2017

City of Kamloops Drinking Water Annual Report

City of Kamloops

05/16/2018

Contents

Introduction

This report was prepared in compliance with the requirements under the British Columbia Drinking Water Protection Act (DWPA) and the City of Kamloops Operating Permit. Included in this document is an overview of the treatment and distribution system within the City, a summary of the total water consumption and water quality analysis within the system and a recap of projects and related operations. This report has been provided to Interior Health and posted on the City of Kamloops website for public reading.

Kamloops Water System

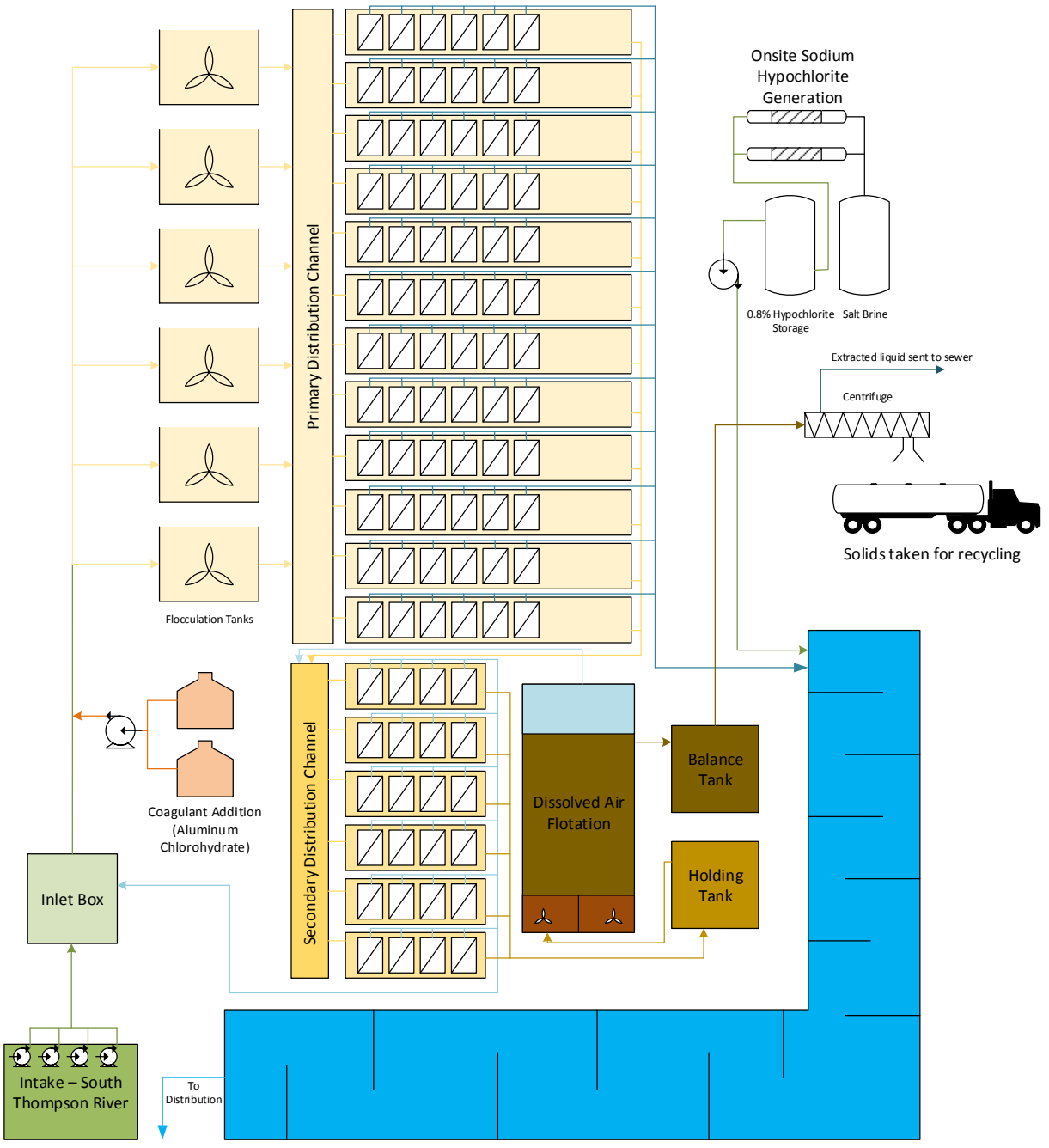
The City of Kamloops drinking water system consists of a single treatment plant that feeds and extensive distribution system that supplies water throughout all areas of the community. The only large community that is not fed from the central system is Rayleigh which has its own system supplied from the North Thompson River know as Rayleigh Waterworks District. The treatment plant, called the Kamloops Centre for Water Quality (KCWQ), is an ultra-filtration membrane treatment facility with chlorination of the finished water to ensure safety of the water throughout the distribution system. Both the water treatment and water distribution/storage systems are assessed and classified as Level IV systems through the Environmental Operators Certification Program (EOCP) and require highly qualified and certified operational staff.

Kamloops Centre for Water Quality (KCWQ)

The KCWQ treats water from the South Thompson River and supplies most of the Kamloops population. The facility uses the GE ZeeWeed 500d series of ultra-filtration membrane water treatment process capable of producing 160 MLD. Leaders in Environmental and Energy Design (LEED) certify the building as a gold standard green building along with the filtering process. Of the water taken into the facility, 99.99 % is produce and delivered as drinking water. The solids recovered through the filtering process are taken to and used as clean cover at the City's Owl Road Resource Recovery Centre.

A Layout of KCWQ and the accompanying processes are shown in Figure 1.

Figure 1: The Kamloops Centre for Water Quality Plant Processes



KCWQ Production Totals

There has been a decrease in water consumption over past 10 years which the can be directly linked to public education and the phasing in of water meters within the city. Figure 2, shows the monthly total water consumption over the past 10 years. While 2017 water consumption was higher than 2016 it was still the second lowest overall in the past 10 years.

Figure 2: Monthly Total Production for the Past 10 Years

Month	Total Production (m^3)										Year to Year Comparison		
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average	Minimum	Maximum
January	1,068,079	1,102,050	1,041,252	1,028,342	1,004,683	997,845	998,516	998,859	999,352	936,100	1,017,508	936,100	1,102,050
February	1,055,727	965,800	882,146	920,659	912,473	870,821	903,897	875,057	876,222	823,798	908,660	823,798	1,055,727
March	1,129,479	1,079,800	1,111,459	1,112,117	1,000,423	1,013,585	1,001,555	1,001,061	991,862	893,219	1,033,503	893,692	1,129,479
April	1,418,228	1,484,942	1,537,427	1,254,472	1,338,717	1,256,169	1,155,441	1,377,097	1,519,266	982,158	1,332,392	982,158	1,537,427
May	2,411,831	2,418,702	2,126,552	1,970,344	2,338,361	2,228,929	1,736,305	2,405,924	2,089,764	1,576,441	2,130,315	1,576,441	2,418,702
June	2,905,390	3,342,126	2,232,802	2,446,945	2,008,220	2,128,609	2,435,774	2,633,979	2,317,143	2,596,685	2,504,767	2,008,220	3,342,126
July	3,803,433	3,742,487	3,408,915	2,902,192	2,895,880	3,424,556	3,187,312	2,922,031	2,421,451	3,322,818	3,203,107	2,421,451	3,803,433
August	3,240,125	3,596,436	3,007,564	3,430,008	3,257,773	3,133,474	2,746,427	2,659,919	2,740,741	2,867,866	3,069,942	2,659,919	3,596,436
September	2,456,995	2,404,774	1,700,291	2,629,657	2,366,983	2,036,171	1,836,736	1,737,829	1,618,868	2,046,575	2,085,634	1,618,868	2,629,657
October	1,357,211	1,320,321	1,281,721	1,301,444	1,383,194	1,254,593	1,237,151	1,147,270	1,096,279	1,128,010	1,250,719	1,096,279	1,383,194
November	1,107,158	1,056,127	1,031,241	991,751	999,703	1,114,296	996,238	976,284	958,048	899,987	1,013,083	899,987	1,114,296
December	502,407	1,049,221	1,037,506	1,003,279	1,011,471	1,005,151	1,006,889	989,458	978,535	919,666	950,358	502,407	1,049,221
Total	22,456,063	23,562,785	20,398,876	20,991,210	20,517,881	20,464,199	19,242,241	19,724,769	18,607,531	18,993,324	20,499,990	18,607,531	23,562,785
Daily Peak	140,499	143,509	132,697	127,032	117,905	124,608	121,608	106,999	99,564	117,078	123,150	99,564	143,509
Peak Date	30-Jun	30-Jul	29-Jul	06-Jul	08-Aug	25-Jul	16-Jul	28-Jun	19-Aug	03-Jul			
Daily Low	28,682	20,180	20,379	29,180	29,794	29,094	28,771	28,603	29,330	15,394	25,941	15,394	29,794

These monthly numbers can be graphically seen in Figure 3. Total consumption for 2017 was still 1.5 billion liters less than the 10-year average and the peak daily demand was still under this 10-year average.

Figure 3: Graphical Representation of the KCWQ 10 Year Monthly Water Consumption

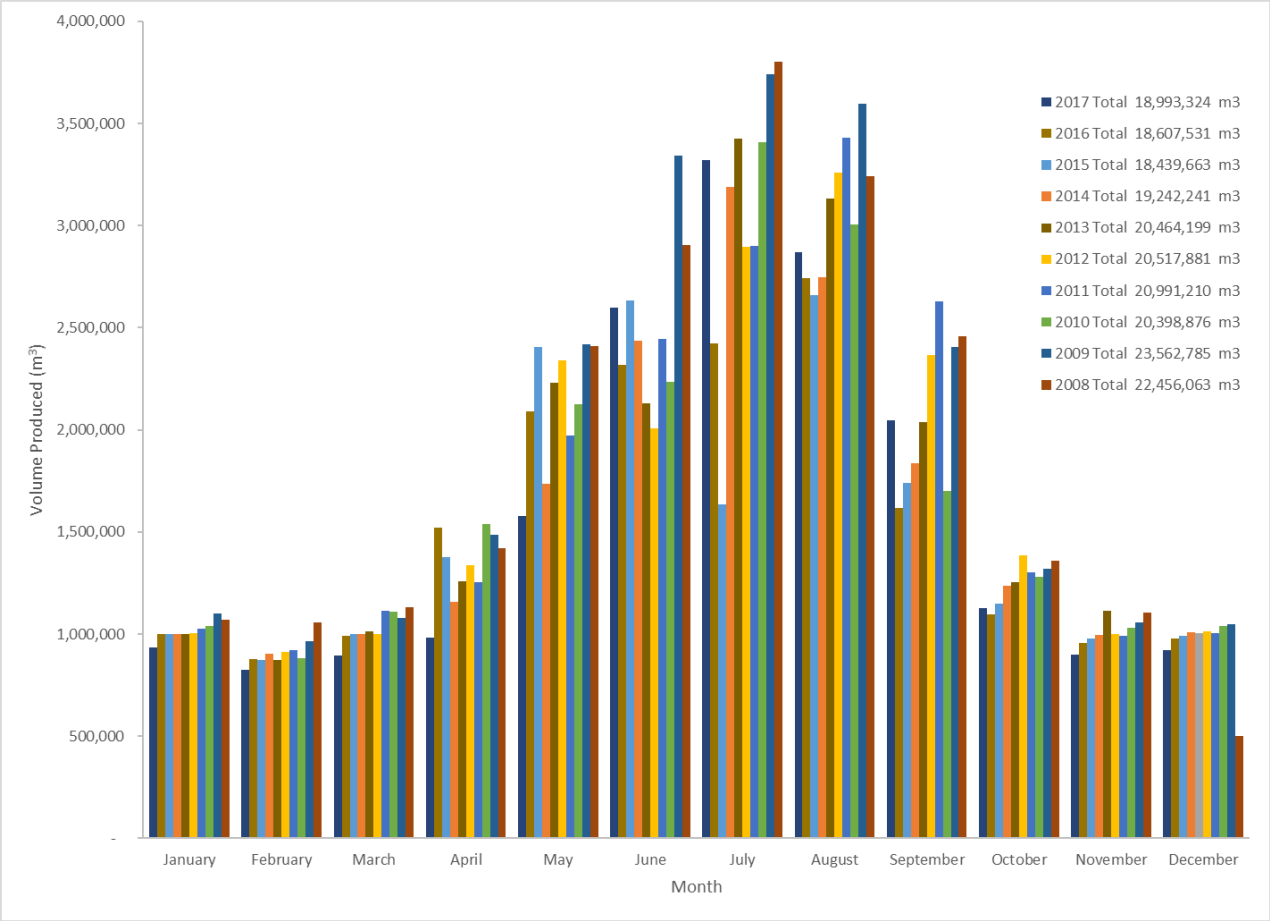
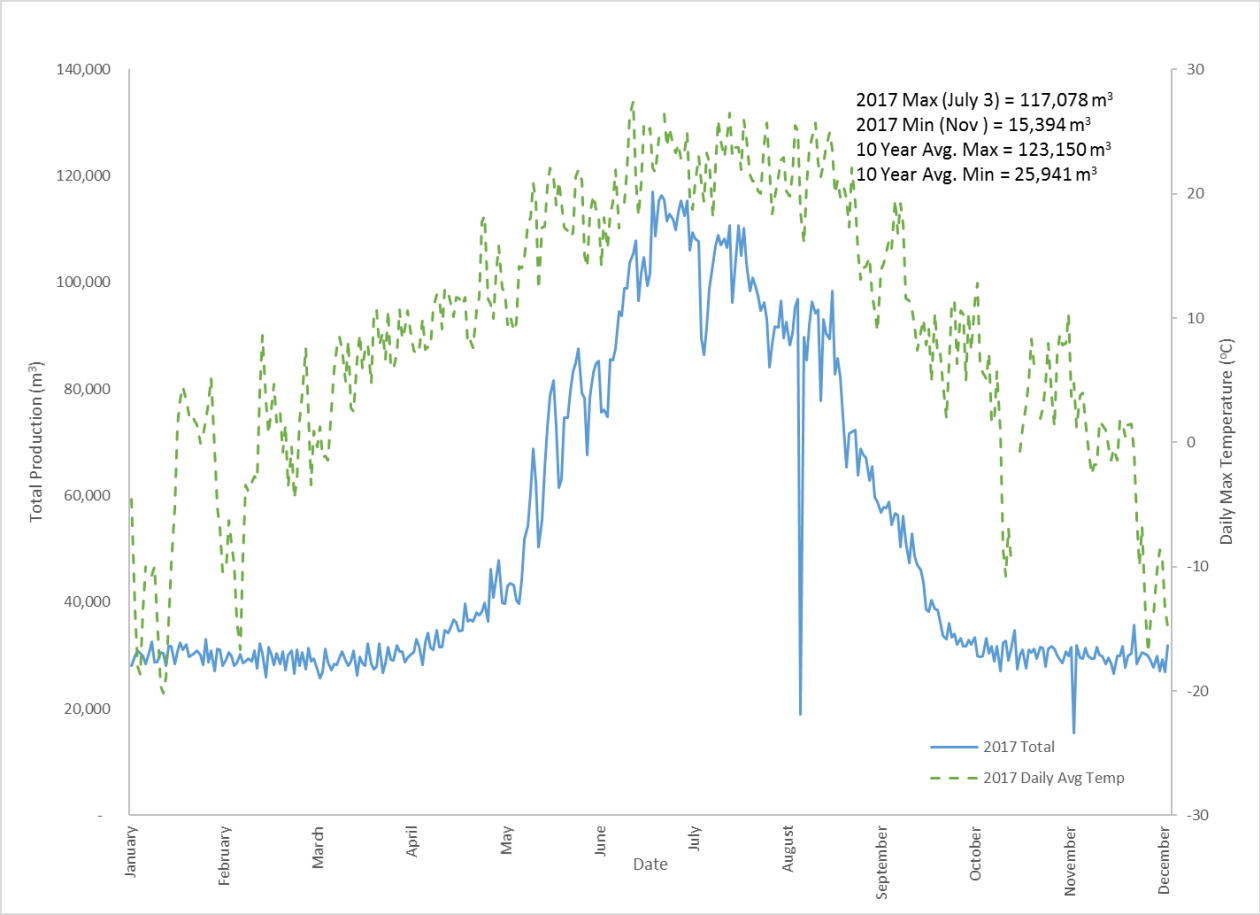


Figure 4 shows the daily water consumption for 2017 with an overlay of the maximum daily temperature. The daily peak for 2017 was 117.1 million litres, which occurred on July 3rd, and is the lowest summer max peak since the facility was commissioned in 2005. The KCWQ can achieve a maximum daily flow of 160

million liters which allows room for population growth well into the future. The large drops in production as noticed in both August and November were due to upgrades within the facility which will be outlined later in this report.

Figure 4: KCWQ Daily Water Flows for 2017 With Daily Average Temperature Overlay



Water Conservation

The universal water meter program was completed in late 2016 providing our first year of fully captured single-family residential usage data in 2017. The beneficial results of the metering program are clearly evident in the production total discussed previously. Irrigation demands continue to be the largest factor in our water demands. Methods to address this challenge are be considered as the next phase of water conservation.

Distribution System Overview

The distribution system consists of over 625 km of water mains, 45 booster stations, 46 reservoirs, 2350 fire hydrants and a total of 24,866 connections. The City also maintains a trucked in water system which feeds potable water to a sports recreation area called the Tournament Capital Ranch (TCR). In the following pages we will give an outline of the distribution system along with summaries of projects and events within the 2017 calendar year.

Booster Stations and Reservoirs

In 2017, Utility's Services Operations Division staff working with Advanced Diving and completed the cleaning of the 1786 Arrowstone Reservoir as part of ongoing rehabilitation program. The water line from the River Street Intake to the Kamloops Center for Water Quality was inspected and found to be in good condition using a remotely operated underwater vehicle (ROV) on October 4, 2017. Increased security at all reservoirs and booster stations was completed including upgraded fencing in some locations.

Distribution System

The distribution system is very extensive and one of the most challenging systems in Canada due to the unique topography of Kamloops. The distribution system the material transporting the water being quite varied as can be seen in Figure 5. The maintenance of this distribution system consists of actively replacing lines that have either reached the end of their functional life, need upgrading due to inadequate sizing for development, or are in poor condition and cause issues.

Figure 5: Water Main Material Summary

Material	Length (km)	% of Total Pipe	% Change from Last Year
AC - Asbestos Cement	179	28.63	-0.31
CI - Cast Iron	36.405	5.82	-1.62
CU - Copper	0.87	0.14	-6.32
DI - Ductile Iron	102.971	16.47	0.46
GI - Galvanized Iron	0.276	0.04	0.00
HYP - High Pressure Concrete	17.492	2.80	0.00
PLY - Polyethylene	1.433	0.23	-7.26
PVC - Polyvinyl Chloride	276.093	44.15	1.19
STL - Steel	10.784	1.72	0.32
Total	625.324	100	

Priorities in the distribution replacement schedule are made on lines that contain ductile iron. These pipes cause the most issues and are scheduled for replacement before any other material type. Increases in any category besides PVC are due to updates in the GIS on previously unidentified or improperly tagged lines; this does not reflect the addition of newly installed lines of that type.

Source Protection

In 2014 a source protection plan for the City of Kamloops was developed. This plan includes recommendations to help mitigate risks to the water source within an area of direct impact to the South Thompson River intake and the now approved North Thompson River emergency intake (details on the North Thompson Emergency Intake project are provided in another section.) Included in this document were Risk Management Actions including the building of a secondary water intake on the North Thompson. Assessments of the recommendations continue.

Cross Connection Program

The City's Cross Connection Control Plan (CCCP) has focused on premise isolation for industrial, commercial, and institutional (ICI) properties. A review of the programs in similar sized communities indicates that they have also focused on premise isolation for the same group of customers to begin the program.

To date, the City's CCCP has mainly been focused on new ICI installations when new development and buildings are added to the system. If cross connection control is required, it is made a condition of the building permit or development permit. A "Backflow Prevention Assembly Testing Report" submitted to Civic Operations and Utilities indicating that the cross connection control device works satisfactorily is required before occupancy of the property is granted.

Monitoring requirements include annual testing by a certified cross connection control device tester. Should the test fail; repairs and recertification or replacement will be required to maintain the safety of the City's water distribution system. The City currently monitors all inventory of roughly 1,300 cross connection control devices (premise isolation and internal protection). We continue to assess ICI properties for cross connection control risks and to determine if control devices are required.

2017 Highlights, Projects and Service Request Summaries

The capital plan for the water utility included over $14 million in projects from a variety of funding sources including water levies, grant money and development cost charges. Our commitment to asset management drives the capital plan as we attempt to replace our aging assets before they fail.

KCWQ Highlights, Projects and Challenges

Utility Services performed major upgrades to the electrical system at KCWQ after a critical power interruption in March of 2017. One of the major power lines feeding the treatment plant had a critical short (Figure 6) and left the process equipment without power. While the process was able to be restarted using a secondary power source, the incident highlighted the need for upgrades to the power and process systems which would prevent similar problems in the future.

Figure 6: The faulty power line to the KCWQ

SCADA – Software, Hardware and Modernized Controls Upgrade.

These major upgrades included the replacement of the old Programmable Logic Controllers (PLCs), which are the brains for the treatment process. With the upgrade, parts of the treatment plant which are separate entities is now being brought into the overall control system. Better surge protection and more backup

systems were also added to the PLCs to help buffer the system if any major power event happens in the future. During the upgrades of this system the process had to be taken out of production a couple of times. This is evident in the very low production number seen in the previous Figure 4 at the end of August and again in November. While the plant was down, there was no interruption to the residents of Kamloops as the distribution system had enough water to bridge these outages.

In addition to the PLC upgrades there were already planned capital upgrades to the Supervisory Control and Data Acquisition (SCADA) at the plant both in 2018 and 2019. This is the interface which allows the operators to control the plant. The upgrades brought the old programming up to date along with the hardware that runs it. These critical changes are a step towards keeping the control systems of the facility healthy and at today's standards.

Distribution Highlights

Booster Stations and Reservoirs:
Upgraded electrical and PLC's at Juniper #3 and 2965 booster stations.

Capital Road Projects:
Grasslands
Replaced 275m of AC water main with 200mm PVC water main including all new service connections and associated valves. Added approximately 60m of 150mm PVC, 70m of 200mm PVC and 350m of 250mm PVC water main including all new service connections and associated valves.

Fleetwood
Replaced AC water main with approximately 6m of 300mm and 65m of 100mm PVC water main including all new service connections and associated valves.

Local Road Projects:
Jasper Avenue
Replaced 12m of AC water main with 150mm PVC, 20, 200mm PVC and 5m 300mm PVC including 6m of hydrant lead. Included were the replacement of 3 residential water services and 1 City park water service to an irrigation box.

Comox Ave
Replaced 47m of AC water main with 150mm PVC water main, 5m of hydrant leads and all associated valves. Included were the replacement of 14 residential water services.

Oak Road
Replaced 8m of AC water main with 150mm PVC, 2m of Hydrant lead and 1 new water service.

The North Thompson Emergency Intake

Construction of the NTEI commenced in the fall of 2016 with Acres Construction awarded the contract. Upon completion, this intake will provide the City of Kamloops with a second source of water in the event of contamination in the South Thompson River.

The construction of the wedge shaped intake structure in the North Thompson River was completed in mid-April 2017. Work has continued throughout the year on the High Lift Pump Station building as well as the water main piping and tie in to the existing 600mm transmission main on Westsyde Rd. Construction of the project is scheduled for completion in April of 2018 with testing and commissioning anticipated to start shortly after that date.

Requests for Service

There were a total of 1,771 requests for service filed in the 2017 calendar year with the public works department related to water distribution and treatment. Figure 7 is a breakdown of the categories to which each of the requests is related.

Figure 7: Service Requests in Water Treatment and Distribution

Request Categories Related to Utilities/ Water	Number of Requests	
	2017	2016
Booster Stations	5	17
Cross Connection Control	28	19
Frozen Services	17	4
General	82	87
Hydrants	66	72
Irrigation On/Off	34	33
No Water	104	77
Reservoirs	6	3
Service Boxes	120	102
Service Location	122	138
Turn Service On/Off	654	592
Water Filling Station	30	61
Water Leak	334	321
Water Pressure	76	83
Water Quality	89	66
Water Restrictions	4	3
Totals	1,771	1,678

Water Quality Sampling and Analysis

The water quality from our source water, at the treatment facility and within the distribution system is analyzed extensively. Samples are collected nightly and analyzed at the KCWQ from the raw water, treated water at the plant and from within the distribution system. Bacteriological samples are also analyzed throughout the distribution system on a weekly basis. Also samples of our source water and one from within the distribution system are taken quarterly and sent off to an accredited lab for extensive analysis.

KCWQ Water Quality Testing

There are a variety of parameters measured which are listed in the following paragraphs which are monitored at the plant in order to check the treatment process. There are also following Figures 8, 9 and 10 that summarise the results of the nightly analysis for the KCWQ. These analyses are done in house by the certified operators at the KCWQ.

True and Apparent Colour

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

pH

pH is a measure of the activity of the hydrogen ion in water. It represents the acidity or basicity of water. The pH scale goes from 0 to 14 with anything smaller than 7 being acidic, anything greater than 7 being basic and 7 being neutral. Drinking water is regulated to fall between a pH of 6.5 to 8.5. In Kamloops we would want to be a little on the higher side of that range in order to protect our pipes against corrosion.

Hardness

Hardness is primarily made up of dissolved calcium and magnesium in water. These compounds are not at all harmful to health and you do actually need them in your diet. However, when they are at high levels they may cause ‘soap scum’ when reacting with soaps, require more soap or detergent when cleaning things and clog pipes and hot water tanks. Hardness is broken down into the following general categories: 0 to 60 mg/L as $CaCO_3$ is considered soft, 61 to 120 mg/L is considered moderate, 121 to 180 is considered hard and anything over 180 mg/L is considered very hard.

Alkalinity

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

Conductivity and Total Dissolved Solids (TDS)

Conductivity and TDS go hand in hand as the probe that measures conductivity in water will give an estimate of the TDS. Conductivity is a measure of how well a water sample conducts electricity. Water is

actually an insulator and in order to conduct electricity is needs dissolved ions. So waters ability to conduct electricity is directly related to the amount of dissolved solids within the water. In water treatment we use this monitor any changes in water quality as it is a fairly quick test.

Total Suspended Solids (TSS)

TSS is a measure of all the colloidal material in water. Measuring this on our raw water gives an indication of the amount of solids that will be removed in our process. The higher the TSS the 'dirtier' the water is. There is no guideline limit on this as there is another related test called turbidity which is a quicker test in which a guideline is applied.

Turbidity

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

Aluminum

Aluminum in our water is of interest as we use an aluminum based coagulant to help in the treatment process. By monitoring the amount of aluminum in our raw and treated water we ensure that our coagulant is not being overdosed and entering our drinking water at elevated levels. The CDWG have an operational guideline for water treatment plants set at 0.1 mg/L.

Free and Total Chlorine (Cl_2)

Chlorine levels are important in water treatment to ensure that water is safe all the way through the distribution system to each home. The primary form of chlorine used in our treatment system is sodium hypochlorite. Free chlorine measures the amount of hypochlorite in our water, while total chlorine measures the free chlorine plus any combined chlorine disinfectants such as chloramines. In our system we must maintain a residual free chlorine level of greater than 0.2 mg/L at the end of the distribution system.

Figure 8: KCWQ Average Monthly Raw Water Analysis

Month	True Colour (PtCo Units)	Apparent Colour (PtCo Units	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as $CaCO_3$)	TDS (mg/L)	Conductivity (µs/cm)	TSS (mg/L)	Turbidity (NTU)	Aluminium (mg/L)	Temp (^{o}C)
January	4.0	10.4	7.8	40.1	39.7	41.2	78.3	2.1	1.6	ND	2.1
February	2.0	20.6	7.7	41.9	40.4	41.4	79.1	5.9	3.7	ND	2.5
March	7.5	19.4	7.8	42.7	41.8	45.7	86.7	6.8	3.5	ND	5.6
April	6.4	22.9	7.8	45.3	44.1	47.4	89.3	6.6	4.1	ND	8.1
May	8.8	101.7	7.8	44.0	43.6	45.5	85.6	30.4	16.0	0.0	10.5
June	5.4	24.4	7.7	38.6	38.5	41.1	74.9	8.8	4.5	ND	13.4
July	6.2	25.8	8.0	38.0	37.6	39.5	75.1	8.0	4.3	0.0	17.6
August	5.9	16.2	7.9	36.8	36.2	38.7	75.5	3.1	2.7	0.0	20.3
September	5.8	16.1	7.9	37.7	33.5	41.5	79.0	3.8	2.5	ND	18.6
October	5.0	12.4	7.9	39.9	38.1	43.1	81.9	1.9	2.0	ND	12.1
November	5.2	14.2	7.8	40.5	39.8	42.3	80.6	1.9	2.1	ND	6.5
December	5.0	14.1	7.8	41.2	40.1	42.7	81.3	2.6	2.0	ND	3.7
Min	2	10	7.71	37	34	38.7	74.9	1.9	1.61	ND	2.1
Max	9	102	7.95	45	44	47.4	89.3	30.4	15.98	ND	20.3
Average	6	25	7.81	41	39	42.5	80.6	6.8	4.09	ND	10.1

Figure 9: KCWQ Average Monthly Treated Water Analysis

Month	True Colour (PtCo Units)	Apparent Colour (PtCo Units	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as $CaCO_3$)	TDS (mg/L)	Conductivity (µs/cm)	Turbidity (NTU)	Aluminium (mg/L)	Temp (^oC)	Free Cl (mg/L)	Total Cl (mg/L)
January	ND	ND	7.7	38.0	38.0	43.3	82.2	0.011	ND	4.0	1.2	1.3
February	ND	ND	7.7	40.0	40.0	45.7	86.8	0.010	ND	4.3	1.2	1.2
March	ND	ND	7.7	42.0	40.0	47.2	89.6	0.010	ND	5.0	1.2	1.2
April	ND	ND	7.7	42.0	42.0	49.4	95.7	0.010	ND	7.5	1.1	1.2
May	ND	ND	7.7	40.0	40.0	47.1	89.3	0.011	ND	10.2	1.1	1.2
June	ND	ND	7.5	38.0	38.0	44.5	84.5	0.012	ND	12.2	1.3	1.3
July	ND	ND	7.9	36.0	35.0	44.6	74.9	0.011	ND	16.5	1.2	1.3
August	ND	ND	0.0	8.1	35.0	4.8	41.6	0.011	ND	0.5	0.6	1.3
September	ND	ND	7.9	36.0	0.0	43.6	59.5	0.011	ND	17.0	1.1	1.2
October	ND	ND	7.8	38.0	0.0	46.8	88.9	0.011	ND	11.0	1.1	1.2
November	ND	ND	7.7	40.0	38.0	45.8	82.7	0.010	ND	7.3	1.2	1.2
December	ND	ND	7.4	39.0	39.0	46.4	88.0	0.011	ND	3.2	1.2	1.3
Min	ND	ND	0.00	8.1	0.0	4.8	41.6	0.010	ND	0.5	0.57	1.16
Max	ND	ND	7.90	42.0	42.0	49.4	95.7	0.012	ND	17.0	1.27	1.31
Average	ND	ND	7.04	36.4	32.1	42.4	80.3	0.011	ND	8.2	1.11	1.24

*ND refers to Non-Detectable Limit

Figure 10: KCWQ Average Monthly Distribution Water Analysis

Month	True Colour (PtCo Units)	Apparent Colour (PtCo Units	pH	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as $CaCO_3$)	TDS (mg/L)	Conductivity (µs/cm)	Turbidity (NTU)	Free Cl2 (mg/L)	Total Cl2 (mg/L)	Temp (^oC)
January	ND	ND	7.9	40.5	40.1	48.7	92.3	0.1	1.1	0.9	7.6
February	ND	ND	7.9	42.0	41.1	50.2	94.7	0.1	0.9	0.9	6.0
March	ND	ND	7.9	43.0	42.4	53.4	101.0	0.1	0.8	0.9	7.5
April	ND	ND	7.9	44.9	44.0	54.5	103.2	0.1	0.8	13.4	9.9
May	ND	ND	7.9	44.7	44.3	53.9	101.9	0.2	0.7	0.8	10.5
June	ND	ND	7.8	39.5	39.3	45.5	86.4	0.2	0.9	0.9	13.1
July	ND	ND	8.0	38.5	38.1	44.2	84.0	0.2	0.8	0.8	14.7
August	ND	ND	7.5	37.0	36.5	43.2	82.1	0.1	0.7	0.8	18.8
September	ND	ND	8.1	38.2	35.4	45.8	87.2	0.1	0.6	0.7	18.1
October	ND	ND	8.0	40.2	38.8	48.6	92.1	0.1	0.5	0.6	14.3
November	ND	ND	8.0	40.8	39.8	50.1	95.2	0.1	0.5	0.5	10.7
December	ND	ND	7.9	41.7	40.5	51.4	97.1	0.2	0.8	0.9	9.4
Min	ND	ND	7.52	37	35	43.2	82.1	0.09	0.47	0.55	6.0
Max	ND	ND	8.05	45	44	54.5	103.2	0.23	1.05	13.39	18.8
Average	ND	ND	7.89	41	40	49.1	93.1	0.13	0.75	1.86	11.7

*ND refers to Non-Detectable Limit

Distribution Sampling

The City of Kamloops is committed to providing safe drinking water to each and every connection within its service area. To this end the distribution system is sampled at over 23 different locations weekly and by the end of the year 24 locations as the Tournament Capital Ranch was included. These samples are analyzed for background bacterial counts, total coliforms and E. Coli.

Background Bacterial Monitoring

Background bacteria monitoring is done through what is called a heterotrophic plate count (HPC). Heterotrophic bacteria are a group of bacteria that use carbon as a food source and can be found in a variety of water sources. Most bacteria found in water are actually heterotrophic. In general, these bacteria are not pathogenic and the HPC test in itself will not tell you whether the water is bad to drink. Because of this there is no maximum acceptable concentration (MAC) as stated in the Canadian Drinking Water Guidelines. What this test does tell you is whether there are conditions within the system that bacteria can regrow or thrive in.

The City of Kamloops uses this test to monitor integrity and overall 'health' of the distribution system. If a sample is positive for background bacteria greater than 200 counts the system is flushed and resampled. Any positive counts of any size for background bacteria are also resampled immediately which is above and beyond any legislative requirements.

Coliform Bacterial Monitoring

Coliform bacteria are a group of bacteria that is a little more of a narrow focus from the HPC test. These bacteria again represent a large group of bacteria found in water, soil, on vegetation and in the feces of mammals. Most of these bacteria are not harmful to humans, but because of the ease of testing of this bacteria it makes for a great indicator of contamination.

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

E. Coli Bacterial Monitoring

E. Coli bacteria are a sub section of coliform bacteria. Again these bacteria may not be harmful to human health, but specific strains can cause serious health issues and even death in some instances. These bacteria are also found almost exclusively in warm blooded feces and therefore a definite sign of contamination. Any positive counts for coliforms or E.coli result in an immediate boil water advisory, resampling and cleaning of the affected area. The results for the 2016 distribution system can be seen in Figure 11.

Figure 11: 2016 Distribution System Biological Sampling

Date	Number of Samples Taken	Samples Positive for Background Bacteria	Samples Positive for Coliforms	Samples Positive for E. Coli	Notes/ Measures Taken
03/01/2017	23				
09/01/2017	23				
16/01/2017	23				
23/01/2017	23				
30/01/2017	23				
06/02/2017	23				
13/02/2017	23				
20/02/2017	23				
27/02/2017	23				
06/03/2017	23				
13/03/2017	23				
20/03/2017	20	3			Background counts of 2, 1 and 1 found in 3 samples
27/03/2017	25				Resamples of backgrounds all negative
31/03/2017	1				TCR Sample started
03/04/2017	24				
10/04/2017	24				
17/04/2017	24				
24/04/2017	24				
01/05/2017	24				
08/05/2017	24				
15/05/2017	24	1			
22/05/2017	24		1		Coliform count of 3, water from a non-potable location, IHA not concerned
29/05/2017	24				
05/06/2017	24				
12/06/2017	24				
19/06/2017	24				
26/06/2017	24				
03/07/2017	24				
10/07/2017	24				
17/07/2017	24				
24/07/2017	24				
31/07/2017	24				
07/08/2017	24				
14/08/2017	24				
21/08/2017	24				
28/08/2017	23	1	1		Background counts of 7300, Coliforms counts of 2, sample taken from Cinnamon Ridge Effluent Disposal (CREDs). Spray Irrigation, not potable
04/09/2017	26				Resample from CREDs negative
11/09/2017	22	2			Background counts of 35 and 64 in 2 samples
18/09/2017	25				Resamples of backgrounds all negative
25/09/2017	22	2			Background counts of 3 and 1 in 2 samples
02/10/2017	25				Resamples of backgrounds all negative
09/10/2017	23				
16/10/2017	23				
23/10/2017	23				
30/10/2017	23				
06/11/2017	23				
13/11/2017	23				
20/11/2017	23				
27/11/2017	23				
04/12/2017	23				
11/12/2017	23				
18/12/2017	23				
25/12/2017					
Totals	1199	9	2	0	

There were a total of 9 positive results for background bacteria and 2 positive for coliforms in 2017. After resampling the background bacteria positive samples, all results came back negative. One coliform sample was taken from a location where the water was deemed non-potable. Interior health was notified and they did not deem it of concern. The other positive coliform sample was taken from a spray irrigation site where the source water is actually treated wastewater effluent and not from our primary drinking water distribution network.

Quarterly Raw and Distribution Sampling

The following are extensive water quality analysis results as completed by a provincially accredited lab from the source water and within the distribution system. In 2017 there was a total of 3 sampling periods. The samples were taken by City staff and sent off to CARO analytical services in Kelowna, BC. The results of these extensive analysis can be seen in Tables 12 through 19. An additional pesticide was added to the watch list in 2017. Glyphosate which is found in products such as "Round-up" was analyzed twice in that calendar year, both times it was not found in detectable levels. As seen in the tables all of the treated water quality parameters are within the Guidelines for Canadian Drinking Water Quality.

Figure 12: CARO Anions Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Bromide	mg/L	0.1	N/A	0	<0.10	0	<0.10	0	<0.10
Chloride	mg/L	0.1	AO<=250	4.58	0.88	3.96	0.68	4.35	0.75
Fluoride	mg/L	0.1	MAC=1.5	<0.10		<0.10		<0.10	
Nitrate as N	mg/L	0.01	MAC=10	0.077	0.072	0.07	0.043	0.022	0.02
Nitrite as N	mg/L	0.01	MAC=1	0.023	<0.010	<0.010	<0.010	<0.010	<0.010
Phosphate, Ortho as P	mg/L	0.01	N/A	<0.010		<0.010		<0.010	
Sulfate	mg/L	1	AO<=500	8.4	8.4	5.1	5	7.3	7.3
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective						

Figure 13: CARO General Parameters Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Colour, True	CU	5	AO<=15	<5	<5	<5.0	<5.0	<5.0	<5.0
Alkalinity, Total (as CaCO3)	mg/L	2	N/A	42	41	37	38.6	45.1	42.6
Alkalinity, Phenolphthalein (as CaCO3)	mg/L	2	N/A	<1	<1	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as CaCO3)	mg/L	2	N/A	42	41	37	38.6	45.1	42.6
Alkalinity, Carbonate (as CaCO3)	mg/L	2	N/A	<1	<1	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	2	N/A	<1	<1	<1.0	<1.0	<1.0	<1.0
Ammonia, Total (as N)	mg/L	0.02	N/A	0.032		<0.020		<0.020	
BOD, 5-day	mg/L	2	N/A	<7		<7.1		<7.3	
Carbon, Total Organic	mg/L	0.5	N/A	2.2	2.2	1.99	1.61	2.57	3.02
Carbon, Dissolved Organic	mg/L	0.5	N/A	2.1		1.92		2.25	
Cyanide, Total	mg/L	0.002	MAC=0.2		<0.0020		<0.0020		<0.0020
Nitrogen, Total Kjeldahl	mg/L	0.05	N/A	0.1	<0.05	0.109	<0.050	0.104	0.065
Oil & Grease, Total	mg/L	2	N/A		<2		<2.0		<2.0
Phenolics, Total	mg/L	0.002	N/A		<0.002		<0.0020		0.0026
Solids, Total Dissolved	mg/L	10	AO<=500	74	76	41	34	62	76
Sulfide, Total	mg/L	0.05	AO<=0.05		<0.05		<0.050		<0.020
Turbidity	NTU	0.1	OG<0.1	2.5	<0.10	2.45	<0.10	3.35	<0.10
Conductivity (EC)	uS/cm	2	N/A	102	118	88.1	100	95.3	105
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective						

Figure 14: CARO Calculated Parameters

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Hardness, Total (Total as CaCO3)	mg/L	0.5	N/A	44.5	43.1	41.3	43.2	39.9	39.1
Nitrate+Nitrite as N	mg/L	0.02	N/A	0.0722	0.0998	0.0426	0.0695	0.0201	0.0219
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective						

Figure 15: CARO Dissolved Metals Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Aluminum, dissolved	mg/L	0.005	N/A	<0.005	<0.005	0.0566	0.0092	0.0061	0.0126
Antimony, dissolved	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00020	<0.00020
Arsenic, dissolved	mg/L	0.0005	N/A	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Barium, dissolved	mg/L	0.005	N/A	0.011	0.01	0.0102	0.0106	0.0105	0.0102
Beryllium, dissolved	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth, dissolved	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Boron, dissolved	mg/L	0.004	N/A	<0.004	<0.004	<0.0040	0.0046	0.0083	0.0101
Cadmium, dissolved	mg/L	0.00001	N/A	<0.00001	<0.00001	<0.000010	<0.000010	<0.000010	<0.000010
Calcium, dissolved	mg/L	0.2	N/A	13.4	13.3	13	13.9	12.2	12
Chromium, dissolved	mg/L	0.0005	N/A	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt, dissolved	mg/L	0.00005	N/A	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00010
Copper, dissolved	mg/L	0.0002	N/A	0.0008	0.0011	0.00052	0.00237	0.00064	0.00485
Iron, dissolved	mg/L	0.01	N/A	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead, dissolved	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00020	<0.00020
Lithium, dissolved	mg/L	0.0001	N/A	0.0007	0.0007	0.00071	0.00073	0.00072	0.00071
Magnesium, dissolved	mg/L	0.01	N/A	2.64	2.41	2.12	2.07	2.27	2.21
Manganese, dissolved	mg/L	0.0002	N/A	0.0026	0.0008	0.0004	0.00022	<0.00020	0.00546
Mercury, dissolved	mg/L	0.00001	N/A					<0.000010	
Molybdenum, dissolved	mg/L	0.0001	N/A	0.0007	0.0007	0.00058	0.00054	0.00066	0.00067
Nickel, dissolved	mg/L	0.0002	N/A	0.0003	0.0002	0.00027	0.0002	<0.00040	<0.00040
Phosphorus, dissolved	mg/L	0.02	N/A	<0.02	<0.02	<0.050	<0.050	<0.050	<0.050
Potassium, dissolved	mg/L	0.02	N/A	0.95	0.92	0.85	0.85	0.91	0.88
Selenium, dissolved	mg/L	0.0005	N/A	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Silicon, dissolved	mg/L	0.5	N/A	3.5	3.3	3.4	3.4	2.9	2.9
Silver, dissolved	mg/L	0.00005	N/A	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, dissolved	mg/L	0.02	N/A	2.32	4.45	1.58	3.89	1.87	4.53
Strontium, dissolved	mg/L	0.001	N/A	0.087	0.083	0.0786	0.0805	0.0789	0.076
Sulfur, dissolved	mg/L	1	N/A	2	2	<3.0	<3.0	<3.0	<3.0
Tellurium, dissolved	mg/L	0.0002	N/A	<0.0002	<0.0002	<0.00020	<0.00020	<0.00050	<0.00050
Thallium, dissolved	mg/L	0.00002	N/A	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Thorium, dissolved	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Tin, dissolved	mg/L	0.0002	N/A	<0.0002	<0.0002	0.00032	<0.00020	0.00027	<0.00020
Titanium, dissolved	mg/L	0.005	N/A	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050
Tungsten, dissolved	mg/L	0.001	N/A					<0.0010	<0.0010
Uranium, dissolved	mg/L	0.00002	N/A	0.0004	0.00006	0.000259	0.000058	0.000258	0.00018
Vanadium, dissolved	mg/L	0.001	N/A	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010
Zinc, dissolved	mg/L	0.004	N/A	<0.004	<0.004	<0.0040	<0.0040	<0.0040	0.0065
Zirconium, dissolved	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Mercury, dissolved	ug/L	0.005	N/A	<0.005	<0.005	<0.0050	<0.0050		<0.0050
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective						

Figure 16: CARO Total Recoverable Metals Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Aluminum, total	mg/L	0.005	OG<0.1	0.068	0.006	0.122	0.0113	0.551	0.0142
Antimony, total	mg/L	0.0001	MAC=0.006	<0.0001	<0.0001	<0.00010	<0.00010	<0.00020	<0.00020
Arsenic, total	mg/L	0.0005	MAC=0.01	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Barium, total	mg/L	0.005	MAC=1	0.011	0.01	0.0116	0.011	0.0198	0.0105
Beryllium, total	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth, total	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Boron, total	mg/L	0.004	MAC=5	<0.004	0.004	<0.0040	<0.0040	0.008	0.0099
Cadmium, total	mg/L	0.00001	MAC=0.005	<0.00001	<0.00001	<0.000010	<0.000010	0.000018	<0.000010
Calcium, total	mg/L	0.2	N/A	14.2	14.1	12.8	13.5	13.7	12.9
Chromium, total	mg/L	0.0005	MAC=0.05	0.0006	<0.0005	0.00144	<0.00050	0.00139	<0.00050
Cobalt, total	mg/L	0.00005	N/A	0.00009	<0.00005	0.00016	<0.00010	0.00066	<0.00010
Copper, total	mg/L	0.0002	AO<=1	0.0017	0.0015	0.00095	0.00325	0.00223	0.00513
Iron, total	mg/L	0.01	AO<=0.3	0.13	<0.01	0.227	0.01	0.944	<0.010
Lead, total	mg/L	0.0001	MAC=0.01	0.0003	<0.0001	0.00018	0.00015	0.00043	0.00026
Lithium, total	mg/L	0.0001	N/A	0.0009	0.0008	0.00078	0.00072	0.00122	0.00078
Magnesium, total	mg/L	0.01	N/A	2.75	2.48	2.14	2.11	2.94	2.37
Manganese, total	mg/L	0.0002	AO<=0.05	0.0071	0.0015	0.00854	0.00085	0.0348	0.00628
Molybdenum, total	mg/L	0.0001	N/A	0.0007	0.0007	0.00063	0.00057	0.00059	0.00071
Nickel, total	mg/L	0.0002	N/A	0.0004	<0.0002	0.00072	0.00029	0.00216	<0.00040
Phosphorus, total	mg/L	0.02	N/A	<0.02	<0.02	<0.050	<0.050	0.072	<0.050
Potassium, total	mg/L	0.02	N/A	0.97	0.93	0.83	0.85	1.1	0.95
Selenium, total	mg/L	0.0005	MAC=0.05	<0.0005	<0.0005	<0.00050	<0.00050	<0.00050	<0.00050
Silicon, total	mg/L	0.5	N/A	3.4	3	3.2	3.2	4.2	3.1
Silver, total	mg/L	0.00005	N/A	<0.00005	<0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Sodium, total	mg/L	0.02	AO<=200	2.43	4.79	1.56	3.98	2.22	5.03
Strontium, total	mg/L	0.001	N/A	0.088	0.084	0.075	0.0789	0.0906	0.0815
Sulfur, total	mg/L	1	N/A	1	1	<3.0	<3.0	<3.0	<3.0
Tellurium, total	mg/L	0.0002	N/A	<0.0002	<0.0002	<0.00020	<0.00020	<0.00050	<0.00050
Thallium, total	mg/L	0.00002	N/A	<0.00002	<0.00002	<0.000020	<0.000020	<0.000020	<0.000020
Thorium, total	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Tin, total	mg/L	0.0002	N/A	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Titanium, total	mg/L	0.005	N/A	<0.005	<0.005	0.0062	<0.0050	0.0269	<0.0050
Tungsten, total	mg/L	0.001	N/A					<0.0010	<0.0010
Uranium, total	mg/L	0.00002	MAC=0.02	0.0004	0.00006	0.000295	0.000055	0.000352	0.000187
Vanadium, total	mg/L	0.001	N/A	<0.001	<0.001	<0.0010	<0.0010	0.0017	<0.0010
Zinc, total	mg/L	0.004	AO<=5	<0.004	<0.004	<0.0040	0.004	0.0049	0.0074
Zirconium, total	mg/L	0.0001	N/A	<0.0001	<0.0001	<0.00010	<0.00010	0.0002	<0.00010
Mercury, total	ug/L	0.005	MAC=1	<0.005	<0.005	<0.0050	<0.0050	<0.0050	<0.0050

MAC = Maximum Acceptable Concentration AO = Aesthetic objective

Figure 17: CARO Pesticides, Herbicides and Fungicides Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Alachlor	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Aldrin	ug/L	0.006	N/A		<0.05		<0.040		<0.006
alpha-BHC	ug/L	0.01	N/A		<0.06		<0.050		<0.010
alpha-Chlordane	ug/L	0.05	N/A		<0.06		<0.050		<0.050
Atrazine	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Azinphos-methyl	ug/L	0.2	MAC=20		<0.26		<0.200		<0.200
beta-BHC	ug/L	0.05	N/A		<0.06		<0.050		<0.050
Bromacil	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Captan	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Chlordane (cis + trans)	ug/L	0.05	N/A						<0.050
Chlorothalonil	ug/L	0.05	N/A		<0.06		<0.050		<0.050
Chlorpyrifos	ug/L	0.01	MAC=90		<0.03		<0.020		<0.010
cis-Permethrin	ug/L	0.01	N/A		<0.13		<0.100		<0.010
Cyanazine	ug/L	0.1	N/A		<0.26		<0.200		<0.100
delta-BHC	ug/L	0.05	N/A		<0.06		<0.050		<0.050
Diazinon	ug/L	0.02	MAC=20		<0.04		<0.030		<0.020
Dichlorvos	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Dieldrin	ug/L	0.01	N/A		<0.05		<0.040		<0.010
Dimethoate	ug/L	0.2	MAC=20		<0.26		<0.200		<0.200
Disulfoton	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Endosulfan I	ug/L	0.01	N/A		<0.06		<0.050		<0.010
Endosulfan II	ug/L	0.01	N/A		<0.06		<0.050		<0.010
Endosulfan sulfate	ug/L	0.05	N/A		<0.06		<0.050		<0.050
Endrin	ug/L	0.02	N/A		<0.03		<0.020		<0.020
Endrin aldehyde	ug/L	0.02	N/A		<0.06		<0.050		<0.020
Endrin ketone	ug/L	0.02	N/A		<0.06		<0.050		<0.020
Fenchlorphos (Ronnel)	ug/L	0.1	N/A		<0.13		<0.100		<0.100
gamma-BHC (Lindane)	ug/L	0.05	N/A		<0.06		<0.050		<0.050
gamma-Chlordane	ug/L	0.05	N/A		<0.06		<0.050		<0.050
Glyphosate	mg/L	0.2	MAC=0.28			<0.050			<0.2
Heptachlor	ug/L	0.01	N/A		<0.06		<0.050		<0.010
Heptachlor epoxide	ug/L	0.01	N/A		<0.06		<0.050		<0.010
Malathion	ug/L	0.1	MAC=190		<0.13		<0.100		<0.100
Methyl parathion	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Metolachlor	ug/L	0.1	MAC=50		<0.13		<0.100		<0.100
Metribuzin	ug/L	0.2	MAC=80		<0.26		<0.200		<0.200
p,p-DDD	ug/L	0.01	N/A		<0.05		<0.040		<0.010
p,p-DDE	ug/L	0.01	N/A		<0.05		<0.040		<0.010
p,p-DDT	ug/L	0.01	N/A		<0.05		<0.040		<0.010
Parathion	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Pentachloronitrobenzene	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Phorate	ug/L	0.1	MAC=2		<0.13		<0.100		<0.100
Simazine	ug/L	0.2	MAC=10		<0.26		<0.200		<0.200
Sulfotep	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Terbufos	ug/L	0.1	MAC=1		<0.13		<0.100		<0.100
trans-Permethrin	ug/L	0.01	N/A		<0.13		<0.100		<0.010
Triallate	ug/L	0.1	N/A		<0.13		<0.100		<0.100
Trifluralin	ug/L	0.2	MAC=45		<0.26		<0.200		<0.200

MAC = Maximum Acceptable Concentration AO = Aesthetic objective

Figure 18: CARO Polycyclic Aromatic Hydrocarbon (PAH) Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Acenaphthene	ug/L	0.05	N/A		<0.050		<0.050		<0.050
Acenaphthylene	ug/L	0.2	N/A		<0.200		<0.200		<0.200
Acridine	ug/L	0.05	N/A		<0.050		<0.050		<0.050
Anthracene	ug/L	0.01	N/A		<0.010		<0.010		<0.010
Benz(a)anthracene	ug/L	0.01	N/A		<0.010		<0.010		<0.010
Benzo(a)pyrene	ug/L	0.01	MAC=0.04		<0.010		<0.010		<0.010
Benzo(b)fluoranthene	ug/L	0.05	N/A		<0.050		<0.050		
Benzo(b+j)fluoranthene	ug/L	0.05	N/A		<0.100		<0.050		<0.050
Benzo(g,h,i)perylene	ug/L	0.05	N/A		<0.050		<0.050		<0.050
Benzo(k)fluoranthene	ug/L	0.05	N/A		<0.050		<0.050		<0.050
2-Chloronaphthalene	ug/L	0.1	N/A						<0.100
Chrysene	ug/L	0.05	N/A		<0.050		<0.050		<0.050
Dibenz(a,h)anthracene	ug/L	0.01	N/A		<0.050		<0.050		<0.010
Fluoranthene	ug/L	0.03	N/A		<0.030		<0.030		<0.030
Fluorene	ug/L	0.05	N/A		<0.050		<0.050		<0.050
Indeno(1,2,3-cd)pyrene	ug/L	0.05	N/A		<0.050		<0.050		<0.050
Naphthalene	ug/L	0.2	N/A		<0.200		<0.200		<0.200
1-Methylnaphthalene	ug/L	0.1	N/A						<0.100
2-Methylnaphthalene	ug/L	0.1	N/A						<0.100
Phenanthrene	ug/L	0.1	N/A		<0.100		<0.100		<0.100
Pyrene	ug/L	0.02	N/A		<0.020		<0.020		<0.020
Quinoline	ug/L	0.05	N/A		<0.050		<0.050		<0.050
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective						

Figure 19: CARO Volatile Organic Compounds (VOC) Analysis

Analyte	Units	Method Detection Limit	Drinking Water Guidline Level	Raw (March 22, 2017)	Prior Road Booster Station (March 22, 2017)	Raw (June 14, 2017)	Lac Le Jeune Booster Station (June 14, 2017)	Raw (Nov 6, 2017)	Highlift Booster Station (Nov 6, 2017)
Benzene	ug/L	0.5	MAC=5		<0.5		<0.5		<0.5
Bromodichloromethane	ug/L	1	N/A		1.1		1.4		<1.0
Bromoform	ug/L	1	N/A		<1.0		<1.0		<1.0
Carbon tetrachloride	ug/L	0.5	MAC=2		<0.5		<0.5		<0.5
Chlorobenzene	ug/L	1	AO<=30		<1.0		<1.0		<1.0
Chloroethane	ug/L	2	N/A		<2.0		<2.0		<2.0
Chloroform	ug/L	1	N/A		22.8		55.6		14.2
Dibromochloromethane	ug/L	1	N/A		<1.0		<1.0		<1.0
1,2-Dibromoethane	ug/L	0.3	N/A		<0.2		<0.2		<0.3
Dibromomethane	ug/L	1	N/A		<1.0		<1.0		<1.0
1,2-Dichlorobenzene	ug/L	0.5	AO<=3		<0.5		<0.5		<0.5
1,3-Dichlorobenzene	ug/L	1	N/A		<1.0		<1.0		<1.0
1,4-Dichlorobenzene	ug/L	1	AO<=1		<1.0		<1.0		<1.0
1,1-Dichloroethane	ug/L	1	N/A		<1.0		<1.0		<1.0
1,2-Dichloroethane	ug/L	1	MAC=5		<1.0		<1.0		<1.0
1,1-Dichloroethylene	ug/L	1	MAC=14		<1.0		<1.0		<1.0
cis-1,2-Dichloroethylene	ug/L	1	N/A		<1.0		<1.0		<1.0
trans-1,2-Dichloroethylene	ug/L	1	N/A		<1.0		<1.0		<1.0
Dichloromethane	ug/L	3	MAC=50		<3.0		<3.0		<3.0
1,2-Dichloropropane	ug/L	1	N/A		<1.0		<1.0		<1.0
3-Dichloropropene (cis + tran	ug/L	1	N/A		<1.0		<1.0		<1.0
Ethylbenzene	ug/L	1	AO<=1.6		<1.0		<1.0		<1.0
Methyl tert-butyl ether	ug/L	1	AO<=15		<1.0		<1.0		<1.0
Styrene	ug/L	1	N/A		<1.0		<1.0		<1.0
1,1,2,2-Tetrachloroethane	ug/L	0.5	N/A		<0.5		<0.5		<0.5
Tetrachloroethylene	ug/L	1	MAC=10		<1.0		<1.0		<1.0
Toluene	ug/L	1	AO<=24		<1.0		<1.0		<1.0
1,1,1-Trichloroethane	ug/L	1	N/A		<1.0		<1.0		<1.0
1,1,2-Trichloroethane	ug/L	1	N/A		<1.0		<1.0		<1.0
Trichloroethylene	ug/L	1	MAC=5		<1.0		<1.0		<1.0
Trichlorofluoromethane	ug/L	1	N/A		<1.0		<1.0		<1.0
Vinyl chloride	ug/L	1	MAC=2		<1.0		<1.0		<1.0
Xylenes (total)	ug/L	2	AO<=20		<2.0		<2.0		<2.0
MAC = Maximum Acceptable Concentration			AO = Aesthetic objective						