

# Clearbrook Waterworks District 2016 Water Quality Report



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**APRIL 2017**

## **Clearbrook Waterworks District**

### **2016 Water Quality Report**

April 2017

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## **Foreword**

Clearbrook Waterworks District (CWD) is pleased to present the 2016 Annual Water Quality Report, prepared in collaboration with Kalwij Water Dynamics Inc. (KWD), and with contributions from James Wiens (CWD's Field Supervisor) and Ryan Federau (CWD's Water Quality Technician). CWD retains the services of a professional hydrogeologist, Dr. Ineke Kalwij (P.Eng.) of KWD, to assist in on-going groundwater monitoring and well maintenance programs. Dr. Kalwij advises CWD Board of Trustees and staff on various aspects pertaining to groundwater supply management and groundwater protection.

Through this report we would like to inform the rate payers about our water system and show our ongoing commitment by the CWD Board of Trustees and staff to deliver the highest quality water. An accomplishment also acknowledged by the awarding of the District's fourth gold medal on February 27, 2016 (preceded by a Bronze medal in 2015), for supplying the World's Best Municipal Water, organized by Berkeley Springs International Water Tasting (a yearly occurring event, held in Berkeley Springs, West Virginia).

CWD system operators are highly trained and skilled and certified through the Environmental Operator's Certification Program, with Level 2 Water Distribution System Operators. CWD complies with all provincial and federal regulations relating to the supply and delivery of potable water, while promoting responsible stewardship of our resource. We value our collaboration with Fraser Health and their feedback. We remain committed to the protection of public health while ensuring an uninterrupted supply of drinking water to our rate payers.

CWD employs a holistic approach to water quality management, utilizing proactive maintenance schedules and asset management practices. CWD adopts up-to-date technologies to achieve more efficient system operation and maintenance practices.

Last year, CWD contracted GeoAdvice Engineering to design a Unidirectional Flushing (UDF) Program which the field crew implemented for the first time last summer. The UDF utilizes

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increased velocities to create a “scouring” effect during the flush, eliminating any build-up on the pipe walls, thereby improving water quality.

Under our Pipe Replacement Program, almost 500 meters of water main has been replaced on Carlsrue Avenue, Castle Court and Casper Court in 2016. Furthermore, three dead ends were eliminated by looping them together, thereby benefitting pipe hydraulics and water quality in that part of the water system.

In 2016, CWD launched a new website with the intent to better serve the rate payers, giving them the flexibility to submit maintenance requests through our website. The website also includes the ability to submit water meter readings, eBilling, and submitting a leak relief request.

Last summer, we hosted our annual Open House at Lynden Well Field as an opportunity for the community to meet with our Board of Trustees, staff, consultants, contractors, and suppliers over some refreshments and barbeque. We would like to thank the community for participating and making the event a truly successful one! We are looking forward to seeing you all at our next Open house in summer 2017.

This year, we will be replacing aging water main on Springhill Street and Old Yale Road. We have started the construction of a fourth replacement production well at Autumn Well Field, and we anticipate the commissioning of this production well later this fall. Through this project we further secure and strengthen our water supply.

Plans are underway for the construction of a new operations facility, to be erected at our reservoir site. Following completion of the new facility, field operations will be moved from the Janzen Street works yard to the reservoir site.

Respectfully submitted,

Jason Hildebrandt  
Administrator

# 1.0 Introduction

This document summarizes water system and water quality information for Clearbrook Waterworks District water supply and distribution system (*CWD's Water System*). As per regulatory requirements, under the Drinking Water Protection Act, water systems (water suppliers) are required to monitor the quality of water supply source(s), the water in the distribution system, and the water supplied to the end users. The primary purpose of this document is to summarize the results of CWD's groundwater quality monitoring program. This document is solely intended for CWD's rate payers and Fraser Health.

For rate payers to stay informed about health related to drinking water we refer to Fraser Health Website: <http://www.fraserhealth.ca/health-info/health-topics/drinking-water/drinking-water-advisories/drinking-water-advisories>.

For information about preventing water-borne infections for people with weakened immune systems: <http://www.healthlinkbc.ca/healthfiles/hfile56.stm>.

**Appendix A** includes a message from Fraser Health about metals in drinking water.

In this report:

- ✓ Information about CWD's Water System: **Section 2.0**;
- ✓ Information about completed projects in 2016: **Section 3.0**;
- ✓ Information about projects scheduled for 2017: **Section 3.0**;
- ✓ Information about water quality assurance practices: **Section 4.0**; and
- ✓ Review of the drinking water quality results: **Section 5.0**.



## 2.0 Water System Operational Aspects

### 2.1 Water System Overview

The supply and distribution system (water system) of Clearbrook Waterworks District (CWD) solely relies on groundwater. CWD is the exclusive drinking water provider to residential and commercial units (1,348 connections) within CWD service area boundaries, serving a population of close to 10,000 through an estimated 32 kilometres (km) of water main (pipe network), with three production wells supplying the system, and 6,820 cubic metres (m<sup>3</sup>) of combined reservoir storage. The water system is fully metered and CWD staff completes the meter reading on a quarterly basis.

The water supply is primarily used for drinking water but is also used to meet fire flow water requirements. The fire hydrants, connected to the water system, have been installed and are maintained by CWD. CWD's operators are all EOCP-certified (EOCP<sup>1</sup> Water Distribution System Operators Level 2).

The water system relies on three replacement production wells for water supply located at Lynden and Autumn Well Fields. Under RW 2-63 Project<sup>2</sup> a replacement production well is being constructed at Autumn Well Field, work of which is scheduled for completion in 2017.

Through SCADA, CWD has real-time access via Remote Terminal Units to pertinent aspects of the water system. This includes the monitoring of flow information (wells, to and from the reservoir), reservoir levels, water system pressure (pump stations), and water temperature (groundwater and reservoirs). SCADA continuously acquires data which is stored in a database. Such data is used by our hydrogeologist for further processing and analysis, which is essential to the periodic review of our supply and distribution system. Through SCADA the wells are operated automatically on a rotational basis. Through SCADA alarm features are enabled, and

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<sup>1</sup> Environmental Operators Certificate Program; for more information: <http://eocp.ca/>.

<sup>2</sup> The fourth replacement well constructed under CWD's Well Replacement Program.

CWD's system operators are notified instantaneously (through their hand-held devices) in case there is a problem with the system's operation or in case of an unauthorized intrusion.



**IMAGE | PUMP STATION AT THE RESERVOIR SITE**

### **Emergency Response Planning**

CWD has an Emergency Response Plan (ERP) in place (updated 2016), which has been reviewed and approved by Fraser Health. CWD has also developed a comprehensive emergency chlorination plan for the fully functioning emergency chlorinators which were installed in the pump houses at Lynden and Autumn Well fields in 2015. These devices are part of our proactive approach to water system management, and are solely used in the event of a water quality related emergency.

## 2.2 Our Aquifer (Water Supply Source)

CWD's production wells extract water from the Abbotsford-Sumas Aquifer. The aquifer covers an area of approximately 161 square kilometres (km<sup>2</sup>); it is a trans-boundary aquifer which extends from the Fraser Valley into Whatcom County of Washington State, USA. It is an unconsolidated aquifer composed of sands and gravels (glacial outwash deposits). Although the aquifer is largely unconfined, some parts of the aquifer are confined. CWD production wells screen the aquifer at a location characterized by an overlaying confining layer. This confining layer of low permeability consists of silt and clay (also termed an *aquitard*); the presence of such *aquitard* is advantageous from an aquifer protection point of view as they are conducive in protecting the aquifer from possible contamination (introduced at the ground surface).

The aquifer is considered a highly productive aquifer. The City of Abbotsford, Clearbrook Waterworks District, and Fraser Valley Trout Hatchery are the major (single) groundwater users (of the Canadian portion of the aquifer). As per BC Aquifer Classification System the Abbotsford-Sumas Aquifer is classified as a heavily developed and highly vulnerable aquifer. CWD has a wellhead and aquifer protection program in place to safeguard our groundwater resource.



**IMAGE | GROUNDWATER PROTECTION**

## 2.3 Groundwater Monitoring

Through SCADA pertinent information (data) is automatically and continuously stored in a data base, and which used for further analysis. Furthermore, manually data is recorded to augment SCADA recorded data.

### Groundwater Extraction

CWD's production wells have been successfully operating (in rotation) throughout 2016. **Figure 2.1 (next page)** shows the monthly groundwater extraction. For each month the figure shows the volumetric contribution of each well. In summary, for 2016:

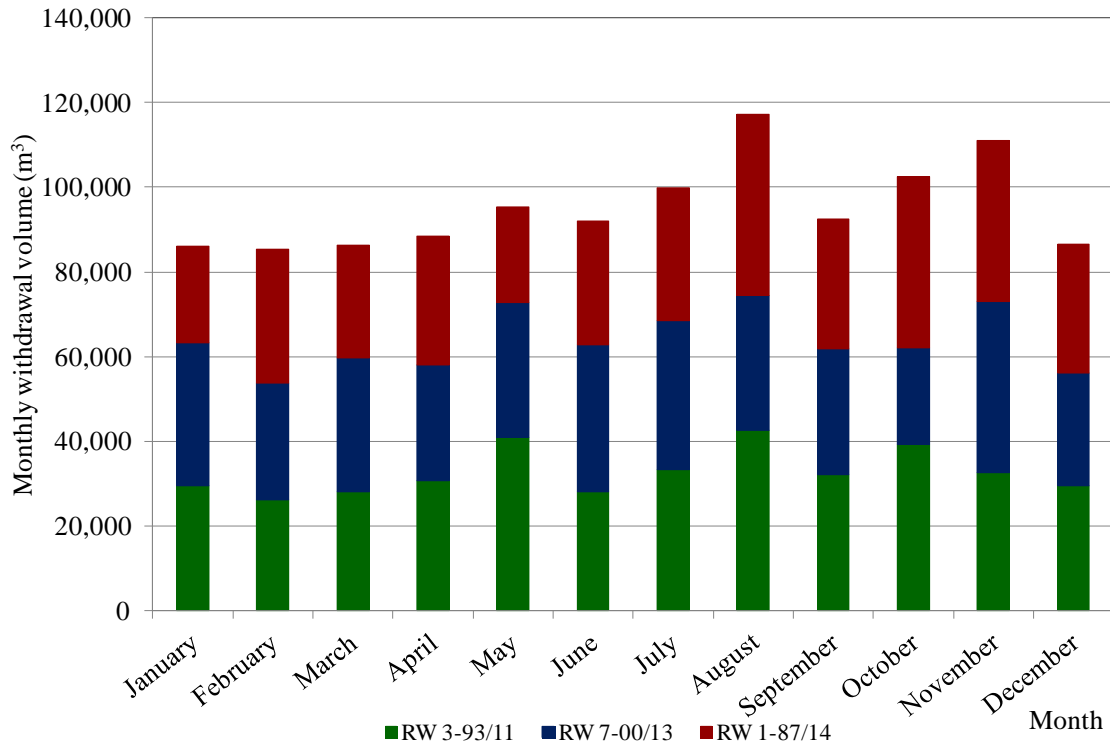
- 1) The total volume of combined extraction is 1.09 billion litres;
- 2) Combined average monthly withdrawal is 90.7 million litres (ML); and
- 3) The combined average daily withdrawal volume is 3.0 ML.

### Groundwater Level

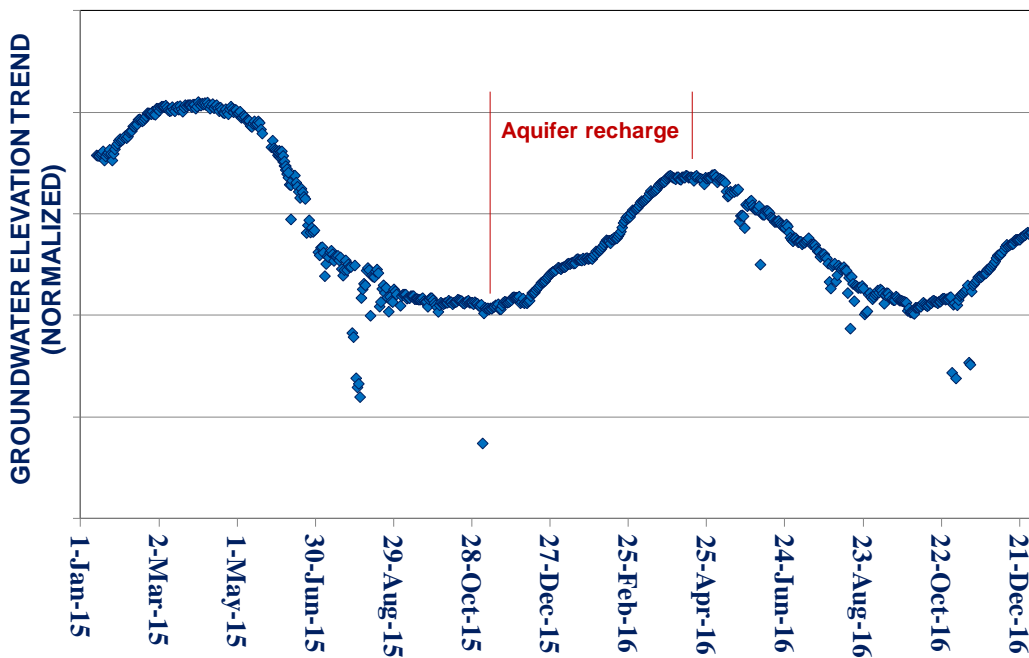
CWD has been monitoring groundwater levels as far back as 1989. Throughout the years the groundwater level monitoring has been strengthened, and, since 2009 groundwater levels (in production wells and monitoring well) are monitoring on a continuous basis via SCADA. The data provides valuable insight in the variation in groundwater levels seasonally and between years. This is important information to ensure aquifer sustainability.

**Figure 2.2 (next page)** shows the (normalized) trend in groundwater levels for one of CWD's monitoring wells. The figure illustrates how the aquifer (i.e., hydrostatic level) responds to recharge (due to precipitation) within a year and between years; the trend suggests that the amount of recharge (and aquifer withdrawal) varies between years. **Aquifer recharge** occurs generally from late October - November to April - May, illustrated by the gradually increasing section of the sine-shaped curves.

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**FIGURE 2.1 | MONTHLY GROUNDWATER EXTRACTION VOLUME**



**FIGURE 2.2 | GROUNDWATER LEVEL TRENDS (MONITORING WELL)**

## **2.4 Community Outreach Program**

Through presentations at CWD's Annual General Meeting (held in March of every year), CWD's Annual Open House, and CWD's website, rate payers are informed about water system projects and the work involved in operating and maintaining a water system. Through information sharing about groundwater monitoring (water levels) and the aquifer (concepts), CWD aims at creating awareness about the drinking water source (our wells), and the importance of groundwater protection among community members. Furthermore, in 2016, CWD in collaboration with KWD gave a presentation at Clearbrook Elementary school about CWD's water system and groundwater concepts.



**IMAGE | 2016 CWD OPEN HOUSE AT LYNDEN WELL FIELD**

## 3.0 Selected Work and Projects

### 3.1 Selected On-going Work and Projects Completed in 2016

#### Water Quality Monitoring (on-going)

- On a bi-weekly basis, water samples are collected from CWD's 25 sampling points, which includes: individual sample stations throughout the district, production wells, and the pump station at the reservoir site (a separate sample point for each reservoir). Water samples are collected on a rotating basis, and analyzed in-house for *Total Coliforms* and *Escherichia Coliform* (see **Section 4.1** of this report).
- Independently, water samples are submitted to Fraser Health for microbiological analysis (same sampling stations, same intervals); (see **Section 4.1** of this report)
- In April and November, 2016, Biological Activity Reaction Tests (BART) were completed for water collected from the source (wells); results are discussed in **Section 5.2** of this report.
- On December 19, 2016, raw water samples were collected from the source (wells) and reservoir site for potability analysis; the water samples were analyzed by Exova Group plc. (Exova) on: (1) *physical properties*; (2) *water chemistry*; and (3) *microbiological parameters*. Results are discussed in **Section 5.1** of this report.

### **Water System Maintenance**

Water system maintenance is on-going through the year. The following is a list of selected maintenance work completed in 2016:

- CWD field staff completed spring and fall water main flushing (through the fire hydrants) of the water system; fall flushing was carried out as per **Unidirectional Flushing Program (UFP)** (high-velocity flushing of water mains);
- Multiple replacements of angle ball valves installed in the water system;
- Replacement of 43 commercial meters;
- All fire hydrants were rebuilt and re-painted during the summer months;
- On-going valve exercising for various projects and for on-going maintenance;
- Leak detection and water main leak repairs;

### **New Multi-Residential Development**

- Two new developments (multi-residential units) were constructed in Clearbrook. Together, these projects required upgrade of the water main (300 meters) from 200 millimetres diameter (200 mm) Ductile Iron (DI) to 250 mm Bionax® PVC Pipe (CIOD) (Bionax) at developers costs, and were installed by the contractor; CWD staff inspected the water main upgrade work on a daily basis. The work also included a 150 mm Bionax tie-in (loop) at one of the projects.



**IMAGE | FIRE HYDRANT  
INSTALLATION**



### **Pipe Replacement Program**

- Water system upgrading was completed at Charlotte Park; the work entailed: (i) the connection of three dead end water mains (connected at Charlotte Park); and (ii) upgrading about 500 metres (m) of water main: 150 mm and 200 mm of Bionax has been installed (upgraded from 100 mm and 150 mm AC pipe).
- The project also includes the connection of a new fire hydrant to the water system on Casper Court, and all of the twenty-two (22) residential service lines were upgraded from  $\frac{3}{4}$  inch (in) to 1 in di



**IMAGE | WATER MAIN REPLACEMENT**

### **Supervisory Control and Data Acquisition (SCADA)**

- Radio and antennae upgrade for the entire SCADA system (at all CWD sites, including the office), completed by Victoria Mobile Radio (VMR); prior to this work a telemetry study was completed by VMR to detect the cause of the SCADA communications problem.
- Resolving of SCADA software issues (the work was completed by QCA Systems Ltd).

### **Groundwater Monitoring Program**

- On a bi-weekly basis CWD staff completes the manual reading (by level sounder) of groundwater levels for all designated monitoring well locations.
- On-going, throughout the year, KWD processes and analyses SCADA data pertaining to well's operation and groundwater levels.

### **Wells Maintenance and Rehabilitation Program**

CWD's *Wells Monitoring, Maintenance and Rehabilitation Program* implements tools that allow for early detection of well problems, and aims at preventing poor well performance and well failure. The goal of a consistent implementation of the well maintenance program is to ensure the wells' longevity, productivity and efficiency. Timely scheduling of preventive maintenance is essential to achieving this goal. The field tests are completed jointly by CWD field staff and KWD; KWD analyzes the data. In 2016:

- Pump speed tests (to assess pump performance) were completed for all three production wells (RW 3-93/11, RW 7-00/13 and RW 1-87/14);
- Step-drawdown pumping tests (to assess well hydraulic performance) were completed for all three production wells.

In May 2016, inactive Well 1-87 was permanently closed. This entailed the removal of the underground chamber and closure of the well by filling the well completed with a sealant (Bentonite clay angular chips). Well closure was completed by Fyfe Well & Water Services; the underground chamber was removed by an excavation contractor. CWD staff removed all the infrastructure and wiring from the underground chamber.

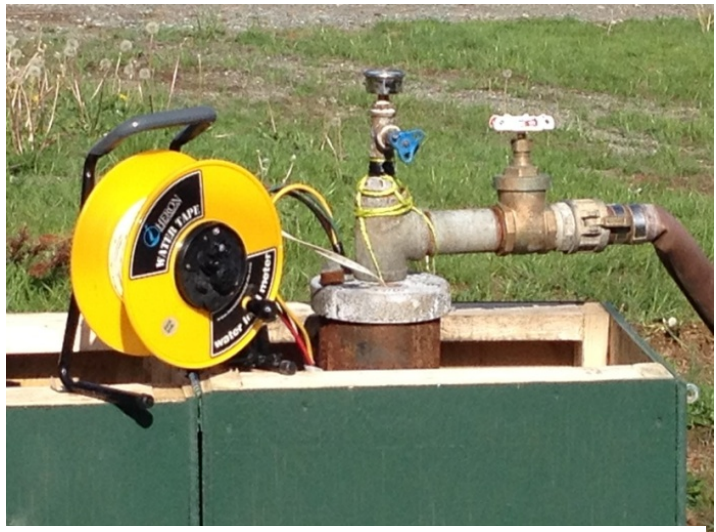
### **Hydraulic Modeling**

Hydraulic modeling was completed for CWD's existing water system model (developed in Innovyze<sup>®</sup> Infowater<sup>®</sup>) pertaining to (i) the simulation of the emergency chlorinator operation (modeling of chlorine residual in the water system); and (ii) the design and modeling of a Uni-

Directional Flushing Program. The hydraulic modeling was completed by GeoAdvice Engineering Inc. (GeoAdvice).

### **Well Replacement Program**

Phase 2 of RW 2-63 Project was implemented in 2016, and which entailed the implementation of the groundwater monitoring program (groundwater levels and water quality) for the test well constructed for future well RW 2-63 (the test well was constructed under Phase 1 of RW 2-63 Project in December 2015). KWD has summarized the results of the groundwater monitoring program in a consulting report (Phase 1 and Phase 2 reporting for RW 2-63 Project).



**IMAGE | GROUNDWATER MONITORING IN PROGRESS (SHORT-DURATION PUMPING TEST)**

### **3.2 Scheduled Projects for 2017**

The following projects are scheduled for 2017:

- 1) **RW 2-63 Project:** The drilling, construction, testing and mechanical completion of RW 2-63; the project includes the tie-in of the well to the water manifold and distribution system; the planning is to bring the well online in 2017; Fyfe Well & Water Services is the drilling contractor; KWD is the project Hydrogeologist;
- 2) **Pump House Expansion Project:** The pump house at Autumn Well field will be expanded to accommodate the operation of a second production well (RW 2-63) and storage of chlorine (for the emergency chlorinators); the project also includes an enclosure for the generator;

- 3) **Well Maintenance Program:** Preventative maintenance for RW 7-00/13 (inspection of the interior condition of the well screen followed by some rehabilitation to remove well screen blockage due to mineral deposits and biofouling); The maintenance will be completed by Fyfe Well & Water Services;
- 4) **Operations Facility Construction Project:** A new facility will be constructed at the reservoir site (and which replaces the operations facility at Janzen Street); and
- 5) **Pipe Placement Program:** Approximately 300 meters of aging A/C water main will be replaced by 250 mm Bionax on Springhill Street and Old Yale Road.

## 4.0 Water Quality Assurance

### 4.1 Water Quality Monitoring

Providing safe, reliable and clean water to our rate payers remains CWD's key responsibility. We take pride in providing drinking water of the highest quality at a reasonable cost, thereby meeting water demand, complying with provincial regulations, and working responsibly to protect our aquifer. According to *Section 15 (b) of the Drinking Water Protection Act* (Government of B.C.), a water supplier must make available to the public the results of the monitoring required by the regulations. The Drinking Water Protection Regulation under the Drinking Water Protection Act sets water quality standards for potable water (selected microbiological constituents in drinking water). The Drinking Water Act and Regulation are enforced for community water systems in British Columbia<sup>3</sup>.

Therefore, as a water purveyor we are required to have our water analyzed to confirm the absence of selected microbiological parameters by an accredited laboratory. This entails the weekly monitoring of our water supply and distribution system: CWD has 25 water sampling locations throughout the District which, and on a rotating basis, are sampled and analyzed for *Total Coliforms* and *Escherichia Coliform (E.coli)*. Furthermore, water samples are collected from the wells and reservoirs, and analyzed on the required microbiological parameters. The results of the



**IMAGE | SAMPLE STATION**

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<sup>3</sup> Environmental health officers routinely inspect, sample and assess community water systems for compliance with the Drinking Water Protection Act and Regulation ([www.fraserhealth.ca](http://www.fraserhealth.ca)).

microbiological water quality samples submitted to and completed by the Fraser Health Authority for 2016 are presented in **Appendix B**.

Furthermore, once a year (in December) water samples are collected from each of the production wells and are submitted to an accredited laboratory for potability analysis (**Section 5.1**). In 2016, water samples were also collected from the reservoirs. In April and November, Biological Activity Reaction Tests were completed for water samples collected from the well and aquifer formation (**Section 5.2**).

## **4.2 Water Quality Technician's Report 2016**

The year 2016 was again an interesting and good year for CWD's water system and water quality monitoring. Throughout 2016 water quality was monitored on a routine basis as per CWD's standard operating procedure; additional water quality testing was completed on an as-needed basis following water system upgrading and maintenance work.

In February 2016, CWD entered the Berkeley Springs International Water Tasting Competition with a water sample from Well RW 7-00/13. Once again, CWD won the gold medal for Best Tasting Municipal Tap Water in the world.

In the summer months, CWD field staff added, replaced and upgraded approximately 500 m of Asbestos-Concrete (A/C) pipe with Bionax® PVC Pipe (CIOD) in the area of Carlsrue Avenue, Casper Court, and Castle, through which also the elimination of existing three dead ends was accomplished (by tying the water main sections together). The necessary pressure testing, water main chlorination (and flushing), and bacteriological testing (in-house) was performed by CWD field staff, and overseen by Opus Engineering. This project was completed in a very efficient manner, thanks to the hard work and dedication of CWD's field staff.

Weekly bacteriological samples were taken for and submitted to Fraser Health, in addition to our own in-house bacteriological water sampling and analysis. A total of 228 samples were taken for Fraser Health, and 334 were taken for in-house analysis, yielding a total of 562 bacteriological samples taken in 2016. CWD's in-house sampling showed no positive *Escherichia Coli* (*E.coli*)

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test results, and any positive *Total Coliform* test results were immediately re-sampled in-house and results for which were found to be negative (no *Total Coliform* count).

In 2016, CWD introduced the Unidirectional Flushing (UDF) Program. UDF is a method of water main flushing that utilizes the closing of valves to isolate certain areas of the distribution system in order to achieve high velocity in the water mains, leading to a thorough scouring effect on the interior surfaces of the water mains. As this was the first time of implementing UDF the water mains were subjected to high water velocity, longer flushing times were often encountered, and more sediment and coloured water was observed. Bacteriological sampling (testing) in areas recently flushed (via UDF) showed several instances of *Total Coliform* proliferation, both in the distribution system as well as our reservoirs. This necessitated the practice of reservoir overflow (in October and November) as well as targeted re-flushing of affected areas (water main sections). In-house water analysis showed that our efforts appeared to be effective as *Total Coliform* bacteria were absent shortly after the flushing program concluded.

The emergency chlorinators installed at Autumn and Lynden well sites (in pump stations) have been test run (water flowed from, and back into a pail) to confirm correct operation. The planning is to have a chlorine storage room be built in Autumn Well Field Pump Station in 2017. Related to the emergency chlorinator operation, hydraulic modeling (of the water system) was completed by GeoAdvice, as part of the Emergency Response Plan, to facilitate fast and efficient chlorination of affected areas (or the entire system in case required) in the event of (microbiological) contamination in the distribution system.

Bacteriological Activity Reaction Tests (BART) sampling and testing took place in early April and late November of 2016. BART results show aggressivity at varying level for some of the tested bacterial communities for one or more water samples collected for the wells (Iron Related Bacteria, IRB, and Heterotrophic Aerobic Bacteria). None of the wells showed bacterial activities pertaining to Sulphate Reducing Bacteria and Slime Forming Bacteria. With respect to IRB, less aggressivity was observed for RW 3-93/11 compared to November 2015 test results (we believe that high aggressivity in 2015 was a result of the completed preventative maintenance for this well).

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On December 19, 2016, water samples were collected from each well (RW 1-87/14, RW 3-93/11, and RW 7-00/13), and were delivered to Exova for our Annual Potability Testing. Furthermore, water samples were collected at the Reservoir Pump Station, representing water entering the reservoirs. The results of the analysis confirm that all analyzed parameters were within the guideline limits (as per *Guidelines for Canadian Drinking Water Quality*).

Overall, it was a good year for CWD. The challenges we faced with the Uni-Directional Flushing Program were met with a cohesive resolve, which brought about a quick, effective solution. It will be interesting to see what effect further implementations of the UDF will have on flushing times and water quality (*Total Coliform*).

Ryan Federau

Water Quality

Clearbrook Waterworks District



## 5.0 Water Quality Review

### 5.1 Potability Analysis Results

Raw water samples were collected from **RW 3-93/11**, **RW 7-00/13**, and **RW 1-87/14** on December 19, 2016<sup>4</sup>. On the same day water samples were collected in the pump house at the **reservoir site** (thereby sampling the water flowing into the reservoirs). The water samples were analyzed by Exova Group plc (Exova), an accredited laboratory located in Surrey B.C., on: (i) *physical properties*; (ii) *water chemistry*; and (iii) *microbiological parameters*. **Appendix C** includes the original lab reports prepared by Exova. All water analyses (and reports) are referenced by **Lot ID 1177995** (Exova reference).

**Tables 5.1 - 5.4** summarize the water quality analysis data (physical parameters, metals, miscellaneous parameters, and microbiological parameters, respectively). Results are evaluated towards the most recent edition of the *Guidelines for Canadian Drinking Water Quality* (Health Canada 2017). The tables also include the results for the sample collected at the reservoir site.

In summary, results of the water analysis suggest that the water quality meets the requirements stated in the most recent edition of the *Guidelines for Canadian Drinking Water Quality*.

Furthermore, the water quality results for the water sample collected at the reservoir is overall similar to the water quality results for the water samples collected at the source (wells). The following paragraphs provide some further information regarding selected results (for the wells), including physical properties, metals, miscellaneous parameters, and microbiology.

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<sup>4</sup> Water samples were collected and submitted to Exova by Ryan Federau (Water Quality Technician).

## Physical Properties

### pH

The pH (“potential of hydrogen”) is a measure for hydrogen-ion concentration in water, and tells something about the acid-base equilibrium. A pH measurement less than 7.0 means that the water is acidic; a value equal to 7.0 means that the water is neutral, and a value more than 7.0 means that water is basic (alkaline).

The pH values (**Table 5.1**) for RW 3-93/11, RW 7-00/13, and RW 1-87/14 are **6.82**, **6.72**, and **7.22** respectively, suggesting that the water ranges from slightly *acidic* to *basic*. According to Health Canada (2017), to pH applies the Operational Guideline for Water Treatment Plants (OG), with a pH ranging from 7.0 to 10.0<sup>5</sup>. OG is not applicable to CWD’s water system. Based on historical records for CWD production wells, pH values vary between years, with results suggesting groundwater to be ranging from (slightly) acidic to basic.

**TABLE 5.1 PHYSICAL PARAMETERS**

Parameter	RW 3-93/11	RW 7-00/13	RW 1-87/14	Reservoir*	Canadian Drinking Water Guidelines	Units	Guideline comment
Sample date	Dec. 19, 2016	Dec. 19, 2016	Dec. 19, 2016	Dec. 19, 2016			
Lot ID	1177995	1177995	1177995	1177995			
Reference No.	1177995-3	1177995-4	1177995-2	1177995-1			
pH (at 25°C)	6.82	6.72	7.22	7.07	7.0-10.5	---	OG
Total dissolved solids (TDS)	166	135	156	157	500	mg/l	below AO
Electric conductivity	-	-	-	-	<i>no guideline set</i>	µS/cm at 25 °C	-
Turbidity	0.22	0.60	0.19	0.15	0.1	NTU	OG
Colour	< 5	< 5	< 5	< 5	<i>no guideline set</i>	Colour units	-
Hardness (CaCO <sub>3</sub> )	100	79	100	100	<i>no guideline set</i>	mg/l	-

AO = Aesthetic Objective; OG = Operational Guideline for Water Treatment Plants

\* The incoming water to the reservoirs is sampled in the pump station.

<sup>5</sup> pH used to have an Aesthetic Objective (AO) guideline, with pH ranging between 6.5 and 8.5.

### **Total Dissolved Solids**

Total Dissolved Solids (TDS) is the total amount of materials dissolved (mineral constituents) in water, computed from conductivity and turbidity. High levels of TDS can cause hardness, unpalatability, mineral deposition and corrosion. At low levels, however, TDS contributes to the palatability of water (Health Canada 1978). TDS and Electrical Conductivity (EC) are closely related. (The more ions dissolved in the water, the higher the value of the electric conductivity).

TDS values (**Table 5.1**) for RW 3-93/11, RW 7-00/13, and RW 1-87/14 are **166 milligrams per litre (mg/l)**, **135 mg/l**, and **156 mg/l**, respectively (and thus below the AO of 500 mg/l).

### **Turbidity**

Turbidity is a measure of the relative clarity of water, and turbidity in water is caused by suspended and colloidal matter (fine sand, clay, silt, organic and inorganic matter, and microscopic organisms). Turbidity is also a useful indicator of groundwater quality changes.

Turbidity values can be impacted by groundwater recharge events as recharging displaces sediments, especially if groundwater is under direct influence of surface water (CWD's water source is not under direct influence of surface water).

Turbidity guideline limit is 0.1 Nephelometric Turbidity Unit (NTU), and which is an OG (and thus not applicable to CWD's water system). However, in order to minimize particulate loading and effectively operate the distribution system, it is considered a good practice to ensure that water entering the distribution system has turbidity levels below 1.0 NTU) (Health Canada 2017).

Turbidity values (**Table 5.1**) are **0.22 NTU**, **0.60 NTU**, and **0.19 NTU** for RW 3-93/11, RW 7-00/13, and RW 1-87/14, respectively.

### **Hardness**

This parameter is an indicator for the degree of softness or hardness of water. Soft water can have a corrosive effect, whereas hard water may result in scale deposits (incrustation in e.g., the water distribution system). MAC has not been established, but generally water with hardness greater than 200 mg/l is considered poor, and in excess of 500 mg/l is unacceptable for most domestic purposes. Hardness (**Table 5.1**) is evaluated based on the concentration of calcium

carbonate ( $\text{CaCO}_3$ ) because calcium ( $\text{Ca}^{2+}$ ) and carbonate ( $\text{CO}_3^{2-}$ ) are the dominant ions in most hard waters.

$\text{CaCO}_3$  values for RW 3-93/11, RW 7-00/13, and RW 1-87/14 are **100 mg/l**, **97 mg/l**, and **100 mg/l** respectively, which categorises the sampled water as moderately hard (60-120 mg/l).

Hardness levels between 80 and 100 mg/L (as  $\text{CaCO}_3$ ) are generally considered to provide an acceptable balance between corrosion and incrustation (Health Canada 1979b).

### **Metals (Extractable)**

#### **Manganese**

Manganese is a metallic element either naturally occurring through weathering of minerals and rocks, or due to human influences entering the groundwater through leaching or effluent. The AO guideline is 0.05 mg/l. Concentrations exceeding 0.15 mg/l can stain plumbing fixtures and laundry. It can also produce undesirable tastes in beverages. Even at concentrations below 0.05 mg/l, manganese may form coatings on water distribution pipes that may slough off as black precipitates (Health Canada 1987). Presence of manganese in water may lead to microbial growth in and around the well casing and water distribution system.

The manganese concentration (**Table 5.2**) for RW 3-93/11 was found to be below Nominal Detection Limit (NDL) of **0.001 mg/l**. The manganese concentration for RW 7-00/13 and RW 1-87/14 are **0.002 mg/l** and **0.033 mg/l**, respectively (which are below AO guideline criterion).

**TABLE 5.2 METALS (EXTRACTABLE)**

Metal extractable	Symbol	RW 3-93/11	RW 7-00/13	RW 1-87/14	Reservoir*	Canadian Drinking Water Guidelines	Units	Guideline comment
Sample date		Dec. 19, 2016	Dec. 19, 2016	Dec. 19, 2016	Dec. 19, 2016			
Lot ID		1177995	1177995	1177995	1177995			
Reference No.		1177995-3	1177995-4	1177995-2	1177995-1			
<b>Aluminium</b>	<b>Al</b>	0.00123	0.00122	0.00120	<0.00100	0.1	mg/l	below OG
<b>Antimony</b>	<b>Sb</b>	0.000042	0.000030	0.000122	0.000064	0.006	mg/l	below MAC
<b>Arsenic</b>	<b>As</b>	0.0004	0.0003	0.0012	0.0006	0.01	mg/l	below MAC
<b>Barium</b>	<b>Ba</b>	0.0066	0.0054	0.0188	0.0107	1	mg/l	below MAC
<b>Boron</b>	<b>Ba</b>	0.015	0.011	0.021	0.016	5	mg/l	below MAC
<b>Cadmium</b>	<b>Cd</b>	0.000029	0.000026	0.000014	0.000017	0.005	mg/l	below MAC
<b>Chromium</b>	<b>Cr</b>	0.000163	0.000218	<0.000050	0.000053	0.05	mg/l	below MAC
<b>Copper</b>	<b>Cu</b>	0.0019	0.0031	<0.0005	<0.0005	1	mg/l	below AO
<b>Lead</b>	<b>Pb</b>	0.000217	0.000108	<0.00001	<0.00001	0.01	mg/l	below MAC
<b>Selenium</b>	<b>Se</b>	0.0006	0.0003	0.0007	0.0005	0.01	mg/l	below MAC
<b>Uranium</b>	<b>U</b>	0.000090	0.000018	0.000150	0.000099	0.02	mg/l	below MAC
<b>Vanadium</b>	<b>V</b>	0.000477	0.000512	0.000387	0.000430	<i>no guideline set</i>	mg/l	-
<b>Zinc</b>	<b>Zn</b>	0.0496	0.0228	0.0011	0.0012	5	mg/l	below AO
<b>Calcium</b>	<b>Ca</b>	29.5	22.2	28.7	28.3	<i>no guideline set</i>	mg/l	-
<b>Iron</b>	<b>Fe</b>	0.007	0.005	0.012	0.008	0.3	mg/l	below AO
<b>Magnesium</b>	<b>Mg</b>	7.4	5.6	7.4	7.0	<i>no guideline set</i>	mg/l	-
<b>Manganese</b>	<b>Mn</b>	<0.001	0.002	0.033	0.004	0.05	mg/l	below AO
<b>Potassium</b>	<b>K</b>	1.6	1.3	2.2	1.7	<i>no guideline set</i>	mg/l	-
<b>Silicon</b>	<b>Si</b>	9.64	10.3	8.21	9.14	<i>no guideline set</i>	mg/l	-
<b>Sodium</b>	<b>Na</b>	10.2	6.9	9.3	8.9	200	mg/l	below AO
<b>Sulphur</b>	<b>S</b>	-	-	-	-	<i>no guideline set</i>	mg/l	-

MAC = Maximum Acceptable Concentration; OG = Operational Guideline; AO = Aesthetic Objective.

\* The incoming water to the reservoirs is sampled in the pump station.

## Iron

Like manganese, iron is a metallic element either naturally occurring through weathering of minerals and rocks, or due to human influences entering the groundwater through leaching or effluent. The **AO** guideline is 0.3 mg/l. Similar to manganese, concentrations exceeding **AO** can cause staining (plumbing fixtures and laundry) and can produce undesirable tastes in beverages. Precipitation of iron is visible as reddish-brown color to water and well components. As with

manganese, the presence of iron may lead to the growth of unwanted bacteria (that form slime coating) in the water infrastructure.

Iron concentrations (**Table 5.2**) for RW 3-93/11, RW 7-00/13, and RW 1-87/14 are **0.007 mg/l**, **0.005 mg/l**, and **0.012 mg/l**, respectively, meeting the **AO** guideline criterion.

### **Arsenic**

Arsenic is a natural element that is widely distributed throughout the Earth's crust, often found naturally in groundwater, through erosion and weathering of soils, minerals, and ores (Health Canada 2006). Arsenic is classified as a human carcinogen. The **MAC** guideline for Arsenic is 0.01 mg/l.

Arsenic concentrations (**Table 5.2**) are **0.0004 mg/l**, **0.0003 mg/l** and **0.0012 mg/l** for RW 3-93/11, RW 7-00/13, and RW 1-87/14, respectively, thereby meeting the **MAC** guideline criterion.

### **Miscellaneous Parameters**

#### **Nitrogen**

Nitrate ( $NO_3^-$ ) and nitrite ( $NO_2^-$ ), both products of the oxidation of nitrogen by micro-organisms in plant, soil and water, are naturally occurring ions that are ever-present in the environment. Nitrates are used widely as inorganic fertilizers. **MAC** levels for nitrate and nitrite are 10 mg/l and 1 mg/l respectively.

Nitrate nitrogen concentrations (**Table 5.3**) are **2.13 mg/l**, **2.86 mg/l**, and **0.886 mg/l** for RW 3-93/11, RW 7-00/13, and RW 1-87/14, respectively (and thus below **MAC** guideline criterion). Water sample results for all three wells indicate that nitrite nitrogen concentrations are **below NDL** of **0.01 mg/l**.

**TABLE 5.3 MISCELLANEOUS PARAMETERS: INORGANICS,  
ANIONS AND NITROGENS**

Parameter	Symbol / Chemical Formula	RW 3-93/11	RW 7-00/13	RW 1-87/14	Reservoir*	Canadian Drinking Water Guidelines	Units	Guideline comment
Sample date	Dec. 19,	Dec. 19, 2016	Dec. 19, 2016	Dec. 19, 2016				
Lot ID	1177995	1177995	1177995	1177995				
Reference No.	1177995-3	1177995-4	1177995-2	1177995-1				
<b>Inorganics</b>								
Alkalinity (total)	CaCO <sub>3</sub>	60	45	81	65	<i>no guideline set</i>	mg/l	-
Fluoride	F <sup>-</sup>	0.048	0.046	0.059	0.073	1.5	mg/l	below MAC
<b>Anions</b>								
Dissolved sulphate	SO <sub>4</sub> <sup>2-</sup>	17.7	13.1	21.4	17.8	500	mg/l	below AO
Dissolved chloride	Cl <sup>-</sup>	28.5	18.2	12.3	21.0	250	mg/l	below AO
<b>Nitrogens (N)</b>								
Nitrate - N	NO <sub>3</sub> <sup>-</sup>	2.13	2.86	0.886	1.84	10.0	mg/l	below MAC
Nitrite - N	NO <sub>2</sub> <sup>-</sup>	<0.01	<0.01	<0.01	<0.01	1.0	mg/l	below MAC

MAC = Maximum Acceptable Concentration; AO = Aesthetic Objective.

\* The incoming water to the reservoirs is sampled in the pump station.

## Fluoride

Fluoride is a chemical that naturally occurs in groundwater from leaching of fluoride-containing rock formations, breakdown of soils, and deposition of atmospheric volcanic particulates.

Fluoride is also introduced to the water system through agricultural practices, chemical manufacturing plants, and septic and sewage systems. Health Canada has established a **MAC** of 1.5 mg/l for fluoride.

Water samples results (**Table 5.3**) show fluoride concentrations of **0.048 mg/l**, **0.046 mg/l**, and **0.059 mg/l** for RW 3-93/11, RW 7-00/13, and RW 1-87/14 respectively (and which are below **MAC**).

## **Microbiology**

### **Total Coliforms**

Total coliforms are bacteria species (organisms) that are found naturally in water, soil, vegetation, and human and animal faeces. Because total coliforms are widespread in the environment, they can be used as one of the many operational tools to determine the efficacy of a drinking water treatment system (Health Canada 2012a). Coliforms are an indicator of the sanitary condition of the groundwater. If any colonies are detected, corrective measures must be implemented.

The Health Canada guideline limit for Total Coliforms is 0 MPN (Most Probable Number) per 100 millilitres (ml); i.e., none detectable per 100 ml (MAC guideline). Water sample results (**Table 5.4**) for all three wells show total coliforms concentration values < 1 MPN/100 ml, thereby meeting Health Canada guideline criterion for total coliforms of **0 per 100 ml**.

### **Escherichia Coliform (E.coli)**

E.coli is member (subgroup) of the total coliforms group but is found exclusively in faeces of humans and animals. Its presence in water indicates not only recent faecal contamination of the water but also the possible presence of intestinal disease-causing bacteria, viruses, and protozoa; The ability to detect faecal contamination in drinking water is a necessity, as pathogenic microorganisms from human and animal faeces in drinking water pose the greatest danger to public health (Health Canada 2012b). The detection of E.coli should lead to an immediate issuing of a boil water advisory, notifying the responsible authorities, investigating the cause of the contamination, and implementing corrective actions.

The MAC guideline limit for E.coli is 0 MPN per 100 ml (i.e., no E.coli colonies must be detected). Water samples results (**Table 5.4**) for all three wells show E.coli concentration values less than 1 MPN/100 ml, thus meeting Health Canada guideline criterion for E.coli of **0 per 100 ml**. (Absence of this bacteria does not necessarily indicate that intestinal viruses and protozoa are also absent.)



TABLE 5.4 MICROBIOLOGICAL PARAMETERS

Parameter	RW 3-93/11	RW 7-00/13	RW 1-87/14	Reservoir*	Canadian Drinking Water Guidelines	Units	Guideline comment
Sample date	Dec. 19, 2016	Dec. 19, 2016	Dec. 19, 2016	Dec. 19, 2016			
Lot ID	1177995	1177995	1177995	1177995			
Reference No.	1177995-3	1177995-4	1177995-2	1177995-1			
<b>Total coliform bacteria</b>	< 1.0	< 1.0	< 1.0	< 1.0	0 MPN / 100 ml	MPN / ml	below MAC
<b>Escherichia coliform bacteria subgroup (E. Coli)</b>	< 1.0	< 1.0	< 1.0	< 1.0	0 MPN / 100 ml	MPN / ml	below MAC
<b>Heterotrophic Count - Aerobic</b>	2.0	< 2	40	2.0	<i>no guideline set</i>	MPN / ml	-

MAC = Maximum Acceptable Concentration.

\* The incoming water to the reservoirs is sampled in the pump station.

## 5.2 Biological Activity Reaction Test (BART)

The biological activity reaction test (BART) is a method to analyze several bacterial communities that can cause problems for water quality (e.g. turbidity), aesthetics (e.g. odour, discoloration, cloudiness) and water infrastructure (e.g. corrosion). The following bacterial communities were analyzed:

1. **Iron Related Bacteria (IRB):** cause taste and odour problems and “red water”. This leads to staining of plumbing fittings and laundry; IRB can provide a place in wells for other bacteria to live, can increase corrosion, and can cause encrustation of well screens and pumps;
2. **Sulphate Reducing Bacteria (SRB):** a group of anaerobic bacteria that generate hydrogen sulphide (H<sub>2</sub>S) and cause a number of significant problems in water, ranging from “rotten egg” odours to the blackening of equipment, slime formations, and the initiation of corrosive processes;

3. **Slime Forming Bacteria (SLYM)**: create slimes, turbidity, foul tastes and odours; and
4. **Heterotrophic Aerobic Bacteria (HAB)**: one form is aerobes, which removes organics quickly, and one form is fermentors (anaerobic) that make acids (very low pH).

### **Data collection protocol**

BART samples were collected in April and November 2016 for RW 3-93/11, RW 7-00/13, and RW 1-87/14. Sufficient downtime was practiced prior to taking the water samples (i.e., 48 hours). Water samples for BART were collected at the start-up of the pump operation ( $t = 0$ ), after 20 minutes of pumping ( $t = 20$ ) and after 2 hours of pumping ( $t = 120$ ). Samples collected at these times represent various distances from the well (i.e., in the well casing, just outside the well screen, and the aquifer formation at  $t = 0$ ,  $t = 20$ , and  $t = 120$ , respectively).

Water samples were collected from each well for preparing the IRB, SRB, SLYM and HAB testers. Water samples were collected for each sample retrieval time; yielding twelve (12) samples (vials) per well. These vials were observed and analyzed during the course of nine (9) days following the start of the BART<sup>6</sup>. For more information about BART and the interpretation of the results, the reader is referred to DBI (2004). BART-Soft v6 (developed and distributed by DBI) is applied to obtain qualitative and quantitative results.

### **BART Results**

**Table 5.5** summarizes the results. The table shows on which day a reaction occurs, and the type of reaction. The number of days from taking the sample to the occurrence of a reaction (i.e. positive reaction) is called “time lag”. In general, the shorter the time lag, the greater the aggressivity of the bacterial population is, and the more likely there is a need for addressing well treatment (i.e., well maintenance / rehabilitation).

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<sup>6</sup> BART is completed in-house by Ryan Federau (Water Quality Technician).

## Clearbrook Waterworks District 2016 Water Quality Report

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Results suggest that:

### With respect to **IRB**

Aggressivity was ranging from low to medium, observed in at least two or more samples for each well (**Table 5.5**). IRB medium aggressivity was observed the most for RW 3-93/11, with the exception of (t = 0) for the November test (*no reaction observed*). RW 7-00/13 results show a low reaction for (t = 0) for the April test, and a medium reaction for (t = 20) for the April test and (t = 0) for the November test. RW 1-87/14 results reveal medium IRB aggressivity for (t = 0) for the April test, and low aggressivity for (t = 20) for the November test.

### With respect to **HAB**

Aggressivity, ranging from low to medium, was observed for all three wells (at least two or more positive reactions per well). For RW 3-93/11 only low aggressivity was reported for (t = 0) and (t = 20) for both tests (April and November). RW 7-00/13 results show medium aggressivity for (t = 0) only (for April and November tests), and low aggressivity for (t = 120). RW 1-87/14 results show low aggressivity for (t = 0) for April and November tests.

### With respect to **SRB** and **SLYM**

None of the wells showed bacterial activities pertaining to **SRB** and **SLYM**. (No reactions, reportedly, occurred in 2014 and 2015.)

In summary, BART results suggest that no actions are required at this point, but vigilance through an ongoing testing program should be practiced.

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2016 Water Quality Report**

**TABLE 5.5 BART RESULTS**

Well	Tester	Test session 2016-01 (Sampled at Apr. 6 & 8, 2016)			Test session 2016-02 (Sampled at Nov. 28 & 29 & 30, 2016)		
		Sample retrieval time			Sample retrieval time		
		t = 0	t = 20 min	t = 120 min	t = 0	t = 20 min	t = 120 min
RW 3-93/11	IRB	Day 6 (FO BR) <b>550 (M)</b>	Day 5 (FO) Day 6 (BR) <b>2,200 (M)</b>	Day 5 (FO) Day 6 (BR) <b>2,200 (M)</b>	no reaction	Day 5 (BR) 2,200 <b>2,200 (M)</b>	Day 5 (BR) 2,200 <b>2,200 (M)</b>
	SRB	no reaction	no reaction	no reaction	no reaction	no reaction	no reaction
	SLYM	no reaction	no reaction	no reaction	no reaction	no reaction	no reaction
	HAB	Day 6 (DO) <b>446 (L)</b>	Day 9 (UP) <b>31 (L)</b>	no reaction	Day 8 (UP) <b>65 (L)</b>	Day 8 (UP) <b>65 (L)</b>	no reaction
	Downtime	48 hours			48 hours		
RW 7-00/13	IRB	Day 9 (FO) <b>8 (L)</b>	Day 5 (FO BR) <b>2,200 (M)</b>	no reaction	Day 6 (FO BR) <b>550 (M)</b>	no reaction	no reaction
	SRB	no reaction	no reaction	no reaction	no reaction	no reaction	no reaction
	SLYM	no reaction	no reaction	no reaction	no reaction	no reaction	no reaction
	HAB	Day 4 (UP) <b>7,440 (M)</b>	no reaction	no reaction	Day 4 (UP) <b>7,440 (M)</b>	no reaction	Day 7 (UP) <b>155 (L)</b>
	Downtime	48 hours			48 hours		
RW 1-87/14	IRB	Day 8 (FO) Day 9 (BR) <b>34 (M)</b>	no reaction	no reaction	no reaction	Day 9 (FO) <b>8 (L)</b>	no reaction
	SRB	no reaction	no reaction	no reaction	no reaction	no reaction	no reaction
	SLYM	no reaction	no reaction	no reaction	no reaction	no reaction	no reaction
	HAB	Day 5 (DO) <b>1,590 (L)</b>	no reaction	no reaction	Day 6 (DO) <b>446 (L)</b>	no reaction	no reaction
	Downtime	48 hours			48 hours		

**Key:**

- IRB Iron Related Bacteria
- SRB Sulphate Reducing Bacteria
- SLYM Slime Forming Bacteria
- HAB Heterotrophic Aerobic Bacteria
- BR Brown ring around the ball: very aerobic IRB
- FO Ring of foam bubbles around the ball: anaerobic IRB communities
- DO Bleaching spreads downwards faster than it ascends in the tester; anaerobic heterotrophic functions dominate
- H High aggressivity
- M Medium aggressivity
- L Low aggressivity
- 1,590 colony forming units per millilitre (cfu /ml) or predicted active cells per  
(number) mL, (pac/mL)

## 6.0 References

DBI. 2004. Biological Activity Reaction Test (BART™). User Manual. Droycon Bioconcepts Inc., Regina, Saskatchewan, Canada. URL: <http://www.dbi.ca>.

Health Canada. 1978. Total Dissolved Solids (TDS) - Technical Document, September 1978 (updated January 1991). Available at: <http://www.hc-sc.gc.ca>.

Health Canada. 1979b. Hardness - Technical Document, February 1979 (reprinted 1995). Available at: <http://www.hc-sc.gc.ca>.

Health Canada. 1987. Manganese. Technical Document. Available at: <http://www.hc-sc.gc.ca>.

Health Canada 2006. Guidelines for Canadian Drinking Water Quality: Arsenic. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment Ottawa, Ontario. Available at <http://www.hc-sc.gc.ca>.

Health Canada. 2012a. Guidelines for Canadian Drinking Water Quality. Guideline Technical Document: Total Coliforms. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment, Ottawa, Ontario. URL: <http://www.hc-sc.gc.ca>.

Health Canada. 2012b. Guidelines for Canadian Drinking Water Quality. Guideline Technical Document: Esherichia coli. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment, Ottawa, Ontario. URL: <http://www.hc-sc.gc.ca>. March 2012.

Health Canada. 2017. Guidelines for Canadian Drinking Water Quality. Summary table. Drinking Water Guidelines. *Prepared by the Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment.* Available at <http://www.hc-sc.gc.ca> (*most recent update of on-line version: February 2017*).

# Appendices

# Appendix A

**Metals in Drinking Water – “Flush” Message” (Fraser Health)**



**fraserhealth**

Better health.  
Best in health care.

February 26, 2016

*Water System Operators*

**Re: Metals in Drinking Water – “Flush” Message in Annual Reports**

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Fraser Health has recently revised its metals at the tap “Flush” message and we are asking all water systems to please include the following health message with your next annual reports to your users.

***Anytime the water in a particular faucet has not been used for six hours or longer, “flush” your cold-water pipes by running the water until you notice a change in temperature. (This could take as little as five to thirty seconds if there has been recent heavy water use such as showering or toilet flushing. Otherwise, it could take two minutes or longer.) The more time water has been sitting in your home's pipes, the more lead it may contain.***

***Use only water from the cold-tap for drinking, cooking, and especially making baby formula. Hot water is likely to contain higher levels of lead.***

***The two actions recommended above are very important to the health of your family. They will probably be effective in reducing lead levels because most of the lead in household water usually comes from the plumbing in your house, not from the local water supply.***

***Conserving water is still important. Rather than just running the water down the drain you could use the water for things such as watering your plants.***

If you have any questions, please contact our Drinking Water Program at 604-870-7903.

Sincerely,

Marc Zubel  
Manager, Drinking Water Program  
Health Protection

Public Health Protection  
Fraser Health Authority

#207 - 2776 Bourquin Crescent West  
Abbotsford BC  
V2S 6A4 Canada

Tel: (604) 870-7900  
Fax: (604) 870-7901  
[www.fraserhealth.ca](http://www.fraserhealth.ca)



## **Appendix B**

Sample Range Report Fraser Health Authority

## Sample Range Report

Fraser Health Authority

**Facility Name:** Clearbrook Waterworks District  
**Date Range:** Jan 1 2016 to Dec 31 2016

**Operator**

<u>Sampling Site</u>	<u>Date Collected</u>	<u>Total Coliform</u>	<u>E. Coli</u>	<u>Fecal Coliform</u>
<u>2580 Langdon St -</u>				
<u>East end of</u>				
<u>driveway, 2580</u>				
<u>Langdon St - East</u>				
<u>end of driveway</u>				
	1/18/2016	L1	L1	
	2/15/2016	L1	L1	
	3/21/2016	L1	L1	
	4/11/2016	L1	L1	
	5/24/2016	L1	L1	
	6/20/2016	L1	L1	
	7/18/2016	L1	L1	
	8/22/2016	L1	L1	
	9/26/2016	L1	L1	
	10/25/2016	L1	L1	
	11/22/2016	<u>L1</u>	<u>L1</u>	
	<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>
<u>2889 Upland Cres.</u>				
<u>2889 Upland Cres</u>				
	1/4/2016	L1	L1	
	2/9/2016	L1	L1	
	3/21/2016	L1	L1	
	5/9/2016	L1	L1	
	6/20/2016	L1	L1	
	8/2/2016	L1	L1	
	9/12/2016	L1	L1	
	10/25/2016	L1	L1	
	12/5/2016	L1	L1	
	12/19/2016	<u>L1</u>	<u>L1</u>	
	<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>
<u>2564 Clearbrook Rd.</u>				
<u>(Office), 2564</u>				
<u>Clearbrook Road</u>				
	1/26/2016	L1	L1	
	2/22/2016	L1	L1	
	3/29/2016	L1	L1	
	5/2/2016	L1	L1	

5/30/2016	L1	L1	
6/27/2016	L1	L1	
8/2/2016	L1	L1	
8/29/2016	L1	L1	
9/26/2016	L1	L1	
11/1/2016	L1	L1	
11/28/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2743 Moorland St.  
2743 Moorland St

1/26/2016	L1	L1	
2/29/2016	L1	L1	
4/25/2016	L1	L1	
5/30/2016	L1	L1	
7/11/2016	L1	L1	
8/22/2016	L1	L1	
10/3/2016	1	L1	
11/14/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>1</b>	<b>0</b>	<b>0</b>

32171 South Fraser  
Way (Petro  
Canada), 32171  
South Fraser Way  
(Petro Canada)

2/2/2016	L1	L1	
2/29/2016	L1	L1	
3/29/2016	L1	L1	
4/25/2016	L1	L1	
5/24/2016	L1	L1	
6/27/2016	L1	L1	
7/25/2016	L1	L1	
8/22/2016	L1	L1	
9/19/2016	L1	L1	
10/17/2016	L1	L1	
11/22/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

31419 Springhill  
Court, 31419  
Springhill Court

1/4/2016	L1	L1	
2/15/2016	L1	L1	
3/29/2016	L1	L1	
5/16/2016	L1	L1	
6/27/2016	L1	L1	
8/8/2016	L1	L1	
9/19/2016	L1	L1	
11/1/2016	L1	L1	
12/12/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

3089 Claudia Court,  
3089 Claudia Court

1/18/2016	L1	L1	
2/29/2016	L1	L1	
4/4/2016	L1	L1	
5/2/2016	L1	L1	
5/30/2016	L1	L1	
6/27/2016	L1	L1	
7/25/2016	L1	L1	
8/29/2016	L1	L1	
9/26/2016	L1	L1	
10/17/2016	L1	L1	
11/22/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

31898 Royal  
Crescent, 31898  
Royal Crescent

1/26/2016	L1	L1	
2/22/2016	L1	L1	
3/14/2016	L1	L1	
4/19/2016	L1	L1	
5/9/2016	L1	L1	
6/6/2016	L1	L1	
7/4/2016	L1	L1	
8/8/2016	L1	L1	
9/19/2016	1	L1	
10/11/2016	L1	L1	
11/14/2016	L1	L1	
12/12/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>1</b>	<b>0</b>	<b>0</b>

31894 Duchess Ave.,  
31894 Duchess Ave

2/2/2016	L1	L1	
2/29/2016	L1	L1	
3/29/2016	L1	L1	
4/25/2016	L1	L1	
5/24/2016	L1	L1	
6/20/2016	L1	L1	
7/11/2016	L1	L1	
8/15/2016	L1	L1	
9/6/2016	L1	L1	
10/11/2016	L1	L1	
11/1/2016	L1	L1	
12/5/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2749 Braeside  
Street, 2749  
Braeside Street

2/2/2016	L1	L1	
----------	----	----	--

3/14/2016	L1	L1	
4/19/2016	L1	L1	
5/2/2016	L1	L1	
6/13/2016	L1	L1	
7/25/2016	L1	L1	
9/6/2016	L1	L1	
10/17/2016	L1	L1	
11/28/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

32073 Mt  
Waddington Ave.,  
32073 Mt  
Waddington Ave

1/11/2016	L1	L1	
2/9/2016	L1	L1	
3/7/2016	L1	L1	
4/11/2016	L1	L1	
5/9/2016	L1	L1	
6/20/2016	L1	L1	
7/25/2016	L1	L1	
8/22/2016	L1	L1	
9/19/2016	L1	L1	
10/17/2016	L1	L1	
11/14/2016	<u>1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>1</b>	<b>0</b>	<b>0</b>

2903 Palm Crescent,  
2903 Palm Crescent

1/11/2016	L1	L1	
2/15/2016	L1	L1	
3/14/2016	L1	L1	
4/19/2016	L1	L1	
5/16/2016	L1	L1	
6/13/2016	L1	L1	
7/4/2016	L1	L1	
8/2/2016	L1	L1	
9/6/2016	L1	L1	
10/3/2016	L1	L1	
11/1/2016	L1	L1	
11/28/2016	L1	L1	
12/5/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

32350 Diamond  
Cres, 32350  
Diamond Cres

1/4/2016	L1	L1	
2/2/2016	L1	L1	
3/7/2016	L1	L1	
4/4/2016	L1	L1	
5/2/2016	L1	L1	
6/6/2016	L1	L1	

7/18/2016	L1	L1	
8/15/2016	L1	L1	
9/12/2016	L1	L1	
11/7/2016	L1	L1	
12/12/2016	L1	L1	
12/19/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2940 Clearbrook  
Rd.(Bible Col), 2940  
Clearbrook Road

1/18/2016	L1	L1	
2/15/2016	L1	L1	
3/21/2016	L1	L1	
4/25/2016	L1	L1	
5/30/2016	L1	L1	
7/4/2016	L1	L1	
8/2/2016	L1	L1	
8/29/2016	L1	L1	
10/3/2016	L1	L1	
10/25/2016	L1	L1	
11/28/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2464 Sunnyside  
Place, 2464  
Sunnyside Place

1/11/2016	L1	L1	
2/22/2016	L1	L1	
4/4/2016	L1	L1	
5/24/2016	L1	L1	
7/4/2016	L1	L1	
8/15/2016	L1	L1	
9/26/2016	L1	L1	
11/7/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

Reservoir C (1985),  
2886 Grandview  
Cres

2/2/2016	L1	L1	
4/4/2016	L1	L1	
6/6/2016	L1	L1	
8/2/2016	L1	L1	
10/3/2016	L1	L1	
12/5/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2664 Albert Way,  
2664 Albert Way

1/18/2016	L1	L1	
3/7/2016	L1	L1	

4/11/2016	L1	L1	
6/13/2016	L1	L1	
7/18/2016	L1	L1	
8/29/2016	L1	L1	
10/11/2016	L1	L1	
11/22/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2459 Centre Street  
(at United Rentals),  
2459 Centre Street  
(at United Rentals)

1/11/2016	L1	L1	
2/9/2016	L1	L1	
3/7/2016	L1	L1	
4/11/2016	L1	L1	
5/9/2016	L1	L1	
6/6/2016	L1	L1	
7/11/2016	L1	L1	
8/8/2016	L1	L1	
9/6/2016	L1	L1	
10/3/2016	L1	L1	
11/7/2016	L1	L1	
12/12/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2577 Victoria Street,  
2577 Victoria St

1/26/2016	L1	L1	
2/22/2016	L1	L1	
3/21/2016	L1	L1	
4/19/2016	L1	L1	
5/16/2016	L1	L1	
6/13/2016	L1	L1	
7/18/2016	L1	L1	
8/15/2016	L1	L1	
9/12/2016	L1	L1	
10/25/2016	L1	L1	
11/14/2016	L1	L1	
12/19/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

Reservoir B (1970),  
2886 Grandview  
Cres

1/4/2016	L1	L1	
2/29/2016	L1	L1	
5/2/2016	L1	L1	
7/4/2016	L1	L1	
9/6/2016	L1	L1	
11/1/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

2425 Lynden Street,  
2425 Lynden Street

1/4/2016	L1	L1	
2/9/2016	L1	L1	
3/14/2016	L1	L1	
4/4/2016	L1	L1	
5/16/2016	L1	L1	
6/13/2016	L1	L1	
7/11/2016	L1	L1	
8/8/2016	L1	L1	
9/12/2016	L1	L1	
10/11/2016	L1	L1	
11/7/2016	L1	L1	
12/5/2016	L1	L1	
12/19/2016	<u>L1</u>	<u>L1</u>	
<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

Result Values:	E - estimated	L - less than	G - greater than
Samples that contain total coliform:	3		1.39% of total
Samples that contain e. coli:	0		0.00% of total
Samples that contain fecal coliform:	0		0.00% of total
Number of consecutive samples that contain total coliform:	0		
Number of samples that contain total coliform in last 30 days:	0/8		
Total number of samples:	216		

**Comments:**

\_\_\_\_\_  
 Environmental Health Officer  
 Jan 16 2017

FOR FURTHER INFORMATION PLEASE CALL: Barb Haworth (604) 870-7900



## Sample Range Report

Fraser Health Authority

**Facility Name:** Clearbrook Waterworks District

**Date Range:** Jan 1 2016 to Dec 31 2016

**Operator**

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
<u>RW 1-87-14, Autumn Ave</u>	1/4/2016	L1	L1	
	4/4/2016	L1	L1	
	7/4/2016	L1	L1	
	10/3/2016	<u>L1</u>	<u>L1</u>	
	<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Result Values:**                      E - estimated                      L - less than                      G - greater than

Samples that contain total coliform:	0		0.00% of total
Samples that contain e. coli:	0		0.00% of total
Samples that contain fecal coliform:	0		0.00% of total
Number of consecutive samples that contain total coliform:	0		
Number of samples that contain total coliform in last 30 days:	0/0		
Total number of samples:	4		

**Comments:**

\_\_\_\_\_  
Environmental Health Officer  
Jan 17 2017

FOR FURTHER INFORMATION PLEASE CALL: Barb Haworth (604) 870-7900

## Sample Range Report

Fraser Health Authority

**Facility Name:** Clearbrook Waterworks District

**Date Range:** Jan 1 2016 to Dec 31 2016

**Operator**

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
<u>RW 3-93, Lynden St</u>	2/2/2016	L1	L1	
	5/2/2016	L1	L1	
	8/2/2016	L1	L1	
	11/1/2016	<u>L1</u>	<u>L1</u>	
	<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Result Values:**                      E - estimated                      L - less than                      G - greater than

Samples that contain total coliform:	0		0.00% of total
Samples that contain e. coli:	0		0.00% of total
Samples that contain fecal coliform:	0		0.00% of total
Number of consecutive samples that contain total coliform:	0		
Number of samples that contain total coliform in last 30 days:	0/0		
Total number of samples:	4		

**Comments:**

\_\_\_\_\_  
Environmental Health Officer  
Jan 17 2017

FOR FURTHER INFORMATION PLEASE CALL: Barb Haworth (604) 870-7900

## Sample Range Report

Fraser Health Authority

**Facility Name:** Clearbrook Waterworks District

**Date Range:** Jan 1 2016 to Dec 31 2016

**Operator**

Sampling Site	Date Collected	Total Coliform	E. Coli	Fecal Coliform
<u>Well RW 7 - 00/13,</u>				
<u>Lynden St</u>				
	2/29/2016	L1	L1	
	6/6/2016	L1	L1	
	9/6/2016	L1	L1	
	12/5/2016	<u>L1</u>	<u>L1</u>	
	<b>Total Positive:</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Result Values:**                      E - estimated                      L - less than                      G - greater than

Samples that contain total coliform:	0		0.00% of total
Samples that contain e. coli:	0		0.00% of total
Samples that contain fecal coliform:	0		0.00% of total
Number of consecutive samples that contain total coliform:	0		
Number of samples that contain total coliform in last 30 days:	0/0		
Total number of samples:	4		

**Comments:**

\_\_\_\_\_  
Environmental Health Officer

Jan 17 2017

FOR FURTHER INFORMATION PLEASE CALL: Barb Haworth (604) 870-7900

## **Appendix C**

Exova Water Quality Analysis Reports

## Report Transmission Cover Page

Bill To: Clearbrook Waterworks District    Project:  
Report To: Clearbrook Waterworks District    ID:  
          2564 Clearbrook Road                    Name:  
          Abbotsford, BC, Canada                Location:  
          V2T 2Y5                                    LSD:  
Attn: Ryan Federau                                P.O.:  
Sampled By:                                        Acct code:  
Company:

Lot ID: **1177995**  
Control Number: C0062014  
Date Received: Dec 19, 2016  
Date Reported: Dec 22, 2016  
Report Number: 2157365

Contact & Affiliation	Address	Delivery Commitments
Accounts Payable Clearbrook Waterworks District	2564 Clearbrook Road Abbotsford, British Columbia V2T 2Y5 Phone: (604) 850-6621 Fax: (604) 850-7862 Email: <a href="mailto:office@clearbrookwaterworks.com">office@clearbrookwaterworks.com</a>	On [Lot Approval and Final Test Report Approval] send (COC, Test Report, Invoice) by Email - Merge Reports
Carol Nam Surrey QC	104, 19575 - 55 Avenue Surrey, British Columbia V3S 8P8 Phone: (604) 514-3322 Fax: (604) 514-3323 Email: <a href="mailto:carol.nam@exova.com">carol.nam@exova.com</a>	On [Report Approval] send (Test Report) by Email - Single Report
Ineke Kalwij Kalwij Water Dynamics Inc	P.O. Box 684 Station Main Port Coquitlam, British Columbia V3B 6H9 Phone: (604) 475-4063 Fax: (604) 475-4062 Email: <a href="mailto:ineke@kalwijwaterdynamics.com">ineke@kalwijwaterdynamics.com</a>	On [Report Approval] send (COC, Test Report) by Email - Merge Reports
Ryan Federau Clearbrook Waterworks District	2564 Clearbrook Road Abbotsford, British Columbia V2T 2Y5 Phone: (604) 309-3986 Fax: (604) 850-7862 Email: <a href="mailto:ryan@clearbrookwaterworks.com">ryan@clearbrookwaterworks.com</a>	On [Lot Verification] send (COA) by Email - Single Report On [Report Approval] send (COC, Test Report) by Email - Merge Reports On [Lot Creation] send (COR) by Email - Single Report

### Notes To Clients:

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## Analytical Report

Bill To: Clearbrook Waterworks District Project:  
 Report To: Clearbrook Waterworks District ID:  
 2564 Clearbrook Road Name:  
 Abbotsford, BC, Canada Location:  
 V2T 2Y5 LSD:  
 Attn: Ryan Federau P.O.:  
 Sampled By: Acct code:  
 Company:

Lot ID: **1177995**  
 Control Number: C0062014  
 Date Received: Dec 19, 2016  
 Date Reported: Dec 22, 2016  
 Report Number: 2157365

Reference Number 1177995-1  
 Sample Date December 19, 2016  
 Sample Time 10:20  
 Sample Location  
 Sample Description Reservoir Incoming / 7.6°C  
 Sample Matrix Drinking Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments	
<b>Metals Extractable</b>						
Aluminum	Extractable mg/L	<0.00100	0.001	0.1	Below OG	
Antimony	Extractable mg/L	0.000064	0.00002	0.006	Below MAC	
Arsenic	Extractable mg/L	0.0006	0.0001	0.010	Below MAC	
Barium	Extractable mg/L	0.0107	0.0001	1	Below MAC	
Boron	Extractable mg/L	0.016	0.002	5	Below MAC	
Cadmium	Extractable mg/L	0.000017	0.00001	0.005	Below MAC	
Chromium	Extractable mg/L	0.000053	0.00005	0.05	Below MAC	
Copper	Extractable mg/L	<0.0005	0.0005	1.0	Below AO	
Lead	Extractable mg/L	<0.00001	0.00001	0.01	Below MAC	
Selenium	Extractable mg/L	0.0005	0.0002	0.05	Below MAC	
Uranium	Extractable mg/L	0.000099	0.00001	0.02	Below MAC	
Vanadium	Extractable mg/L	0.000430	0.00005			
Zinc	Extractable mg/L	0.0012	0.0005	5.0	Below AO	
<b>Microbiological Analysis</b>						
Total Coliforms	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Escherichia coli	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Heterotrophic Count - Aerobic	SimPlate	MPN/mL	2.0	2		
<b>Physical and Aggregate Properties</b>						
Colour	True	Colour units	<5	5		
Turbidity		NTU	0.15	0.02		
<b>Routine Water</b>						
pH - Holding Time			Exceeded			
pH	at 25 °C		7.07		6.5-8.5	Within AO
Calcium	Extractable	mg/L	28.3	0.01		
Iron	Extractable	mg/L	0.008	0.004	0.3	Below AO
Magnesium	Extractable	mg/L	7.0	0.02		
Manganese	Extractable	mg/L	0.004	0.001	0.05	Below AO
Potassium	Extractable	mg/L	1.7	0.04		
Silicon	Extractable	mg/L	9.14	0.005		
Sodium	Extractable	mg/L	8.9	0.1	200	Below AO
T-Alkalinity	as CaCO3	mg/L	65	5		
Chloride	Dissolved	mg/L	21.0	0.05	250	Below AO
Fluoride	Dissolved	mg/L	0.073	0.01	1.5	Below MAC
Nitrate - N	Dissolved	mg/L	1.84	0.01	10	Below MAC

## Analytical Report

Bill To: Clearbrook Waterworks District Project:  
Report To: Clearbrook Waterworks District ID:  
2564 Clearbrook Road Name:  
Abbotsford, BC, Canada Location:  
V2T 2Y5 LSD:  
Attn: Ryan Federau P.O.:  
Sampled By: Acct code:  
Company:

Lot ID: **1177995**  
Control Number: C0062014  
Date Received: Dec 19, 2016  
Date Reported: Dec 22, 2016  
Report Number: 2157365

---

<b>Reference Number</b>	1177995-1
<b>Sample Date</b>	December 19, 2016
<b>Sample Time</b>	10:20
<b>Sample Location</b>	
<b>Sample Description</b>	Reservoir Incoming / 7.6°C
<b>Sample Matrix</b>	Drinking Water

---

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
<b>Routine Water - Continued</b>						
Nitrite - N	Dissolved	mg/L	<0.01	0.01	1	Below MAC
Sulfate (SO4)	Dissolved	mg/L	17.8	0.1	500	Below AO
Hardness	as CaCO3 (extractable)	mg/L	100	1		
Total Dissolved Solids	Extractable	mg/L	157	1		

## Analytical Report

Bill To: Clearbrook Waterworks District  
 Report To: Clearbrook Waterworks District  
 2564 Clearbrook Road  
 Abbotsford, BC, Canada  
 V2T 2Y5  
 Attn: Ryan Federau  
 Sampled By:  
 Company:

Project:  
 ID:  
 Name:  
 Location:  
 LSD:  
 P.O.:  
 Acct code:

Lot ID: **1177995**  
 Control Number: C0062014  
 Date Received: Dec 19, 2016  
 Date Reported: Dec 22, 2016  
 Report Number: 2157365

**Reference Number** 1177995-2  
**Sample Date** December 19, 2016  
**Sample Time** 09:52  
**Sample Location**  
**Sample Description** RW 1-87/14 / 7.6°C  
**Sample Matrix** Drinking Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments	
<b>Metals Extractable</b>						
Aluminum	Extractable mg/L	0.00120	0.001	0.1	Below OG	
Antimony	Extractable mg/L	0.000122	0.00002	0.006	Below MAC	
Arsenic	Extractable mg/L	0.0012	0.0001	0.010	Below MAC	
Barium	Extractable mg/L	0.0188	0.0001	1	Below MAC	
Boron	Extractable mg/L	0.021	0.002	5	Below MAC	
Cadmium	Extractable mg/L	0.000014	0.00001	0.005	Below MAC	
Chromium	Extractable mg/L	<0.000050	0.00005	0.05	Below MAC	
Copper	Extractable mg/L	<0.0005	0.0005	1.0	Below AO	
Lead	Extractable mg/L	<0.00001	0.00001	0.01	Below MAC	
Selenium	Extractable mg/L	0.0007	0.0002	0.05	Below MAC	
Uranium	Extractable mg/L	0.000150	0.00001	0.02	Below MAC	
Vanadium	Extractable mg/L	0.000387	0.00005			
Zinc	Extractable mg/L	0.0011	0.0005	5.0	Below AO	
<b>Microbiological Analysis</b>						
Total Coliforms	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Escherichia coli	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Heterotrophic Count - Aerobic	SimPlate	MPN/mL	40.0	2		
<b>Physical and Aggregate Properties</b>						
Colour	True	Colour units	<5	5		
Turbidity		NTU	0.19	0.02		
<b>Routine Water</b>						
pH - Holding Time			Exceeded			
pH	at 25 °C		7.22		6.5-8.5	Within AO
Calcium	Extractable	mg/L	28.7	0.01		
Iron	Extractable	mg/L	0.012	0.004	0.3	Below AO
Magnesium	Extractable	mg/L	7.4	0.02		
Manganese	Extractable	mg/L	0.033	0.001	0.05	Below AO
Potassium	Extractable	mg/L	2.2	0.04		
Silicon	Extractable	mg/L	8.21	0.005		
Sodium	Extractable	mg/L	9.3	0.1	200	Below AO
T-Alkalinity	as CaCO3	mg/L	81	5		
Chloride	Dissolved	mg/L	12.3	0.05	250	Below AO
Fluoride	Dissolved	mg/L	0.059	0.01	1.5	Below MAC
Nitrate - N	Dissolved	mg/L	0.886	0.01	10	Below MAC



## Analytical Report

Bill To: Clearbrook Waterworks District Project:  
Report To: Clearbrook Waterworks District ID:  
2564 Clearbrook Road Name:  
Abbotsford, BC, Canada Location:  
V2T 2Y5 LSD:  
Attn: Ryan Federau P.O.:  
Sampled By: Acct code:  
Company:

Lot ID: **1177995**  
Control Number: C0062014  
Date Received: Dec 19, 2016  
Date Reported: Dec 22, 2016  
Report Number: 2157365

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**Reference Number** 1177995-2  
**Sample Date** December 19, 2016  
**Sample Time** 09:52  
**Sample Location**  
**Sample Description** RW 1-87/14 / 7.6°C  
**Sample Matrix** Drinking Water

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Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
<b>Routine Water - Continued</b>						
Nitrite - N	Dissolved	mg/L	<0.01	0.01	1	Below MAC
Sulfate (SO4)	Dissolved	mg/L	21.4	0.1	500	Below AO
Hardness	as CaCO3 (extractable)	mg/L	100	1		
Total Dissolved Solids	Extractable	mg/L	156	1		

## Analytical Report

Bill To: Clearbrook Waterworks District  
 Report To: Clearbrook Waterworks District  
 2564 Clearbrook Road  
 Abbotsford, BC, Canada  
 V2T 2Y5  
 Attn: Ryan Federau  
 Sampled By:  
 Company:

Project:  
 ID:  
 Name:  
 Location:  
 LSD:  
 P.O.:  
 Acct code:

Lot ID: **1177995**  
 Control Number: C0062014  
 Date Received: Dec 19, 2016  
 Date Reported: Dec 22, 2016  
 Report Number: 2157365

**Reference Number** 1177995-3  
**Sample Date** December 19, 2016  
**Sample Time** 09:21  
**Sample Location**  
**Sample Description** RW 3-93/11 / 7.6°C  
**Sample Matrix** Drinking Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments	
<b>Metals Extractable</b>						
Aluminum	Extractable mg/L	0.00123	0.001	0.1	Below OG	
Antimony	Extractable mg/L	0.000042	0.00002	0.006	Below MAC	
Arsenic	Extractable mg/L	0.0004	0.0001	0.010	Below MAC	
Barium	Extractable mg/L	0.0066	0.0001	1	Below MAC	
Boron	Extractable mg/L	0.015	0.002	5	Below MAC	
Cadmium	Extractable mg/L	0.000029	0.00001	0.005	Below MAC	
Chromium	Extractable mg/L	0.000163	0.00005	0.05	Below MAC	
Copper	Extractable mg/L	0.0019	0.0005	1.0	Below AO	
Lead	Extractable mg/L	0.000217	0.00001	0.01	Below MAC	
Selenium	Extractable mg/L	0.0006	0.0002	0.05	Below MAC	
Uranium	Extractable mg/L	0.000090	0.00001	0.02	Below MAC	
Vanadium	Extractable mg/L	0.000477	0.00005			
Zinc	Extractable mg/L	0.0496	0.0005	5.0	Below AO	
<b>Microbiological Analysis</b>						
Total Coliforms	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Escherichia coli	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Heterotrophic Count - Aerobic	SimPlate	MPN/mL	2.0	2		
<b>Physical and Aggregate Properties</b>						
Colour	True	Colour units	<5	5		
Turbidity		NTU	0.22	0.02		
<b>Routine Water</b>						
pH - Holding Time			Exceeded			
pH	at 25 °C		6.82		6.5-8.5	Within AO
Calcium	Extractable	mg/L	29.5	0.01		
Iron	Extractable	mg/L	0.007	0.004	0.3	Below AO
Magnesium	Extractable	mg/L	7.4	0.02		
Manganese	Extractable	mg/L	<0.001	0.001	0.05	Below AO
Potassium	Extractable	mg/L	1.6	0.04		
Silicon	Extractable	mg/L	9.64	0.005		
Sodium	Extractable	mg/L	10.2	0.1	200	Below AO
T-Alkalinity	as CaCO3	mg/L	60	5		
Chloride	Dissolved	mg/L	28.5	0.05	250	Below AO
Fluoride	Dissolved	mg/L	0.048	0.01	1.5	Below MAC
Nitrate - N	Dissolved	mg/L	2.13	0.01	10	Below MAC

## Analytical Report

Bill To: Clearbrook Waterworks District Project:  
 Report To: Clearbrook Waterworks District ID:  
 2564 Clearbrook Road Name:  
 Abbotsford, BC, Canada Location:  
 V2T 2Y5 LSD:  
 Attn: Ryan Federau P.O.:  
 Sampled By: Acct code:  
 Company:

Lot ID: **1177995**  
 Control Number: C0062014  
 Date Received: Dec 19, 2016  
 Date Reported: Dec 22, 2016  
 Report Number: 2157365

**Reference Number** 1177995-3  
**Sample Date** December 19, 2016  
**Sample Time** 09:21  
**Sample Location**  
**Sample Description** RW 3-93/11 / 7.6°C  
**Sample Matrix** Drinking Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
<b>Routine Water - Continued</b>						
Nitrite - N	Dissolved	mg/L	<0.01	0.01	1	Below MAC
Sulfate (SO4)	Dissolved	mg/L	17.7	0.1	500	Below AO
Hardness	as CaCO3 (extractable)	mg/L	100	1		
Total Dissolved Solids	Extractable	mg/L	166	1		

## Analytical Report

Bill To: Clearbrook Waterworks District  
 Report To: Clearbrook Waterworks District  
 2564 Clearbrook Road  
 Abbotsford, BC, Canada  
 V2T 2Y5  
 Attn: Ryan Federau  
 Sampled By:  
 Company:

Project:  
 ID:  
 Name:  
 Location:  
 LSD:  
 P.O.:  
 Acct code:

Lot ID: **1177995**  
 Control Number: C0062014  
 Date Received: Dec 19, 2016  
 Date Reported: Dec 22, 2016  
 Report Number: 2157365

**Reference Number** 1177995-4  
**Sample Date** December 19, 2016  
**Sample Time** 09:35  
**Sample Location**  
**Sample Description** RW 7-00/13 / 7.6°C  
**Sample Matrix** Drinking Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments	
<b>Metals Extractable</b>						
Aluminum	Extractable mg/L	0.00122	0.001	0.1	Below OG	
Antimony	Extractable mg/L	0.000030	0.00002	0.006	Below MAC	
Arsenic	Extractable mg/L	0.0003	0.0001	0.010	Below MAC	
Barium	Extractable mg/L	0.0054	0.0001	1	Below MAC	
Boron	Extractable mg/L	0.011	0.002	5	Below MAC	
Cadmium	Extractable mg/L	0.000026	0.00001	0.005	Below MAC	
Chromium	Extractable mg/L	0.000218	0.00005	0.05	Below MAC	
Copper	Extractable mg/L	0.0031	0.0005	1.0	Below AO	
Lead	Extractable mg/L	0.000108	0.00001	0.01	Below MAC	
Selenium	Extractable mg/L	0.0003	0.0002	0.05	Below MAC	
Uranium	Extractable mg/L	0.000018	0.00001	0.02	Below MAC	
Vanadium	Extractable mg/L	0.000512	0.00005			
Zinc	Extractable mg/L	0.0228	0.0005	5.0	Below AO	
<b>Microbiological Analysis</b>						
Total Coliforms	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Escherichia coli	Enzyme Substrate Test	MPN/100 mL	<1.0	1.0	0 per 100 mL	Below MAC
Heterotrophic Count - Aerobic	SimPlate	MPN/mL	<2.0	2		
<b>Physical and Aggregate Properties</b>						
Colour	True	Colour units	<5	5		
Turbidity		NTU	0.60	0.02		
<b>Routine Water</b>						
pH - Holding Time			Exceeded			
pH	at 25 °C		6.72		6.5-8.5	Within AO
Calcium	Extractable	mg/L	22.2	0.01		
Iron	Extractable	mg/L	0.005	0.004	0.3	Below AO
Magnesium	Extractable	mg/L	5.6	0.02		
Manganese	Extractable	mg/L	0.002	0.001	0.05	Below AO
Potassium	Extractable	mg/L	1.3	0.04		
Silicon	Extractable	mg/L	10.3	0.005		
Sodium	Extractable	mg/L	6.9	0.1	200	Below AO
T-Alkalinity	as CaCO3	mg/L	45	5		
Chloride	Dissolved	mg/L	18.2	0.05	250	Below AO
Fluoride	Dissolved	mg/L	0.046	0.01	1.5	Below MAC
Nitrate - N	Dissolved	mg/L	2.86	0.01	10	Below MAC

## Analytical Report

Bill To: Clearbrook Waterworks District Project:  
Report To: Clearbrook Waterworks District ID:  
2564 Clearbrook Road Name:  
Abbotsford, BC, Canada Location:  
V2T 2Y5 LSD:  
Attn: Ryan Federau P.O.:  
Sampled By: Acct code:  
Company:

Lot ID: **1177995**  
Control Number: C0062014  
Date Received: Dec 19, 2016  
Date Reported: Dec 22, 2016  
Report Number: 2157365

---

**Reference Number** 1177995-4  
**Sample Date** December 19, 2016  
**Sample Time** 09:35  
**Sample Location**  
**Sample Description** RW 7-00/13 / 7.6°C  
**Sample Matrix** Drinking Water

---

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
<b>Routine Water - Continued</b>						
Nitrite - N	Dissolved	mg/L	<0.01	0.01	1	Below MAC
Sulfate (SO4)	Dissolved	mg/L	13.1	0.1	500	Below AO
Hardness	as CaCO3 (extractable)	mg/L	79	1		
Total Dissolved Solids	Extractable	mg/L	135	1		

Approved by:   
Mathieu Simoneau  
Operations Manager

Data have been validated by Analytical Quality Control and Exova's Integrated Data Validation System (IDVS).

Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

## Methodology and Notes

Bill To: Clearbrook Waterworks District Project:  
 Report To: Clearbrook Waterworks District ID:  
 2564 Clearbrook Road Name:  
 Abbotsford, BC, Canada Location:  
 V2T 2Y5 LSD:  
 Attn: Ryan Federau P.O.:  
 Sampled By: Acct code:  
 Company:

Lot ID: **1177995**  
 Control Number: C0062014  
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 Date Reported: Dec 22, 2016  
 Report Number: 2157365

## Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Alk, pH, EC, Turb in water (Surrey)	APHA	* Alkalinity - Titration Method, 2320 B	21-Dec-16	Exova Surrey
Alk, pH, EC, Turb in water (Surrey)	APHA	* pH - Electrometric Method, 4500-H+ B	21-Dec-16	Exova Surrey
Anions by IEC in water (Surrey)	APHA	* Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	19-Dec-16	Exova Surrey
Heterotrophic (Standard) Plate Count (Aerobic SP) - Surrey	APHA	Enzyme Substrate Method, 9215 E	19-Dec-16	Exova Surrey
Metals SemiTrace (Extractable) in water (Surrey)	US EPA	* Metals & Trace Elements by ICP-AES, 6010C	19-Dec-16	Exova Surrey
Total and E-Coli - Colilert - DW (Surrey)	APHA	Enzyme Substrate Test, APHA 9223 B	19-Dec-16	Exova Surrey
Trace Metals (extractable) in Water (Surrey)	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	19-Dec-16	Exova Surrey
True Color in water (Surrey)	APHA	* Spectrophotometric - Single Wavelength Method, 2120 C	21-Dec-16	Exova Surrey
Turbidity - Water (Surrey)	APHA	* Turbidity - Nephelometric Method, 2130 B	19-Dec-16	Exova Surrey

\* Reference Method Modified

## References

APHA Standard Methods for the Examination of Water and Wastewater  
 US EPA US Environmental Protection Agency Test Methods

## Guidelines

Guideline Description Health Canada GCDWQ  
 Guideline Source Guidelines for Canadian Drinking Water Quality, Health Canada, October 2014  
 Guideline Comments MAC = Maximum Acceptable Concentration  
 AO = Aesthetic Objective  
 OG = Operational Guideline for Water Treatment Plants  
 Refer to Health Canada GCDWQ for complete guidelines and additional drinking water information at [www.hc-sc.gc.ca](http://www.hc-sc.gc.ca)

## Comments:

The comparison of test results to guideline limits is provided for information purposes only. This is not to be taken as a statement of conformance / nonconformance to any guideline, regulation or limit. The data user is responsible for all conclusions drawn with respect to the data and is advised to consult official regulatory references when evaluating compliance.

Please direct any inquiries regarding this report to our Client Services group.  
 Results relate only to samples as submitted.

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