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2009 Annual Overview of Wilderness Mountain's Drinking Water Quality

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ENVIRONMENTAL SUSTAINABILITY
CAPITAL REGIONAL DISTRICT
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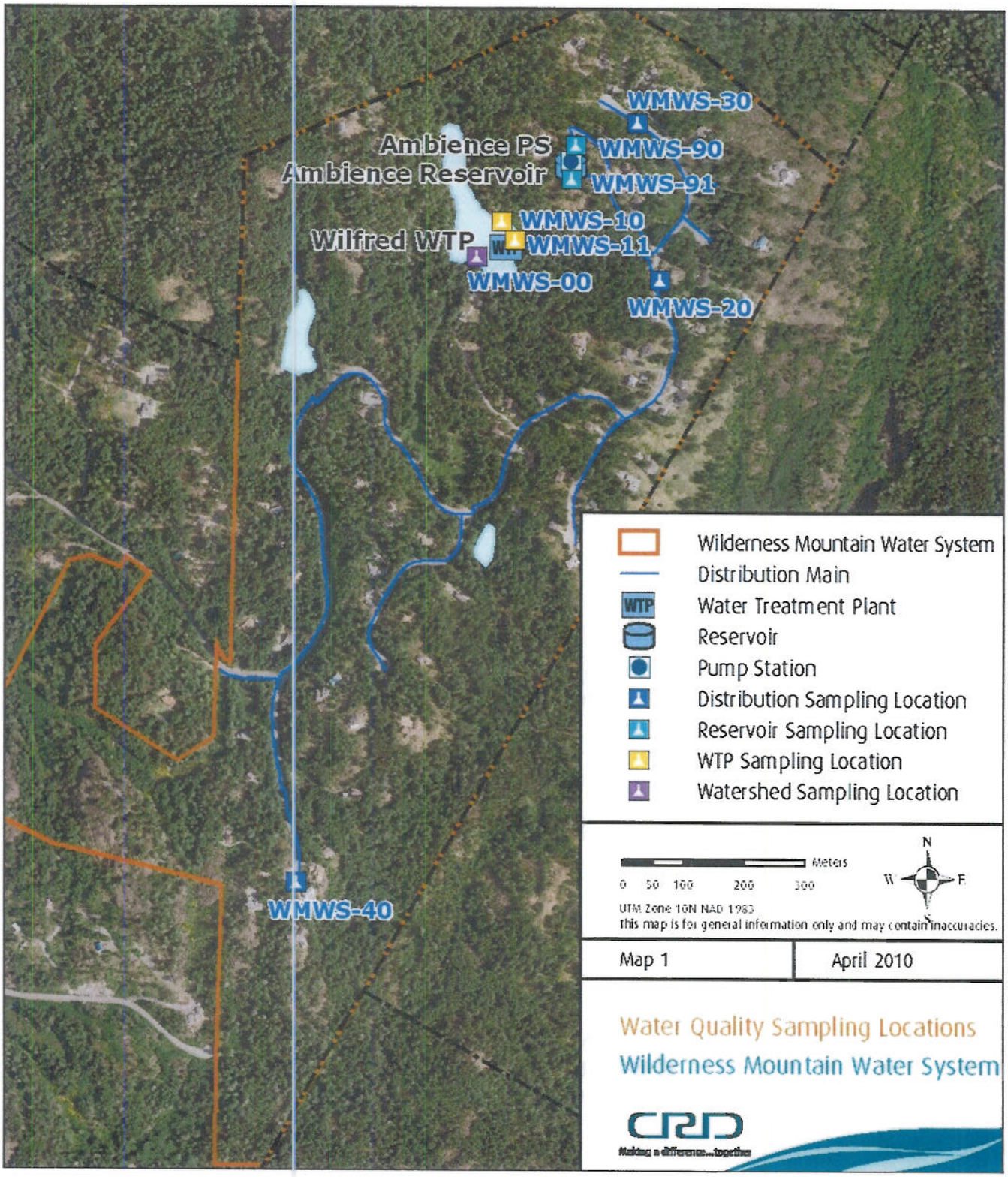
WMWS-30
Ambience PS
Ambience Reservoir
WMWS-90
WMWS-91
WMWS-10
Wilfred WTP
WMWS-11
WMWS-00
WMWS-20
WMWS-40
Wilderness Mountain Water System
Distribution Main
WTP
Water Treatment Plant
Reservoir
Pump Station
Distribution Sampling Location
Reservoir Sampling Location
WTP Sampling Location
Watershed Sampling Location
Meters
0 50 100 200 300
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UTM Zone 10N NAD 1983
This map is for general information only and may contain inaccuracies.
Map 1
April 2010
Water Quality Sampling Locations
Wilderness Mountain Water System
CRD

Executive Summary

This report is the annual overview of water quality testing conducted in 2009 in the Wilderness Mountain Drinking Water System. With the exception of a short period in July, when a Boil Water Advisory was issued, all the results were within the limits of both the *Guidelines for Canadian Drinking Water Quality* and the BC *Drinking Water Protection Regulation* and broadly show that the drinking water in this system is good quality and is safe to drink. This report is posted on the Capital Regional District (CRD) website at http://www.crd.bc.ca/jdf/waterwaste/wqreportswm.htm.

Samples and Tests. In 2009, CRD staff collected 218 samples from the Wilderness Mountain Drinking Water System and analyzed those samples for 1,754 individual tests. Approximately 270 different types of analyses were conducted on these samples. The data collected in 2009 are reported in the water quality data tables (**Tables 1 and 2**) that are posted in the Wilderness Mountain section of the CRD website and can be found at http://www.crd.bc.ca/jdf/waterwaste/wqreportswm.htm

Raw Source Water. In 2009, routine weekly sampling of the raw water entering Wilfred Water Treatment Plant started in mid-July and continued through December. The bacterial quality of the raw water entering the treatment plant was quite good containing total coliform concentrations generally below 1000 colony forming units per 100 millilitres (CFU/100 mL) and *E. coli* concentrations below 20 CFU/100mL. During the period of Oct-Dec, 2009, the biological activity in Wilfred Reservoir was, as expected at that time of year, relatively low. Concentrations of algae were not a problem.

Treatment Process. The treatment process used to disinfect the raw source water entering the Wilfred Water Treatment Plant from Wilfred Reservoir was free chlorine. Initially (prior to July 2009), the chlorine dosage rate at the Plant was approximately 1.5 mg/L. This dosage rate was increased in July and then maintained at approximately 3 mg/L to the end of the year and into 2010.

Treated Distribution Water. In July 2009, total coliform bacteria were found in a number of samples collected from the first customer, the distribution system sampling locations and the balancing reservoirs. These positive total coliform results (some of which contained more than 10 total coliform bacteria per 100 mL) caused the Wilderness Mountain Drinking Water System to be out of compliance with the BC *Drinking Water Protection Regulation* and prompted a precautionary short-term Boil Water Advisory. No *E. coli* bacteria were found in any of the treated water samples collected in the distribution system.

Parasites. In the sample collected in Dec, 2009, no *Giardia* cysts or *Cryptosporidium* oocysts were detected in the raw source water entering the Wilfred Water Treatment Plant.

Physical-Chemical. All the physical and chemical parameters were well within the Canadian Guideline limits except for summer water temperatures (above the 15°C aesthetic limit from July 9th - when routine sampling started - through September 24th) and several turbidity (cloudy water) results above 1 nephelometric turbidity units (NTUs) in July.

Metals, Non-Metals and Organics. All inorganic chemicals including metals and non-metals were within Guideline values at the entry point to the distribution system. No synthetic organic chemicals including pesticides and herbicides were detected in the raw water entering the treatment plant.

Disinfection By-Products. In the samples collected in November, 2009, total trihalomethanes (TTHMs) were well below (21.6 to 50 µg/L) the Canadian Guideline limit of 100 µg/L. Similarly, a second group of disinfection by-products, haloacetic acids (referred to as HAA5 because the limit is based on the concentration of a group of five HAAs) were well below (4.5 to 22.8 µg/L) the Canadian Guideline limit for HAAs of 80 µg/L. (**Note**: Disinfection by-product samples collected in early 2010 exceeded these limits.)

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1. Introduction

This report is the annual overview of the results from water quality samples collected in 2009 from the Wilderness Mountain Drinking Water System (**Map 1**). This report is posted on the Capital Regional District (CRD) website at http://www.crd.bc.ca/jdf/waterwaste/wqreportswm.htm.

The 2009 water quality data summaries for the untreated source water (**Table 1**) and the treated water at the first customer **(Table 2)** are provided at the end of this report (for hard copy only) and are also posted on the CRD website at

Table 1. http://www.crd.bc.ca/jdf/waterwaste/documents/2009WildernessTable1.pdf
Table 2. http://www.crd.bc.ca/jdf/waterwaste/documents/2009WildernessTable2.pdf

2. Water System Description

The Wilderness Mountain Drinking Water System is located on the western side of Mount Matheson in the Juan de Fuca Electoral District, British Columbia (**Map 1**). In 2009, the CRD owned the Wilderness Mountain Drinking Water System and operated it on behalf of the residents within the Wilderness Mountain Water Corporation service area. In 2009, this water system supplied drinking water to 67 service connections.

2.1. Source Water

Drinking water for the Wilderness Mountain Drinking Water System comes from Wilfred Reservoir, a 57,088 cubic metre (12.557 million imperial gallon) surface water reservoir of which 42,378 cubic metres (9.322 million imperial gallons) of useable water is available above the intake pipe. There are two small concrete dams and one spillway. The reservoir is recharged annually from runoff water from the adjacent uphill watershed lands. The annual drawdown has not been well documented and was influenced in the past by a substantive leak in the distribution system. The top water level elevation of the reservoir is 220 m above sea level and the reservoir has a maximum depth of approximately 10 m.

The forested catchment lands (watershed) surrounding Wilfred Reservoir (and the reservoir itself) are privately owned and are protected via Covenant ET42850 which was reassigned as of Dec. 31, 2008. The covenant is held jointly by the private owners, the CRD, the VNHS Habitat Acquisition Trust Foundation and the TLC Land Conservancy of BC. Broadly, this covenant protects the natural flora and fauna of the catchment lands, prevents any occupation that will impair or interfere with its natural state and restricts activities within the catchment lands that may be detrimental to hydrology and water quality including, but not limited to, no pesticides no hunting, and no gathering or grazing of domestic animals. Vehicle and public access to the catchment lands is controlled with locked gates and signs. A 2001 Impact Assessment states that no recreational uses shall be permitted on Wilfred Reservoir.

2.2. Water Intake and Disinfection

Wilfred Water Treatment Plant is located on the southeast shore of Wilfred Reservoir. Water from the reservoir enters a fixed level intake pipe located approx 4 m below the surface of the reservoir (at full pool) and is pumped into the Wilfred Water Treatment Plant using a submersible pump. The treatment process consists of the addition of sodium hypochlorite (provides free chlorine) to disinfect the drinking water.

2.3. Distribution System

Treated (disinfected) drinking water is pumped up the hill from the Wilfred Water Treatment Plant and enters the distribution system at the junction of Cains Way and Ambience Place. At this point, the water goes in two directions: north toward the two storage tanks (balancing reservoirs) and south past the first customer location on its way to the rest of the distribution system. At the first customer location, the water has been in contact with free chlorine for approximately 20 minutes.

2.4. Balancing Reservoirs

Treated water is stored in two 30,000 gallon, concrete, balancing reservoirs located near the top of Mount Matheson at the end of Ambience Way. These balancing reservoirs are interconnected and operate in parallel (i.e. water rises and falls in each reservoir in tandem). Each reservoir is serviced by a single inlet-outlet line located near the bottom of the reservoir.

3. Multiple Barrier Approach

All large drinking water utilities across Canada use a multiple barrier approach to prevent drinking water contamination and this approach can also be applied to smaller drinking water systems. The barriers to prevent contamination can include procedures, processes, operations and physical components. It should be noted that in any drinking water system, an individual barrier may be relatively weak and hence may be easily bypassed or defeated. This could result in the drinking water in that system becoming contaminated. However, if these relatively weak individual barriers are used in combination with each other and, especially if they are arranged in a fashion so that they complement each other, these multiple barriers are a very powerful means of preventing drinking water contamination. The exact type of barriers and how they are used are often unique to an individual drinking water system.

3.1. Barriers to Water Quality Contamination

The seven barriers typically used to prevent the water quality in a public drinking water system from becoming contaminated are listed below.

1. **Good Water System Design.** Good water system design is one of the pre-eminent barriers to drinking water contamination as it allows all of the other components within the water system to operate in an optimal fashion and does not contribute to the deterioration of the quality of the drinking water contained within the system. Good water system design includes such aspects as drinking water treatment plants that are easy to operate, piping appropriately sized to the number of users being supplied and the use of appropriate pipe materials. In the Wilderness Mountain Drinking Water System, this barrier was partially in place in 2009. Prior to the CRD taking over the operation of the system, it is presumed that the system design was reviewed by the Health Authorities. Nevertheless, good engineering principles will be used in the design of the new water treatment facility.

2. **Source Water Protection**. The source water protection barrier is used to control or eliminate as many of the physical, chemical and biological threats occurring within a catchment area which have the potential to contaminate the source water reservoir. The better the source protection, the less stress is placed on the next barrier (water treatment) to perform properly. Source water protection barriers may include restricted public access, no commercial logging, no farming, no mining, no recreational use and no use of herbicides, pesticides or fertilizers within catchment lands. It also may include an active Watershed Management Program. In the Wilderness Mountain Drinking Water System, this barrier was partially in place in 2009 although not to the same extent as in Greater Victoria Water Supply Area. The source water contained in Wilfred Reservoir lies within a catchment area where a number of activities are prohibited (see description in **Section 2.1**).

3. **Water Treatment**. The water treatment barrier is used to prevent contaminants in the source water from entering the distribution system. The type of water treatment used must be appropriate to the level of source water protection provided and the potential for source water contamination. For a surface water supply, water treatment typically includes both filtration and disinfection. In the Wilderness Mountain Drinking Water System, the water treatment barrier was partially in place in 2009 since the treatment process (using free chlorine) provided protection against bacteria and viruses but not against parasites and turbidity.

4. **Distribution System Maintenance.** This barrier includes activities such as annual water main flushing, hydrant maintenance, valve exercising, leak detection and reservoir cleaning and disinfection. This barrier helps to promote good water quality within the distribution system. In the Wilderness Mountain Drinking Water System, this barrier was largely in place in 2009 as a major leak was fixed, the water system flushed and the storage tanks disinfected.

5. **Infrastructure Replacement.** The timely replacement of aging water system infrastructure is an important mechanism to prevent the deterioration of water quality in the water mains. In the Wilderness Mountain Drinking Water System, this barrier was largely in place in 2009. The distribution system is not sufficiently old that it would require replacement and planning is underway for a new treatment plant.

6. **Well Trained and Experienced Staff.** All Water System Operators must receive regular training and be certified to operate water system components. In addition, the laboratory staff cannot analyze drinking water samples unless the laboratory has been inspected by representatives of the BC Ministry of Health and issued an operating certificate. In the Wilderness Mountain Drinking Water System, this barrier was largely in place in 2009 as CRD staff are still becoming familiar with the operation of this system.

7. **Cross Connection Control.** Cross Connection Control provides a barrier to contamination by detecting conditions that have the potential to introduce contaminants into the drinking water caused by back-flow or back-siphonage. In the Wilderness Mountain Drinking Water System, this barrier was not in place in 2009.

8. **Water Quality Monitoring.** While water quality monitoring is not a barrier in itself to prevent contamination, it is often included as a barrier because it acts as an audit and ensures that the other barriers are operating in a satisfactory manner. In the Wilderness Mountain Drinking Water System, this barrier was in place during the latter half of 2009.

4. Water Quality Regulations

In British Columbia, public drinking water systems must comply with several levels of regulations and requirements: Provincial, Federal and local Health Authority.

4.1. Provincial Regulations

The CRD Water Services Department (name changed in January, 2010 to Integrated Water Services) is the Water Supplier for the Wilderness Mountain Drinking Water System and must comply with the British Columbia *Drinking Water Protection Act* and *Drinking Water Protection Regulation* (see website at

http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/00_01009_01
http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_200_2003

4.2. Federal Regulations

In addition to Provincial regulations, the CRD Water Quality Division uses the much larger group of water quality parameters listed in the *Guidelines for Canadian Drinking Water Quality* for compliance purposes. The water quality limits in the *Guidelines for Canadian Drinking Water Quality* (see http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/sum_guide-res_recom/index-eng.php) fall into one of five categories:

1. **Maximum Acceptable Concentration (MAC).** This is a health-related limit and lists the maximum acceptable concentration of a substance that is known or suspected to cause adverse effects on health. Thus, an exceedence of a MAC can be quite serious and requires immediate action by the Water Supplier.

2. **Aesthetic Objectives (AO).** These limits apply to certain substances or characteristics of drinking water that can affect its acceptance by consumers or interfere with treatment practices for supplying good-quality drinking water. These limits are generally not health related unless the substance is well above the AO.

3. **Parameters without Guidelines**. Some chemical and physical substances have been identified as not requiring a numerical guideline because currently available data indicate that it poses no health risk or aesthetic problem at the levels currently found in drinking water in Canada. In **Tables 1 and 2**, these substances are listed as '**No Guideline Required**'.

4. **Archived Parameters.** Guidelines are archived for parameters which are no longer found in Canadian drinking water supplies at levels that could pose a risk to human health, including pesticides which are no longer registered for use in Canada, and mixtures of contaminants that are addressed individually. Some of these parameters are still being included in the current water quality monitoring program because the analytical laboratory includes them in their scans. In **Tables 1 and 2**, these parameters are listed as '**Guideline Archived**'.

5. **Operational Guidance (OG).** The limit was established based on operational considerations and listed as an Operational Guidance Value. For example, the limit for aluminum is designed to apply only to drinking water treatment plants using aluminum-based coagulants.

It should be noted that not all of the water quality parameters analyzed by the Water Quality Division have Canadian Guideline limits since some of these parameters are used for operational purposes. Where the Guidelines are silent for a particular parameter, the limit for that parameter is left blank in **Tables 1 and 2.**

4.3. Local Health Authority Requirements

For existing public drinking water systems that use surface water sources, the Vancouver Island Health Authority (VIHA) has issued a new policy that requires those water systems to maintain the following water treatment specification known as '4-3-2-1' (see details below).

- 4-log (99.99%) removal/inactivation of viruses
- 3-log (99.9%) removal/inactivation of parasites (*Giardia* cysts and *Cryptosporidium* oocysts)
- 2 treatment processes, usually filtration and disinfection
- 1 NTU turbidity (maximum) in finished water

These treatment goals may be placed on the Operating Permit as a condition that the public water system must meet. For existing water systems, VIHA is initially focussing its compliance effort on systems serving more than 500 persons. The new treatment facility for the Wilderness Mountain Drinking Water System may be required to meet these specifications.

5. Operational Changes and Events

Effective January 15, 2009, CRD Water Services took over operational control of the Wilderness Mountain Drinking Water System. Some of the operational activities undertaken and significant events that occurred are listed below:

- 11-Feb-2009 Repaired leak on 6" water main near 652 Seascape
- 26-Mar-2009 Cleaned and disinfected the south (round) balancing reservoir
- 30-Mar-2009 Cleaned and disinfected the north (square) balancing reservoir
- 18-Jul-2009 Sent out notice of Boil Water Advisory in response to bacterial contamination
- 18-Jul-2009 Raised chlorine dosage level to 3.0 mg/L at the Wilfred Water Treatment Plant
- 22-Jul-2009 Flushed the distribution system in response to the Boil Water Advisory
- 06-Aug-2009 Removed Boil Water Advisory

6. Water Quality Monitoring

6.1. Water Quality Monitoring Program

In 2009, the Water Quality Division of CRD Environmental Sustainability Department established a Water Quality Monitoring Program for the Wilderness Mountain Drinking Water System that provided not only regulatory compliance information for the drinking water system but also provided data for the design of the new water treatment facility. Under this Water Quality Monitoring Program, the Water Quality Division was responsible for the collection, analysis and reporting of water quality information in all portions of the Wilderness Mountain Drinking Water System from the source reservoir to the point of deliver (typically the water meter) to each consumer. (**Note**: Operationally, routine samples were collected by CRD Water Management Division staff under the guidance of the Water Quality Division and submitted to the Water Quality Laboratory for analyses. Quarterly, semi-annual and annual samples were collected by Water Quality Division sampling staff and submitted to internal and external laboratories.)

6.2. Sampling Frequency and Parameter Testing

Starting in mid-2009, 218 samples were collected from the Wilderness Mountain Drinking Water System and analyzed for 1,754 individual tests (this includes 553 field tests). Approximately 270 different types of tests were conducted on these samples. The sampling frequency for the individual parameters tested is shown in the last column in **Tables 1** and **2.**

6.2.1. SOURCE WATER

Starting in the fall of 2009, Wilfred Reservoir was sampled for algae. In 2009, 7 algal samples were collected from a one metre depth at the end of the dock at the Wilfred Treatment Plant. This sampling location was not ideal as it did not provide information on the algal concentrations in the water entering the intake but was an acceptable compromise which provided some algal data.

6.2.2. RAW WATER ENTERING PLANT

Also starting in September, 2009, the raw source water entering Wilfred Treatment Plant was sampled weekly and analyzed for a variety of parameters including 13 physical parameters, 13 non-metallic inorganic chemicals, 3 bacteriological parameters, 3 chlorophyll species, 2 parasites, 32 metallic parameters, 85 pesticides and herbicides, 17 polycyclic aromatic hydrocarbons (PAHs), 33 phenolics, and 72 other synthetic organic chemicals. In 2009, 52 samples were collected from the raw water entering the Wilfred Treatment Plant.

6.2.3. TREATED WATER AT FIRST CUSTOMER

At the first customer sampling location downstream of the Wilfred Treatment Plant (near 719 Cains Way), the testing included 7 physical-chemical parameters, 4 bacteriological parameters, 2 disinfectant parameters and 16 disinfection by-products (trihalomethanes and haloacetic acids) (**Table 2**). In 2009, 28 bacteriological samples were collected from the first customer sampling location.

6.2.4. DISTRIBUTION SYSTEM

At the two sampling locations established in the distribution system, water quality monitoring was comprised primarily of chlorine residual testing and bacterial indicator analyses. In 2009, 58 bacteriological samples were collected from the distribution system (primarily from two sampling locations - opposite 759 Cains Way and 563 Wilderness Place).

6.2.5. BALANCING RESERVOIRS

Starting in mid-2009, both of the balancing reservoirs were sampled weekly. Similar to the distribution system, the monitoring program focused on chlorine residuals and indicator bacteria testing. In 2009, 61 bacteriological samples were collected from the two balancing reservoirs.

7. Water Quality Results

The results of the 2009 Water Quality Monitoring Program for the Wilderness Mountain Drinking Water System are provided below. In addition, the summarized water quality data collected from the raw water entering the Wilfred Treatment Plant is shown in **Table 1** while **Table 2** lists the data for the treated water collected at the first customer sampling location below the Wilfred Treatment Plant. Both of these tables are provide at that back of this report (for hard copy only) and are posted on the CRD website at
http://www.crd.bc.ca/jdf/waterwaste/wqreportswm.htm.

In these tables, please note that the median (middle value between the high and low) is used in these tables rather than the average value. In a data set, the median eliminates the effect of extreme values (very high or very low) on the average value and provides a more realistic representation of typical conditions. **Figures 1** to **5** (also at end of the report) provide a graphical presentation of selected parameters at specific sampling locations for comparison to previous years.

7.1. Indicator Bacteria and Chlorine Residual

The Water Quality Division analyses drinking water samples for several different groups of indicator bacteria including total coliforms, *E. coli* and heterotrophic plate count (HPC) bacteria. These bacterial groups are called indicators because their presence in water indicate that disease-causing organisms may also be present. Where appropriate, the Canadian Guideline concentration limits for these bacteria are listed in **Tables 1** and **2** under the heading CANADIAN GUIDELINES.

Starting in mid-2009, the Wilderness Mountain Drinking Water System samples were all tested for total coliform bacteria using membrane filtration with the exception of the raw water entering the plant which was tested using the most probable number method (Colilert). In addition, Wilderness Mountain samples were tested for *E. coli* bacteria using membrane filtration with the exception of the raw water entering the treatment plant which was tested using the most probable number method (Colilert).

7.1.1. RAW WATER ENTERING PLANT

Total Coliform Bacteria. Starting in July 2009, total coliform samples were collected weekly from the raw water entering the treatment plant (see **Figure 1** near end of report). Moderate concentrations (typically below 1000) of total coliform bacteria were found in the raw source (untreated) water entering the Wilfred Treatment Plant during July through September of 2009 with an annual median of 196 total coliforms per 100 mL (See **Table 1**).

***E. coli* Bacteria.** In 2009, while 76% of the samples collected from the raw source water contained *E. coli*, all of the *E. coli* counts during July through December were below 20 CFU/100 mL (**Figure 1**) (**Table 1**). The low concentration of *E. coli* bacteria in the raw water entering the Wilfred Treatment Plant indicated that Wilfred Reservoir was a good quality source and met one VIHA conditions under which a water system may operate without filtration (i.e. below 20).

Heterotrophic Plate Count. Starting in mid-2009, the median Heterotrophic Plate Count (HPC) was 1,140 bacteria per mL with individual values ranging from 0 to 2,110 (**Table 1**). These numbers are typical of many surface water sources.

7.1.2. TREATED WATER AT FIRST CUSTOMER

Bacterial Indicators. The data collected from the treated water sampling location near the first customer downstream of the Wilfred Treatment Plant indicated that the bacteriological quality of the disinfected water was good in August through December. However, in July, the bacteriological quality was unacceptable when two of the five samples collected tested positive for total coliforms (**Table 3**). It is worth noting that the total coliform positives occurred when the chlorine dosage at the Wilfred Treatment Plant was quite low (less than 1.5 mg/L). However, once the chlorine dosage was increased in mid-July, there were no more occurrences of coliform positives. Overall, only two (7.1%) total coliform positive samples were observed in the 28 samples analyzed from July through December, 2009 (**Table 3**). No *E. coli* bacteria were detected at the first customer sampling location. The annual median Heterotrophic Plate Count was 320 with individual values ranging from 30 to 1,920 (**Table 2**). These latter numbers are not excessive and of no particular concern.

A summary of the bacterial indicators, turbidity, chlorine residual and water temperature at the first customer sampling location is provided in **Table 3**.

TABLE 3. 2009 Water Quality at First Customer, Wilderness Mtn Water System

		Total Coliforms (TC)				E. coli	Turbidity	Chorine Residual	Water Temperature
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	E. coli Samples > 0	Adverse > 1 NTU	Median mg/L as Cl2	Median (° C)
JUL	5	2	40	0	0	0	0	0.36	17.6
AUG	5	0	0	0	0	0	0	1.52	18.3
SEP	4	0	0	0	0	0	0	1.63	16.8
OCT	5	0	0	0	0	0	1	1.05	11.8
NOV	4	0	0	0	0	0	0	0.71	7.6
DEC	5	0	0	0	0	0	0	2.70	4.2
Totals	**28**	**2**	**7.1**	**0**	**0**	**0**	**1**	**1.23**	**11.9**

Chlorine Residual. The chlorine residual levels at the first customer sampling location below the Wilfred Treatment Plant ranged from a low of 0.19 mg/L in July to a high of 3.1 mg/L in December (**Figure 2**). The large fluctuation in chlorine residuals during July through November was due in part to inconsistent sampling technique and in part to optimizing the dosage level to ensure adequate disinfection of the raw water. The annual median chlorine residual (28 weekly readings) at this location was 1.23 mg/L (**Table 3**). This means that the chlorine demand (i.e. the amount of chlorine needed to oxidize the various components in the water) is about 1 to 1.5 mg/L which is typical of those water systems that contain moderate levels of carbon.

7.1.3. DISTRIBUTION SYSTEM WATER

Bacterial Indicators. In the period from July to the end of 2009, total coliform bacteria were detected in July and October in the distribution system. In July 2009, the percentage positive total coliform samples exceeded the 10% total coliform limit and five samples had coliform numbers exceeding 10 total coliform bacteria per 100 mL (**Figure 3**). This means that the Wilderness Mountain distribution system was out of compliance with the BC *Drinking Water Protection Regulation* for the month of July 2009 (**Table 4**). The positive samples prompted the issuance of a Boil Water Advisory and the raising of the chlorine dosage on July 18, 2010. The annual total coliform positive percentage for 2009 (July through December) was 13.8% (**Table 4**). None of the samples in the distribution system contained *E. coli*. The annual median HPC bacterial count was 490 per mL with individual values ranging from 38 to 20,000. While the median value is not excessive, the high range shows that the low chlorine residuals observed in the distribution

system are allowing bacteria to grow in the summer.

A summary of the bacterial indicators, turbidity, chlorine residual and water temperature in the distribution system is provided in **Table 4.**

TABLE 4. 2009 Water Quality in Distribution System, Wilderness Mtn Water System

		Total Coliforms (TC)				E. coli	Turbidity	Chorine Residual	Water Temperature
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	E. coli Samples > 0	Adverse > 1 NTU	Median mg/L as Cl2	Median (° C)
JAN	1	0	0	0	0	0	0	0.03	10.4
MAR	1	0	0	0	0	0	0	0.28	
JUL	8	7	87.5	0	5	0	1	0.11	17.6
AUG	10	0	0	0	0	0	1	0.13	18.1
SEP	10	0	0	0	0	0	0	0.14	16.3
OCT	10	1	10	0	0	0	1	0.09	12.2
NOV	8	0	0	0	0	0	0	0.04	7.8
DEC	10	0	0	0	0	0	1	0.10	5.2
Totals	**58**	**8**	**13.8**	**0**	**5**	**0**	**4**	**0.1**	**12.6**

Chlorine Residuals. The chlorine residual levels in the distribution system ranged from a low of 0 to 1.48 mg/L with monthly medians ranging from 0.03 to 0.28 mg/L (**Table 4**). The annual chlorine residual median (based on 58 samples) was only 0.1 mg/L. This low value indicated that the chlorine residual cannot be carried adequately to the extremities of the distribution system and can lead to the growth of bacteria.

7.1.1. BALANCING RESERVOIRS

Bacterial Indicators. In a similar fashion to the bacterial contamination noted in July, 2009 in the distribution system, three total coliform positive samples were found in the balancing reservoirs (**Table 5**) and simply confirm that the entire water system contained these indicator bacteria at that time. Subsequently, no additional positive samples were found during the balance of the year. No *E. coli* bacteria were found in the balancing reservoirs. The annual median HPC count was 285 per mL with individual values ranging from 20 to 8,700.

A summary of the bacterial indicators, turbidity, chlorine residual and water temperature in the distribution system is provided in **Table 5.**

TABLE 5. 2009 Water Quality in Balancing Reservoirs, Wilderness Mtn Water System

		Total Coliforms (TC)				E. coli	Turbidity	Chorine Residual	Water Temperature
Month	Samples Collected	Samples TC>0	Percent TC>0	Resamples TC>0	Samples TC>10	E. coli Samples > 0	Adverse > 1 NTU	Median mg/L as Cl2	Median (° C)
JAN	1	0	0	0	0	0			4.3
MAR	1	0	0	0	0	0	0	0.2	
APR	3	0	0	0	0	0	0	0.28	
JUL	10	3	30	0	0	0	0	0.27	17.6
AUG	10	0	0	0	0	0	0	0.45	18.8
SEP	8	0	0	0	0	0	0	0.54	16.8
OCT	10	0	0	0	0	0	0	0.29	12.1
NOV	8	0	0	0	0	0	0	0.17	7.7
DEC	10	0	0	0	0	0	0	0.50	4.5
Totals	**61**	**3**	**4.9**	**0**	**0**	**0**	**0**	**0.33**	**12.6**

Chlorine Residuals. The chlorine residual levels in the balancing reservoirs ranged from 0 to 0.65 mg/L with monthly medians ranging from 0.17 to 0.50 mg/L (**Table 5**). The annual chlorine residual median (based on 61 samples) was 0.33 mg/L. This is also a relatively low value for balancing reservoirs given that these reservoirs supply the distribution system. These low values are indicative of poor water circulation within the balancing reservoirs.

7.2. Parasites

In 2009, a parasite sample was collected in December and sent to Hyperion Research Laboratories, a contract laboratory in Alberta. No *Giardia* cysts or *Cryptosporidium* oocysts were detected in this sample.

7.3. Physical - Chemical

Water samples were collected for a variety of physical and chemical parameters to provide not only compliance information but also to monitor operational changes within the Wilderness Mountain Drinking Water System.

7.3.1. PHYSICAL PARAMETERS

The physical parameters monitored in the raw water entering the Wilfred Treatment Plant are listed on **Page 1** in **Table 1** in the section titled **Physical Parameters**. The sampling frequency for the physical parameters varied and was dependent on the variability of the data for the parameter being monitored and how it was used. In 2009, colour, turbidity and water temperature were sampled weekly to monthly while other parameters were sampled quarterly.

The raw water entering the Wilfred Treatment Plant is soft (17.3 mg/L) (**Table 1**), it has a neutral pH (median of 6.81), moderate colour (median of 10 true colour units) and low to moderate turbidity or cloudiness (median of 0.84 nephelometric turbidity units). It is also very low in acid buffering capacity having an alkalinity of 9.18 mg/L, has low to moderately ionic strength (conductivity of 90.1 µS/cm), moderate solids (total dissolved solids of 52 mg/L, total suspended solids of 0.8 mg/L and total solids of 53 mg/L), and moderate level of total organic carbon (3.6 mg/L). **Table 1** lists both the annual median value, the range of values during the period from July to December 2009 and the Guideline limit (as a reference only for the raw source water).

The disinfection process slightly changed one or two of these parameters as shown on **Page 1** in **Table 2**. The colour and pH were lowered slightly while the conductivity increased slightly due to the addition of chlorine. This is a normal response to chlorine disinfection.

In 2009, the values for all of the physical parameters were within the Canadian Guideline limits except for water temperature during the summer months (above the 15°C limit from the time the first sample was collected in July to September 24th) and one turbidity value in the treated water.

7.3.2. NON-METALLIC INORGANIC CHEMICALS

The non-metallic inorganic chemicals monitored by the Water Quality Division in the raw water entering the Wilfred Water Treatment Plant are listed on **Page 1** in **Table 1** in the section titled **Non-Metallic Inorganic Chemicals**. The list includes the nitrogen and phosphorus (nutrients), fluoride, chloride and several other miscellaneous chemicals. The sampling frequency for these parameters is either quarterly or semi-annually.

- **Fluoride.** No fluoride is added to the water in the Wilderness Mountain Drinking Water System and no fluoride is naturally present in the source reservoir (no fluoride detected) (**Table 1**). This means that the fluoride level in the water is inadequate for dental purposes and individuals must provide their own fluoride supplements for dental protection if they so desire.

- **Nutrients**. Both nitrogen and phosphate levels are moderately low and there is nothing particularly unusual about the nutrients in the raw water entering the Wilfred Plant (**Table 1**). These chemicals are monitored as part of the control of the regrowth of bacteria in the distribution system and contribution to algal blooms in the source reservoir.

All of the non-metallic inorganic chemicals were well within the Canadian Guideline limits and the values are consistent with a high quality water source.

7.3.3. METALS

The metallic inorganic chemicals monitored by the Water Quality Division in the raw water entering Wilfred Water Treatment Plant are listed on **Page 2** in **Table** 1 in the section titled **Metals**. The list includes a variety of the so-called 'heavy metals' such as copper, lead, iron, zinc and mercury. Most of these heavy metals have either health-related or aesthetic Canadian Guideline limits. The metals are sampled semi-annually. Questions are often asked about the following metals:

- **Lead**. The level of lead in the raw water entering Wilfred Plant was 0.40 µg/L (parts per billion) and, at this level, can be considered virtually absent from the water (**Table 1**). There are no known lead service lines in the distribution system.

  NOTE: Residents should be aware that brass taps in the household often contain some lead which can dissolve into the water contained within the body of the tap during overnight standing. To eliminate this small amount of dissolved lead from the water, simply run the tap for 30 seconds each morning before using the water for drinking or preparing food. The water entering a residence from the distribution system is virtually free of lead.

- **Mercury**. The level of mercury in the raw water entering Wilfred Plant was less than the detection limit of 0.02 µg/L (parts per billion) (**Table 1**). This value is more than fifty times lower than the Canadian Guideline limit and therefore can also be considered virtually absent from the water.

- **Selenium**. The level of selenium naturally present in the water was less than the detection limit of 0.0001 mg/L and at this level is considered to be virtually absent (**Table 1**). This parameter is of interest to people who take selenium supplements.

- **Sodium** The level of sodium naturally present in the water was low (8.4 mg/L) (**Table 1**). This parameter is of interest to those people on low sodium diets.

All of the metals were well within the Canadian Guideline limits and the values are consistent with a high quality drinking water source.

7.3.4. ORGANICS

The organic chemicals monitored by the Water Quality Division in the raw water entering Wilfred Treatment Plant are summarized on **Page 3** in **Table 1** in the section titled **Organic Parameters**. The list includes a wide range of pesticides and herbicides, polycyclic aromatic hydrocarbons (PAHs), phenols and other synthetic organic chemicals that may come from a variety of industrial sources.

All of the organic chemicals tested were well within the Guideline limits.

7.4. Disinfectants and Disinfection By-Products

The disinfection of the water with chlorine produces a number of by-products of that disinfection process. Trihalomethanes (THMs) and haloacetic acids (HAAs) are two groups of these (DBPs) that will be monitored quarterly in accordance with the Canadian Guidelines.

In the raw source water entering the Wilfred Treatment Plant, the principal components that would act as precursors for the production of DBPs are naturally occurring organic compounds that result from the passage of rainwater through leaves and vegetation on the grounds surrounding Wilfred Reservoir and the algae that are present within the reservoir. The primary concern about DBPs has been long term (chronic) exposure.

It should be noted that the disinfection process is essential to safeguard drinking water and that the health risks from disinfection by-products (including trihalomethanes and haloacetic acids) are much less than the risks from consuming water that has not been disinfected. The use of chlorine as a water disinfectant has virtually eliminated waterborne microbial diseases.

In 2009, disinfection by-product samples were collected in December from two treated water locations: first customer sampling location and an extremity of distribution system. The Canadian Guideline limits for the substances of concern are listed on **Page 1** in **Table 2** in the section titled **Disinfectants** and on **Page 2** in **Table 2** in the section titled **Disinfection By-Products**. An overview of the disinfection by-products results for the distribution system is provided below:

- **Free and Total Chlorine.** The maximum total chlorine residual in the distribution system in 2009 was 3.10 mg/L (occurred at first customer location). This value falls slightly above the disinfectant Canadian Guideline limit of 3.0 mg/L for total chlorine. However, the remaining measurements at this location were all below the Guideline limit (30 samples total).

- **Trihalomethanes**. The trihalomethanes most commonly found in drinking water are chloroform, bromodichoromethane, dibromochloromethane and bromoform. In 2009, the average level of total trihalomethanes (TTHMs) at the first customer sampling location was 21.6 µg/L and the extremity was 50.4 µg/L. Both of these values are well below the Canadian Guideline limit of 100 µg/L (**Table 2**). (**Note**: TTHMs results collected in early 2010 exceeded the limits.)

- **Haloacetic Acids**. Haloacetic acids (HAAs) are a second group of disinfection by-products that are produced when chlorine is used as a disinfecting chemical. The haloacetic acids are comprised of mono-, di-, and trichloroacetic acids plus mono- and dibromoacetic acids. For regulatory purposes, the regulatory agencies use the 5 haloacetic acids (referred to as HAA5) that are most commonly found in drinking water. The US Environmental Protection Agency (USEPA) set a maximum contaminant level (MCL) of 60 µg/L for HAA5 effective January 2002. In 2008, Canada set a maximum acceptable concentration (MAC) limit of 80 µg/L for the HAA5.

  In 2009, HAAs were monitored once in December and the average level of HAA5 at the first customer sampling location was 21.2 µg/L (**Table 2**) and at the extremity was 4.5 µg/L. Both of these values are well below both the lower USEPA limit and the 2008 Canadian limit.
  (**Note**: HAA5 results collected in early 2010 exceeded the limits.)

7.5. Chlorophyll and Algae

Wilfred Reservoir contains a variety of biological communities including bacteria, periphyton (algae attached to submerged surfaces), phytoplankton (algae floating within the water column), zooplankton (tiny animals also floating within the water column), aquatic insects, fish and macrophytes (aquatic plants). Together these biological communities interact and assist in keeping the water in the Wilfred Reservoir clean and healthy.

- **Chlorophyll-a**. The overall level of algal activity in Wilfred Reservoir can be measured using chlorophyll-a (a component of all algal cells). In 2009, the concentration of chlorophyll-a in the water entering the Wilfred Plant (from an intake 4 m below the water surface) was sampled weekly starting in late October. The levels of chlorophyll-a ranged between 3.4 µg/L to 4.9 µg/L **(Figure 4).** These chlorophyll concentrations are considered low to moderate for a drinking water source reservoir.

- **Algae**. Starting in mid-September, 2009, the types and concentrations of algae occurring in Wilfred Reservoir at one metre depth off the end of the dock at Plant were measured. During the period of Sept to Dec, 2009, the concentrations of algae were relatively low (see figure below) and did not pose a problem for either the treatment process or consumers. (**Note**: This chart also shows some of the algal data collected in early 2010 and the increase in algal concentrations.)

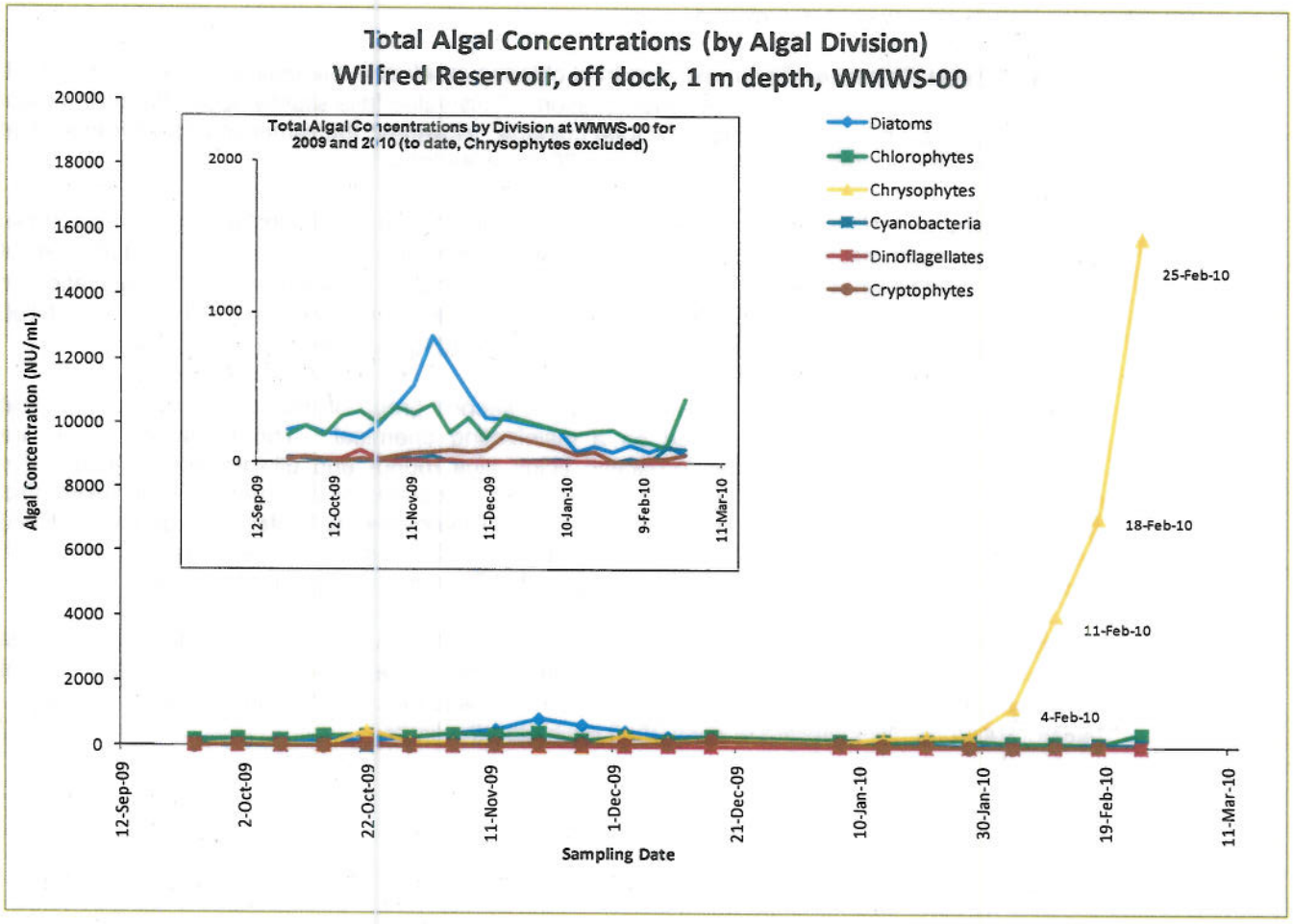

Figure 1. Total Coliforms, E.coli and Water Temperature in Raw Water Entering Wilfred Treatment Plant in 2009

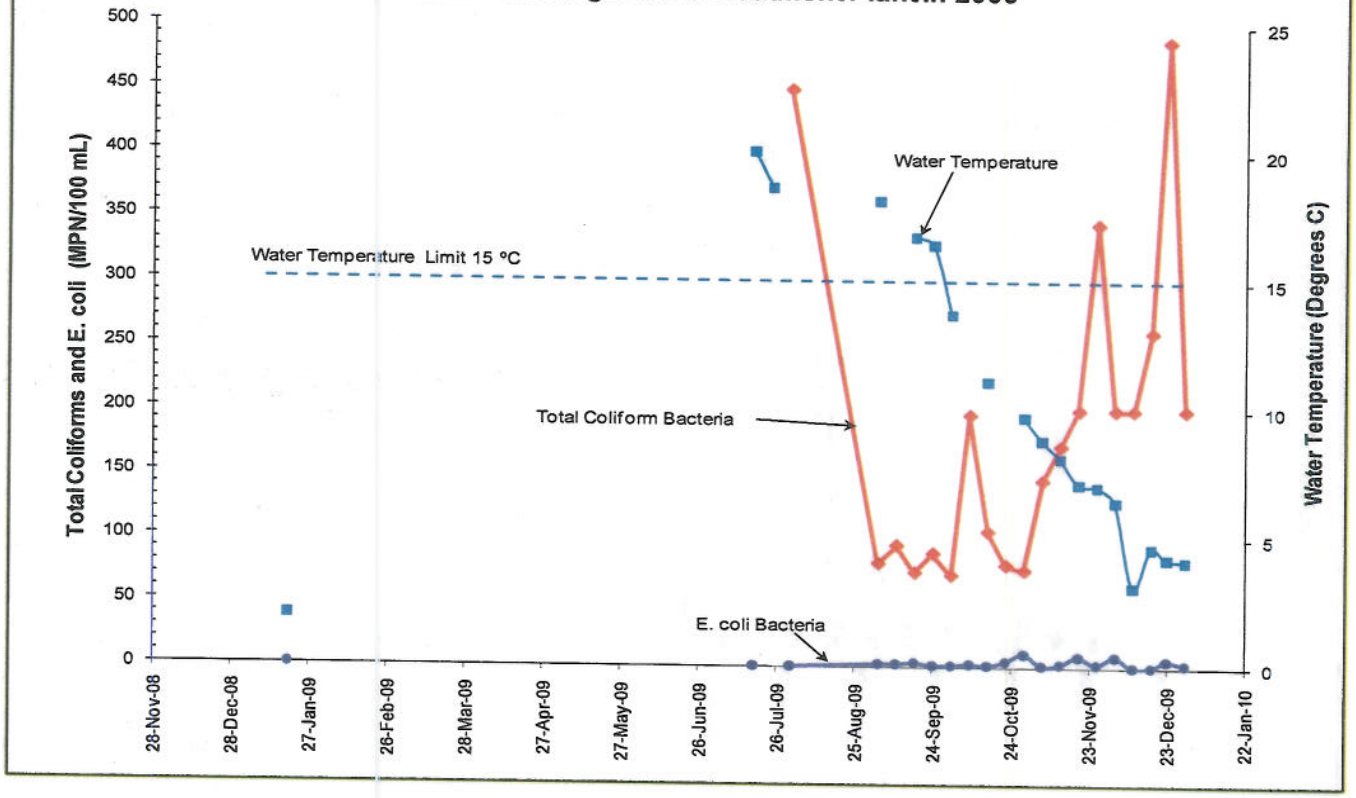

Figure 2. Total Coliforms and Total Chlorine Residual at First Customer Below Wilfred Treatment Plant in 2009

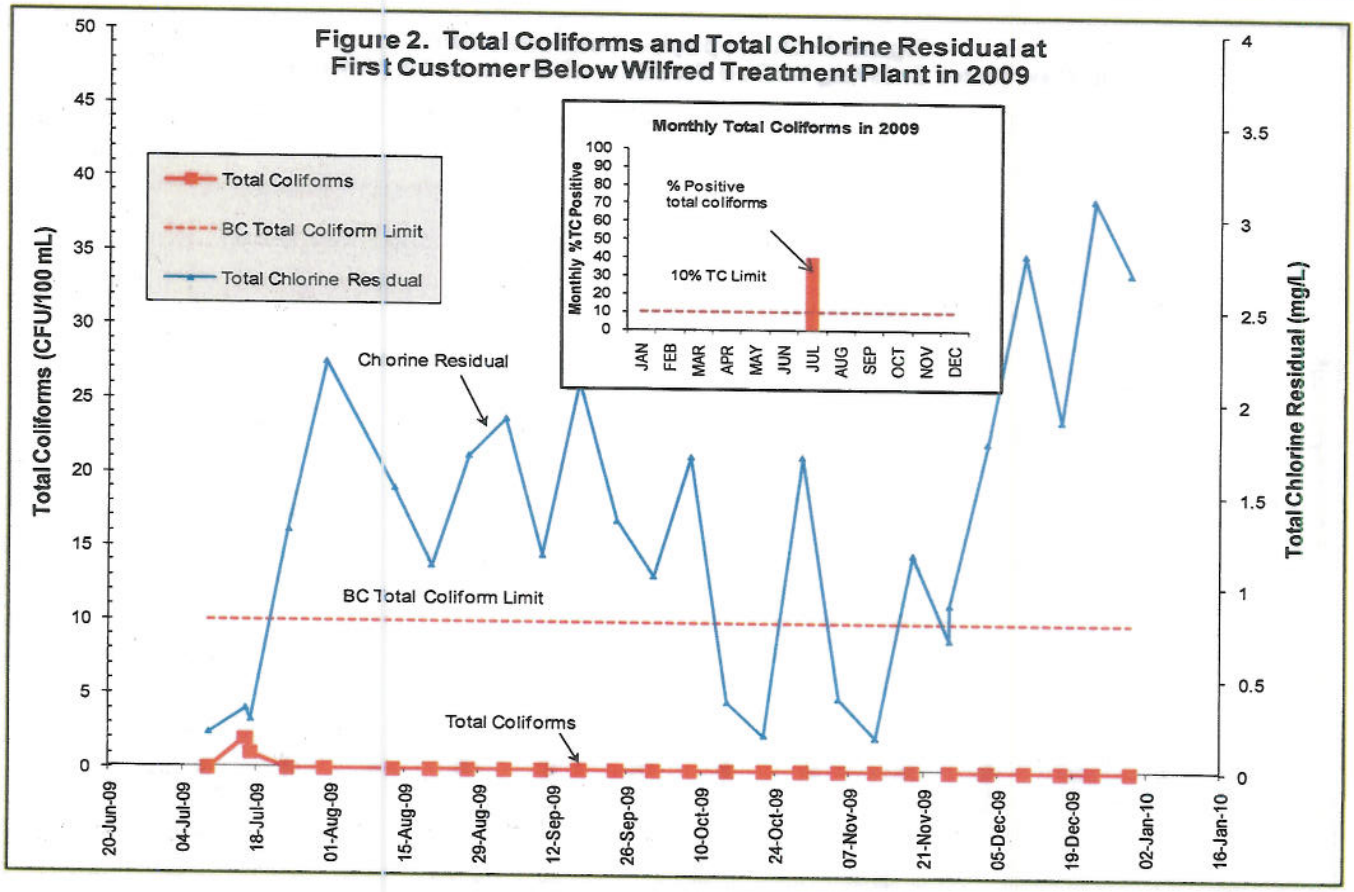

Figure 3. Total Coliforms and Total Chlorine Residual in Wilderness Mountain Distribution System in 2009

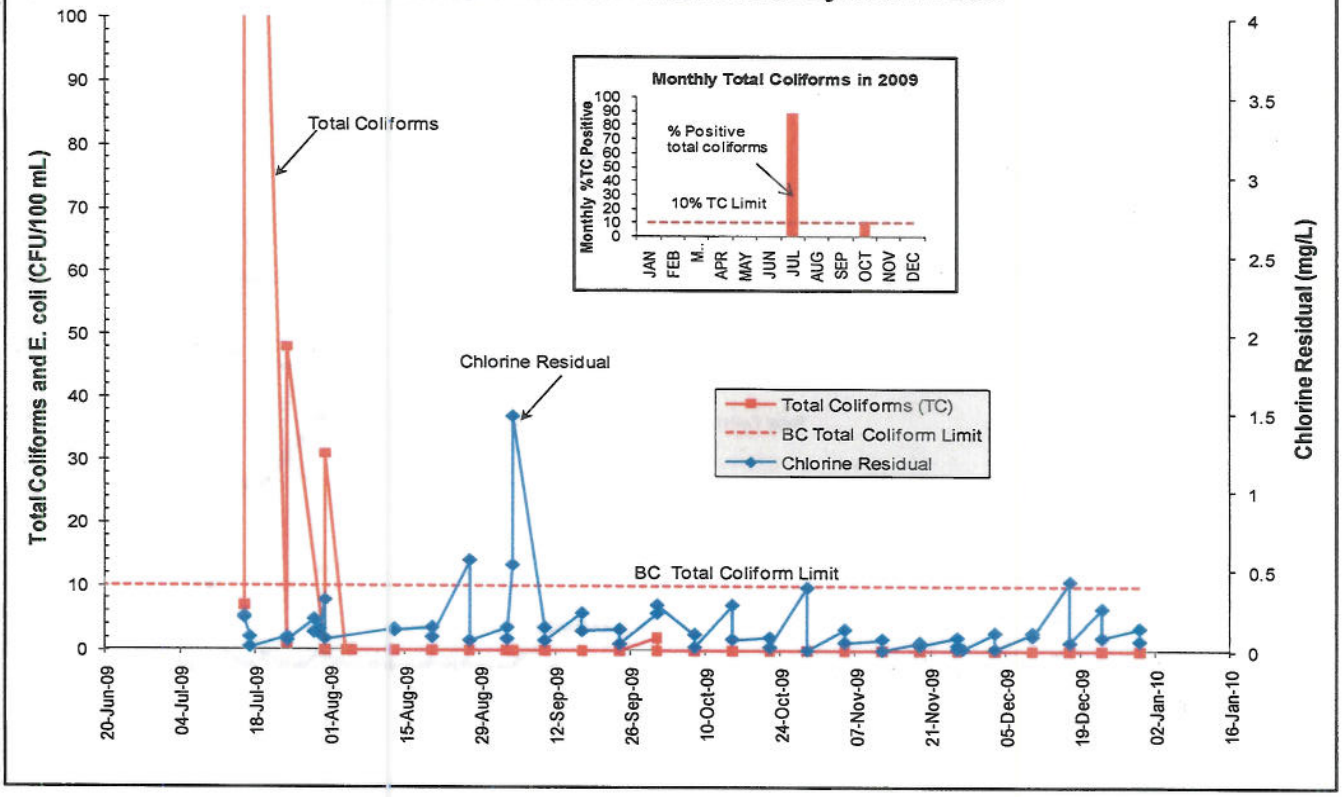

Figure 4. Chlorophyll-a Concentrations in Raw Water Entering Wilfred Treatment Plant in 2009, (WMWS-10)

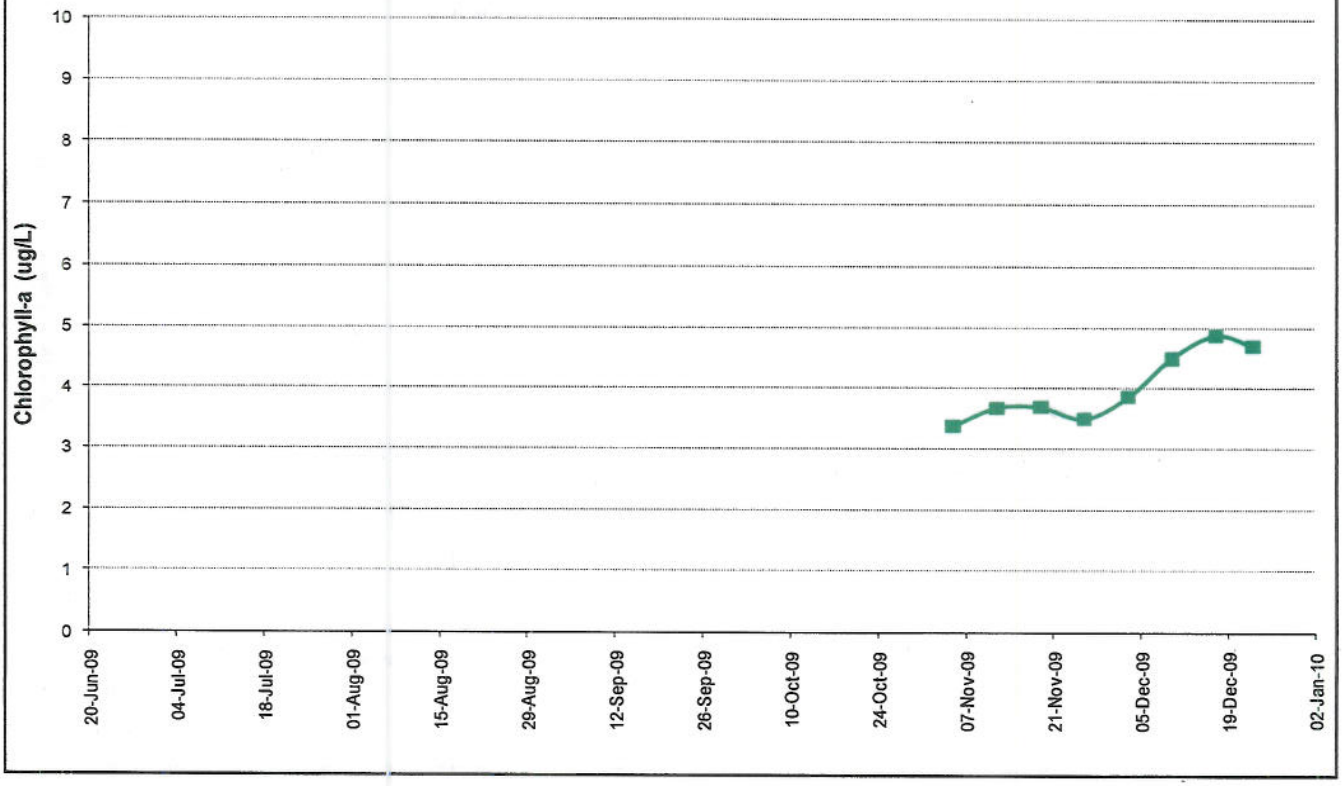

TABLE 1. 2009 UNTREATED (RAW) WATER QUALITY ENTERING WILFRED TREATMENT PLANT

WILDERNESSTables2.xlsx

(Guideline values provide reference only for untreated water)

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			Target
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum-Maximum	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Physical Parameters (ND means Not Detected by analytical method used)										
Alkalinity, Total	mg/L	**9.18**	5	8.03	9.70					Quarterly
Carbon,Total Organic	mg/L as C	**3.6**	1			Guideline Archived				Quarterly
Colour, True	TCU	**10.3**	22	5.3	14	≤15 AO				Monthly
Conductivity @ 25 C	uS/cm	**90.1**	11	82.3	92.9					Quarterly
Hardness as $CaCO_3$	mg/L	**19.8**	1			No Guideline Required				Quarterly
pH	pH units	**6.81**	8	6.17	7.15	6.5 - 8.5 AO				Quarterly
Total Dissolved Solids	mg/L	**52.0**	1			≤500 AO				Quarterly
Total Suspended Solids	mg/L	**0.83**	1							Quarterly
Total Solids	mg/L	**53.0**	1							Quarterly
Turbidity, Grab Samples	NTU	**0.84**	26	0.51	1.36					Weekly
Ultraviolet Absorption, 5 cm	Abs.@254 nm	**0.347**	11	0.209	0.515					Quarterly
Ultraviolet Transmittance	%	**82.8**	4	81.6	86.7					Quarterly
Water Temp., Grab Samples	degrees C	**8.1**	19	1.9	20.0	≤15 AO				Weekly
Non-Metallic Inorganic Chemicals (ND means Not Detected by analytical method used)										
Ammonia, Total	ug/L as N	**9.3**	1			Guideline Under Review				Quarterly
Bromide	mg/L as Br	**0.091**	1							Annual
Bromate	ug/L	**ND**	1			10 MAC				Annual
Chloride	mg/L as Cl	**16.0**	1			≤ 250 AO				Annual
Cyanide	mg/L as Cn	**ND**	1			0.2 MAC				Annual
Fluoride	mg/L as F	**ND**	1			1.5 MAC				Annual
Nitrogen, Total	ug/L as N	**147.7**	1							Quarterly
Phosphate,Total	ug/L as P	**5.47**	1							Quarterly
Silica	mg/L as SiO_2	**3.50**	1							Annual
Silicon	mg/L as Si	**1.45**	1							Annual
Sulphate	mg/L as SO_4	**10.4**	1			≤ 500 AO				Quarterly
Sulphide	mg/L as H_2S	**ND**	1			≤ 0.05 AO				Annual
Sulphur	mg/L as S	**4.0**	1							Annual

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
NTU = Nephelometric Units
TCU = True Colour Units

AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 1. 2009 UNTREATED (RAW) WATER QUALITY ENTERING WILFRED TREATMENT PLANT

WILDERNESSTables2.xlsx

(Guideline values provide reference only for untreated water)

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			Target
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum-Maximum	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Metals (ND means Not Detected by analytical method used)										
Aluminum	mg/L as Al	0.045	1			0.2 Operational Guideline				Annual
Antimony	mg/L as Sb	ND	1			0.006 MAC				Annual
Arsenic	mg/L as As	0.0001	1			0.01 MAC				Annual
Barium	mg/L as Ba	0.002	1			1.0 MAC				Annual
Beryllium	mg/L as Be	ND	1							Annual
Bismuth	mg/L as Bi	ND	1							Annual
Boron	mg/L as B	ND	1			5 MAC				Annual
Cadmium	mg/L as Cd	ND	1			0.005 MAC				Annual
Calcium	mg/L as Ca	4.23	1			No Guideline Required				Annual
Chromium	mg/L as Cr	ND	1			0.05 MAC				Annual
Cobalt	mg/L as Co	ND	1							Annual
Copper	mg/L as Cu	0.0093	1			≤ 1.0 AO				Annual
Iron	mg/L as Fe	0.17	1			≤ 0.3 AO				Annual
Lead	ug/L as Pb	0.40	1			10 MAC				Annual
Lithium	ug/L as Li	ND	1							Annual
Magnesium	mg/L as Mg	2.23	1			No Guideline Required				Annual
Manganese	mg/L as Mn	0.092	1			≤ 0.05 AO				Annual
Mercury, Total	ug/L as Hg	ND	1			1 MAC				Annual
Molybdenum	mg/L as Mo	ND	1							Annual
Nickel	mg/L as Ni	ND	1							Annual
Potassium	mg/L as K	0.37	1							Annual
Selenium	mg/L as Se	ND	1			0.01 MAC				Annual
Silver	mg/L as Ag	ND	1			No Guideline Required				Annual
Sodium	mg/L as Na	8.35	1			≤ 200 AO				Annual
Strontium	mg/L as Sr	0.019	1							Annual
Thallium	ug/L as Tl	ND	1							Annual
Tin	mg/L as Sn	ND	1							Annual
Titanium	mg/L as Ti	ND	1							Annual
Uranium	ug/L as U	ND	1			20 MAC				Annual
Vanadium	mg/L as V	ND	1							Annual
Zinc	mg/L as Zn	ND	1			≤ 5.0 AO				Annual
Zirconium	ug/L as Zr	ND	1							Annual

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
NTU = Nephelometric Units
TCU = True Colour Units

AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 1. 2009 UNTREATED (RAW) WATER QUALITY ENTERING WILFRED TREATMENT PLANT

WILDERNESSTables2.xlsx

(Guideline values provide reference only for untreated water)

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			Target
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum-Maximum	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	Coliforms/100 mL	196	21	71	2,419					
E. coli	E.coli/100 mL	2	21	0	10					Weekly
Hetero. Plate Count, 28C (7 day)	CFU/1 mL	1,140	11	0	2,110	No Guideline Required				Weekly
										Weekly
Chlorophyll										
Chlorophyll a	ug/L	3.78	8	3.37	4.87					
Chlorophyll b	ug/L	0.14	8	0.06	0.21					Weekly
Chlorophyll c	ug/L	0	8	0.23	0.37					Weekly
										Weekly
Parasites						No MAC Established				
Cryptosporidium, Total oocysts	oocysts/100 L	0	1			Zero detection desirable				
Giardia, Total cysts	cysts/100 L	0	1			Zero detection desirable				Semi Annual
										Semi Annual
Organic Parameters (ND means Not Detected by analytical method used)										
Organic Scans										
85 Pesticides/Herbicides	ug/L	ND	1			Only 29 have limits				
17 Polycyclic Aromatic Hydrocarbons	ug/L	ND	1			Only 1 has a limit				Irregular
33 Phenols	ug/L	ND	1			Only 4 have limits				Irregular
72 Other Synthetic Chemicals	ug/L	ND	1			Only 15 have limits				Irregular
										Irregular

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
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TCU = True Colour Units

AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 2. 2009 WILDERNESS MTN WATER QUALITY AT FIRST CUSTOMER

annual/WILDERNESSTables2.xlsx

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Min.	Range Max.	≤ = Less than or equal to	Median	Samples Analyzed	Range Min.-Max.	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Physical Parameters										
Colour, True	TCU	**5.6**	6	4.9	7.4	≤ 15 AO				Monthly
Conductivity @ 25 C	uS/cm	**95.3**	1							Quarterly
Odour	Flavour Profile	Not analyzed in 2009				Inoffensive				Weekly
pH	pH units	**6.68**	2	6.46	6.91	6.5 - 8.5 AO				Quarterly
Taste	Flavour Profile	Not analyzed in 2009				Inoffensive				Weekly
Turbidity, Grab Samples	NTU	**0.74**	25	0.49	1.22	1 MAC and ≤ 5 AO				Weekly
Water Temperature, Grab Samples	degrees C	**11.9**	27	3.4	20.7	≤ 15 AO				Weekly
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	**0**	28	0	2	0 MAC				Weekly
E. coli	CFU/100 mL	**0**	28			0 MAC				Weekly
Coliform, Background	CFU/100 mL	**0**	21	0	5	No Guideline Required				Weekly
Hetero. Plate Count, 28C (7 day)	CFU/1 mL	**320**	4	30	1,920	No Guideline Required				Special
Disinfectants										
Disinfectants										
Chlorine, Free Residual	mg/L as Cl2	**1.10**	28	0.05	2.7					Weekly
Chlorine, Total Residual	mg/L as Cl_2	**1.23**	30	0.18	3.1	3.0 MAC (chloramines)				Weekly

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
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TCU = True Colour

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Median = middle point of all values

TABLE 2. 2009 WILDERNESS MTN WATER QUALITY AT FIRST CUSTOMER

annual/WILDERNESSTables2.xlsx

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Min.	Range Max.	≤ = Less than or equal to	Median	Samples Analyzed	Range Min.-Max.	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Disinfection By-Products (ND means Not Detected by analytical method used)										
Trihalomethanes (THMs)										
Bromodichloromethane (BDCM)	ug/L	2.4	1							Quarterly
Bromoform (BRFM)	ug/L	ND	1							Quarterly
Chloroform (CHLF)	ug/L	19.2	1							Quarterly
Dibromochloromethane (DBCM)	ug/L	ND	1							Quarterly
Total Trihalomethanes (TTHM)	ug/L	21.6	1			100 MAC				Quarterly
Haloacetic Acids (HAAs)										
Bromochloroacetic Acid (BCAA)	ug/L	1.60	1							Quarterly
Bromodichloroacetic Acid (BDCAA)	ug/L	ND	1							Quarterly
Chlorodibromoacetic Acid (CDBAA)	ug/L	ND	1							Quarterly
Dibromoacetic Acid* (DBAA)	ug/L	0.31	1							Quarterly
Dichloroacetic Acid* (DCAA)	ug/L	15.6	1							Quarterly
Monobromoacetic Acid* (MBAA)	ug/L	ND	1							Quarterly
Monochloroacetic Acid* (MCAA)	ug/L	ND	1							Quarterly
Tribromoacetic Acid (TBAA)	ug/L	ND	1							Quarterly
Trichloroacetic Acid* (TCAA)	ug/L	5.2	1							Quarterly
Haloacetic Acids (*5 Total, HAA5)	ug/L	21.2	1			80 MAC				Quarterly
Haloacetic Acids (9 Total, HAA9)	ug/L	22.8	1							Quarterly

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
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TCU = True Colour

AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 1. 2009 UNTREATED (RAW) WATER QUALITY ENTERING WILFRED TREATMENT PLANT

WILDERNESSTables2.xlsx

(Guideline values provide reference only for untreated water)

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			Target
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum-Maximum	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Physical Parameters (ND means Not Detected by analytical method used)										
Alkalinity, Total	mg/L	**9.18**	5	8.03	9.70					Quarterly
Carbon,Total Organic	mg/L as C	**3.6**	1			Guideline Archived				Quarterly
Colour, True	TCU	**10.3**	22	5.3	14	≤15 AO				Monthly
Conductivity @ 25 C	uS/cm	**90.1**	11	82.3	92.9					Quarterly
Hardness as $CaCO_3$	mg/L	**19.8**	1			No Guideline Required				Quarterly
pH	pH units	**6.81**	8	6.17	7.15	6.5 - 8.5 AO				Quarterly
Total Dissolved Solids	mg/L	**52.0**	1			≤500 AO				Quarterly
Total Suspended Solids	mg/L	**0.83**	1							Quarterly
Total Solids	mg/L	**53.0**	1							Quarterly
Turbidity, Grab Samples	NTU	**0.84**	26	0.51	1.36					Weekly
Ultraviolet Absorption, 5 cm	Abs.@254 nm	**0.347**	11	0.209	0.515					Quarterly
Ultraviolet Transmittance	%	**82.8**	4	81.6	86.7					Quarterly
Water Temp., Grab Samples	degrees C	**8.1**	19	1.9	20.0	≤15 AO				Weekly
Non-Metallic Inorganic Chemicals (ND means Not Detected by analytical method used)										
Ammonia, Total	ug/L as N	**9.3**	1			Guideline Under Review				Quarterly
Bromide	mg/L as Br	**0.091**	1							Annual
Bromate	ug/L	**ND**	1			10 MAC				Annual
Chloride	mg/L as Cl	**16.0**	1			≤ 250 AO				Annual
Cyanide	mg/L as Cn	**ND**	1			0.2 MAC				Annual
Fluoride	mg/L as F	**ND**	1			1.5 MAC				Annual
Nitrogen, Total	ug/L as N	**147.7**	1							Quarterly
Phosphate,Total	ug/L as P	**5.47**	1							Quarterly
Silica	mg/L as SiO_2	**3.50**	1							Annual
Silicon	mg/L as Si	**1.45**	1							Annual
Sulphate	mg/L as SO_4	**10.4**	1			≤ 500 AO				Quarterly
Sulphide	mg/L as H_2S	**ND**	1			≤ 0.05 AO				Annual
Sulphur	mg/L as S	**4.0**	1							Annual

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
NTU = Nephelometric Units
TCU = True Colour Units

AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 1. 2009 UNTREATED (RAW) WATER QUALITY ENTERING WILFRED TREATMENT PLANT

WILDERNESSTables2.xlsx

(Guideline values provide reference only for untreated water)

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			Target
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum-Maximum	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Metals (ND means Not Detected by analytical method used)										
Aluminum	mg/L as Al	0.045	1			0.2 Operational Guideline				Annual
Antimony	mg/L as Sb	ND	1			0.006 MAC				Annual
Arsenic	mg/L as As	0.0001	1			0.01 MAC				Annual
Barium	mg/L as Ba	0.002	1			1.0 MAC				Annual
Beryllium	mg/L as Be	ND	1							Annual
Bismuth	mg/L as Bi	ND	1							Annual
Boron	mg/L as B	ND	1			5 MAC				Annual
Cadmium	mg/L as Cd	ND	1			0.005 MAC				Annual
Calcium	mg/L as Ca	4.23	1			No Guideline Required				Annual
Chromium	mg/L as Cr	ND	1			0.05 MAC				Annual
Cobalt	mg/L as Co	ND	1							Annual
Copper	mg/L as Cu	0.0093	1			≤ 1.0 AO				Annual
Iron	mg/L as Fe	0.17	1			≤ 0.3 AO				Annual
Lead	ug/L as Pb	0.40	1			10 MAC				Annual
Lithium	ug/L as Li	ND	1							Annual
Magnesium	mg/L as Mg	2.23	1			No Guideline Required				Annual
Manganese	mg/L as Mn	0.092	1			≤ 0.05 AO				Annual
Mercury, Total	ug/L as Hg	ND	1			1 MAC				Annual
Molybdenum	mg/L as Mo	ND	1							Annual
Nickel	mg/L as Ni	ND	1							Annual
Potassium	mg/L as K	0.37	1							Annual
Selenium	mg/L as Se	ND	1			0.01 MAC				Annual
Silver	mg/L as Ag	ND	1			No Guideline Required				Annual
Sodium	mg/L as Na	8.35	1			≤ 200 AO				Annual
Strontium	mg/L as Sr	0.019	1							Annual
Thallium	ug/L as Tl	ND	1							Annual
Tin	mg/L as Sn	ND	1							Annual
Titanium	mg/L as Ti	ND	1							Annual
Uranium	ug/L as U	ND	1			20 MAC				Annual
Vanadium	mg/L as V	ND	1							Annual
Zinc	mg/L as Zn	ND	1			≤ 5.0 AO				Annual
Zirconium	ug/L as Zr	ND	1							Annual

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
NTU = Nephelometric Units
TCU = True Colour Units

AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 1. 2009 UNTREATED (RAW) WATER QUALITY ENTERING WILFRED TREATMENT PLANT

WILDERNESSTables2.xlsx

(Guideline values provide reference only for untreated water)

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			Target
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Minimum	Range Maximum	≤ = Less than or equal to	Median	Samples Analyzed	Range Minimum-Maximum	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	Coliforms/100 mL	196	21	71	2,419					
E. coli	E.coli/100 mL	2	21	0	10					Weekly
Hetero. Plate Count, 28C (7 day)	CFU/1 mL	1,140	11	0	2,110	No Guideline Required				Weekly
										Weekly
Chlorophyll										
Chlorophyll a	ug/L	3.78	8	3.37	4.87					
Chlorophyll b	ug/L	0.14	8	0.06	0.21					Weekly
Chlorophyll c	ug/L	0	8	0.23	0.37					Weekly
										Weekly
Parasites						No MAC Established				
Cryptosporidium, Total oocysts	oocysts/100 L	0	1			Zero detection desirable				
Giardia, Total cysts	cysts/100 L	0	1			Zero detection desirable				Semi Annual
										Semi Annual
Organic Parameters (ND means Not Detected by analytical method used)										
Organic Scans										
85 Pesticides/Herbicides	ug/L	ND	1			Only 29 have limits				
17 Polycyclic Aromatic Hydrocarbons	ug/L	ND	1			Only 1 has a limit				Irregular
33 Phenols	ug/L	ND	1			Only 4 have limits				Irregular
72 Other Synthetic Chemicals	ug/L	ND	1			Only 15 have limits				Irregular
										Irregular

mg/L = milligrams per litre
ug/L = micrograms per litre

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AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 2. 2009 WILDERNESS MTN WATER QUALITY AT FIRST CUSTOMER

annual/WILDERNESSTables2.xlsx

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Min.	Range Max.	≤ = Less than or equal to	Median	Samples Analyzed	Range Min.-Max.	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Physical Parameters										
Colour, True	TCU	**5.6**	6	4.9	7.4	≤ 15 AO				Monthly
Conductivity @ 25 C	uS/cm	**95.3**	1							Quarterly
Odour	Flavour Profile	Not analyzed in 2009				Inoffensive				Weekly
pH	pH units	**6.68**	2	6.46	6.91	6.5 - 8.5 AO				Quarterly
Taste	Flavour Profile	Not analyzed in 2009				Inoffensive				Weekly
Turbidity, Grab Samples	NTU	**0.74**	25	0.49	1.22	1 MAC and ≤ 5 AO				Weekly
Water Temperature, Grab Samples	degrees C	**11.9**	27	3.4	20.7	≤ 15 AO				Weekly
Microbial Parameters										
Indicator Bacteria										
Coliform, Total	CFU/100 mL	**0**	28	0	2	0 MAC				Weekly
E. coli	CFU/100 mL	**0**	28			0 MAC				Weekly
Coliform, Background	CFU/100 mL	**0**	21	0	5	No Guideline Required				Weekly
Hetero. Plate Count, 28C (7 day)	CFU/1 mL	**320**	4	30	1,920	No Guideline Required				Special
Disinfectants										
Disinfectants										
Chlorine, Free Residual	mg/L as Cl2	**1.10**	28	0.05	2.7					Weekly
Chlorine, Total Residual	mg/L as Cl_2	**1.23**	30	0.18	3.1	3.0 MAC (chloramines)				Weekly

mg/L = milligrams per litre
ug/L = micrograms per litre

CFU = Colony Forming Units
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AO = Aesthetic Objective
MAC = Max. Acceptable Conc.
Median = middle point of all values

TABLE 2. 2009 WILDERNESS MTN WATER QUALITY AT FIRST CUSTOMER

annual/WILDERNESSTables2.xlsx

PARAMETER		2009 ANALYTICAL RESULTS				CANADIAN GUIDELINES	HISTORICAL RESULTS			
Parameter Name	Units of Measure	Annual Median	Samples Analyzed	Range Min.	Range Max.	≤ = Less than or equal to	Median	Samples Analyzed	Range Min.-Max.	Sampling Frequency
mg/L = parts per million ug/L = parts per billion										
Disinfection By-Products (ND means Not Detected by analytical method used)										
Trihalomethanes (THMs)										
Bromodichloromethane (BDCM)	ug/L	2.4	1							Quarterly
Bromoform (BRFM)	ug/L	ND	1							Quarterly
Chloroform (CHLF)	ug/L	19.2	1							Quarterly
Dibromochloromethane (DBCM)	ug/L	ND	1							Quarterly
Total Trihalomethanes (TTHM)	ug/L	21.6	1			100 MAC				Quarterly
Haloacetic Acids (HAAs)										
Bromochloroacetic Acid (BCAA)	ug/L	1.60	1							Quarterly
Bromodichloroacetic Acid (BDCAA)	ug/L	ND	1							Quarterly
Chlorodibromoacetic Acid (CDBAA)	ug/L	ND	1							Quarterly
Dibromoacetic Acid* (DBAA)	ug/L	0.31	1							Quarterly
Dichloroacetic Acid* (DCAA)	ug/L	15.6	1							Quarterly
Monobromoacetic Acid* (MBAA)	ug/L	ND	1							Quarterly
Monochloroacetic Acid* (MCAA)	ug/L	ND	1							Quarterly
Tribromoacetic Acid (TBAA)	ug/L	ND	1							Quarterly
Trichloroacetic Acid* (TCAA)	ug/L	5.2	1							Quarterly
Haloacetic Acids (*5 Total, HAA5)	ug/L	21.2	1			80 MAC				Quarterly
Haloacetic Acids (9 Total, HAA9)	ug/L	22.8	1							Quarterly

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