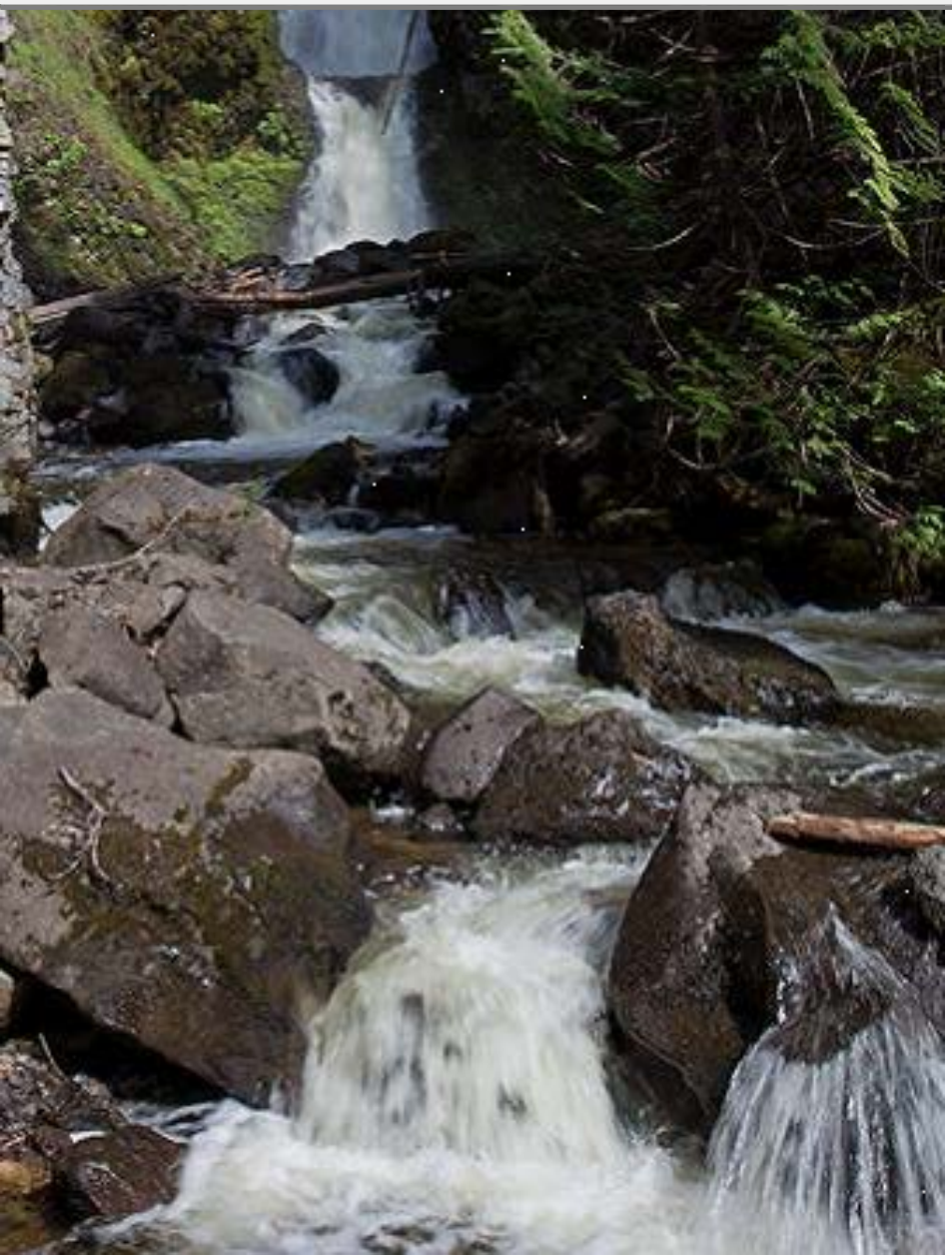
2016 Water System Report



DISTRICT OF CLEARWATER

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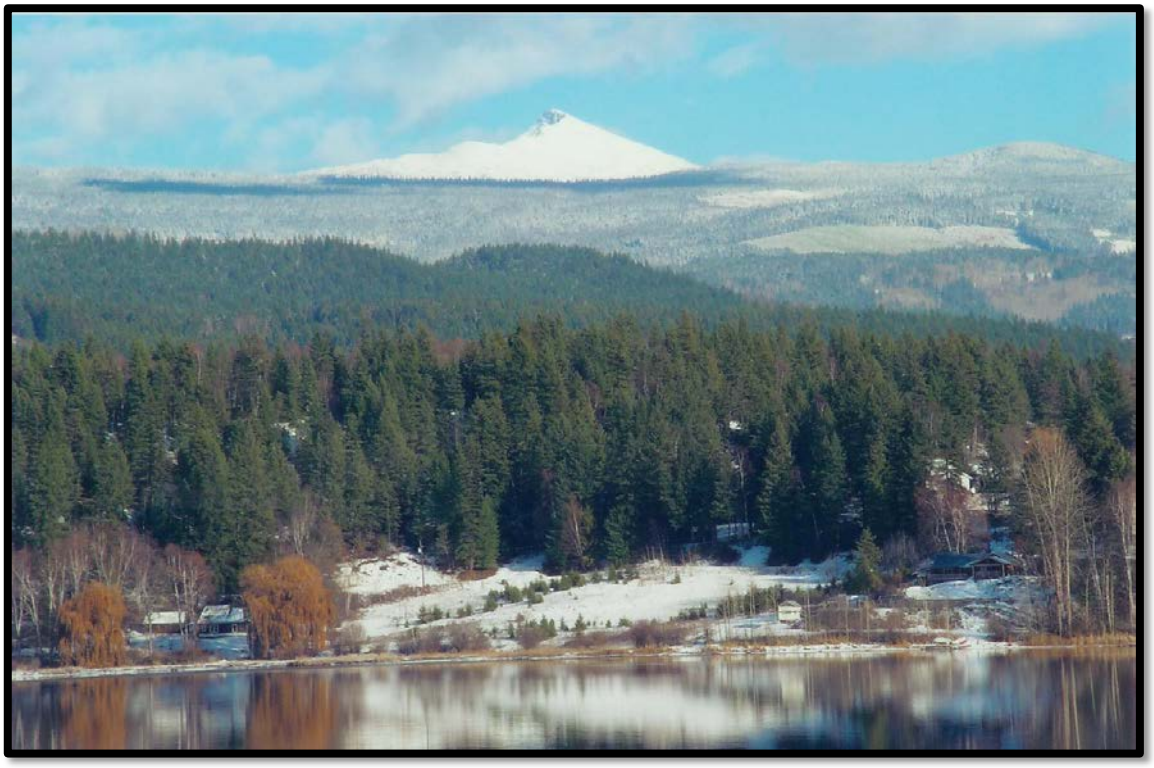
1.0 Introduction

The purpose of this report is to provide an annual update on the operation, maintenance and monitoring of the District of Clearwater's (District) water distribution system for the 2016 calendar year. Included within the scope of this report is the following:

- Water system overview:
- Operator certification;
- Operation and maintenance activities;
- 2016 water consumption information;
- Drinking water quality monitoring;
- 2016 challenges and successes; and
- Upcoming capital improvements.

The information enclosed herein is intended to satisfy the requirements of the Interior Health Authority's 'Conditions on Operating Permit' and confirm that the District is continuing to provide residents with safe and reliable drinking water.



2.0 Water System Overview

The community of Clearwater is located on the Yellowhead Highway 5, approximately 125 km north of Kamloops. The population of Clearwater is approximately 2,400 and the primary industries are forestry, tourism and agriculture.

The District's community water system has two sources, groundwater and surface water. Surface water is provided from the Russell, Hascheak and McDougall Creek watersheds. Groundwater is supplied from two groundwater sources; Clearwater River Aquifer (Well No. 1) and the Dutch Lake Aquifer (Well No. 2).

Raw water from all three production sites is treated using sodium hypochlorite. The Russell Creek surface water source is also treated using Ultra Violet (UV) Light Reactors. The water is then distributed throughout the community using approximately 40 km of watermain as well as the Archibald Road reservoir.

2.1 Russell Creek Source

The reservoir and intake on Russell Creek were constructed in 1971-1972. The works include a small diversion structure on Hascheak Creek which allows flow to be diverted into the Russell Creek reservoir. In 1973, a diversion structure and ditch were constructed to direct flow from McDougall Creek to the upper reaches of Hascheak Creek.

From the Russell Creek intake, a 250 mm (10") diameter ductile iron watermain conveys flow to the UV Treatment station (upgraded in 2013) approximately 60 m below the intake. The water is then treated using two UV reactors and sodium hypochlorite. The supply main continues to the Russell Creek booster station, which was constructed in 1997 and upgraded in 2013.

The upgrades completed in 2013 were designed to provide 44 L/sec at a design TDH of 20.5 m.

2.2 Clearwater River Aquifer – Well #1

The Clearwater River Aquifer - Well #1 was constructed in 1980 to provide an alternate supply to the Russell Creek source. The construction of the well was prompted by inadequate flows from the Russell Creek source in the winter of 1979 to 1980.

Well #1 is located on the east bank of the Clearwater River about 25 m from the average river water level. On the basis of pump testing, the safe yield of the well was reported to be 35 L/s (550 USgpm) with a drawdown of 7.4 m (24.4 feet).

The original design for the well indicated a vertical turbine pump. However, during pump installation it was realized that the well alignment could not accommodate a vertical turbine pump. Consequently, a 75 hp submersible pump was installed, with a rated capacity of 31 L/s (500 USgpm) at 131.1m (430 feet) total dynamic head.

Previous studies of Well #1 have indicated that this well source has limited capacity when the adjacent Clearwater River is at seasonal low water levels, historically winter through early spring. During this time, water depth above the pump has been measured to be approximately 7.0 m. At a pumping rate of 30 L/s, the drawdown is anticipated to be approximately 7.0 m. Therefore, Well #1 only provides a reliable source during the summer months, when the water level in the Clearwater River is expected to be higher than seasonal minimums. The operating capacity of Well No. 1 as determined by night reservoir drawdown assessments is 27 L/s.

Water pumped from Well #1 is treated using sodium hypochlorite; the injection point is located in the pump discharge piping. An assessment of Well #1 completed by AMEC Earth and Environmental (AMEC) in 2009 indicated that the well is under the direct influence of the Clearwater River and may be classified as groundwater at risk (GWAR).

2.3 Dutch Lake Aquifer – Well #2

The Dutch Lake Aquifer - Well #2 was constructed in 1999 and is located on the south side of the Old North Thompson Highway approximately 100 m from Dutch Lake. The well completion report indicates that the capacity of the well is 70 L/s (1100 USGPM). The well is equipped with a 150 hp vertical turbine pump.

The operational capacity of Well #2 is limited by the capacity of the supply main between the well and the Archibald Road reservoir. The pump has a speed control system which limits the discharge pressure at the well to 160 psi. Furthermore, the District has received water quality complaints regarding the presence of black solids in the drinking water. This is likely a result of manganese oxidation caused by chlorination of the raw water. Manganese concentrations appear to be limited when Well #2 operates at lower frequencies. As such, operation has been adjusted to allow the aquifer to "re-charge" between pumping cycles. Manganese does not have a health limit in the Guidelines for Canadian Drinking Water Quality; however, there is an aesthetic objective of 0.05 mg/L.

Well #2 was also assessed by AMEC in 2009. The results indicated that Well #2 is also under the influence of surface water (Dutch Lake) and that effective in-ground filtration is occurring.

2.4 Water System Control

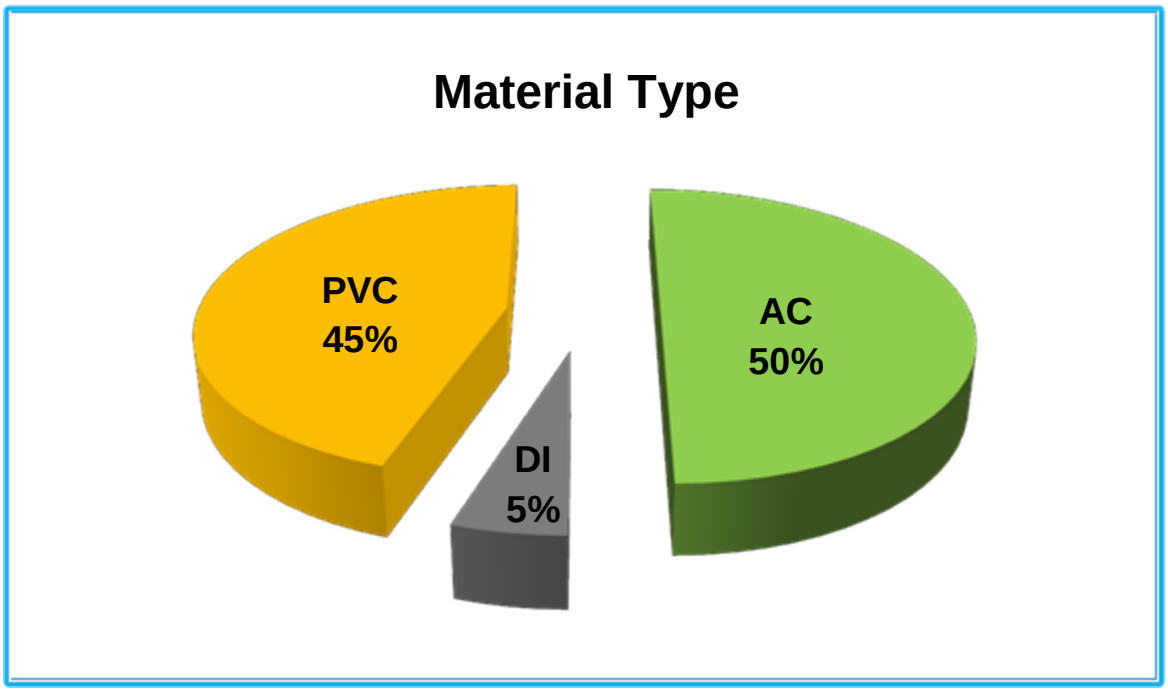
The water system is controlled by a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system allows for each production and detention site (Reservoir) to communicate with one another; allowing the system to operate with little operator involvement. The District is in the process of upgrading this control system; see Section 8.2 for further information.

2.5 Distribution System

The District's water distribution system comprises over 40 km of watermains. The system is made up of approximately:

- 50% (21 km) Asbestos Cement (AC) pipe constructed before 1978;
- 5% (2 km) Ductile Iron (DI) pipe constructed in 1972 and 1981; and
- 45% (17 km) Polyvinyl Chloride (PVC) pipe constructed after 1980.

FIGURE 2-1: DISTRIBUTION PIPE MATERIAL SUMMARY



There are three pressure reducing valve (PRV) stations that divide the distribution system into three pressure zones:

- Zone 1 – Majority of the Distribution system; Sunshine Valley, Weyerhaeuser, Raft River, etc.
    - Supplied by the Archibald Road reservoir.
- Zone 2 – Strawberry Flats
    - Serviced by two PRV stations on Swanson Road and Clearwater Station Road.
- Zone 3 – Harby Road
    - Serviced by a PRV station on the Old North Thompson Highway.

3.0 System Classification, Staffing & Operator Certification

In 2009, the District's water distribution system was classified as a Class II system.

The Environmental Operators Certification Program (EOCP) certification of the District's water system operators is as follows:

Employee	Certification Number	Level
Robert L Griffiths	6549	WD-II, CH, WWC-I, WT-I
Bryan W Lipp	6545	WD-II, CH, WWC-OIT
Ken Green	5140	WT-I

4.0 System Operation & Maintenance

Regular inspections, maintenance and water quality testing are performed by the system operators to ensure optimal operation of the District's water system. Water quality monitoring is discussed in Section 5.0. Operation and maintenance of the water system involves weekly, biweekly, monthly and periodic, or 'as-needed' tasks.

4.1.1 Daily Tasks

- Record sodium hypochlorite use at the Russell Creek, Well #1 and Well #2;
- Record flow meter readings at the Russell Creek, Well #1 and Well #2;
- Inspect the Russell Creek booster station pumps to ensure normal operation;

4.1.2 Weekly Tasks

- Sample and record chlorine residuals at two sites within the water distribution system;
- Inspect pressure reducing valves and pump standing water from chambers as necessary;
- Clean water system buildings;
- Replace chemicals (as needed);

4.1.3 Monthly Tasks

- Verify calibration of on-line chlorine analyzer at Archibald Road reservoir using field kit;
- Check static water level in Well #1;

4.1.4 Periodic, or "as -needed" Tasks

- Troubleshoot minor electrical and mechanical equipment problems;
- Load and unload sodium hypochlorite containers;
- Record the time and nature of any alarms received on the water system and take appropriate action;
- Flush and clean the watermains (four times per year minimum);
- Exercise control valves, isolation valves, hydrants and related appurtenances (annually); and
- Remove sediment and organics build-up in Russell Creek pond (every 2-3 years).

5.0 2016 Water Consumption

The 2015 Annual Water System Report stated that there was an estimated Well #1 flowmeter error of 25% and that the total water consumption for the years 2013 to 2015 had been adjusted accordingly. Replacement of the Well #1 flowmeter in June of 2016 revealed that the Well #1 flowmeter was in fact correct. As such, the flowrates for 2013 to 2015 have been re-adjusted to the correct totals and included in the summary below. Table 5-1, Figure 5-1 and Figure 5-2 are provided to illustrate the production of each raw water source in 2016:

2016:

Total volume – 1,203,120 m^3 (7.4% increase from 2015)
Average Day – 3,296 m^3/day

2015:

Total volume – 1,119,837 m^3 (5.3% increase from 2014)
Average Day – 3,068 m^3/day

2014:

Total volume – 1,063,091 m^3 (5.8% increase from 2013)
Average Day – 2,912 m^3/day

2013:

Total volume – 1,005,230 m^3
Average Day – 2,754 m^3/day

TABLE 5-1: 2016 WATER PRODUCTION SUMMARY

	Well #1 (m^3)	Well #2 (m^3)	Russell Creek (m^3)	Total Volume (m^3)
January	46,871	37	21,032	67,940
February	43,672	548	32,336	76,556
March	14,441	27,788	32,033	74,262
April	33,772	61,909	3,250	98,931
May	57,283	74,585	968	132,836
June	6,469	65,699	44,580	116,748
July	17,402	788	107,514	125,704
August	10,321	1,644	124,526	136,491
September	8,926	1,024	91,447	101,397
October	53,328	790	19,115	73,233
November	47,899	180	47,812	95,891
December	51,302	0	51,828	103,130
2016 Summary	**391,687**	**234,992**	**576,441**	**1,203,120**

FIGURE 5-1: 2016 WATER PRODUCTION SUMMARY

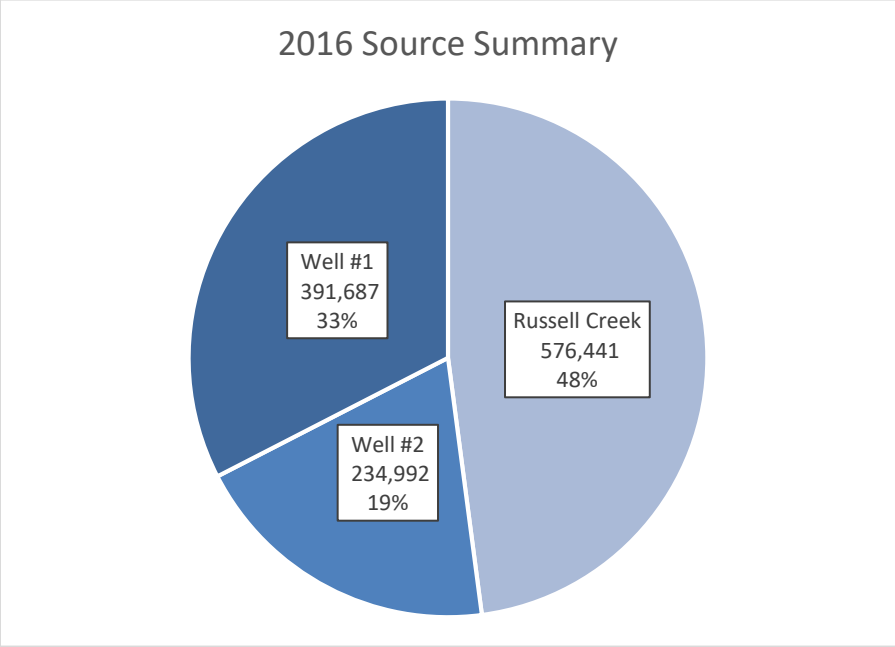
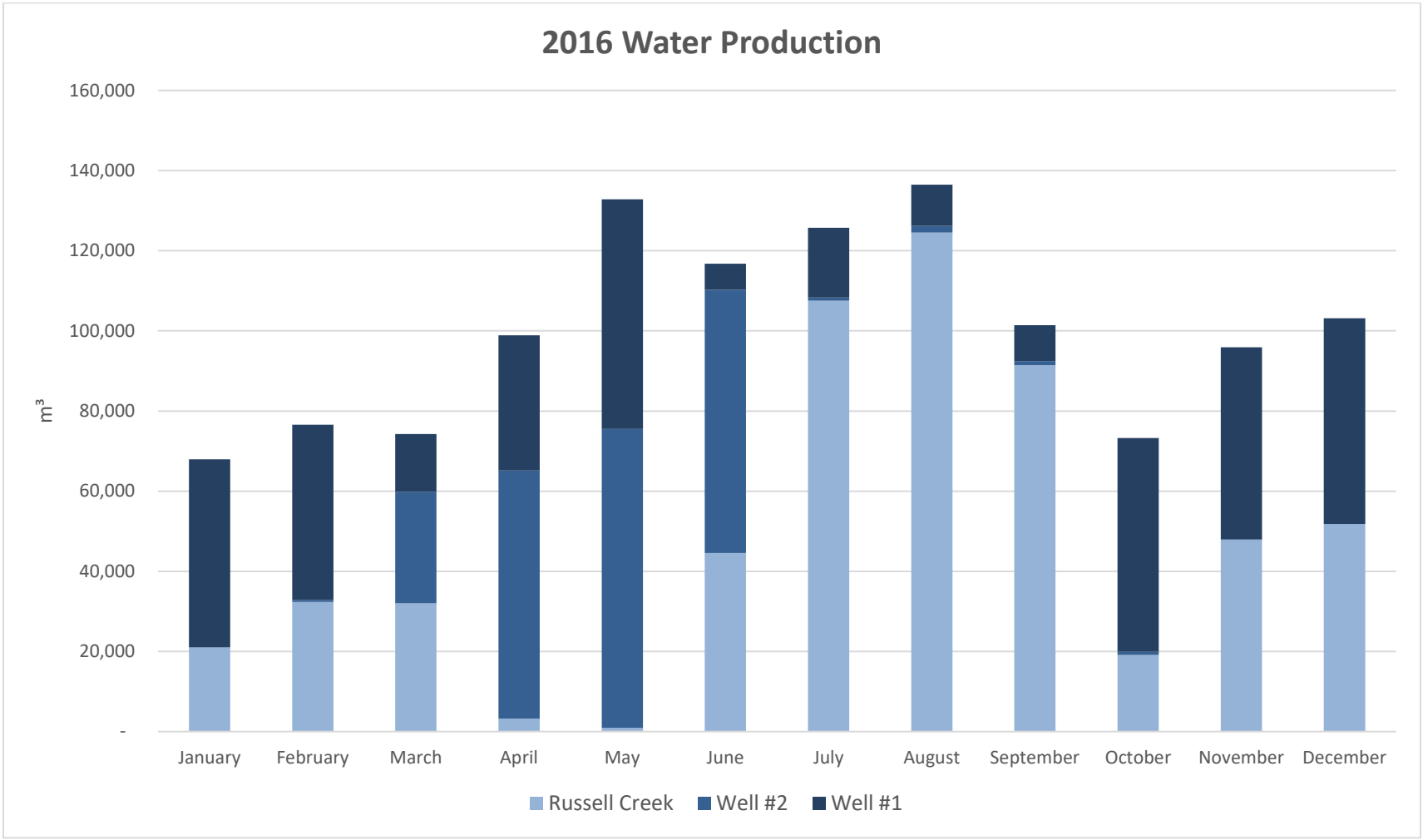


FIGURE 5-2: 2016 MONTHLY WATER PRODUCTION



6.0 Water Quality Monitoring Program

The District of Clearwater is required to operate the water distribution system as per the "Conditions of Permit" provided by the local health authority; which is the Interior Health Authority (IHA).

Table 6-1 displays the sampling parameters, locations and frequency for the District's water quality monitoring program. This testing is used to monitor the distribution system and alert District staff of potential drinking water quality issues. This program is reassessed on an annual basis or when system upgrades are undertaken.

Drinking water quality is a function of source water quality, water treatment, and changes to water quality in the distribution system. Therefore, water quality monitoring is comprised of three main components: source water monitoring, treated water monitoring, and distribution system monitoring.

6.1.1 Source Water Monitoring

The source water monitoring undertaken by District staff includes both field and lab tests. Results of these tests are used to assess general raw water chemistry in comparison to the Guidelines for Canadian Drinking Water Quality (GCDWQ) which are published by Health Canada.

6.1.2 Treatment System Monitoring

Additional treatment system performance monitoring is in place; this includes UV transmissivity, chlorine residual, pH and turbidity monitoring. This monitoring is performed in real-time and is connected to the District's SCADA system. The SCADA system will notify District staff in the event the treatment system deviates from pre-set parameters.

6.1.3 Distribution System Monitoring

The Drinking Water Protection Regulation (DWPR) requires that water suppliers monitor for Total Coliforms and Escherichia Coli (E. Coli) at a certified lab. A summary of Total Coliforms and E. Coli parameters is provided in Table 6-2. The distribution system is also monitored for disinfection by-products and chlorine residuals to ensure safe levels are maintained.

TABLE 6-1: WATER QUALITY SAMPLING SUMMARY

Parameter	Frequency	Analysis	Locations
Escherichia coli, Total Coliforms	Weekly	Lab	▪ 2 Samples weekly within the distribution system ▪ Raw Creek at UV Station (UV001)
Turbidity	Weekly	Field	▪ 2 Samples weekly within the distribution system
		SCADA	▪ Surface water at UV Station
Temperature	Weekly	Field	▪ 2 Samples weekly within the distribution system ▪ UV Station raw and treated
	Bi-Weekly	Field	▪ Raw Creek (combo)
	Monthly	Field	▪ 2 Wells
pH		SCADA	▪ Raw Creek (combo) ▪ 2 Wells
Conductivity		SCADA	▪ Raw Creek (combo) ▪ 2 Wells
Chlorine Residual	Weekly	Field	▪ 2 Samples weekly within the distribution system
UV Absorbance	Monthly	Lab	▪ Raw Creek
Total Organic Carbon	Monthly	Lab	▪ Raw Creek at UV Station (UV001) ▪ 2 Wells
Dissolved Organic Carbon	Monthly	Lab	▪ 2 Wells
Trihalomethanes (THMs)	Annually	Lab	▪ 2 Distribution samples (summer)
Haloacetic Acids (HAAs)	Annually	Lab	▪ 2 Distribution samples (summer)
Comprehensive Drinking Water Test	Annually	Lab	▪ Raw Creek at UV Station ▪ 2 Wells

TABLE 6-2: WATER QUALITY STANDARDS

Parameter	Standard
Fecal coliform bacteria	No detectable fecal coliform bacteria per 100 mL
Escherichia coli	No detectable *Escherichia 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

7.0 Water Quality Results

District staff conducted treated and raw water sampling throughout 2016 in accordance with Table 6.1. Water samples were sent to Caro Analytical Services and ALS Global for bacteriological testing and other laboratory testing. The water quality sampling program was revised from the 2015 program in June 2016.

7.1 Water Source Quality

Through 2016, the District undertook the following monitoring of the raw water (prior to treatment) produced by the three water sources.

- Well No. 1 (PW001) and Well No. 2 (PW002)
  - Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC) monthly
  - Annual comprehensive drinking water test
  - pH and conductivity
- Russell Creek (UV001 Raw)
  - UV absorbance, UV transmittance and TOC monthly
  - Total Coliforms and E. Coli weekly
  - Annual comprehensive drinking water test
  - pH and conductivity

The testing results for the 2016 are presented in Table 7.1 and summarized as follows:

- TOC and DOC in Wells 1 and 2 were consistently less than 1.0 mg/L for all but one sampling event on April 12, 2016. During this time, DOC was 1.1 mg/L and 1.4 mg/L in Well 1 and 2, respectively.
- Samples were at or below the detection limit of 0.5 mg/L in more than 33% of the samples. Organic carbon is a measure of naturally occurring organic matter. While it is not a constituent of concern, organics can combine with chlorine to produce disinfection by-products which can be potentially harmful.
- There were no positive tests for Total Coliforms or E. Coli in any of the raw water bacteriological tests for the wells in 2016
- TOC in Russell Creek ranged between 0.6 and 4.4 mg/L, with the higher concentrations occurring in the freshet period. For a surface water, TOC concentrations of less than 3.0 mg/L are considered to be low.
- UV transmittance values for Russell Creek ranged between 81.5% and 95.5% with minimum values measured during the freshet. UV transmittance is continuously measured in the UV treatment facility.
- Russell Creek raw water bacteriological testing displayed high concentrations of Total Coliforms and 3 positive results for E Coli. As seen in Table 7-1, 3 cfu/100mL was measured in February and 1 cfu/100mL in March and August.

TABLE 7-1: WATER SOURCE QUALITY DATA

Water Well #1 (Raw) (PW 001)

Date	Total Organic Carbon (mg/L)	Dissolved Organic Carbon (mg/L)	Total Coliform (#/100mL)	E. coli (#/100mL)
5-Jan-16	0.6	0.6	<1	<1
2-Feb-16	<0.5	<0.5	<1	<1
1-Mar-16	0.6	0.6	<1	<1
12-Apr-16	nr	1.1	<1	<1
3-May-16	<0.5	<0.5	<1	<1
14-Jun-16	<0.5	<0.5	<1	<1
5-Jul-16	nr	nr	<1	<1
2-Aug-16	1	0.8	<1	<1
27-Sep-16	nr	nr	<1	<1
11-Oct-16	nr	nr	nr	nr
n.d.	nr	nr	nr	nr
5-Dec-16	nr	nr	nr	nr

Water Well #2 (Treated) (PW 002)

Date	Total Organic Carbon (mg/L)	Dissolved Organic Carbon (mg/L)	Total Coliform (#/100mL)	E. coli (#/100mL)
5-Jan-16	0.8	0.6	<1	<1
2-Feb-16	<0.5	<0.5	<1	<1
1-Mar-16	0.8	0.7	<1	<1
12-Apr-16	nr	1.4	<1	<1
3-May-16	0.6	<0.5	<1	<1
14-Jun-16	<0.5	<0.5	<1	<1
5-Jul-16	nr	nr	<1	<1
2-Aug-16	1	0.9	<1	<1
27-Sep-16	nr	nr	<1	<1
11-Oct-16	nr	nr	nr	nr
n.d.	nr	nr	nr	nr
5-Dec-16	nr	nr	nr	nr

Russell Creek UV Station (UV 001 Raw)

Date	UV Absorbance Unfiltered (%)	Total Organic Carbon (mg/L)	UV Transmittance (%)	Total Coliform (#/100ml)	E. coli (#/100ml)
4-Jan-16	0.02	1.6	94.4	<1	<1
1-Feb-16	0.6	0.6	95.5	3	3
7-Mar-16	1.4	1.4	94.1	1	1
18-Apr-16	4.3	4.4	nr	1	<1
30-Mar-16	3	3.2	81.5	<1	<1
13-Jun-16	nr	1.6	88.1	10	<1
4-Jul-16	ns	2.2	ns	3	<1
8-Aug-16	nr	1.9	92.6	56	1
6-Sep-16	0.05	2.9	90.4	68	<1
3-Oct-16	0.07	2.5	86.2	14	<1
7-Nov-16	nr	nr	nr	14	<1
5-Dec-16	0.04	3.2	90.5	7	<1

7.2 Distribution System Disinfection By-Products

In accordance with the District's operating permit issued by IHA, sampling for Trihalomethanes (THM's) and Haloacetic Acids (HAA's) is undertaken at sites on the extremity of the distribution system service area. The results for 2016 are presented in Table 7-2. All test results for both THM's and HAA's were well within acceptable concentrations (MAC) specified in the Canadian Drinking Water Quality Guidelines.

TABLE 7-2: DISTRIBUTION SYSTEM DISINFECTION BY-PRODUCTS

	Distribution System Location				
Location Name	Raft River (WDSSRR01)	Fawn Rd (WDSSFR03)	Standard/ Guidelines	MRL Limits	Unit of Measurement
Date	14/06/2016	14/06/2016			
Time	11:45:00 AM	1:10:00 PM			
Halo acetic Acids (HAAs)	0.046	0.045	0.08	0.002	mg/L
Trihalomethanes (THMs)	0.067	0.063	0.1	0.004	mg/L

7.3 Distribution System Bacteriological Tests

A total of 143 treated water samples were analyzed in 2016 for E. Coli and Total Coliforms. Samples were taken at four locations within the distribution system (Raft River, Sunshine Valley, Fawn Road and Park Drive). Total Coliforms are an indicator organism. Their presence likely suggests that for the sample collected there was insufficient chlorine present to kill the coliform bacteria. This could be a result of stagnant water or contamination of the sample (e.g. from the tap where it was collected). No hits, as seen in Table 7-3, indicates that the system is receiving adequate chlorination.

TABLE 7-3: DISTRIBUTION SYSTEM BACTERIOLOGICAL TESTS

Month	Number of Samples	Number of E. Coli Hits	Number of Total Coliform Hits	Number of Samples within DWPR	Percentage of Samples within DWPR
January	16	0	0	16	100%
February	16	0	0	16	100%
March	16	0	0	16	100%
April	16	0	0	16	100%
May	15	0	0	15	100%
June	14	0	0	14	100%
July	8	0	0	8	100%
August	8	0	0	8	100%
September	12	0	0	12	100%
October	10	0	0	10	100%
November	8	0	0	8	100%
December	4	0	0	4	100%

7.4 Full Spectrum Water Quality Analysis

Full spectrum water quality test results for the District' three water sources are presented in Appendix A.

8.0 Capital Works and Other Initiatives

This section provides a summary of initiatives that were completed in 2016, are underway, or are in the planning stages. There is also discussion on issues that have been identified for possible action.

8.1 Completed in 2016

The following projects were completed in 2016 to upgrade the water supply or distribution system:

- Revised water sampling program
- Replaced flow meter at Well #1 in June.
- Replaced Well #1 Programmable Logic Controller to provide interface to SCADA system.
- Installed fibre-optics line to intake at Russell Creek from Booster Station.
- Complete distribution system leakage repairs at the following locations:
    - March 2016- Watermain repair on Clearwater Station Road. AC pipe fixed at two locations.
    - March 2016- Replaced leaking standpipe on Park Drive.
    - May 2016- Service line repair at 209 Dutch Lake Road.
    - October 2016- Service line repair at Riverview Crescent.
    - November 2016- Watermain repair on Dutch Lake Road.
    - December 2016- Service line repair on Riverview Crescent.
    - Nighttime Water Consumption Assessment (ongoing)

8.2 System Improvements

8.2.1 2017 Minor Projects

In 2017 the District will be looking to complete the following minor capital projects to improve water quality sampling as well as some minor operational needs.

- Complete the cross-connection control program
- Re-write the water service connection & regulation bylaw
- Complete the Night Time Water Consumption Assessment

8.2.2 2017 Major Projects

The District was successful in securing grant funding for the following projects which are schedule to begin in 2017:

- Construction of a new Well #3 at the Well #1 site.

- Completion of Phase 1 of a 3-Phase 300mm supply main from Well #3 to the Archibald Reservoir.

9.0 Source Protection

In order to comply with the Interior Health “Conditions of Permit” and the *British Columbia Drinking Water Protection Act*, the District is required to complete source protection plans for each of its sources. Source protection plans are intended to assess the local factors and conditions that may influence the drinking water supply and to provide a strategy to mitigate the risks.

In accordance with the District’s Infrastructure Master Plan, the District has selected a reliable long term water source (Well #3). The District will take steps toward developing a source protection plan for the new water source once construction is complete.

APPENDIX A

Drinking Water Lab Results

Well #1	1990	1997	2013	2014	2015	2016
Sample Date					**June 2/15**	**June 24/16**
Carbon, Total Organic			1	0.5	0.5	
Carbon, Dissolved Organic			0.6	0.5	<0.5	
UV Absorbance @ 254nm					<0.01	
UV Absorbance @ 254nm; unfiltered					<0.01	
UV Transmittance @ 254nm					97.8	
Hardness, Total (Total as CaCO3)	44.6	98.9	47.4	46.6	48.8	42.4
Hardness, Total (Diss. as CaCO3)			47	45.7	48.7	
Recoverable Metals						
Aluminum, total	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Antimony, total			<0.001	<0.001	0.005	<0.001
Arsenic, total	<0.001	< 0.0005	<0.005	<0.005	<0.005	<0.005
Barium, total	0.02	0.061	<0.05	<0.05	<0.05	<0.05
Beryllium, total			<0.001	<0.001	<0.001	<0.001
Bismuth, total			<0.001	<0.001	<0.001	
Boron, total	<0.01	<0.01	<0.04	<0.04	<0.04	<0.04
Cadmium, total	<0.0005	<0.005	<0.0001	<0.0001	<0.0001	<0.0001
Calcium, total	14.1	30.8	14	14.1	14.6	13.5
Chloride, total	<0.5	0.5				
Chromium, total			<0.005	<0.005	<0.005	<0.005
Cobalt, total			<0.0005	<0.0005	<0.0005	<0.0005
Copper, total	<0.01	<0.005	<0.002	<0.002	0.005	0.004
Iron, total	0.03	0.068	<0.1	<0.10	<0.10	<0.1
Lead, total	0.001	<0.05	<0.001	<0.001	<0.001	<0.001
Lithium, total			<0.001	<0.001	<0.001	
Magnesium, total	2.29	5.3	3.2	2.8	3	2.5
Manganese, total	<0.01	0.004	<0.002	<0.002	<0.002	<0.002
Mercury, total			<0.0002	<0.0002	<0.00002	<0.00002
Molybdenum, total			0.001	<0.001	0.002	<0.001
Nickel, total			<0.002	<0.002	<0.002	<0.002
Phosphorus, total		<0.1	<0.2	<0.2	<0.2	<0.2
Potassium, total			1	0.7	1	0.8
Selenium, total			<0.005	<0.005	<0.005	<0.005
Silicon, total			<5	<5	<5	<5
Silver, total			<0.0005	<0.0005	<0.0005	<0.0005
Sodium, total	1.9	1.4	3	2.5	3.1	2.4
Strontium, total			0.1	0.09	0.08	
Sulfur, total			<10	18	<10	
Tellurium, total			<0002	<0.002	<0.002	
Thallium, total			<0.0002	<0.0002	<0.0002	
Thorium, total			<0.001	<0.001	<0.001	
Tin, total			<0.002	<0.002	<0.002	
Titanium, total			<0.05	<0.05	<0.05	
Uranium, total	<0002		0.0003	0.0002	0.0003	0.0002
Vanadium, total			<0.01	<0.01	<0.01	<0.01
Zinc, total	<0.01	0.031	<0.04	<0.04	<0.04	<0.04
Zirconium, total			<0.001	<0.001	<0.001	

Well #2	2005	2006	2013	2014	2015	2016
Sample Date					**June 2/15**	**June 24/16**
Carbon, Total Organic			0.8	0.7	<0.5	
Carbon, Dissolved Organic			0.6	0.6	<0.5	
UV Absorbance @ 254nm					<0.01	
UV Absorbance @ 254nm; unfiltered					<0.01	
UV Transmittance @ 254nm					98.3	
Hardness, Total (Total as CaCO3)	110	99	103	108	112	111
Hardness, Total (Diss. as CaCO3)			105	104	128	
Recoverable Metals						
Aluminum, total	0.0097	<0.05	0.07	<0.05	<0.05	<0.05
Antimony, total			<0.001	<0.001	0.004	<0.001
Arsenic, total	0.0008	<0.01	<0.005	<0.005	<0.005	<0.005
Barium, total	0.00077	<0.08	<0.05	<0.05	<0.05	<0.05
Beryllium, total			<0.001	<0.001	<0.001	<0.001
Bismuth, total			<0.001	<0.001	<0.001	
Boron, total	<0.008	<0.01	<0.04	<0.04	<0.04	<0.04
Cadmium, total	0.00001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium, total	31.7	27.49	26	29.4	30.2	32.5
Chloride, total	2.6	4.6				
Chromium, total			<0.005	<0.005	<0.005	<0.005
Cobalt, total			<0.0005	<0.0005	<0.0005	<0.0005
Copper, total	0.0011	0.011	0.005	0.004	0.002	<0.002
Iron, total	<0.005	<0.01	0.6	0.19	<0.10	<0.1
Lead, total	0.00037	<0.21	<0.001	<0.001	<0.001	<0.001
Lithium, total			<0.001	<0.001	0.001	
Magnesium, total	8.49	7.9	9.3	8.3	8.8	9.2
Manganese, total	0.0272	0.084	0.081	0.135	0.036	0.062
Mercury, total			<0.0002	<0.0002	<0.00002	<0.00002
Molybdenum, total			0.002	0.002	0.003	0.003
Nickel, total			<0.002	<0.002	<0.002	<0.002
Phosphorus, total	0.069	<0.08	<0.2	<0.2	<0.2	<0.2
Potassium, total			3.5	2.7	3	3.4
Selenium, total			<0.005	<0.005	<0.005	<0.005
Silicon, total			8	7	7	8
Silver, total			<0.0005	<0.0005	<0.0005	<0.0005
Sodium, total	10.4	8.43	69.1	12.6	9.3	10.1
Strontium, total			0.16	0.16	0.16	
Sulfur, total			10	<10	<10	
Tellurium, total			<0.002	<0.002	<0.002	
Thallium, total			<0.0002	<0.0002	<0.0002	
Thorium, total			<0.001	<0.001	<0.001	
Tin, total			<0.002	<0.002	<0.002	
Titanium, total			<0.05	<0.05	<0.05	
Uranium, total	0.00011	<0.01	<0.0002	<0.0002	<0.0002	<0.0002
Vanadium, total			<0.01	<0.01	<0.01	<0.01
Zinc, total	0.0011	<0.002	<0.04	<0.04	<0.04	<0.04
Zirconium, total			<0.001	<0.001	<0.001	

Surface Water – Russell Creek	2013	2014	2015	2016
Sample Date			**June 2/15**	**June 24/16**
Carbon, Total Organic	3.5	1.6	2.3	
Carbon, Dissolved Organic	3.3	1.5	2.1	
UV Absorbance @ 254nm	0.08	0.05	0.06	
UV Absorbance @ 254nm; unfiltered	0.09	0.05	0.06	
UV Transmittance @ 254nm	84	88.8	86.8	88.1
Hardness, Total (Total as CaCO3)	80.9	84.3	66.9	72.3
Hardness, Total (Diss. as CaCO3)		85.5	68.5	
Recoverable Metals				
Aluminum, total	<0.05	<0.05	<0.05	<0.05
Antimony, total	<0.001	<0.001	0.006	<0.001
Arsenic, total	<0.005	<0.005	<0.005	<0.005
Barium, total	0.07	0.7	0.05	0.07
Beryllium, total	<0.001	<0.001	<0.001	<0.001
Bismuth, total	<0.001	<0.001	<0.001	
Boron, total	<0.04	<0.04	<0.04	<0.04
Cadmium, total	<0.0001	<0.0001	<0.0001	<0.0001
Calcium, total	26	26.9	21.8	25.3
Chromium, total	<0.005	<0.005	<0.005	<0.005
Cobalt, total	<0.0005	<0.0005	<0.0005	<0.0005
Copper, total	<0.002	<0.002	0.371	0.002
Iron, total	<0.1	<0.10	<0.10	<0.1
Lead, total	<0.001	<0.001	<0.001	<0.001
Lithium, total	<0.001	<0.001	<0.001	
Magnesium, total	3.9	4.2	3	3.3
Manganese, total	<0.002	<0.002	0.003	<0.002
Mercury, total	<0.0002	<0.0002	<0.00002	<0.00002
Molybdenum, total	<0.001	<0.001	0.001	<0.001
Nickel, total	<0.002	<0.002	<0.002	<0.002
Phosphorus, total	<0.2	<0.2	<0.2	<0.2
Potassium, total	0.3	<0.2	<0.2	0.2
Selenium, total	<0.005	<0.005	<0.005	<0.005
Silicon, total	<5	<5	<5	<5
Silver, total	<0.0005	<0.0005	<0.0005	<0.0005
Sodium, total	1.2	1	1	1.1
Strontium, total	0.11	0.11	0.07	
Sulfur, total	12	<10	<10	
Tellurium, total	<0.002	<0.002	<0.002	
Thallium, total	<0.0002	<0.0002	<0.0002	
Thorium, total	<0.001	<0.001	<0.001	
Tin, total	<0.002	<0.002	<0.002	
Titanium, total	<0.05	<0.05	<0.05	
Uranium, total	<0.0002	<0.0002	<0.0002	<0.0002
Vanadium, total	<0.01	<0.01	<0.01	<0.01
Zinc, total	<0.04	<0.04	0.25	<0.04
Zirconium, total	<0.001	<0.001	<0.001	