Additionally 158 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 2017 two samples were Positive for Total Coliforms. On the Coral Beach system at the Pumphouse one sample was returned with one total coliform and negative for Ecoli. On the Oyama Lake source one sample at the Easthill site was returned with one total coliform and negative for E.coli. Following bacteriological samples 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. SCADA information is reported monthly to IHA in the web posted Monthly Water Quality reports. 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 5 -10 below for District of Lake Country Water System. The list of sample sites for each distribution system is located in Appendix B.

Beaver Lake Source

Table 5. *2017 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). 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.*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.06	0.28	0.42	2	6.4	64
MAX	4.08	4.67	3.3	18	7.8	125
AVERAGE	2.30	2.52	0.95	12	6.9	82
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15*** ***AO***	***7.0-10.5*** ***AO***	

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

Okanagan Lake Source

Table 6. *2017 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). 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.*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.03	0.17	0.21	4	7.4	214
MAX	2.15	2.70	3.00	19	8.7	370
AVERAGE	0.73	0.85	0.50	9	8.1	295
WQ Guidelines *Aesthetic objective (AO)*			***1 (max) ≤ 5 NTU AO***	***15*** ***AO***	***7.0-10.5*** ***AO***	

Oyama Lake Source

Table 7. *2017 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). 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.*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.48	0.69	0.24	9	6.1	40
MAX	4.02	4.40	1.09	21	7.5	94
AVERAGE	2.57	2.79	0.51	15	6.5	58
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15*** ***AO***	***7.0-10.5*** ***AO***	

Kalamalka Lake Source

Table 8. *2017 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). 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 (i.e. Kalamalka lake water in Oyama distribution lines).*

	Free Chlorine mg/L	Total Chlorine mg/L	Turbidity NTU	Temp °C	pH	Conductivity µS/cm
MIN	0.20	0.33	0.25	3	7.3	240
MAX	2.96	3.02	2.1	17	8.6	414
AVERAGE	1.30	1.47	0.75	8	8.2	392
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15*** ***AO***	***7.0-10.5*** ***AO***	

Coral Beach Water System

Table 9. *2017 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	0.24	0.40	0.24	1	7.4	280
MAX	3.30	3.46	5.00	15	8.4	759
AVERAGE	1.26	1.41	0.59	10	8.0	330
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max)*** **≤ 5 NTU AO**	***15*** ***AO***	***7.0-10.5*** ***AO***	

Lake Pine Water System

Table 10. *2017 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	Conductivity µS/cm
MIN	0.13	0.23	0.21	1.0	7.8	277
MAX	3.48	3.80	0.89	16	8.2	399
AVERAGE	1.15	1.33	0.43	9	8.0	333
WQ Guidelines ***Aesthetic objective (AO)***			***1 (max) ≤ 5 NTU AO***	***15 AO***	***7.0-10.5 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 is now year four that Kalamalka Lake source has been the primary supply during the non-irrigation season (approximately October 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 Beaver, Okanagan and Lake Pine distributions all had samples of less than 0.20 ppm free chlorine. The free and total chlorine levels are closely monitored and 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.

In 2017 the GCDWQ changed and the Aesthetic Objectives of pH were changed from 6.5-8.5 to 7.0-10.5. The Beaver and Oyama sources regularly did not meet these objectives whereas the deep water intakes on Okanagan and Kalamalka were generally within this range. Temperature on all systems fluctuates with weather and raw water conditions. All systems at some point had at least one sample that was at or above the aesthetic temperature guidelines. Overall averages on all systems were well under the 15 degrees guidelines.

Water Quality Advisory and Boil Water Notice

The following sources throughout 2017 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 supplementation of alternate sources to optimize water quality. WQA Reminder notification are sent to customers on their water bills, it is permanently posted on our web and is publicized on various occasions in our local newspaper paper (the View) and DLC social media. In a situation where there is a lower water quality event, such as a Boil Water Notice, customers would be notified as per the IHA approved Potable Water Supply Emergency Response Plan for the DLC.

In June 2017, IHA released a report as part of public awareness campaign called *Drinking Water in Interior Health.* It is an "Assessment of Drinking Water Systems, Risks to Public Health, and Recommendations for Improvement." (January 2017). The Chief Medical Health officer, Dr. Corneil, advises that "This report should be viewed as an opportunity to renew and rejuvenate conversations between drinking water officers, water supply managers, municipal leaders, and members of the community," and is "An opportunity to ensure we are moving forward, together, towards a common goal: access to clean, safe, and reliable tap water for all people at all times."

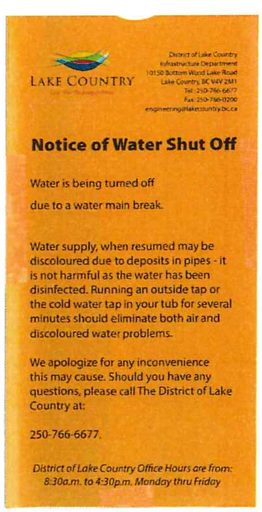
For the DLC we will continue our communications with IHA as we work towards achieving goals in our Water Master Plan and look forward to learning more about IHA's public awareness campaign. Currently IHA has developed a series of educational videos providing information on how the water systems work, how water is treated, and what safety issues the community should be aware of.

As with the 2006 Turbidity Notification Campaign, IHA maintains the requirement of 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 bill inserts as well as posted on the DLC web page and through our social media and local paper as 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.

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 2017 water operations crew responded to approximately 9 service repairs and 4 water main breaks. No Boil Water Notices were issued in 2017.

Repairs in 2017 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 event to Interior Health Authority (IHA) and it is 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.

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 trihalomethanes (*includes the total of chloroform, bromodichloromethane, dibromochloromethane and bromoform*) in drinking water is 0.100 mg/L (100 µg/L). This is 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)

2017 trihalomethane analysis in the DLC Water System showed Oyama and Beaver Lake sources had total THM averages that exceeding the Guidelines for Canadian Drinking Water Quality (GCDWQ). This may be due to the higher levels of organics in the upland lakes. All THM results displayed as a running average are detailed in Figures 2-7.

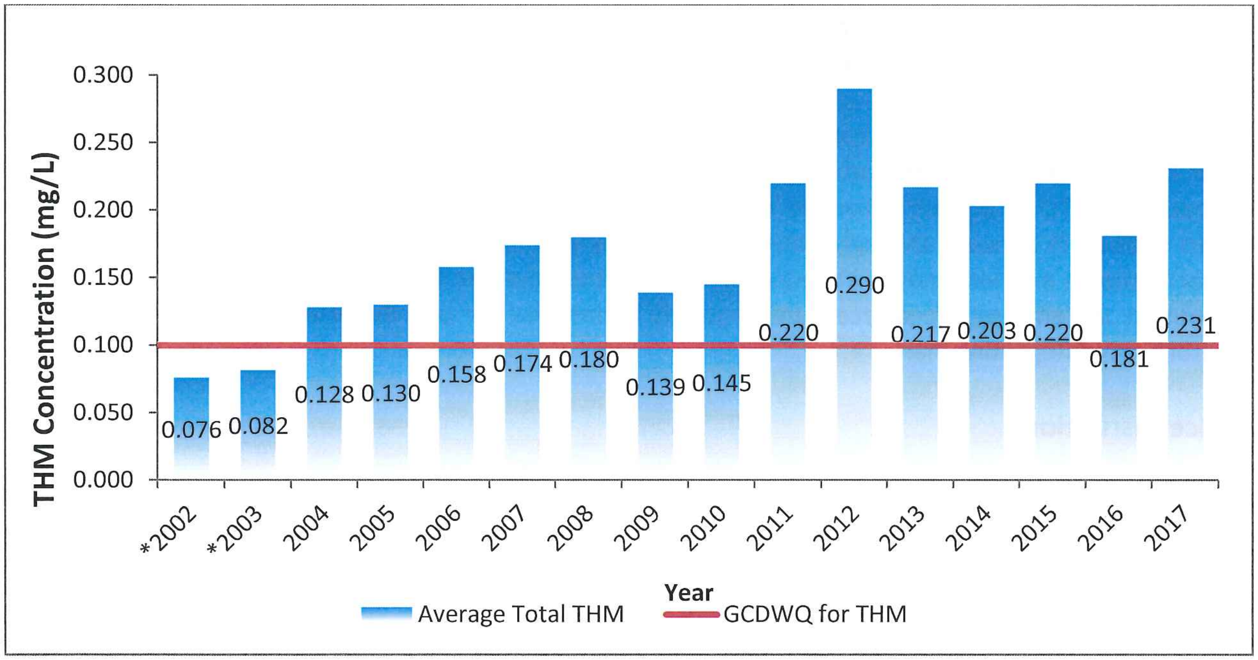


Figure 2. DLC Beaver lake source trihalomethane (THM) data collected 2002 – 2017. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). *2002 and 2003 data limited to one sample date.

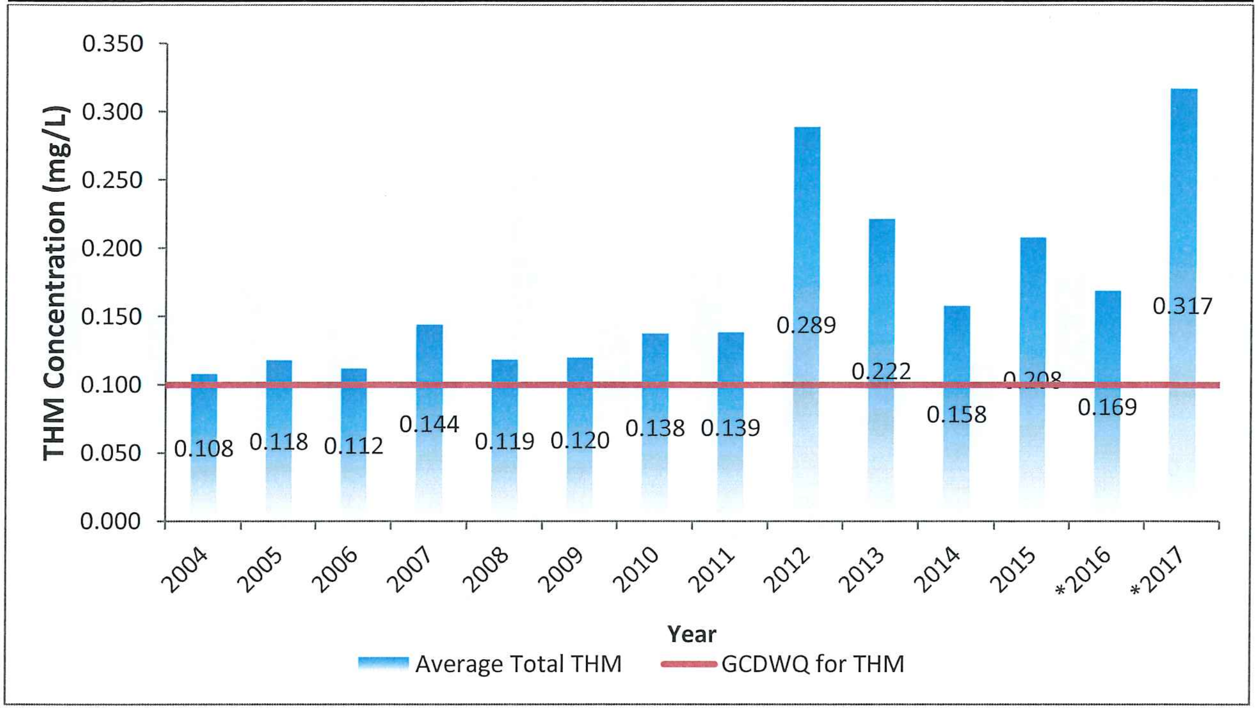


Figure 3. DLC Oyama lake source trihalomethane (THM) data collected 2004 – 2017. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). Sampling of Oyama source occurs only during irrigation season (approximately May – October) due to Kalamalka source in distribution lines during non-irrigation season. *2016 and 2017 limited to one sample date.

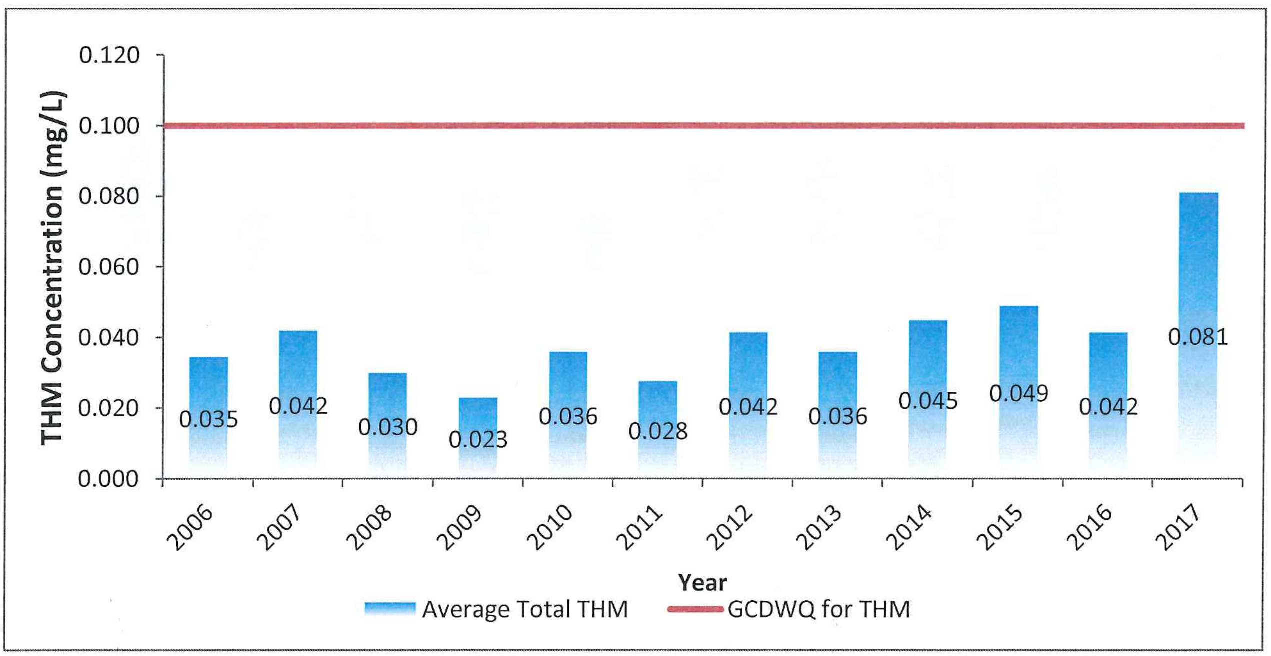


Figure 4. DLC Kalamalka lake source trihalomethane (THM) data collected 2006 – 2017. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ). Kalamalka sampling includes sites within Oyama distribution lines during non-irrigation season (approximately October – May).

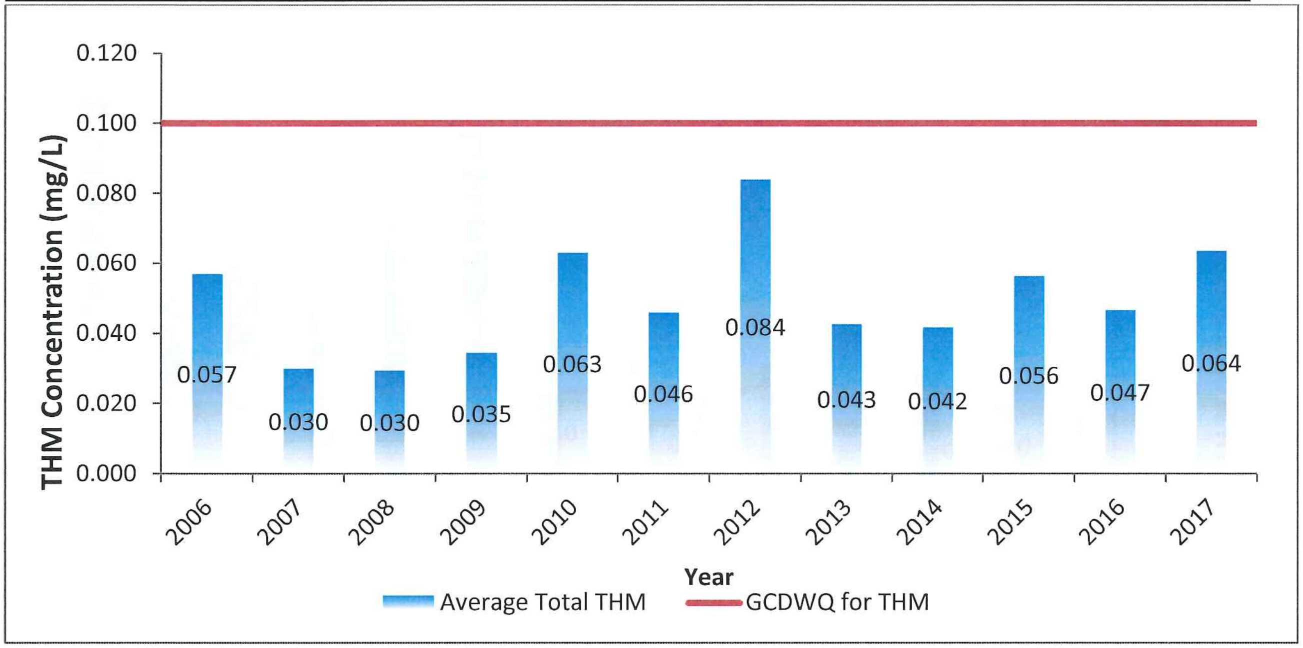


Figure 5. DLC Okanagan lake source trihalomethane (THM) data collected 2006 – 2017. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

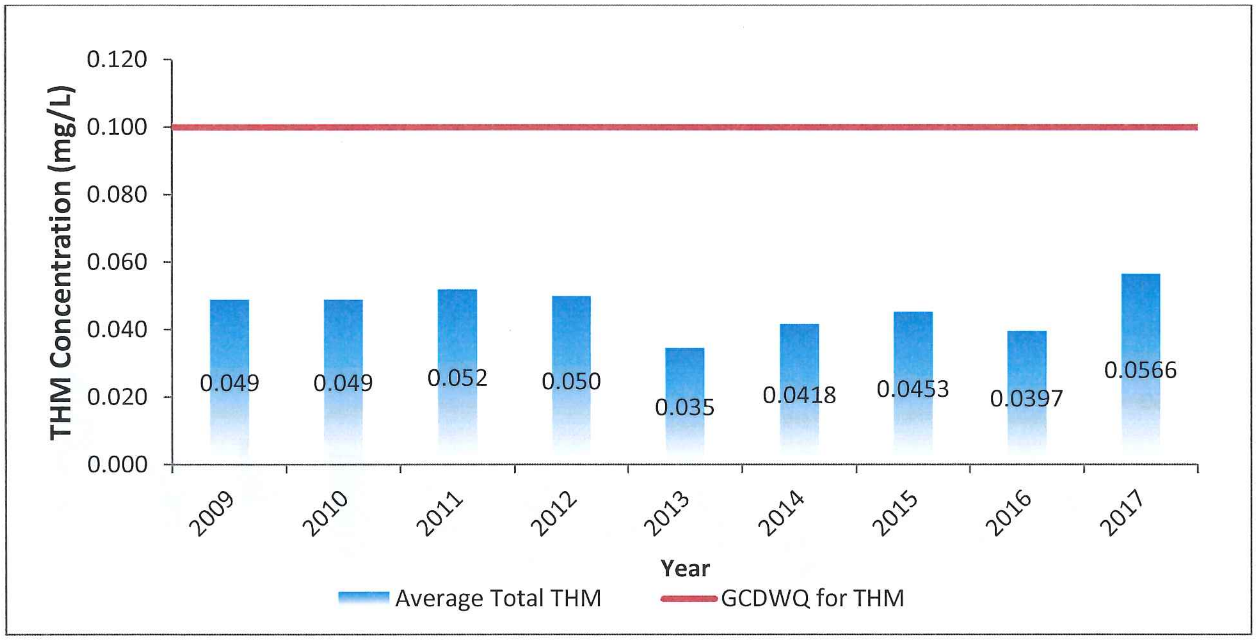


Figure 6. DLC Coral Beach System (Okanagan lake source) trihalomethane (THM) data collected 2009 – 2017. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

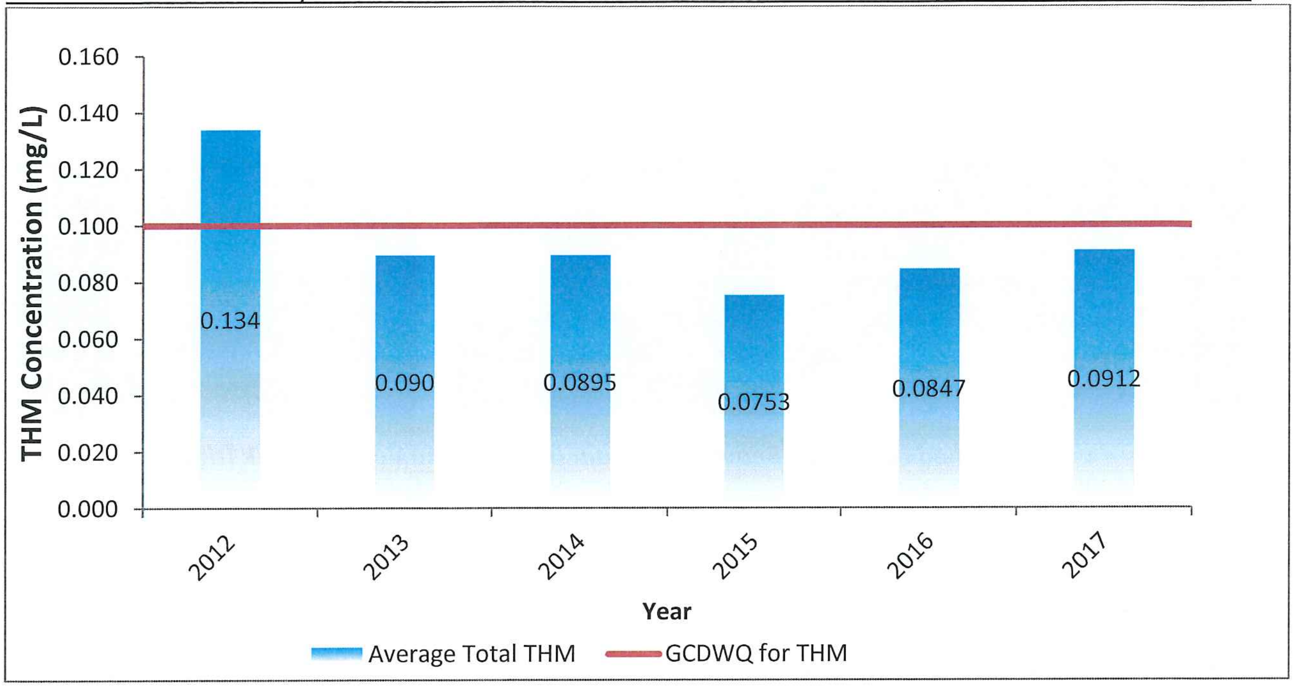


Figure 7. DLC Lake Pine System (Okanagan lake source) trihalomethane (THM) data collected 2012 – 2017. Average Total THM values relative to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

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. 2017 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.

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 the PR station, this dedicated sample site was instead installed outside of the station and is subject to freezing in winter. For all occasions in 2017 when this site was sampled all CT requirements were achieved with 99.9% -100% deactivation. The CT spreadsheet is located in Appendix C.

Source Sampling (Raw Water)

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

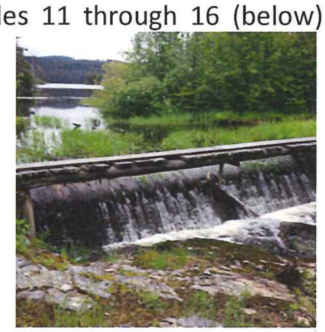


Crooked Lake (left) Beaver Lake Dam (middle) and Vernon Creek (right)

At raw water intakes we analyze water quality parameters that will provide adequate measurement of chemical and physical water quality. These data is compared 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 11 through 16 (below). Data iscollected from each source from the following sites:

- 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)
- Kalamalka Lake source: Kalamalka Pump Station (Table 14)
- Okanagan Lake Source: Coral Beach Pump House (Table 15)
- Okanagan Lake Source: Lake Pine Pump House (Table 16)

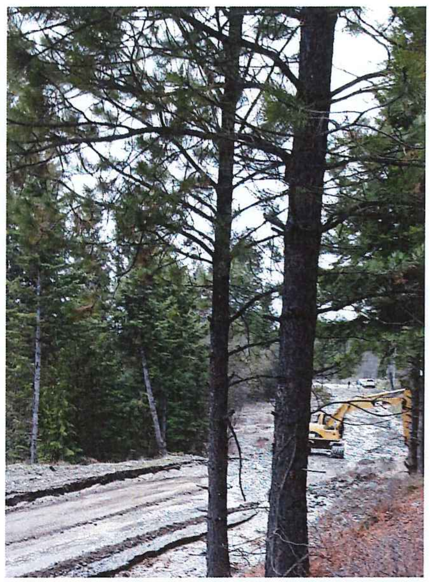


Oyama Lake Dam Spillway

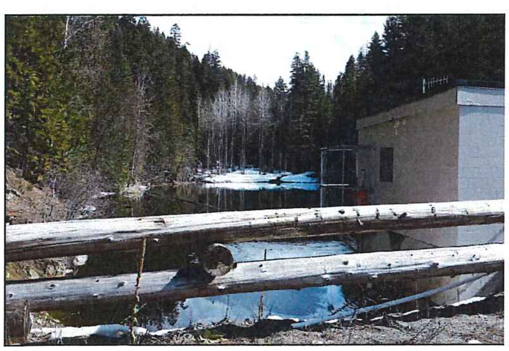
Results are stored electronically and undergo verification prior to monthly and annual reporting to ensure quality controlled data. These data are used to characterize the quality of raw water intakes, monitor levels of physical, chemical and biological changes occurring in raw drinking water, establish 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.

On May 5th a washout occurred on Beaver Lake Road and within a previous forestry cut block, washing significant amounts of sediment and other debris into Vernon creek and ultimately our community's water intake. This drinking water source was immediately switched off preventing high turbidity water (>1000NTU) from entering into the Eldorado reservoir. The Vernon Creek intake was completely off-line to assess damage from sediment, large debris and other potential impacts on infrastructure. When this event occurred the Eldorado reservoir was full. Once the reservoir level was substantially reduced, the Okanagan water source was then utilized to supplement during this period. The Beaver Lake source was back in commission mid-month with limited but functioning ability to provide water again to our customers. At the end of May, full Beaver lake water source was again in the distribution lines. At no time did our customers receive high turbidity water.

Clarke Creek during 2017 freshet



Pictures of Beaver Lake Road washout during the 2017 flood event.



Vernon creek intake: May 2016 (left) and May 2017 (right)

Table 11. *District of Lake Country Water System, 2017 Raw Water, Beaver Lake Source: Vernon Creek Intake/Eldorado Reservoir. (All data reported from weekly water quality monitoring using hand-held equipment.)*

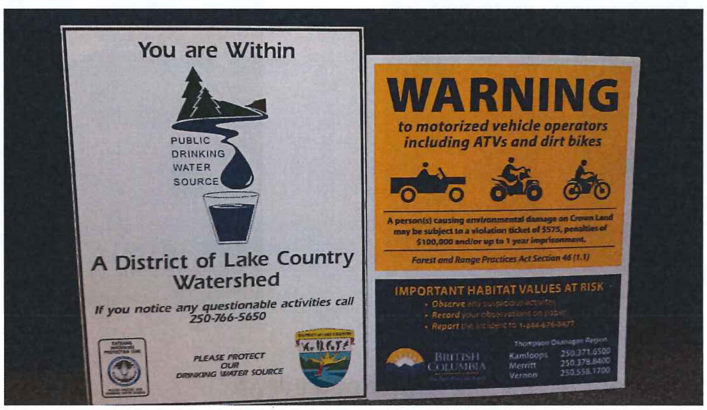
weekly sampling and on-line water quality eqiupment verification	[1]Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF EColi CFU/100 ml	[3] % of samples less than 10 Ecoli/100mL (N=52)
MIN	40	0.35	4	6.0	58	11	≥4	<1	98%
MAX	100	3.80	18	8.0	145	68	600	26	
AVERAGE	71	0.92	12	7.5	79	32	46 samples		
WQ Guidelines			*15*	*7.0-10.5*			*<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

In 2017, the DLC continued to respond and investigate complaints of unsanctioned off road activities in high vulnerability areas directly along creeks and Beaver Lake Road, below our drinking water reservoirs. above intakes. In addition to the flooding event above, these areas appear to have a cumulative impact, from sources of sediment, on the elevated turbidity in our drinking water source.



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

In 2017 the upland source flooding also filled Okanagan and Kalamalka lakes as they surpassed full pool and peaked the second weekend of June. Sandbags, gabion cages, tiger dams and temporary rip rap were built around critical areas such as our intake buildings in protection efforts against high water levels and pounding wave action. All structures stayed in place for June and remained in place until the RDCO Emergency Operations Centre confirmed they were safe to remove. The removal of these structures was completed by August 11th when the Local State of Emergency was not renewed.

At times through the flooding period, surface waters were quite murky with large amounts of floating debris (trees, pieces of docks, and barrels). Throughout this period the deep water intakes on Okanagan and Kalamalka lakes remained in good water quality with stable turbidity and normal (low) E.coli counts. Following the contracted barge works to re-armour (rip rap protection) at the Okanagan Lake pump house, it was determined that the intake pipe had been punctured and required immediate repair. At all times during this period, adequate disinfection was in place and no bacterial counts or high turbidity occurred in the distribution system.

Table 12. *District of Lake Country Water System, 2017 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=34)
MIN	120	0.21	4	7.8	258	<5	<1	<1	86	100%
MAX	180	0.92	9	8.3	294	9	25	11	88	
AVERAGE	156	0.42	6	8.1	271	<5	34 SAMPLES		87	
WQ Guidelines			***15***	***7.0-10.5***			***<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 May 5th the intense storm event also washed large rocks and woody debris into the Oyama Creek Intake. This system, however, was off line as Kalamalka was the primary water source at this time. As such, there was no interruption to service for this system.

Oyama Creek Intake filled with debris.

Emergency Operations Centre for the Regional District of the Central Okanagan was activated on May 6th and by Monday May 8th the District of Lake Country declared a Local State of Emergency to address local flooding. Throughout this month the DLC's infrastructure, including upland and deep-water intake buildings, were monitored and flood preventions measures where implemented at critical locations.

Table 13. *District of Lake Country Water System, 2017 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	[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=23)
MIN	40	0.27	6.2	7.26	45	5	14	<1	
MAX	60	0.84	18	8.0	63	80	700	270	69%
AVERAGE	43	0.49	13	7.5	50	43	23 samples		
WQ Guidelines			*15*	*7.0-10.5*			*<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 Monday May 8th it was reported that a slide event into the South East Bay of Kalamalka Lake had occurred following the freshet/storm event from the 5th. The DLC hired an aquatic biologist to collect samples and assess the potential for impact to our drinking water intake on that source. The results showed that plume's turbidity was just over 12 NTU and the bacteria counts were quite low with the highest at 9 CFU/100mL of *E.coli*. Ongoing monitoring of this site and at our intake continued throughout the month.

Slide site and Kalamalka Lake shown from drone following May 5th Storm. (Larratt Aquatic Consulting Ltd.)

Table 14. *District of Lake Country Water System, 2017 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=49)
MIN	180	0.30	4	7.9	370	<5	<1	<1	88	98%
MAX	220	1.51	11	8.5	397	<5	38	19	91	
AVERAGE	200	0.68	7	8.2	384	<5	49 Samples		90	
WQ Guidelines			*15*	*7.0-10.5*			*<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. *Coral Beach Water System, 2017 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.)*

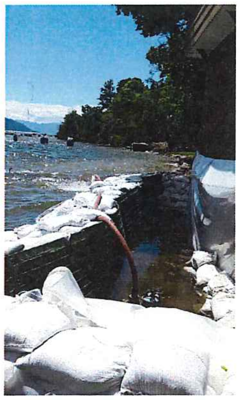
weekly sampling and on-line water quality eqiupment verification	[1]Hardness mg/L as CaCO3	[2] Turbidity NTU	Temp °C	pH	Cond µS/cm	TRUE color TCU	MF TOTAL CFU/100 ml	MF E.Coli CFU/100 ml	UVTransmittance @ 254 nm unflitered	[3] % of samples less than 10 E.coli/100mL (N=35)
MIN	140	0.23	7	7.8	260	<5	<1	<1	81	100%
MAX	160	5.20	17	8.4	275	5	4	<1	87	
AVERAGE	148	0.58	11	8.1	267	<5	35 Samples		85	
WQ Guidelines			*15*	*7.0-10.5*			*<1*	*<1*		
Aesthetic objective (AO) Maximum Allowable Concentation (MAC)	*acceptable*	*1 (max)* ≤ 5 NTU AO	*AO*	*AO*		*AO*	*MAC*	*MAC*		

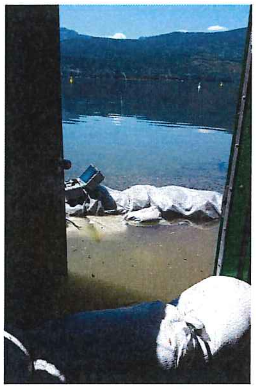
1 According to the criteria set out by the Guidelines for Canadian Drinking Water Quality (GCDWQ) the degree of hardness of drinking water may be classified in terms of ts calcium carbonate concentration as follows: soft, 0 to <60 mg/L; medium hard, 60 to <120 mg/L; hard, 120 to < 180 mg/L; and very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

The Coral Beach pump house was protected as best as possible, however, the dedicated water quality raw water sampling pump was damaged and determined dangerous to utilize; no raw water sampling occurred early June through mid-August. The pump could not be replaced until the static ground water and Lake Levels substantially decreased and the building floor remained dry.





Lake Pine (left) and Coral Beach (right) pump-houses flood/high water protection measures.

The local state of Emergency for the DLC (and other local governments within the Regional District of Central Okanagan (RDCO)) remained in place through August 11th. In July, the main stem Lakes, Okanagan and Kalamalka were back to full pool mid-month however, with high water levels and potential damage from gusting winds and pounding wave action, protection measures at critical sites had remained in place until the month end. Through this period, the deep water intakes on Okanagan and Kalamalka lakes experienced a slight turbidity increase; however, they remained under the advisory limit and in good water quality standing. Barge companies continued through August removing debris washed onto DLC shores and as of the end of August have completed this major undertaking. DLC properties including intakes and other water associated infrastructure underwent assessment and were dealt with through the Provincial Response and Recovery Program.

Lake Pine pumphouse *Wave action impacts along Okanagan Lake*

Table 16. *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=50)
MIN	140	0.23	7	7.8	210	<5	<1	<1	84	100%
MAX	160	0.90	15	8.3	337	6	≥17	1	88	
AVERAGE	145	0.45	11	8.0	278	<5	50 Samples		86	
WQ Guidelines			*15*	*7.0-10.5*			*<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

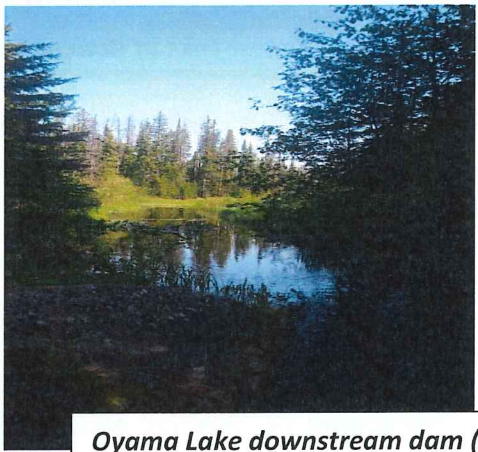
2 Turbidity is reported as weekly equipment verification and not SCADA.

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

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).

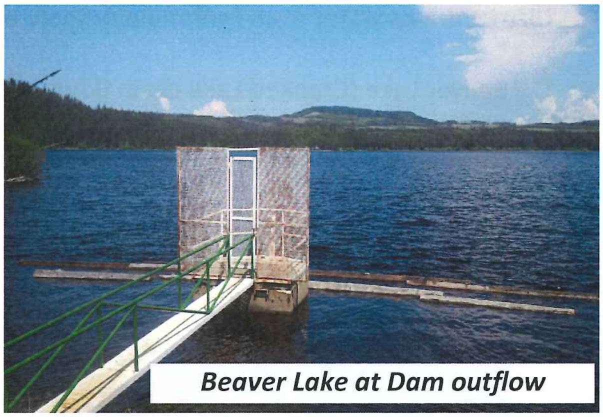
The Oyama and Vernon Creek watersheds together encompass approximately 141.1 km2. Together, the two community watersheds supply the DLC with approximately 65% of their source water. Both watersheds are dependent on upland storage reservoirs that rely on snow pack for annual water regeneration and supply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

Algal blooms and other aquatic growth in our drinking water reservoirs can occur at various times 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.

In July Kalamalka Lake began to Marl and although it was less intense than previous years, the beautiful blue and turquoise green colours (picture above submitted as Jewels of Lake Country through DLC photo contest, V.Gouliquer) were still present. 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.

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:

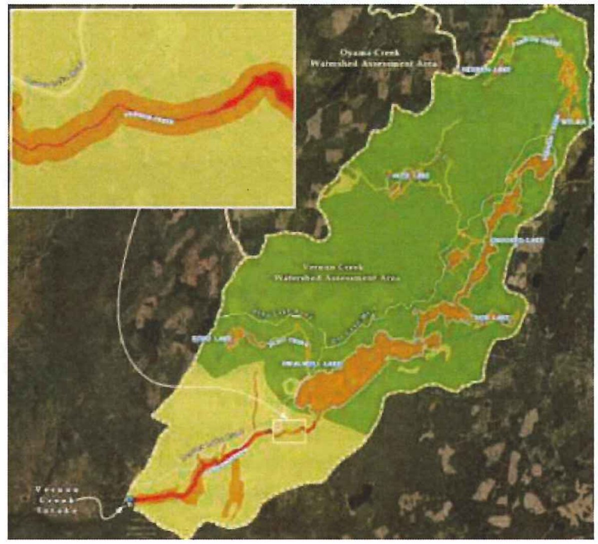
2010 Oyama and Vernon Creek Source Water Assessment (Watershed Protection Plan)]
2010 Source to Tap Assessment South Kalamalka Lake Intake (DLC water system)
2010 Source to Tap Assessment of the Okanagan lake Intake (DLC water system)
2015 Source Water Assessment and implementation Plan: Oyama and Vernon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

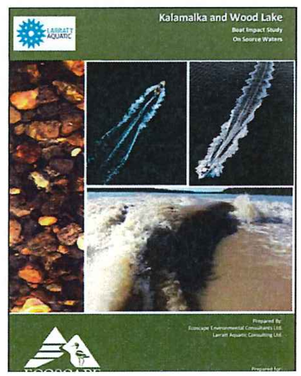
The Source Water Assessment continues to play an important role in the management and planning in our community watersheds. In 2017 a specific stakeholder meeting to follow up on identified risks and actions in the SWA was not held. However, throughout 2017 there were various meetings (and continuous 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.

In 2018 scheduled meetings will again commence as major licencees in our watershed have opted out of public advisory group planning and the DLC is no longer a participant in their sustainable forest management process. 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 all activities are 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 2017 sampling season was compiled and updated into the Kalamalka Lake Water Quality Study, Microflora, Water Chemistry & Thermal Profiles Report. The 2017 sampling season began in May during flooding and continued monthly into the fall; this marks the 19th year of collaboration on this comprehensive study.

In October, the DLC attended RDNO'S stakeholder technical advisory committee meeting to participate in addressing all risk management actions for site specific contaminants detailed in the SWA. One aspect of this meeting focused on the Kalamalka and Wood Lake Boat Impact Study (March 2017).

In June 2017, DLC council officially received this study and it was that this report be referred to staff to work on an implementation committee to devise implementation strategies and public consultation initiatives to review the recommendations of the report.

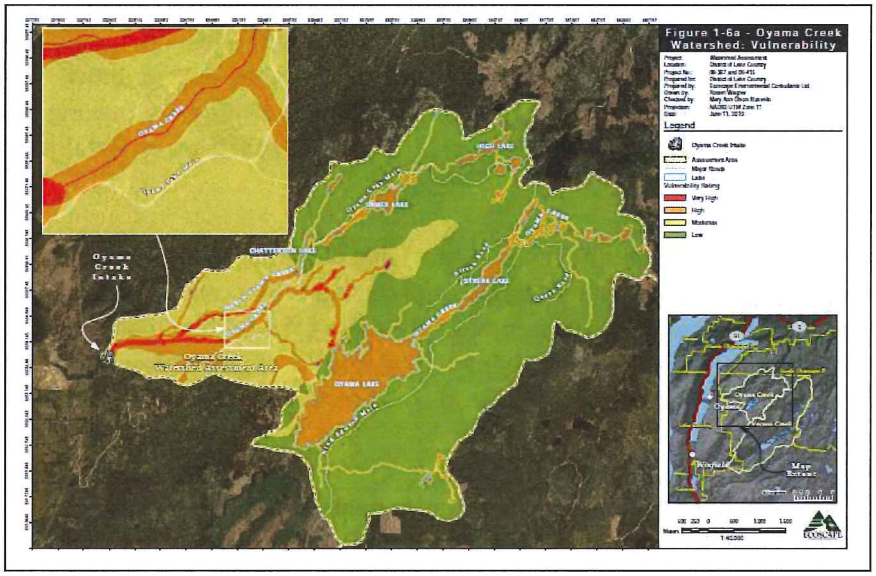


Under this direction, DLC staff (Strategic & Support Services Manager and Water Quality Technician) will be collaborating with the RDNO, District of Coldstream and RDCO with an initial step of further public engagement. Anticipated funding for this is expected to be attained through an OBWB grant; this to be further discussed and grant application submitted in 2018.
It is anticipated that this report will be a major driver in our drafting)r source water protection as we also work towards Council's directive to furt and to craft a comprehensive source water protection plan for Kalamalka Lake a ncluding an implementation plan.

Range Management

The Okanagan Shuswap District Range Program's annual meeting took place in the spring at the District of Lake Country. The 2017 range summary and 2018 planning meeting was smaller than the previous years with only the RDNO and the DLC watersheds: Duteau, Oyama and Beaver. This setting works much better for individual discussions and specific updates with range use permit holders in our community watersheds. Outside of this meeting, 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.

Overall, the discussions this year focused on collaboration among local gov't, ranchers, Ministries within FLNRO), BMP's, research projects, debris stream protection, Intention paper for livestock watering regulations under the Water Sustainability Act, watershed fire risk planning and Recreational development. Again during 2017 the concern remained of the impact for (non-sanctioned and unknown but authorized) recreational activities in our watershed and forestry development.



All major licencees and the SSSP have agreed to use the DLC vulnerability zone mapping in their planning and development process.

Shown left is the Oyama Creek Vulnerability zone map.

DLC staff also actively participated and presented at various educational workshops for range, water stewardship, watershed protection and forestry planning committees throughout 2017. These presentations, workshops and associations are important for conveying and gaining further understanding the complexity of integrated watershed land use. Science based research and collaborative partnerships have been the key to identifying and developing solutions for resolving water quality and quantity issues.

Forestry

Harvest activities in our community watershed continued in 2017. There are two major licencees in our watersheds: Tolko and BC Timber Sales, both of which had harvest operations in 2017. The DLC makes an ongoing effort to maintain communications through staff involvement with the Sustainable Forest Management Plans (SFMP) Public Advisory Group and direct contact as necessary. However, as mentioned under the watershed section, both Tolko and BCTS have opted out of public advisory group planning. Both Tolko and BCTS are now obtaining their certification through the Sustainable Forestry Initiative (SFI) that is not open to public input or consultation in the development and reporting of targets and indicators in the open consultation process as the DLC had previously participated in with the SFMP.

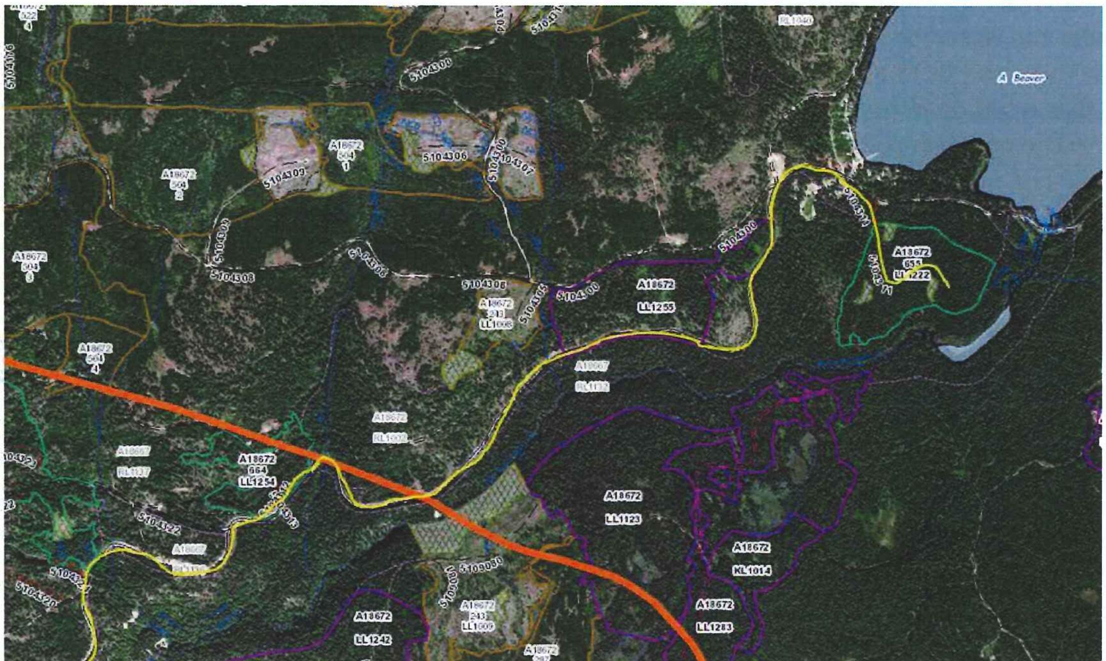
Major Licencees in our community watersheds are well aware of our Watershed Protection Plan and the DLC has requested it be used as a planning tool when developing harvest plans. Harvest/site plans are reviewed by DLC staff and recommendations are provided as needed to address issues such as access (cattle 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 (FSP) or belong to a certification process such as the SFMP or SFI. These FSP plans are to include a set of values/principles, objectives, indicators and target/performance measures that promotes sustainable forestry practices through addressing environmental, economic and social aspects of forest management. Major Licencees aquire certification to show they are sustainably managing their forestry activities and products. It is the responsibility of the small scale salvage operator and the Province to ensure that best management practices are being followed. The DLC as requested to be given the opportunity to provide comments and recommendations on our two major licencees FSP's so that high vulnerabilities, risks and other important concerns in protecting water quality and quantity are addressed. However, in 2017 Tolko did not advise of when they posted their FSP for public input and we were unaware of this until after the public comment period was closed.

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).

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 as the cumulative hydrometric impacts were apparent in the 2017 flooding.

In 2017 Tolko proposed logging along Beaver Lake Road and near the Beaver Lake dam. Prior to logging the DLC, Ranchers, (FLNRO – Range) and Beaver Lodge were in various discussions' and block-walks to make Tolko aware of the water quality, quantity, access and other concerns with harvesting in this area through their referral process. The DLC made requests for special consideration in the areas of access management into the high vulnerability areas off Beaver Lake Road, restricted motorized vehicle access from the campground, cattle management areas, road deactivations and rehabilitation all to reduce cumulative impact sources of sediment that contribute to high turbidly in our drinking water source.



Section of map of Tolko's proposed logging off Beaver Lake Road and more specifically (below), the sites below the Beaver Lake resort and Dam.

Other blocks discussed this month but not up for harvest until 2018 are LL1251, LL1252, and LL1253 – Located along Beaver Lake road. Block walks and recommendations for risk to water quality, quantity and access have been completed. DLC concerns focused on culverts and drainage especially following the flooding and road wash outs during freshet.

Of primary concern to the DLC are blocks above the Vernon Creek Intake's community water supply. The DLC hired a specialized hydrologist with forestry expertise to specifically address our apprehension with these sites. Concerns were with the Lincenee's Terrain assessment, the steep slopes above the community's drinking water intake and that DLC's specific water management prescriptions were being addressed in Tolko's plans. Tolko is fully aware of this high vulnerability area and sensitivities of this block; they are committed to continue discussions and a further block walk in 2018 will take place.

Appendix A – Summary of Positive Bacteriological Results in Distribution

	Total coliforms CFU/100 mL	E.coli CFU/100 mL	Presence Absence (total coliforms)	Presence Absence (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 distribution system					47	24
Okanagan Lake Source	none detected in distribution system					63	44
Oyama Lake Source (WQA)						23	11
Easthill	1	<1			8/Aug/17		
Kalamalka Lake Source	none detected in distribution system					52	29
Coral Beach Water System: Okanagan Lake Source						49	28
Coral Beach Pump House	1	<1			12/Jul/17		
Lake Pine Water System: Okanagan Lake Source	none detected in distribution system					49	22
					TOTAL:	***283***	***158***

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 Cl2/NTU when required	Yard Hydrant	Online WQ equipment verification	Eclipse #88	Hose bib	Sink	Stainless port	Galvanised pipe	Continuous run	Point of Disinfection	First Customer	Intermediary	End of line	Chronic problem area	Stale water problem area	Seasonal only	Future Online CT monitoing site	Recommend install Eclipse #88	Sample Site Modification Required	Recommend not use
Coral Beach Intake **RAW**	CB Ok Lk		x			x						x										x	
Coral Beach Pump Stn	CB Ok Lk					x				x			x	x						x			
Coral Beach Pump Stn (distrib sample site)	CB Ok Lk		x					x					x	x									
Coral Beach Reservoir (Future)	CB Ok Lk		x												x						x		
Coral Beach South End	CB Ok Lk	x	x		x											x					x		

Appendix C – 2017 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	FLOW Usgpm	TIME (hrs)
1	7.00	2.10	12.00	2.10	4516.6	**217.6**	20.8	0.10	**100.00**	409124	190	35.8
2	7.00	2.10	12.00	1.00	2150.8	**194.7**	11.0	0.09	**100.00**	409125	190	35.8
5	7.10	3.00	12.00	2.80	6022.2	**221.7**	27.2	0.10	**100.00**	409128	190	35.8
6	7.10	3.10	12.00	2.20	4731.7	**212.4**	22.3	0.10	**100.00**	409129	190	35.8
10	6.98	2.00	12.00	1.80	4581.1	**212.4**	21.6	0.08	**100.00**	484131	190	42.4
11	7.10	2.00	12.00	2.35	5980.9	**231.5**	25.8	0.09	**100.00**	484131	190	42.4
12	7.10	2.00	12.00	2.60	6617.1	**235.0**	28.2	0.09	**100.00**	484131	190	42.4
16	7.20	2.80	12.00	3.40	8653.2	**240.3**	36.0	0.09	**100.00**	484131	190	42.4
17	7.10	2.00	12.00	2.35	5980.9	**231.5**	25.8	0.09	**100.00**	484131	190	42.4
19	6.89	1.90	12.00	2.35	5980.9	**215.0**	27.8	0.08	**100.00**	484131	190	42.4
23	7.00	2.10	12.00	3.02	7686.1	**229.8**	33.5	0.09	**100.00**	484131	190	42.4
24	6.90	2.00	12.00	3.00	7635.2	**222.3**	34.3	0.09	**100.00**	484131	190	42.4
26	6.85	2.10	12.00	2.74	6973.5	**213.6**	32.6	0.08	**100.00**	484131	190	42.4
30	7.00	2.30	12.00	3.22	8195.1	**228.8**	35.8	0.09	**100.00**	484131	190	42.4
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	FLOW Usgpm	TIME (hrs)
1	7.01	2.21	13.00	2.76	5479.4	**225.8**	24.3	0.11	**100.00**	409124	206	33.1
2	7.00	2.00	13.00	3.30	6551.5	**234.4**	27.9	0.12	**100.00**	409125	206	33.1
3	6.92	2.10	12.00	3.20	6882.4	**224.7**	30.6	0.10	**100.00**	409126	190	35.8
7	6.98	1.90	13.00	2.94	5836.9	**230.2**	25.4	0.12	**100.00**	409130	206	33.1
15	6.95	2.20	12.00	2.88	6194.4	**222.2**	27.9	0.10	**100.00**	409138	190	35.8
16	6.90	2.00	13.00	2.70	5360.5	**218.9**	24.5	0.11	**100.00**	409139	206	33.1
21	6.86	2.40	13.00	2.90	5757.7	**211.8**	27.2	0.11	**100.00**	409144	206	33.1
22	6.80	2.90	13.00	2.60	5162.1	**196.6**	26.3	0.10	**100.00**	409145	206	33.1
28	2.90	2.20	13.00	6.80	13501.0	**24.1**	560.7	0.01	**100.00**	409151	206	33.1
DATE MAR	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	FLOW Usgpm	TIME (hrs)
29	7.10	5.00	10.00	0.35	903.4	**141.3**	6.4	0.05	**100.00**	409151	159	43.0
29	7.00	5.00	10.00	2.00	5162.1	**176.6**	29.2	0.07	**100.00**	409152	159	43.0
30	6.90	5.00	10.00	0.35	903.4	**130.8**	6.9	0.05	**100.00**	409153	159	43.0
30	6.90	5.00	10.00	2.00	5162.2	**169.9**	30.4	0.07	**100.00**	409154	159	43.0
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	FLOW Usgpm	TIME (hrs)
1	7.21	8.10	263.00	0.56	55.0	127.4	0.4	1.30	94.91	409124	4169	1.6

Appendix C – 2017 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	FLOW Usgpm	TIME (hrs)
5	6.85	14.90	167.20	1.49	230.0	80.2	2.9	0.52	100.00	409128	2650	2.6
6	6.74	15.00	226.60	1.52	173.1	76.5	2.3	0.67	100.00	409129	3592	1.9
7	6.73	15.30	251.00	1.48	152.2	74.4	2.0	0.72	100.00	409130	3979	1.7
8	6.73	15.80	197.20	1.77	231.7	73.8	3.1	0.56	100.00	409131	3126	2.2
9	6.60	15.40	175.10	2.84	418.6	77.3	5.4	0.52	100.00	409132	2776	2.5
12	6.72	14.30	214.20	2.74	330.2	87.1	3.8	0.72	100.00	409135	3395	2.0
13	6.83	14.80	230.40	2.70	302.5	87.6	3.5	0.78	100.00	409136	3652	1.9
14	6.83	14.70	228.00	2.74	310.2	88.5	3.5	0.78	100.00	409137	3614	1.9
15	6.80	13.50	207.10	2.64	329.0	94.5	3.5	0.76	100.00	409138	3283	2.1
16	6.70	13.60	260.80	2.62	259.3	90.0	2.9	0.91	100.00	409139	4134	1.6
19	6.79	14.10	265.40	2.66	258.7	90.4	2.9	0.93	100.00	409142	4207	1.6
20	6.66	14.10	266.80	2.62	253.5	85.6	3.0	0.88	100.00	409143	4229	1.6
21	6.81	14.40	299.20	2.90	250.2	90.4	2.8	1.05	100.00	409144	4743	1.4
22	6.68	13.90	296.60	2.88	250.6	88.7	2.8	1.02	100.00	409145	4702	1.5
23	6.88	13.70	343.70	2.69	202.0	96.4	2.1	1.28	100.00	409146	5448	1.3
26	6.59	16.50	360.00	2.30	164.9	69.1	2.4	0.96	100.00	409149	5707	1.2
27	6.66	16.30	371.00	2.66	185.1	73.6	2.5	1.06	100.00	409150	5881	1.2
28	6.74	15.70	353.00	2.50	182.8	78.5	2.3	1.07	100.00	409151	5596	1.2
29	6.78	15.20	330.00	3.00	234.6	84.9	2.8	1.09	100.00	409152	5231	1.3
30	6.77	15.90	375.90	2.84	195.0	79.9	2.4	1.16	100.00	409153	5959	1.1
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	FLOW Usgpm	TIME (hrs)
4	6.72	16.60	428.90	3.28	197.4	76.2	2.6	1.27	100.00	409127	6799	1.0
5	6.80	16.10	433.90	2.88	171.3	79.9	2.1	1.34	100.00	409128	6878	1.0
6	6.78	16.70	438.10	3.00	176.7	76.5	2.3	1.30	100.00	409129	6945	1.0
7	6.72	17.70	428.60	2.66	160.2	68.5	2.3	1.14	100.00	409130	6794	1.0
10	6.82	17.80	448.10	2.66	153.2	70.7	2.2	1.23	100.00	409133	7103	1.0
11	6.79	17.40	417.40	2.94	181.8	73.0	2.5	1.18	100.00	409134	6617	1.0
12	6.80	17.40	425.70	2.90	175.8	73.1	2.4	1.21	100.00	409135	6748	1.0
13	6.73	17.60	415.80	2.46	152.7	68.4	2.2	1.10	100.00	409136	6591	1.0
14	6.69	17.70	404.90	2.78	177.2	68.1	2.6	1.07	100.00	409137	6418	1.1
17	6.60	16.70	410.70	3.44	216.2	72.7	3.0	1.16	100.00	409140	6510	1.0
18	6.75	16.30	390.20	3.16	209.0	78.4	2.7	1.18	100.00	409141	6185	1.1
19	6.66	16.50	391.70	3.22	212.2	74.7	2.8	1.13	100.00	409142	6209	1.1
20	6.75	17.10	380.40	2.96	200.8	73.4	2.7	1.08	100.00	409143	6030	1.1
21	6.73	16.50	368.40	3.36	235.4	77.4	3.0	1.10	100.00	409144	5840	1.2
24	6.64	17.00	391.60	3.26	214.9	71.7	3.0	1.09	100.00	409147	6208	1.1
25	6.69	16.20	367.00	3.14	220.8	77.0	2.9	1.09	100.00	409148	5818	1.2
26	6.78	16.40	422.00	3.14	192.1	78.7	2.4	1.29	100.00	409149	6690	1.0
27	6.80	17.00	427.00	2.92	176.5	75.2	2.3	1.24	100.00	409150	6769	1.0
28	6.69	17.30	425.00	3.14	190.7	71.3	2.7	1.17	100.00	409151	6737	1.0
31	6.74	17.30	426.00	3.14	190.2	72.7	2.6	1.20	100.00	409154	6753	1.0

Appendix C – 2017 Giardia Performance Monitoring (continued)

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	FLOW Usgpm	TIME (hrs)
1	6.74	17.50	395.00	2.96	193.4	**71.1**	2.7	1.09	**100.00**	409124	6262	1.1
2	6.80	17.30	406.00	3.04	193.3	**74.1**	2.6	1.17	**100.00**	409125	6436	1.1
3	6.83	17.30	398.00	2.90	188.1	**74.5**	2.5	1.15	**100.00**	409126	6309	1.1
4	6.76	17.80	397.00	2.80	182.0	**69.6**	2.6	1.07	**100.00**	409127	6293	1.1
8	6.74	18.10	368.00	3.22	225.8	**69.1**	3.3	0.98	**100.00**	409131	5834	1.2
9	6.77	17.60	350.00	3.44	253.7	**73.1**	3.5	0.99	**100.00**	409132	5548	1.2
10	6.78	17.50	334.00	3.32	256.6	**73.5**	3.5	0.95	**100.00**	409133	5295	1.3
11	6.74	17.50	319.00	3.38	273.5	**72.5**	3.8	0.90	**100.00**	409134	5057	1.3
14	6.63	17.70	274.00	3.88	365.5	**69.9**	5.2	0.74	**100.00**	409137	4343	1.6
15	6.71	16.70	267.00	3.12	301.6	**74.9**	4.0	0.77	**100.00**	409138	4232	1.6
16	6.84	16.10	315.00	3.32	272.0	**82.9**	3.3	1.01	**100.00**	409139	4993	1.4
17	6.87	16.10	337.00	3.48	266.5	**84.5**	3.2	1.10	**100.00**	409140	5342	1.3
18	6.71	16.20	324.00	3.34	266.1	**78.3**	3.4	0.98	**100.00**	409141	5136	1.3
21	6.40	15.40	318.70	3.96	320.7	**74.8**	4.3	0.92	**100.00**	409144	5052	1.3
22	6.68	15.60	345.30	3.22	240.7	**80.2**	3.0	1.07	**100.00**	409145	5474	1.2
23	6.80	16.30	351.00	3.40	250.0	**80.8**	3.1	1.10	**100.00**	409146	5564	1.2
24	6.77	16.50	333.00	3.38	262.0	**78.7**	3.3	1.02	**100.00**	409147	5279	1.3
25	6.75	15.90	319.00	3.22	260.5	**80.8**	3.2	1.00	**100.00**	409148	5057	1.3
28	6.77	15.40	302.50	3.78	322.5	**86.4**	3.7	1.01	**100.00**	409151	4795	1.4
29	6.72	15.80	298.60	3.52	304.3	**81.5**	3.7	0.94	**100.00**	409152	4733	1.4
30	6.87	15.80	307.60	3.18	266.8	**85.1**	3.1	1.01	**100.00**	409153	4876	1.4
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	FLOW Usgpm	TIME (hrs)
6	6.90	16.40	288.00	3.28	293.9	**83.0**	3.5	0.93	**100.00**	409129	4565	1.5
12	6.70	15.70	172.00	4.08	612.2	**83.2**	7.4	0.55	**100.00**	409135	2727	2.5
15	7.00	14.00	168.80	1.00	152.9	**85.3**	1.8	0.56	**100.00**	409138	2676	2.5
18	7.10	11.80	111.70	0.97	224.1	**102.7**	2.2	0.44	**100.00**	409141	1771	3.9
25	6.90	10.90	125.70	3.42	702.2	**122.3**	5.7	0.60	**100.00**	409148	1993	3.4
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	FLOW Usgpm	TIME (hrs)
2	6.95	11.10	70.00	2.24	825.9	**115.4**	7.2	0.31	**100.00**	409125	1110	6.1
10	6.95	8.80	44.00	2.70	1583.8	**139.2**	11.4	0.24	**100.00**	409133	697	9.8
11	7.00	8.80	31.00	2.06	1715.1	**136.3**	12.6	0.16	**100.00**	409134	491	13.9
12	6.92	9.10	33.00	1.98	1548.6	**128.7**	12.0	0.16	**100.00**	409135	523	13.0
23	6.99	9.10	12.00	3.80	8173.3	**145.8**	56.1	0.07	**100.00**	409146	190	35.8
24	6.91	9.10	12.00	1.98	4258.7	**128.2**	33.2	0.06	**100.00**	409147	190	35.8
31	7.15	8.00	13.00	1.52	3017.9	**145.7**	20.7	0.07	**100.00**	409154	206	33.1
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	FLOW Usgpm	TIME (hrs)
2	7.15	7.60	13.00	1.50	2978.0	**149.6**	19.9	0.08	**100.00**	409125	206	33.1
7	7.15	6.50	8.00	2.14	6904.0	**170.2**	40.6	0.05	**100.00**	409130	127	53.8
8	7.10	6.50	8.00	1.10	3548.8	**151.2**	23.5	0.05	**100.00**	409131	127	53.8
27	7.10	5.90	6.00	1.98	8517.5	**172.1**	49.5	0.04	**100.00**	409150	95	71.7
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	FLOW Usgpm	TIME (hrs)
4	7.10	5.70	7.00	2.07	7632.1	**175.7**	43.4	0.05	**100.00**	409127	111	61.5
6	7.17	5.60	7.00	2.60	9586.3	**188.0**	51.0	0.05	**100.00**	409129	111	61.5
7	7.17	5.60	7.00	2.50	9217.6	**186.9**	49.3	0.05	**100.00**	409130	111	61.5
24	7.10	5.60	7.00	3.00	11061.6	**187.1**	59.1	0.05	**100.00**	409147	111	61.5
25	7.10	5.60	7.00	2.60	9586.8	**183.1**	52.4	0.05	**100.00**	409148	111	61.5
26	7.10	5.60	7.00	2.50	9218.1	**182.0**	50.6	0.05	**100.00**	409149	111	61.5
27	7.10	5.60	7.00	2.00	7374.5	**176.0**	41.9	0.05	**100.00**	409150	111	61.5
28	7.10	5.60	7.00	3.00	11061.7	**187.1**	59.1	0.05	**100.00**	409151	111	61.5
29	7.10	5.60	7.00	2.70	9955.6	**184.1**	54.1	0.05	**100.00**	409152	111	61.5
30	7.10	5.60	7.00	3.00	11061.8	**187.1**	59.1	0.05	**100.00**	409153	111	61.5

Appendix D – Nutrient Sampling Upland Drinking Water Reservoirs

2017 Nutrients						
Site		BEAVER	OYAMA	DAMER	BEAVER	OYAMA
Date		23-May-2017	23-May-2017	23-May-2017	29-Jun-2017	30-Jun-2017
Anions						
Nitrate (as N)	mg/L	0.021	<0.0010	<0.010	-	-
Nitrate (MAC)	mg/L	10	10	10	10	10
Nitrite (as N)	mg/L	<0.010	<0.010	<0.010	-	-
Nitrite (MAC)	mg/L	1	1	1	1	1
Phosphate (as P)	mg/L	<0.010	<0.010	<0.010	-	-
No current guidelines						
Sulfate	mg/L	1.8	1.4	1.8	-	-
Sulfate (AO)	mg/L	≤ 500	≤ 500	≤ 500	≤ 500	≤ 500
General Parameters						
Alkalinity, Total (as CaCO3)	mg/L	17.4	14.4	16.4	-	-
No current guidelines						
Alkalinity,Phenolphthalein (as	mg/L	<1.0	<1.0	<1.0	-	-
No current guidelines						
Alkalinity, Bicarbonate (as CaCO3)	mg/L	17.4	14.4	16.4	-	-
No current guidelines						
Alkalinity, Carbonate (as CaCO3)	mg/L	<1.0	<1.0	<1.0	-	-
No current guidelines						
Alkalinity, Hydroxide (as CaCO3)	mg/L	<1.0	<1.0	<1.0	-	-
No current guideline						
Ammonia (as N)	mg/L	0.044	0.037	0.041	-	-
No current guidelines						
Total Organic Carbon	mg/L	11.4	13.0	19.8	-	-
No current guidelines						
Dissolved Organic Carbon	mg/L	10.8	12.8	18.9	-	-
No current guidelines						
Chlorophyll-a	ug/L	1.47	1.12	0.84	-	-
No current guidelines						
Colour, True	CU	55	50	110	-	-
Colour(AO)	CU	≤15	≤15	≤15	≤15	≤15
Nitrogen, Total Kjeldahl	mg/L	0.229	0.297	0.303	-	-
No current guidelines						
Phosphorus, Total (as P)	mg/L	0.0183	0.0162	0.0187	-	-
No current guidelines						
Calculated Parameters						
Hardness, Total (as CaCO3)	mg/L	20.6	16.6	21.2	21.4	18.7
No current guidelines						
Nitrate+ Nitrite (as N)	mg/L	0.0211	<0.0100	<0.0100	-	-
No current guidelines						
Total Nitrogen	mg/L	0.250	0.297	0.303	-	-
No current guidelines						
Organic Nitrogen	mg/L	0.185	0.260	0.262	-	-
No current guidelines						

2017 Nutrients						
Site		BEAVER	OYAMA	DAMER	BEAVER	OYAMA
Date		23-May-2017	23-May-2017	23-May-2017	29-Jun-2017	30-Jun-2017
Metals						
Total Dissolved Aluminium	mg/L	0.0531	0.0614	0.198	-	-
Total Recoverable Aluminium	mg/L	-	-	-	0.0716	0.0714
Aluminium (OG)	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Dissolved Antimony	mg/L	<0.00010	<0.00010	<0.00010	-	-
Total Recoverable Antimony	mg/L	-	-	-	<0.00010	<0.00010
Antimony (MAC)	mg/L	0.006	0.006	0.006	0.006	0.006
Total Dissolved Arsenic	mg/L	<0.00050	<0.00050	<0.00050	-	-
Total Recoverable Arsenic	mg/L	-	-	-	<0.00050	<0.00050
Arsenic (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01
Total Dissolved Barium	mg/L	0.0051	0.0068	0.0081	-	-
Total Recoverable Barium	mg/L	-	-	-	0.0055	0.0073
Barium (MAC)	mg/L	1	1	1	1	1
Total Dissolved Beryllium	mg/L	<0.00010	<0.00010	<0.00010	-	-
Total Recoverable Beryllium	mg/L	-	-	-	<0.00010	<0.00010
No current guidelines						
Total Dissolved Bismuth	mg/L	<0.00010	<0.00010	<0.00010	-	-
Total Recoverable Bismuth	mg/L	-	-	-	<0.00010	<0.00010
No current guidelines						
Total Dissolved Boron	mg/L	0.005	0.006	0.014	-	-
Total Recoverable Boron	mg/L	-	-	-	0.016	<0.004
Boron (MAC)	mg/L	5	5	5	5	5
Total Dissolved Cadmium	mg/L	<0.000010	<0.000010	<0.000010	-	-
Total Recoverable Cadmium	mg/L	-	-	-	<0.000010	<0.000010
Cadmium (MAC)	mg/L	0.005	0.005	0.005	0.005	0.005
Total Dissolved Calcium	mg/L	5.44	4.07	4.68	-	-
Total Recoverable Calcium	mg/L	-	-	-	5.59	4.59
No current guidelines						
Total Dissolved Chromium	mg/L	<0.00050	<0.00050	0.00050	-	-
Total Recoverable Chromium	mg/L	-	-	-	<0.00050	0.00061
Chromium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05
Total Dissolved Cobalt	mg/L	<0.00010	<0.00010	<0.00010	-	-
Total Recoverable Cobalt	mg/L	-	-	-	<0.00010	<0.00010
No current guidelines						
Total Dissolved Copper	mg/L	0.00092	0.00142	0.00220	-	-
Total Recoverable Copper	mg/L	-	-	-	0.00106	0.00166
Copper (AO)	mg/L	≤ 1	≤ 1	≤ 1	≤ 1	≤ 1
Total Dissolved Iron	mg/L	0.126	0.117	0.184	-	-
Total Recoverable Iron	mg/L	-	-	-	0.165	0.164
Iron (AO)	mg/L	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3	≤ 0.3
Total Dissolved Lead	mg/L	<0.00010	<0.00010	<0.00010	-	-
Total Recoverable Lead	mg/L	-	-	-	<0.00010	<0.00010
Lead (MAC)	mg/L	0.01	0.01	0.01	0.01	0.01
Total Dissolved Lithium	mg/L	0.00042	0.00056	0.00114	-	-
Total Recoverable Lithium	mg/L	-	-	-	0.00042	0.00059
No current guidelines'						
Total Dissolved Magnesium	mg/L	1.70	1.55	2.30	-	-
Total Recoverable Magnesium	mg/L	-	-	-	1.80	1.75
No current guidelines						
Total Dissolved Manganese	mg/L	0.0110	0.00582	0.00475	-	-
Total Recoverable Manganese	mg/L	-	-	-	0.00546	0.0100
Manganese (AO)	mg/L	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05
Total Dissolved Mercury	mg/L	<0.00002	<0.00002	<0.00002	-	-
Total Recoverable Mercury	mg/L	-	-	-	0.000035	<0.000020
Mercury (MAC)	mg/L	0.001	0.001	0.001	0.001	0.001
Total Dissolved Molybdenum	mg/L	0.00018	0.00015	0.00021	-	-
Total Recoverable Molybdenum	mg/L	-	-	-	0.00021	0.00014
No current guidelines						
Total Dissolved Nickel	mg/L	0.00071	0.00118	0.00202	-	-
Total Recoverable Nickel	mg/L	-	-	-	0.00077	0.00134
No current guidelines						
Total Dissolved Phosphorus	mg/L	<0.050	<0.050	<0.050	-	-
Total Recoverable Phosphorus	mg/L	-	-	-	<0.050	<0.050
No current guidelines						

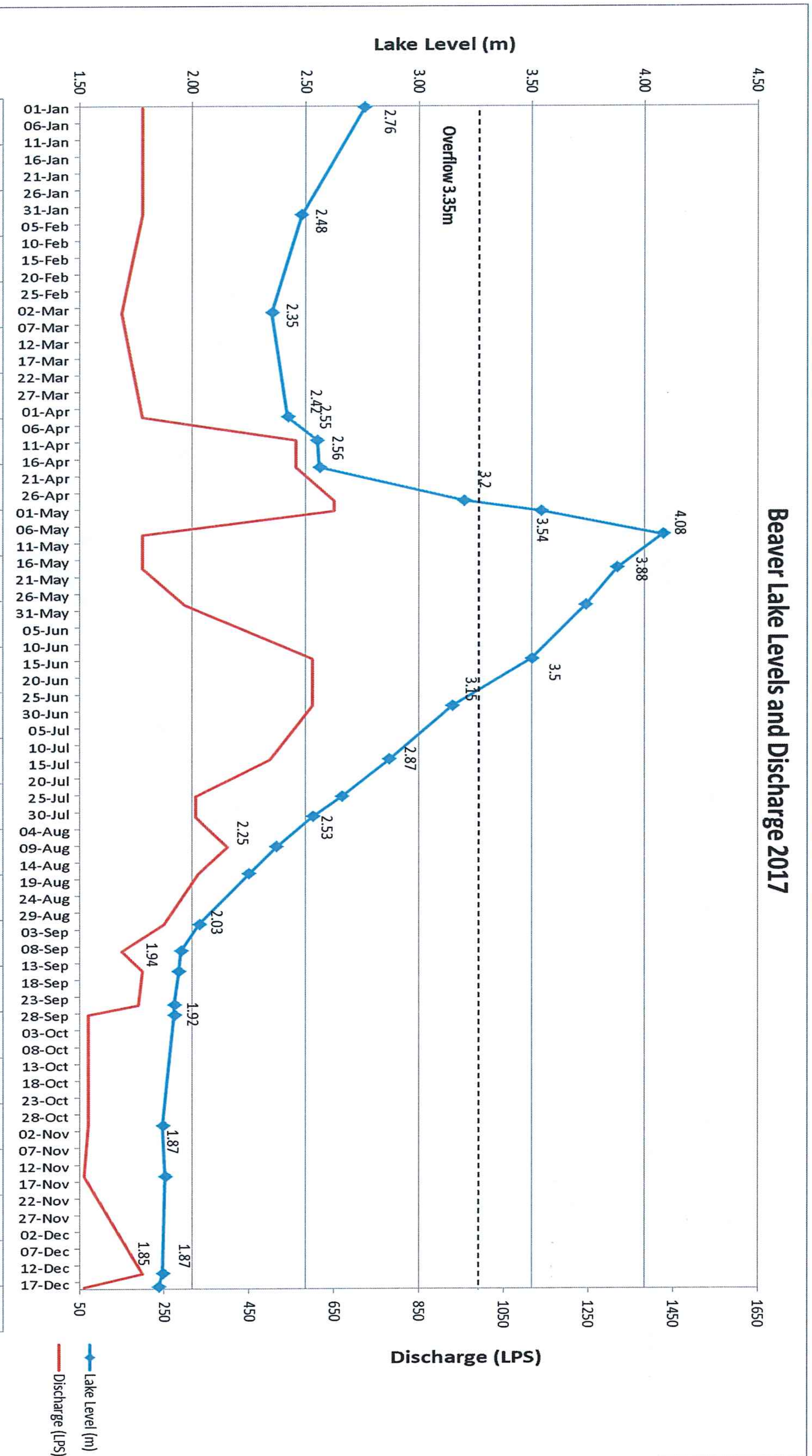
2017 Nutrients

Site		BEAVER	OYAMA	DAMER	BEAVER	OYAMA
Date		23-May-2017	23-May-2017	23-May-2017	29-Jun-2017	30-Jun-2017
Metals Continued						
Total Dissolved Potassium	mg/L	0.84	0.96	1.28	-	-
Total Recoverable Potassium	mg/L	-	-	-	0.92	1.12
No current guidelines						
Total Dissolved Selenium	mg/L	<0.00050	<0.00050	<0.00050	-	-
Total Recoverable Selenium	mg/L	-	-	-	<0.00050	<0.00050
Selenium (MAC)	mg/L	0.05	0.05	0.05	0.05	0.05
Total Dissolved Silicon	mg/L	4.7	4.6	7.2	-	-
Total Recoverable Silicon	mg/L	-	-	-	4.6	4.7
No current guidelines						
Total Dissolved Silver	mg/L	0.000077	0.000120	0.000189	-	-
Total Recoverable Silver	mg/L	-	-	-	<0.000050	<0.000050
No current guidelines						
Total Dissolved Sodium	mg/L	1.97	1.96	2.22	-	-
Total Reocoverable Sodium	mg/L	-	-	-	2.06	2.28
Sodium (AO)	mg/L	≤ 200	≤ 200	≤ 200	≤ 200	≤ 200
Total Dissolved Strontium	mg/L	0.0309	0.0275	0.0278	-	-
Total Recoverable Strontium	mg/L	-	-	-	0.0313	0.0333
No current guidelines						
Total Dissolved Sulfur	mg/L	<3.0	<3.0	<3.0	-	-
Total Recoverable Sulfur	mg/L	-	-	-	<3.0	<3.0
No current guidelines						
Total Dissolved Tellurium	mg/L	<0.00020	<0.00020	<0.00020	-	-
Total Recoverable Tellerium	mg/L	-	-	-	<0.00020	<0.00020
No current guidelines						
Total Dissolved Thallium	mg/L	<0.000020	<0.000020	<0.000020	-	-
Total Recoverable Thallium	mg/L	-	-	-	<0.000020	<0.000020
No current guidelines						
Total Dissolved Thorium	mg/L	<0.00010	<0.00010	<0.00010	-	-
Total Recoverable Thorium	mg/L	-	-	-	<0.00010	<0.00010
No current guidelines						
Total Dissolved Tin	mg/L	<0.00020	<0.00020	<0.00020	-	-
Total Recoverable Tin	mg/L	-	-	-	<0.00020	<0.00020
No current guidelines						
Total Dissolved Titanium	mg/L	<0.0050	<0.0050	0.0058	-	-
Total Recoverable Titanium	mg/L	-	-	-	<0.0050	<0.0050
No current guidelines						
Total Dissolved Uranium	mg/L	0.000038	0.000052	0.000150	-	-
Total Recoverable Uranium	mg/L	-	-	-	0.000037	0.000049
Uranium (MAC)	mg/L	0.02	0.02	0.02	0.02	0.02
Total Dissolved Vanadium	mg/L	<0.0010	<0.0010	<0.0010	-	-
Total Recoverable Vanadium	mg/L	-	-	-	<0.0010	<0.0010
No current guidelines						
Total Dissolved Zinc	mg/L	<0.0040	<0.0040	<0.0040	-	-
Total Recoverable Zinc	mg/L	-	-	-	<0.0040	0.0041
Zinc (AO)	mg/L	≤ 5	≤ 5	≤ 5	≤ 5	≤ 5
Total Dissolved Zirconium	mg/L	0.00062	0.00071	0.00172	-	-
Total Recoverable Zirconium	mg/L	-	-	-	0.00056	0.00055
No current guidelines						

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 – Beaver Lake & Oyama Lake Levels and Discharge

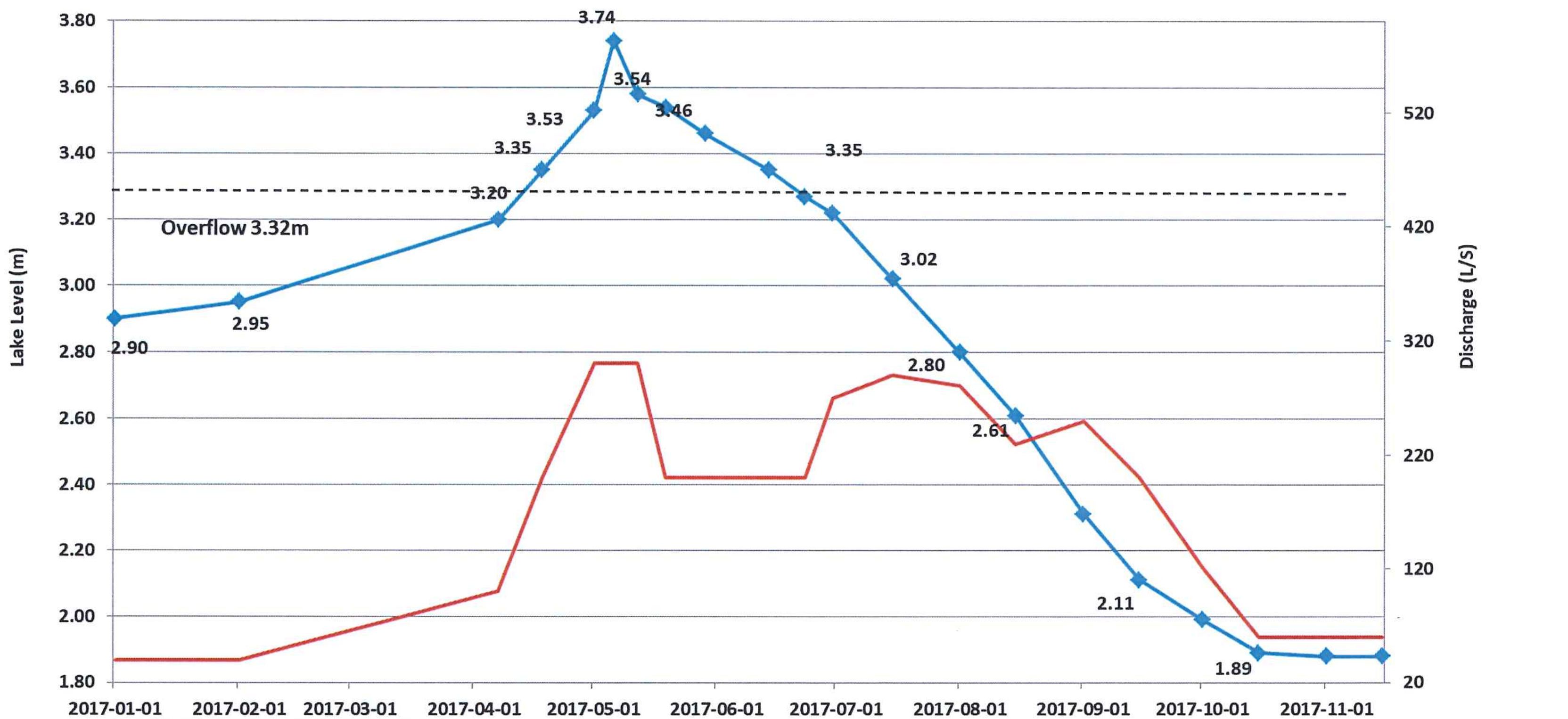


	01-Jan	02-Feb	03-Mar	03-Apr	10-Apr	18-Apr	28-Apr	01-May	08-May
Lake Level (m)	2.76	2.48	2.35	2.42	2.55	2.56	3.2	3.54	4.08
Discharge (LPS)	200	200	150	200	560	560	650	650	200

	18-May	29-May	14-Jun	28-Jun	14-Jul	25-Jul	31-Jul	09-Aug	17-Aug
Lake Level (m)	3.88	3.74	3.5	3.15	2.87	2.66	2.53	2.37	2.25
Discharge (LPS)	200	300	600	600	500	325	325	400	330

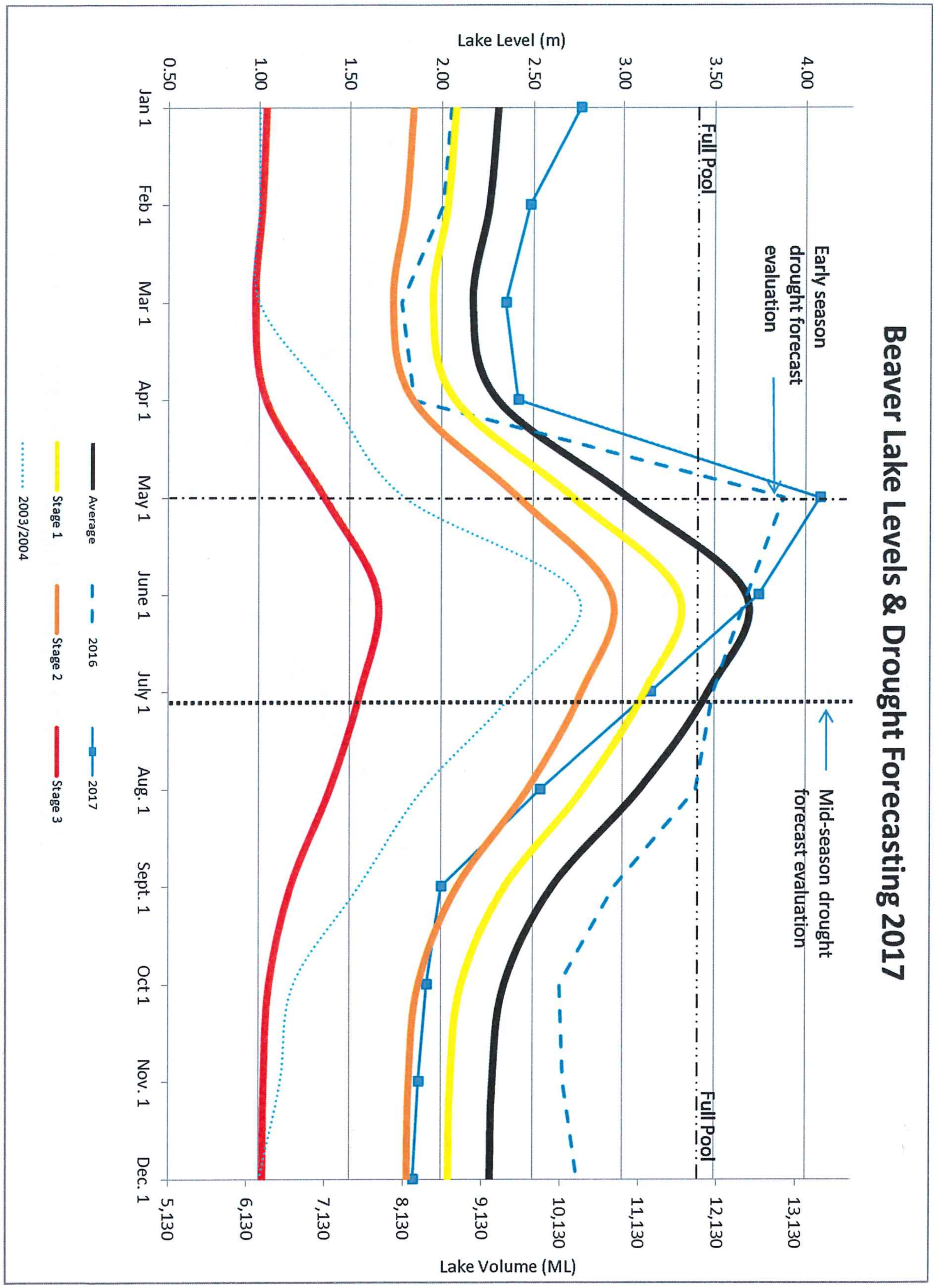
	01-Sep	09-Sep	15-Sep	25-Sep	28-Sep	31-Oct	15-Nov	14-Dec	18-Dec
Lake Level (m)	2.03	1.95	1.94	1.92	1.92	1.87	1.88	1.87	1.85
Discharge (LPS)	250	150	200	190	70	70	60	200	60

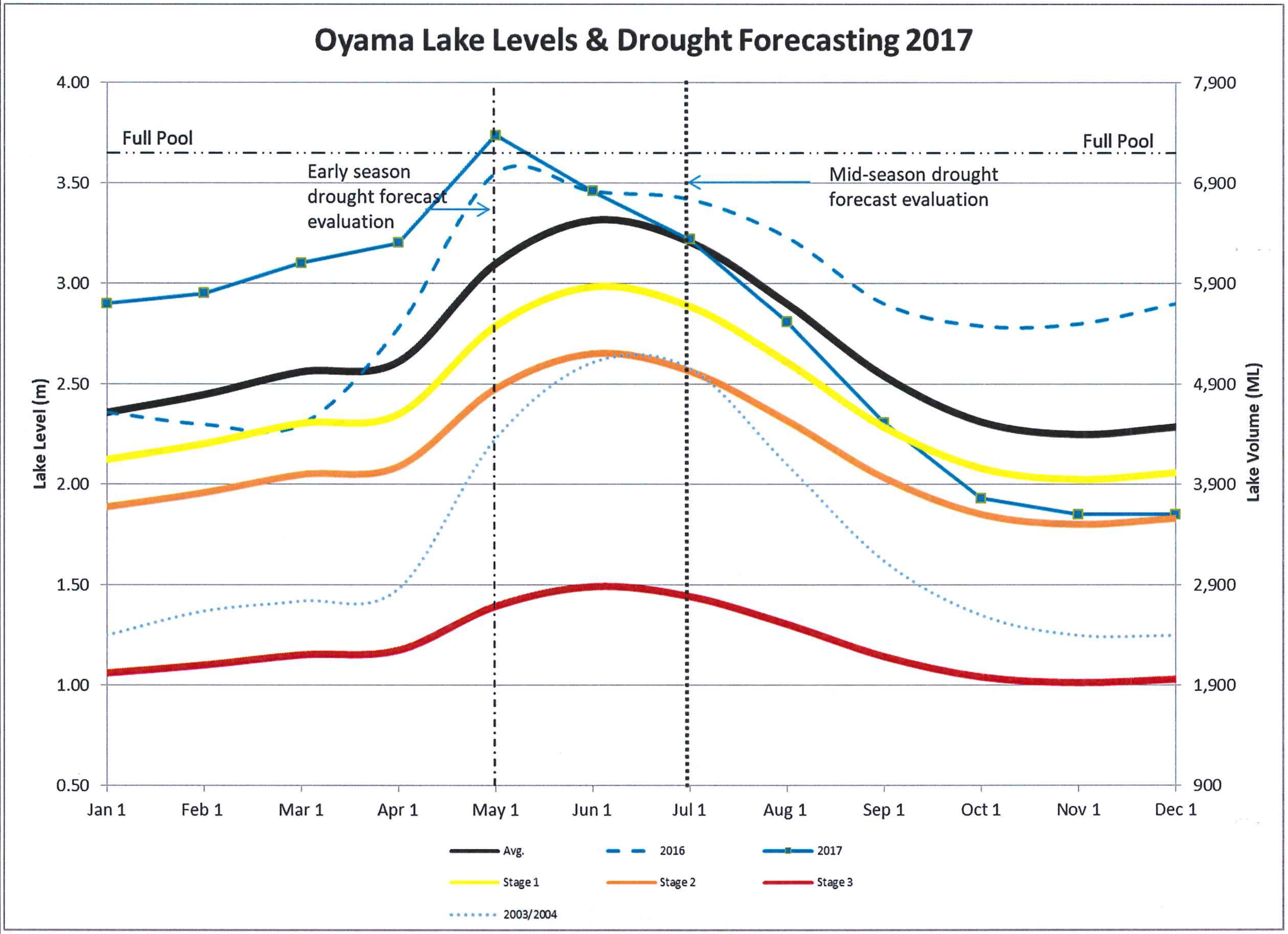
Oyama Lake Levels and Discharge 2017



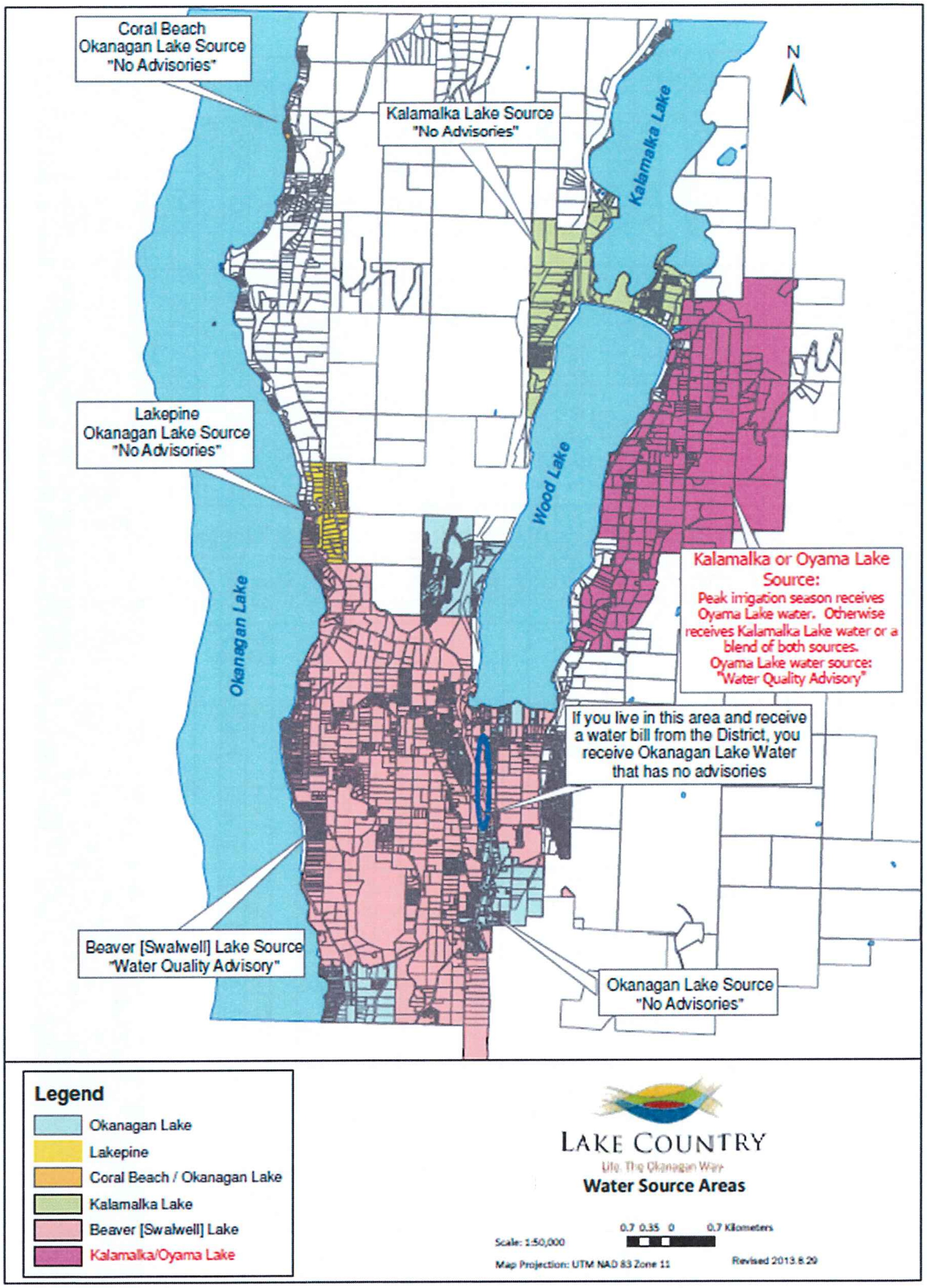
	1-Jan-17	1-Feb-17	7-Apr-17	18-Apr-17	1-May-17	6-May-17	12-May-17	19-May-17	29-May-17	14-Jun-17	23-Jun-17	30-Jun-17	15-Jul-17	1-Aug-17	15-Aug-17	1-Sep-17	15-Sep-17	1-Oct-17	15-Oct-17	1-Nov-17	15-Nov-17
Lake Level (m)	2.90	2.95	3.20	3.35	3.53	3.74	3.58	3.54	3.46	3.35	3.27	3.22	3.02	2.80	2.61	2.31	2.11	1.99	1.89	1.88	1.88
Discharge (L/S)	40	40	100	200	300	300	300	200	200	200	200	270	290	281	230	250	200	120	60	60	60

Appendix F – Drought Forecast for Beaver Lake & Oyama Lake




Oyama Lake Levels & Drought Forecasting 2017
Full Pool
Full Pool
Early season drought forecast evaluation
Mid-season drought forecast evaluation
Lake Level (m)
Lake Volume (ML)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
7,900
6,900
5,900
4,900
3,900
2,900
1,900
900
Jan 1
Feb 1
Mar 1
Apr 1
May 1
Jun 1
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1
Avg.
2016
2017
Stage 1
Stage 2
Stage 3
2003/2004

Appendix G – 2017 SOURCE AREA MAP



Appendix H – Kalamalka UV Station log Sheets

January 2017

JANUARY 2017			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	0850	J.R	2313554	2723128	401/402	72.8	77.1	91.1	67.1	4.06	38.66	91.4	3.8	1.7
2	1120	J.R	2315139	2723689	401/402						0	91.9		
3	10:00	TF	2315331	2724971	401/402						–	90.2		
4	0930	J.R	2317240	2725142	401/402	67.7	89.1	99.8	63.4	3.99	39.4	91.4	4.2	2.6
5	1030	RJB	2317192	2725324	401/402	68	90	101	63	4.06	37	91.4	4.3	2.7
6	9:00	TF	2317343	2726869	401/402							92.3		
7	8:00	MDT	2318435	2727057	401/402	65.8	88.2	98.1	62.5	3.95	39.32	91.2	4.2	2.6
8	830	MDT	2319299	2727845	401/402							92.7		
9	0900	J.R.	2319692	2728892	401/402						0	91.6		
10	830	RJB	2321000	2729086	401/402									
11	14:06	J.R	2321262	2730224	401/402	67	72.8	82.1	63.4	3.97	38.6	91.2	3.7	1.7
12	1300	J.R	2321661	2731020	401/402						0	91.6		
13	1120	J.R	2323024	2731209	401/402						0	91.2		
14					401/402									
15					401/402									
16	0910	J.R	2325165	2733092	401/402						0	91.2		
17	1200	J.R.	2325353	2734546	401/402	69.2	99.8	101.8	63.5	4.07	39	91.4	4.3	2.7
18	1200	J.R.	2326661	2734733	401/402	68.3	83.9	102.8	63.8	4.02	39	91.6	4.3	2.6
19	1330	J.R	2327268	2735003	401/402	70	66.6	82.6	61.9	3.8	39	90.3	3.8	1.7
20	1145	J.R.	2327459	2736476	401/402						0	91.8		
21					401/402									
22	400	RJB	2328885	2737706	401/402									
23	1440	J.R	2329025	2739559	401/402	85.9	73.8	143	66.2	4.14	37.9	91.2	4.3	2.5
24	1130	J.R.	2329308	2739863	401/402	65.2	86.2	99.6	61.6	4.0	38.2	91.5	4.3	2.7
25	1300	J.R	2330859	2740014	401/402						0	91.6		
26	0900	J.R.	2331046	2741681	401/402									
27	0910	J.R.	2332038	2741664	401/402	65.9	83.0	98.2	61.2	4.05	39	91.3	4.2	2.6
28	1145	TF	2333027	2741941	401/402							91.4		
29	1000	TF	2333115	2743359	401/402	65	85	99	61	3.99	37	91.1	4.2	2.6
30	13:11	MRM	2334696	2743546	401/402									
31	1130	TF	2334872	2744296	401/402	69	65	82	63	3.97	39	91.0	3.7	1.7
JANUARY					401/402									

February 2017

FEBRUARY 2017			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					401/402									
2	1345	ROB	2335256	2745301	401/402	89	84	90	72	4.37	37	92.3	3.6	1.8
3	1013	J.R	2335481	2746502	401/402	93.3	89.2	95.5	77.1	4.33	39	91.4	3.7	1.8
4	0900	J.R	2336731	2746616	401/402						0	91.3		
5	0850	J.R	2338167	2746801	401/402							91.8		
6	1100	J.R	2338369	2747932	401/402	84.9	82.9	95.2	72.1	4.32	39	91.4	3.7	1.7
7	11:20	TF	2338529	2748746	401/402							91.8		
8	1020	J.R	2340247	2750359	401/402									
9	1445	J.R	2341439	2750531	401/402	85.9	89.7	89.1	75.2	4.28	39	91.3	3.6	1.8
10	0730	J.R	2341927	2750531	401/402						0	91.9		
11	8:30	MW	2342160	2752192	401/402									
12	6:40	MW	2343463	2752378	401/402	86.4	94.5	89.7	75.1	4.31	38.72	96.9	3.6	1.8
13	8:12	MW	2344029	2752560	401/402									
14	1220	J.R	2346219	2754175	401/402						0	91.9		
15	1150	J.R	2345651	2756356	401/402						0	91.6		
16	0950	J.R	2345838	2755333	401/402	102.1	89.7	97.3	76.4	4.60	39	91.5	3.2	1.6
17	11:15	TF	2346079	2756306	401/402							91.9		
18					401/402									
19					401/402									
20					401/402									
21	1030	ROB	2348097	2759835	401/402									
22					401/402									
23	3:15	TF	2349788	2761129	401/402	91	81	92	73	4.13	39	90.0	3.7	1.7
24	8:20	TF	2349474	2761815	401/402									
25	8:30	TF	2351528	2762074	401/402							90.7		
26	8:20	TF	2351717	2763540	401/402							92.1		
27	1030	ROB	2353071	2763736	401/402	82	87	87	74	4.19	39	90.5	3.6	1.8
28	1500	TF	2353677	2764460	401/402	98	80	92	72.7	4.12	39	89.9	3.7	1.7
29					401/402									
30					401/402									
31					401/402									
FEBRUARY					401/402									

March 2017

MARCH 2017			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	11:30	TF	2353869	2765486	401/402							90.9		
2	1130	ROS	2355388	2765 72	401/402									
3	0850	J.R.	2355580	2766759	401/402	102.7	88.2	96	75.7	4.37	39	91.9	3.7	1.7
4	0950	J.R.	2355763	2767620	401/402						0	91.5		
5	0730	J.R.	2357612	2767731	401/402	104.6	95.0	96.8	81	4.40	39	91.3	3.2	1.7
6	1330	ROB	2358156	2768922	401/402	102	87	95	74	4.37	37	91.8	3.8	1.7
7	14:45	TF	2358341	2770483	401/402							91.2		
8	14:00	TF	2358341	2771543	401/402	101	85	94	75	4.25	39	91.1	3.7	1.6
9	1315	TF	2358341	2772703	401/402	103	90	95	77	4.34	37	90.8	3.8	1.7
10	1015	ROB	2359895	2772920	401/402	103	85	95	75	4.27	37	90.6	3.8	1.7
11	630	MCM	2360082	2773155	401/402	86.6	91.5	65	72	4.32	39	92	3.7	1.8
12	700	MCM	2361652	2773331	401/402									
13					401/402									
14					401/402									
15	1015	J.R.	2363714	2775289	401/402	101.0	91.0	94.6	80	4.26	39.9	91.3	3.8	1.7
16	1240	J.R.	2364900	2776858	401/402						0	91.8		
17	1145	J.R.	2365385	2777041	401/402						0	91.5		
18	8:00	TF	2365571	2777742	401/402	98	83	93	75	4.14	37	89.4	3.7	1.7
19	8:15	TF	2365580	2779010	401/402	81	85	84	71	4.23	37	90.8	3.7	1.8
20	1515	PM	2365959	2780656	401/402						0	89.8		
21	1115	PM	2367458	2780846	401/402							90		
22	0910	PM	2367639	2782015	401/402	97.5	74.4	93.2	69.4	4.02	39	89.7	3.7	1.6
23	1030	PM	2368015	2782773	401/402	85.5	89.2	90.6	75.5	4.19	39	91.1	3.6	1.8
24	1130	J.R.	2369557	2782950	401/402	82.5	91.7	88.2	76.3	4.30	38	91.6	3.6	1.8
25	12	ROB	2369882	2784543	401/402									
26		ROB	2371405	2784732	401/402									
27	1330	PM	2371586	2786084	401/402	95.8	78.7	92.7	71.8	4.16	39	90	3.7	1.6
28	1510	J.R.	2371943	2786844	401/402						0	91.8		
29	1030	ROB	2372110	2788151	401/402									
30	0830	J.R.	2372299	2789617	401/402									
31	1510	J.R.	2373845	2789801	401/402	82.2	83.0	86.8	72.8	4.24	39	91.6	3.6	1.8
MARCH					401/402									

April 2017

APRIL 2017			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	1120	J.R	2374294	2789979	401/402						0	91.6		
2	0835	J.R	2374294	2791617	401/402						0	91.9		
3	1315	J.R.	2375991	2791811	401/402						0	91.8		
4	1005	J.R.	2376176	2792727	401/402	119.1	79.9	85.7	71.6	4.19	4.0	91.4	3.7	1.6
5	1000	ROB	2376358	2793805	401/402									
6	0900	J.R.	2377962	2793951	401/402	121.1	77.8	86.1	69.1	4.22	38	91.6	3.7	1.7
7	1100	ROB	2378152	2795485	401/402									
8	7:20	MDM	2378721	2795667	401/402	83.2	83.7	89.2	72	4.34	39	92.4	3.6	1.8
9	8:20	MDM	2380036	2795845	401/402									
10	1100	ROB	2380424	2797589	401/402									
11	1415	J.R	2381956	2797829	401/402						0	91.9		
12	0935	J.R	2382275	2797878	401/402	81.2	82	85.7	71.9	4.22	39	91.6	3.6	1.8
13	1208	J.R	2383727	2798266	401/402	116.3	88.4	95.8	77.7	4.26	40.02	90.6	3.8	1.7
14					401/402									
15					401/402									
16					401/402									
17					401/402									
18	1030	ROB	2386740	2803353	401/402	113	83	84	75	4.18	39	91.2	3.7	1.6
19	1200	ROB	2387234	2803830	401/402	80	81	85	72	4.16	39	90.7	3.6	1.8
20	730	ROB	2388460	2804012	401/402									
21	1130	ROB	2388689	2805421	401/402	83	83	87	73	4.34	39	90.6	3.7	1.8
22	1100	ROB	2388977	2806521	401/402	81	81	84	72	4.23	38	90.6	3.6	1.8
23		ROB	2390417	2806684	401/402									
24	9:30	TF	2390605	2807605	401/402	100	84	84	75	4.20	39	90.5	3.7	1.6
25	11:30	MAM	2390786	2808635	401/402									
26					401/402									
27					401/402									
28	1400	MAM	2394152	2810441	401/402	81	81.8	84	69.9	4.34	39	92.4	3.6	1.8
29	1000	TF	2394717	2810619	401/402							93		
30	8:45	TF	2394776	2812270	401/402	87	85	91	74	4.39	38	92.5	3.6	1.8
31					401/402									
APRIL					401/402									

May 2017

MAY 2017			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	1510	J.A.	2396603	2812657	401/402						ø	92.3		
2	1045	ROB	2396593	2814180	401/402									
3	1030	ROB	2396668	2814414	401/402	114	84	96	71	4.42	38	93.6	3.8	1.7
4	900	ROB	2399235	2814836	401/402	76	76	80	66	4.31	38	93.4	3.6	1.8
5					401/402									
6					401/402									
7	1130	J.A.	2402712	2817140	401/402	112.9	85.4	92.1	72.4	4.42	38.1	92.3	3.8	1.7
8	1130	J.A.	2402912	2818739	401/402						ø	91.9		
9	1250	J.A.	2403952	2818977	401/402	75.1	73.5	80.5	67.7	4.07	39	91.4	3.6	1.8
10	930	ROB	2404363	2820362	401/402	76	75	82	67	4.23	38	92.3	3.6	1.8
11	0900	J.A.	2406002	2820551	401/402						ø	91.4		
12	0945	J.A.	2406386	2821685	401/402	98.6	79.7	91.7	71.8	4.24	38.6	91.9	3.7	1.6
13					401/402									
14					401/402									
15	1155	J.A.	2409198	2823920	401/402						ø	91.6		
16	1020	J.A.	2410729	2824161	401/402						ø	92.1		
17	1350	J.A.	2410906	2825452	401/402						ø	91.2		
18	915	ROB	2412624	2825649	401/402									
19	1300	ROB	2413234	2826375	401/402									
20					401/402									
21	1400	ROB	2417051	2828544	401/402	74	74	83	65	4.26	39	93.7	3.6	1.8
22					401/402	~~72~~	~~72~~							
23	1300	ROB	2419703	2828764	401/402	72	72	80	65	4.12	40	92	3.6	1.8
24	1030	ROB	2421910	2828978	401/402									
25	1115	ROB	2425467	2829198	401/402	77	78	117	71	4.10	40	90.7	4.3	2.6
26	1530	J.A.	2430815	2832721	401/402	156.7	156.3	160.8	161.7	3.86	94	91.6	6.0	2.8
27	930	TF	2432285	2833035	401/402	187	207	234	166	4.19	92	92.3	7.8	4.2
28	1030	TF	2437920	2835410	401/402	169	181	214	158	4.07	95	91.9	7.6	4.1
29	1120	J.A.	2446501	2836411	401/402	161.6	172.7	201.3	153.1	3.93	96	91.3	7.5	4.1
30	1400	ROB	2455560	2837775	401/402	170	182	214	151	4.22	93	93.6	7.5	4.1
31	1130	ROB	2462750	2838480	401/402	179	191	227	155	4.36	94	94.7	7.1	4.5
MAY					401/402									

June 2017

JUNE 2017 DAY	TIME	Chk'd	FLOW Totalizer 401 (m3)	FLOW Totalizer 402 (m3)	Running Reactor	Lamp Intensity 1 (W/m2)	Lamp Intensity 2 (W/m2)	Lamp Intensity 3 (W/m2)	Dosage UV SP (W/m2)	Dosage Validated Log	Flow (LPS)	UVT %	Power Bank 1 (KWH)	Power Bank 2 (KWH)
1	0915	J.R.	2466468	2841658	401/402						ø	91.6		
2	1115	J.R.	2462685	2842502	401/402						ø	91.6		
3	0820	J.R.	2468620	2844653	401/402	123	154	178	143.0	4.07	86	91.8	6.0	5.8
4	1100	J.R.	2469877	2844957	401/402	129.4	153.9	179.7	143	4.05	86.1	91.8	6.0	5.8
5	1310	P.M.	2471650	2846529	401/402	135.7	136	158.9	124.1	4.05	82.7	92.1	5.9	3.0
6					401/402									
7	845	ROB	2476047	2850301	401/402	135	138	160	125	4.04	82	92.9	5.8	3.0
8	945	ROB	2478140	2852790	401/402									
9					401/402									
10					401/402									
11					401/402									
12	0845	ROB	2485715	2864293	401/402	151	142	166	136	3.94	86	92	6.0	2.8
13					401/402									
14	1130	ROB	2492817	2868862	401/402	149	148	175	142	3.92	90	90.9	5.9	2.8
15	1005	ROB	2496111	2871339	401/402									
16	1245	ROB	2498942	2873996	401/402									
17	8:00	TF	2500737	2875294	401/402							93.6		
18	7:45	TF	2502820	2878215	401/402	135	142	164	125	4.03	85	93.4	5.9	3.0
19	1450	J.R.	2506803	2881825	401/402	190	178.4	211.1	158.8	4.06	90	94.3	7.7	3.7
20	1200	ROB	2510057	2884409	401/402									
21	1000	ROB	2512552	2886956	401/402									
22	1130	ROB	2516026	2889882	401/402	163	142	169	138	3.92				
23	1200	ROB	2518747	2892933	401/402	131	141	163	133	4.0	88	93.1	5.8	3.0
24	6	MCM	2520826	2895440	401/402	182	195	234	139	4.67	88	92.4	7.7	4.1
25	7:00	MCM	2526606	2898210	401/402	172	187	223	153	4.24	87	91.6	7.5	4.1
26					401/402									
27	930	ROB	2536252	2904249	401/402	165	180	216	154	4.04	88	90.2	7.6	4.1
28	930	ROB	2540213	2907728	401/402	168	162	213	153	4.05	89	91	7.5	4.1
29	1510	J.R.	2547525	2910025	401/402						ø	91.6		
30	1000	ROB	2553390	2910025	401/402	165	177	210	153	4.01	86	89.3	7.5	4.1
31					401/402									
JUNE					401/402									

July 2017

JULY 2017			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	J.R.	2566086	2910983	401/402	176.7	187.7	220.2	151.4	4.13	89.8	92.1	7.5	4.1
2	1115	J.R.	2576238	2916548	401/402	216.6	176.7	237.7	156.2	4.18	92.8	91.8	7.7	3.7
3	0915	J.R.	2582663	2923460	401/402	233.7	189.1	252.7	164.5	4.31	89.1	92.1	7.7	3.7
4	1150	J.R.	2564243	2931866	401/402	197.8	178.3	239.3	163	4.09	88.8	91.4	7.7	3.7
5	1010	J.R.	2564195	2938983	401/402	213.8	192.3	244.0	163.7	4.19	86.5	91.9	7.7	3.7
6	930	RoB	2570589	2941449	401/402	155	168	196	148	3.90	90		7.5	4.1
7	800	RoB	2577386	2942457	401/402	172	200	212	159	4.08	95	91.6	7.5	4.1
8					401/402									
9	1030	RoB	2590289	2946386	401/402	182	208	220	161	4.22	59	91.3	7.5	4.1
10	1000	RoB	2591845	2952912	401/402	188	179	218	165	4.08	92	90.3	7.7	3.7
11	1100	RoB	2592090	2961097	401/402	197	188	230	173	4.13	92	89.7	7.7	3.7
12	1230	RoB	2599347	2962151	401/402	183	209	217	162	4.22	86	91.3	7.5	4.1
13	1300	RoB	2601422	2967651	401/402	187	175	220	159	4.14	87	90.4	7.7	3.7
14	0915	J.R.	2605434	2969746	401/402	200.2	187.1	234.6	165.2	4.24	89	91.6	7.7	3.7
15					401/402	174	198	205						
16					401/402									
17	1100	RoB	2610247	2988935	401/402	172	198	205	164	3.97	91	88.4	7.5	4.1
18	1110	J.R.	2615636	2991098	401/402	181.5	208.4	216.1	173	4.17	93.2	91.8	7.5	4.1
19	1015	RoB	2619594	2994424	401/402	168	172	211	153	4.10	87	91.6	7.7	3.7
20	1340	J.R.	2620965	3001226	401/402	175.4	185.5	227.6	159.6	4.09	91.85	91.1	7.7	3.7
21	1130	RoB	2621914	3007962	401/402	177	184	226	159	4.17	88	90.3	7.7	3.7
22	12:00	TK	2627508	3010309	401/402	177	191	231	159	4.16	86	90.8	7.8	3.8
23					401/402									
24					401/402									
25	830	RoB	2631238	3027560	401/402	170	182	226	155	4.11	87	90.7	7.7	3.7
26	1100	RoB	2636099	3030943	401/402	156	171	208	148	3.92	87	89.3	7.8	3.8
27	830	RoB	2642105	3031891	401/402	167	196	178	155	4.08	92	91.2	7.5	4.1
28	1000	RoB	2648843	3037992	401/402									
29	9:00	MRM	2651256	3037992	401/402	160	169	156	157	3.84	[illegible]	86	7.5	4.1
30	7:15	MRM	2658555	3038957	401/402	161	169	156	157	3.84	92	88.9	7.5	4.1
31	1000	J.R.	2660507	3044885	401/402	145.2	170.2	213.6	139.8	3.93	91.8	91.6	7.2	3.7
JULY					401/402									

August 2017

AUGUST 2017			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	1030	ROB	2662646	3052337	401/402	145	178	223	135	4.06	86	93.9	7.7	3.7
2	1000	ROB	2667575	3054303	401/402	154	180	179	137	4.26	89	94.5	7.5	4.1
3	1000	J.R.	2672582	3056625	401/402	180.8	180.3	227.2	135	3.92	88	91.8	7.8	3.6
4	1100	J.R.	2674371	3060732	401/402	166.6	201.1	193.4	153	4.10	89	91.3	7.5	4.1
5	1045	J.R.	2676666	3062183	401/402	126.3	126.9	177.2	226.5	3.76	88	91.9	7.2	3.2
6	1255	J.R.	2683641	3066674	401/402	216.6	179.7	226.4	160.4	4.23	88	91.4	7.9	3.8
7	1130	J.R	2688332	3070953	401/402	210.1	170.8	201.9	154.5	4.15	87.08	90.9	7.8	3.8
8	1030	ROB	2688598	3078221	401/402	209	168	202	150	4.21	86	92.4	7.7	3.7
9	930	ROB	2692029	3081677	401/402	196	158	192	147	4.04	87	91.0	7.7	3.7
10	1105	J.R	2696964	3084641	401/402	213	171.6	204.5	155.5	4.17	87	91.3	7.8	3.8
11		J.R	2700160	3087080	401/402	163.4	193	183.7	150.5	4.07	86.1	91.3	7.5	4.1
12	1000	ROB	2702710	3091031	401/402	194	159	196	162	3.93	88	89.2	7.7	3.7
13					401/402	~~158~~	~~132~~	~~146~~	~~114~~	~~4.03~~	~~87~~			
14	1345	ROB	2709126	3097797	401/402	158	132	146	114	4.03	87	93.9	5.9	2.8
15	930	ROB	2712393	3103921	401/402	209	163	198	147	4.16	93	93.3	7.7	3.7
16	1100	ROB	2715690	3108363	401/402	208	162	199	147	4.11	86	91.4	7.8	3.8
17	1030	ROB	2718866	3111478	401/402	143	167	158	146	3.04	91	86.3	7.5	4.1
18	10:30	TF	2721736	3116606	401/402						92			
19	7:30	MRM	2723261	3121511	401/402	173.3	143	176	148	3.73	88	86.7	7.7	3.7
20	6:30	MRM	2703987	3128112	401/402	163	180	179	157	3.89	90	88.3	7.7	4.2
21	1030	TF	2727320	3132038	401/402	232	165	203	156	3.97	87	88.6	7.7	3.8
22	1045	JR	2730647	3136142	401/402	153.1	128.7	169	162.1	4.02	89	91.8	7.5	4.1
23	1250	J.R	2732282	3142984	401/402	159.1	179.8	175.5	166.5	4.1	89	91.9	7.5	4.1
24	1300	J.R.	2734250	3148724	401/402	227.4	111.7	202.0	150.3	4.03	87	91.2	7.7	3.7
25	1030	J.R	2736754	3152274	401/402	163	191.1	180.6	166.9	4.18	84.2	92.1	7.6	4.1
26	8:10	TF	2739367	3155589	401/402	173	203	188	159	4.03	89.9	91	7.8	4.2
27	10:10	TF	2742721	3158024	401/402	165	195	183	154	4.07	86	85	7.7	4.7
28	1310	J.R	2746919	3161536	401/402						0	91.5		
29	1320	J.R	2749234	3165739	401/402						0	94		
30					401/402									
31	1030	ROB	2755338	3170278	401/402	165	193	182	149	4.11	91	91.8	7.6	4.1
AUGUST					401/402									

September 2017

SEPTEMBER 2017			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	1300	ROB	2758615	3174120	401/402	227	162	202	149	4.09	86	91.1	7.9	3.8
2	6:40	MCM	2760770	3176877	401/402	156	183	174	147	3.97	87	90.2	7.6	4.1
3	10:50	MCM	2766846	3179198	401/402	211	148	149	166	3.79	91	89.5	7.8	3.8
4	7:00	MCM	2770934	3181098	401/402									
5	1200	ROB	2772420	3187450	401/402	230	161	202	146	4.12	91.4	84	7.9	3.8
6					401/402									
7	1630	ROB	2775140	3196392	401/402	156	185	210	138	4.30	66*	90.2	7.7	4.1
8	6:30	TF	2778497	3198642	401/402	166	197	222	152	4.13	84	90.9	7.6	4.1
9	6:00	MK	2781109	3201816	401/402									
10	11:00	MK	2783510	3204331	401/402									
11	1030	J.R.	2785448	3206059	401/402						0	91.6		
12	1445	J.R.	2788933	3208662	401/402						0	91.6		
13	1100	ROB	2791153	3210471	401/402	225	154	200	145	4.00	85	90.3	7.9	3.8
14	1200	ROB	2793772	3212893	401/402									
15	1315	J.R.	2796351	3215171	401/402	153.4	183.6	205.3	141.4	4.11	82.1	91.5	7.6	4.1
16					401/402									
17	8:00	LW			401/402	140	166	187	133	3.99	80	90	7.6	4.1
18	11:00	J.R.	2803090	3221939	401/402	167	199.0	221.0	163.3	4.2	84	91.8	7.6	4.1
19	0900	J.R.	2805143	3223719	401/402	151	179.2	200.4	160.4	4.04	84	91.1	7.6	4.1
20	1649	J.R.	2807968	3226342	401/402	212	176	181.6	133.6	4.10	86	91.8	7.9	3.8
21	1040	J.R.	2810255	3228943	401/402						0	91.2		
22	1130	J.R.	2811836	3230386	401/402									
23	1030	J.R.	2814076	3231855	401/402	236.2	166.0	209.7	158.9	3.91	88.5	91.4	7.9	3.8
24	1140	J.R.	2815870	3233433	401/402	224.6	152.1	202.6	160.5	4.04	86.6	91.2	7.9	3.8
25	1220	J.R.	2817971	3234480	401/402	163.5	194.9	217.8	155.9	4.2	81.8	91.6	7.7	4.1
26	900	ROB	2819585	3237614	401/402									
27	1050	J.R.	2821816	3239531	401/402	233.6	157.3	210.1	150.6	4.19	85.6	91.8	7.9	3.8
28	1015	J.R.	2823497	3241215	401/402	241.1	162.5	215.7	155.1	4.19	84.2	92.1	7.9	3.8
29	1030	ROB	2825836	3243370	401/402									
30	0930	TK	2826912	3245517	401/402							89		
31					401/402									
SEPTEMBER					401/402									

October 2017

OCTOBER 2017			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	9:20	TF	2828660	3247568	401/402							88		
2	1300	J.R.	2831288	3250576	401/402						0	91.5		
3	1000	RDB	2832628	3252191	401/402									
4	1100	RDB	2834213	3253641	401/402	153	191	236	145	3.98	80	88	7.8	4.2
5	1400	RDB	2835567	3254915	401/402									
6	1230	J.R.	2836384	3255767	401/402						0	91.8		
7					401/402									
8	1000	RDB	2838116	3257142	401/402	199	157	212	140	4.20	84	92.8	80	3.9
9	940	RDB	2838904	3257948	401/402	150	188	219	136	4.17	74	91.5	76	4.1
10					401/402									
11					401/402									
12					401/402									
13	0910	J.R.	2841033	3260211	401/402	198.1	152.8	205.7	140.0	4.01	80.0	90.3	7.8	3.8
14	900	MK	2841256	3260837	401/402									
15	10:00	MK	2841482	3261056	401/402									
16					401/402									
17	1110	J.R.	2842163	3261708	401/402	178.5	165.2	197.0	135	4.02	86	91.6	7.9	3.8
18	800	RDB	2842258	3264339	401/402	126	98	132	82	4.46	39	91.8	6.0	0.8
19	1500	J.R.	2843599	3265180	401/402	69.2	88.5	121.4	63.8	4.08	39	91.9	4.2	2.6
20					401/402									
21					401/402									
22					401/402									
23					401/402									
24	830	RDB	2847396	3269335	401/402									
25	1130	RDB	2848652	3269572	401/402	85	90	133	75	4.23	39	90.7	4.2	2.6
26	1230	RDB	2849401	3269809	401/402									
27	0930	J.R.	2849647	3271339	401/402						0	91.3		
28					401/402									
29					401/402									
30	1200	J.R.	2851925	3273385	401/402						0	91.9		
31					401/402									
OCTOBER					401/402									

November 2017

NOVEMBER 2017			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	900	ROB	2853855	3273651	401/402									
2	1:00	J.R	2854892	3275385	401/402						0	96.8		
3					401/402									
4	1045	J.R	2855976	3275561	401/402						0	91.5		
5	1040	J.R	2856205	3276674	401/402	85.3	65.5	119.8	6.3	4.07	39	91.2	4.3	2.5
6	1415	PM	2856434	3277376	401/402							89.2		
7	1215	PM	2856894	3278627	401/402							89.1		
8	1200	PM	2857703	3278865	401/402	68.0	80.1	116.6	64.7	3.93	39	90.1		
9					401/402									
10	730	ROB	2860083	3279273	401/402	132	103	146	88	4.39	38	88.6	2.8	7.3
11					401/402									
12					401/402									
13					401/402									
14	1140	J.R	2860810	3283150	401/402						0	91.6		
15					401/402									
16	830	ROB	2862869	3283737	401/402	86	68	124	66	4.00	39	91.4	4.3	2.5
17	1215	J.R	2863095	3284619	401/402						0	91.8		
18	810	MRW	2864020	3285378	401/402							94.5		
19	230	MRW	2864420	3285619	401/402	65	72	83	59	4.16	38	93.9	3.6	1.8
20	1045	J.R	2865498	3286214	401/402						0	92.1		
21	1435	J.R	2866248	3287208	401/402						0	91.6		
22	930	ROB	2866948	3287442	401/402									
23	0845	J.R			401/402						0	91.3		
24					401/402									
25	900	ROB	2869430	3288406	401/402									
26					401/402									
27	0915	J.R	2869667	3290186	401/402	108.8	75.5	143.9	68.7	4.13	39	91.6	4.4	2.5
28	0910	J.R	2871171	3290349	401/402	92.9	63.6	90.9	60.3	3.97	38	91.6	3.8	1.7
29	1040	J.R	2871926	3291357	401/402	112.8	78.3	148.7	69.5	4.24	38	91.5	4.3	2.5
30	1030	ROB	2872161	3291391	401/402									
31					401/402									
NOVEMBER					401/402									

December 2017

DECEMBER 2017			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	1315	J.R.	2874055	3291629	401/402						0	91.4		
2	9:45	TF	2874283	3291862	401/402							89.8		
3	8:30	TF	2874283	3293496	401/402							89.1		
4	1000	J.R.	2874867	3294100	401/402	62.1	68.9	86.6	60.1	3.88	40	91.3	3.6	1.8
5	0940				401/402									
6	0940	J.R.	2877074	3296585	401/402						0	91.6		
7					401/402									
8	936	ROB	2877531	3296313	401/402	62	68	81	60	3.89	37	90.3	3.6	4.9
9					401/402									
10					401/402									
11	1110	J.R.	2877871	3299716	401/402	74.6	91.5	132.0	67.2	4.17	38	91.6	4.3	2.0
12	0830	J.R.	2878033	3300897	401/402	59.0	71.9	79.2	55.2	3.94	39	92.1	3.6	1.8
13	1435	J.R.	2878703	3301122	401/402	65.2	81.5	116.8	63.4	3.93	40	91.3	4.2	2.6
14					401/402									
15	1000	ROB	2881280	3301358	401/402	69	87	130	64	4.03	39	91.3	4.2	2.6
16					401/402									
17					401/402									
18	1110	J.R.	2883355	3302806	401/402	103	72	137.6	65.1	4.15	39	92.1	4.3	2.5
19	930	ROB	2883529	3303884	401/402	105	133	156	88	4.48	38	90.3	5.8	3.0
20					401/402									
21	1000	J.R.	2883873	3305766	401/402						0	91.4		
22	1220	J.R.	2885566	3305766	401/402						0	91.6		
23		ROB	2886330	3306601	401/402	101	134	153	86	4.46	39	91.3	3.8	3.0
24					401/402									
25	8:45	TF	2887945	3307056	401/402							91.4		
26	8:50	TF	2889188	3307728	401/402	105	74	138	67	4.14	39	91.8	4.3	2.5
27	11:00	2-5	2888435	3309176	401/402							91.4		
28	14:40	2-5	2888435	3310800	401/402							91.8		
29	7:00	2-5	2888680	3310800	401/402							91.7		
30	13:30	2-5	2888479	3312606	401/402							92		
31	1150	J.R.	2885929	3314306	401/402						0	91.2		
DECEMBER					401/402									

Appendix I – Environmental Operators Certification Program (EOCP)

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

According to the EOCP Primary disinfection can include chlorination and ultraviolet of 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