Regional District of
Kitimat-Stikine

2018 HAZELTON WASTE MANAGEMENT FACILITY ANNUAL REPORT

June 2019

Prepared for:

British Columbia Ministry of Environment & Climate Change Strategy
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Prepared by:

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Hazelton Waste Management Facility Overview

The Hazelton Waste Management Facility (Hazelton WMF) is owned and operated by the Regional District of Kitimat-Stikine (Regional District or RDKS). It is located approximately 4 km east of the District of New Hazelton at 82 Birch Road, access is from Highway 16.

The Hazelton WMF is responsible for the management of municipal solid and liquid waste generated from commercial and residential sources in the area of Hazelton, which includes the area from South Hazelton to Moricetown and the Kispiox Valley. Waste collected at the Kitwanga Transfer Station is consolidated and hauled to the Hazelton WMF. The following communities utilize the transfer station; Cedarvale, Kitwanga, Gitsegukla, Gitwangak, and Gitanyow. The Hazelton WMF is operated in accordance with the Regional District Kitimat-Stikine Solid Waste Management Plan (1995).

Landfill operations are regulated by the Ministry of Environment and Climate Change Strategy's Operation Certificate MR-17226, most recently updated in February 2018. This annual report will follow criteria outlined in the Operational Certificate that was issued in May 2013.

The Hazelton Waste Management Facility *Design, Operations, and Closure Plan for Hazelton Waste Management Facility*, being authored by Sperling Hanson and Associates, is in Draft form, and will be completed in 2019. It is currently awaiting the final site design, primarily in relation to wetland design.

Figure 1. Location of the Hazelton Waste Management Facility

The Hazelton WMF currently contains septage receiving lagoons, a landfill, an equipment storage building, and U-Bays for residential drop-off of tires and scrap metal including large appliances and

propane tanks. The facility is currently undergoing upgrades which include: wetlands and a phytoremediation orchard for effluent collection and treatment, and a Z-wall for public drop off.

The details of the Facility water quality monitoring program, including groundwater, surface water, and leachate results will be discussed in a document prepared by Sperling Hansen Associates and can be found in Appendix A.

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Figures and Tables

1.0 Introduction

This annual report covers the period from January 1 to December 31, 2018 and has been prepared to fulfill the requirements of the Hazelton Landfill Operational Certificate MR-17226. The Operational Certificate (OC) was issued by the Ministry of Environment and Climate Change Strategy on May 30, 2013 and amended on February 7, 2018.

The OC authorizes the discharge of municipal solid and liquid wastes and outlines the criteria for environmental and human protection at the landfill. This report meets the requirements outlined in Section (12.2) of the Operational Certificate by providing the following information:

- Total volume or tonnage of waste discharged to the landfill in 2018;
- Total volume or tonnage of waste recycled and diverted in 2018;
- Total volume of sewage waste discharged to septage facility in 2018,
- Volume of effluent discharged to each the phytoremediation and Wetland #4;
- Occurrences or observations of wildlife attempting to access the facility; and
- The results and evaluation of all monitoring programs undertaken in 2018 (Sperling Hansen Associates, Appendix A).

2.0 Waste Discharge

The Hazelton Waste Management Facility serves the Hazelton area and receives garbage consolidated at the Kitwanga Transfer Station. Some communities that are served by the Hazelton facility offer residential curbside collection; the facility also provides disposal and diversion services to many residents and businesses who self-haul their garbage. Metal (including scrap, propane tanks, and large appliances), tires, and cardboard (commercial and residential) are collected and stored at the facility for recycling. Clean wood is segregated and burned on site as outline in the OC.

The OC permits the discharge of municipal solid waste, municipal liquid waste, asbestos, and contaminated soil (with contaminants in concentrations less than “hazardous waste” as defined by the *Hazardous Waste Regulation*). Some types of municipal solid waste are deemed “Controlled Waste” by RDKS bylaw 688, which includes; animal carcasses (over 50 kg), loads of construction and demolition debris or land clearing debris greater than $5m^3$, contaminated soils, clean soils, broken asphalt and concrete up to 30cm in diameter, and waste ash from incinerators.

The annual totals for 2018 of each type of permitted waste discharged at the Hazelton Landfill are shown in Table 1. Additional details about each of these materials is included below.

Table 1. Waste Discharge Qualities for 2018

Material	2018 Quantity (tonnes)	
Waste Discharge*		
Garbage	3660.5	
Controlled Waste	62.7	
Garbage Hauled from Kitwanga	927.8	
Diverted Wastes		
Metal		408.8
Tires		10**
Cardboard		72**
Total Landfilled	**4651***	
Total Materials Diverted		**490.8**

Note: *This value is based on pre-compaction volume (m^3) data collected from October to December 2018, inclusive, extrapolated to a 12-month data set. Volume data was converted to tonnage using the U.S. Environmental Protection Agencies *Volume to Weight Conversion Factors* (2016) value of 175kg/m^3 for uncompacted mixed municipal solid waste.

** Value is an estimate

2.1 Municipal Solid Waste (Garbage)

Garbage is defined as discharged materials not including; Prohibited Waste (hazardous or radioactive waste, slaughter waste, explosive or highly combustible materials, auto hulks, Extended Producer Responsibility (EPR) materials, organic materials originating from work camps, and non-EPR tires), Restricted Waste (metal, EPR-covered tires, and cardboard), and clean wood. Clean wood is segregated and burned under controlled conditions as required by the Operational Certificate.

In 2018, 4651 tonnes of garbage was deposited in the landfill.

2.1.1 Septage

Septage is defined as septic tank pumpage and treated sewage sludge, but does not include Other Sewage Wastes (wastewater, sewage or slurry, including catch basins, oil water separators, shop floor drains). Septage is disposed in the Hazelton Septage receiving lagoons. The facility has two lagoons available for disposal. The liquid fraction is treated in the leachate treatment system. Dewatered solids are buried in the landfill.

The volume of septage was not tracked during 2018.

2.1.2 Effluent Discharged to Phytoremediation and Wetland 4

The Hazelton Waste Management Facility Phase 1 is currently under construction, with completion expected in 2019. The final discharge locations; phytoremediation and Wetland 4, are being constructed in spring/summer of 2019. Discharge volumes will be tracked for 2019 reporting. Aside from the incidental discharge event described in the attached Environmental Monitoring Report, there were no controlled discharge events in 2018.

3.0 Diverted Materials

The Hazelton Landfill restricts the disposal of recyclable materials that have other disposal options available. The District of New Hazelton provides residents with biweekly collection of unlimited quantities of recycling. Residents of other communities may access recycling depots run by industry-funded programs for no fee. Commercial waste generators are responsible for making their own arrangements to have some restricted materials collected separately and taken for processing.

The RDKS provides drop-off facilities for restricted materials that are not already managed by other operators in the service area. These include metals, cardboard (primarily for commercial customers, although open to all site users) and tires.

3.1 Metals

Metals collected at the Hazelton Waste Management facility are stockpiled and sold as scrap to a Terrace-based metal salvage recycler. Ozone depleting substances are removed from all pertinent materials prior to collection by scrap metal recycler.

In 2018, a total 408.8 tonnes of metal was collected and diverted at the Hazelton Waste Management Facility.

3.2 Cardboard

To ensure three is an avenue for diversion of institutional and commercial cardboard in the Hazelton Area the Regional District provides cardboard bins on-site which are emptied weekly under contract for recycling.

During 2018, 72 tonnes of carboard was collected for recycling from the Hazelton Waste Management Facility.

3.3 Tires

Tires are an Extended Producer Responsibility material in British Columbia, managed by the Tire Stewardship of BC. Since there are no tire depots conveniently located in the Hazelton area, the RDKS collects and stockpiles tires, which are then collected by the Stewardship.

During 2018, approximately 10 tonnes of tires were collected for recycling through the Tire Stewardship of BC at the Hazelton Waste Management Facility.

4.0 Wildlife Occurrences and Observations

The Hazelton Facility is located in an area with bears, wolves, coyotes, several species of birds of prey, and many other species of mammals that may attempt access to the facility. To prevent wildlife from gaining access, the entire facility is enclosed in a fence, and the landfill area is enclosed within an electric fence.

To more effectively prevent vectors from gaining access to the landfill active face, as of November 2017 the Revelstoke Iron Grizzly (RIG), is used as an alternative daily cover. It is positioned each day to cover all waste, with soil from site used as intermediate cover.

Facility operators are required to inspect the fence line weekly, testing for proper voltage, proper tension on fence stands, overall condition of the fence, and signs of wildlife activity. The results of the inspections are recorded on the Daily Operation Inspection Form.

There were no mammalian wildlife incidents or encounters observed during 2018 at the Hazelton Waste Management Facility. There was minimal vector activity from birds, including raptor species (bald eagles), and corvid species (crows and ravens).

5.0 Environmental Monitoring Report

Environmental monitoring for the Hazelton Waste Management Facility was conducted by a Regional District of Kitimat-Stikine Environmental Technician, following the 2013 British Columbia Field Sampling Manual published by the Ministry of Environment and Climate Change Strategy. All in-situ and laboratory data for groundwater, surface water, and leachate monitoring results has been analyzed and reviewed by Sperling Hanson Associates. The compiled data, interpretation, and recommendations can be found in Appendix A.

6.0 Summary

During 2018, 4651 tonnes of total of refuse including garbage, construction and demolition materials, consolidated waste from the Kitwanga Transfer Station, and controlled waste was disposed of in the Hazelton landfill. Additionally, 490.8 tonnes of materials were diverted from the landfill during 2018. These materials include; 408.8 tonnes of metal, 10 tonnes of tires, and 72 tonnes of cardboard. The diverted total does not include septage or clean wood.

There were no mammalian wildlife occurrences at the Hazelton Waste Management Facility during 2018.

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Appendix A Environmental Monitoring Report

Hazelton Waste Management Facility
2018 Annual Monitoring Report
- FINAL -

PREPARED FOR: REGIONAL DISTRICT OF KITIMAT-STIKINE

PREPARED BY: SPERLING HANSEN ASSOCIATES

June 19, 2019

PRJ19009

SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

- Landfill Services
- Land Reclamation
- Corporate Management
- Groundwater Hydrogeology

SPERLING
HANSEN
ASSOCIATES

• Landfill Engineering
• Solid Waste Planning
• Environmental Monitoring
• Landfill Fire Control

June 19, 2019 PRJ19009

Mr. Roger Tooms
Manager, Works and Services
Regional District of Kitimat-Stikine
Suite 300, 4545 Lazelle Avenue
Terrace, B.C. V8G 4E1

Dear Mr. Tooms,

RE: Hazelton Waste Management Facility 2018 Annual Monitoring Report

Sperling Hansen Associates (SHA) are pleased to provide you with the Hazelton Waste Management Facility 2018 Annual Monitoring Report. This report reflects on the water quality trends for surface water and groundwater as well as the monitoring program for the 2018 monitoring year.

If you have any questions regarding our submission or require any further information, please do not hesitate to contact me.

Yours truly,

SPERLING HANSEN ASSOCIATES

Carly Wolfe, EIT
Bioresource Engineer

EXECUTIVE SUMMARY

This annual monitoring report provides a synopsis of surface water and groundwater quality at the Hazelton Waste Management Facility, with a focus on water quality observed in 2018 relative to historical trends. Sampling that occurred in 2018 followed the amended Operational Certificate (OC) 17226. In 2018, two new Shallow Groundwater (SGW) wells, SGW-4 and SGW-5, were installed to monitor altered leachate flow patterns resulting from the Environmental Upgrades Project.

Generally, it appears that the quality of shallow groundwater quality in close proximity to the landfill is impacted, as represented by SGW-1 and SGW-3, with conductivity, chloride, iron, and hardness being the key parameters that are elevated and in excess of aquatic life and drinking water criteria. In general, trends show increasing attenuation with further distance from the landfill. Monitoring locations SGW-2 and SGW-5 at the property boundary provide evidence that leachate is significantly attenuated once it reaches the property boundary as indicated by a decrease in leachate indicator parameters. Despite the attenuation, there are still exceedances of the British Columbia Water Quality Guidelines (BCWQG) for aquatic life (AW) and drinking water (DW) at downstream SGW-2, SGW-4, and SGW-5. Of importance, there were exceedances of the Contaminated Sites Regulation Drinking Water (CSR-DW) Standards for iron and/or manganese at SGW-2 and SGW-4 in 2018. According to the amended OC, exceedances of the CSR-DW at these SGW monitoring locations trigger initiation of the Groundwater Quality Exceedances Response Plan. However, the Response Plan cannot be conducted yet as the Phytoremediation system is still undergoing construction.

Downgradient groundwater quality at BH-5B showed potential evidence of leachate impact, as it showed conductivity and chloride levels (typical indicator of leachate impact) elevated above background water samples. Of importance, there were exceedances of the CSR-DW Standards for arsenic, cobalt, iron, and manganese at BH-5B in 2018. According to the amended OC, exceedances of the CSR-DW at this location trigger initiation of the Groundwater Quality Exceedances Response Plan. However, as indicated previously, the Response Plan cannot be conducted yet as the Phytoremediation system is still undergoing construction. It should be noted that several of the exceedances are similar to background conditions. Also, it is difficult to determine the portion of contamination resulting from nearby highway operations. For these reasons, it is difficult to determine whether or not the landfill is impacting groundwater at the downstream BH-5B monitoring location. SHA recommends that water quality at BH-5B continue to be monitored and if leachate indicator parameters trend upwards, at least one additional groundwater monitoring well should be installed downgradient of the landfill. The new groundwater well should target the shallow and deep groundwater flow system to provide early warning sentinel wells that can be used to better assess groundwater impacts.

The groundwater in BH-03, which would intercept any flow from landfill leachate before it reached the public water well, has water quality that is consistent with background trends and thus does not indicate leachate impact. There were no exceedances of the water quality criteria at BH-03 in 2018. Notably, the chloride concentrations are at background concentration which implies that only natural, clean water flows at this location. Furthermore, metal concentrations at BH-03 are all similar or lower than background concentrations.

In terms of surface water, at the Beaver Pond outlet, SW-05 water quality was very similar to background water quality entering Beaver Pond at SW-06 and SW-08. Further downstream at SW-07, water quality

is also similar to background. Neither of the downstream surface water locations show signs of leachate impact.

There was no authorized discharge to the Phytoremediation Area or via Wetland #4 for 2018. However, there was some confusion with leachate management during construction and the contractor pumped leachate from MH#1 to Wetland #4 instead of the EQ Pond. Due to this, an unknown volume of leachate was released. Once the issue was identified, the discharge was stopped and directed to the EQ Pond. Samples were collected directly from Wetland #4, including an acute toxicity sample, and results were compliant with the OC discharge criteria.

It should be noted that the BCWQG and CSR standards were updated in 2018 and therefore 2018 water quality data has been compared to the new criteria. Historical exceedances of past criteria remain highlighted in the water quality tables.

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1. INTRODUCTION AND SCOPE

Sperling Hansen Associates (SHA) was retained by the Regional District of Kitimat-Stikine (RDKS) to prepare the 2018 Annual Monitoring Report for the Hazelton Waste Management Facility (WMF). This report details a review of the site conditions, and the groundwater and surface water quality monitoring results for the year of 2018.

The WMF is located at the south-west quadrant of District Lot 1574, Cassiar Land District, and is operated by the RDKS under the Operational Certificate (OC) MR-17226 issued on May 30, 2013. The OC was amended on February 7, 2018 to reflect changes to the site based on the Hazelton WMF Environmental Upgrades Project and future operations. The amended OC can be found in Appendix D.

2. SITE SETTING

The Hazelton WMF is located off of Highway 16 about 3 km east of New Hazelton. The landfill is accessed by a 1 km long gravel access road that follows the historic alignment of the old Highway 16 to Smithers. The lease property is bound by Hwy 16 to the north and an existing BC Hydro power line to the south. The landfill has been operating as a natural control facility that relies on the native soils and natural attenuation capacity to protect the environment. Landfill upgrades and the construction of a leachate treatment system are currently being implemented. The construction will be completed in 2019.

Figure 1: Hazelton Landfill Site Location

2.1 Site Topography and Drainage

Surface water run-on generally flows from the east and south of the site and is diverted from the WMF by the perimeter ditch and directed to the low-lying wetlands north and west of the landfill. Surface water from the wetlands eventually forms Rossvale Creek Tributary II and, after joining other tributaries, forms Rossvale Creek. Rossvale Creek then flows into the Bulkley River. The streams, wetlands, and flow divides in the vicinity of the landfill are shown in Figure 2 (Appendix A). Surface water that is intercepted by the perimeter ditch on the east side of the site flows into the Beaver Pond which is located directly north, downgradient of the landfill. The surface water intercepted by the perimeter ditches on the west side of the site flows into wetlands to the west. Surface water from both the wetlands and the Beaver Pond flows into Rossvale Creek where it then flows north under Highway 16 and to the Bulkley River. The surface water flow regime is described in great detail in the Design, Operations and Closure Plan (DOCP) prepared by SHA.

The Environmental Upgrades Project currently underway altered some flow patterns at site. All site run-on was redirected from the Waste Management Facility site by perimeter ditching, refer to Figure 2 (Appendix A). Site runoff was contained on-site by ditching and grading which directed runoff to the on-site wetland system area. This area contained a natural wetland system which allowed for sedimentation to occur. The run-off from the wetlands flowed to the Beaver Pond. During May of 2018, the Wetland #2 berms were constructed which eliminated discharge of on-site run-off to the Beaver Pond. Per OC guidelines, stormwater is now collected and treated within the lagoon system.

2.2 Geological and Hydrogeological Setting

The stratigraphy and groundwater flow of the underlying material was evaluated from a limited number of boreholes and thus is not fully understood. Figure 3 (Appendix A), shows the location of the groundwater boreholes, including three single groundwater monitoring wells (BH-01, BH-02 and BH-03) and two nested shallow and deep monitoring wells (BH-04 and BH-05). The site is comprised of dense till with occasional sandy gravel seams and boulders.

Permeability estimates range from $3.4x10^{-7}$ to $9.0x10^{-10}$ kg m/s^2, which SHA has determined should make a suitable secondary barrier for leachate.

The groundwater table ranges from a depth of 2 m to 57 m which may suggest that there is a perched water table close to the ground surface, and a much deeper water table, as the water table at BH-03 indicates. It is believed that shallow groundwater (perched water table) flows in a north-westerly direction away from potential receivers including Waterfall Creek and the New Hazelton drinking wells to the southwest of the landfill (Figure 3); however, any deep groundwater migrating from the landfill in a south westerly direction would be intercepted by BH-03, therefore any leachate impact would be confirmed. The deep groundwater flow system has been intersected by only one well (BH-03), therefore, the direction of groundwater flow at the site cannot be determined. Low permeability soil was encountered in the soil samples from the deep and shallow bore holes, which helps reduce the risks associated with the migration of groundwater pollutants as described in SHA's 2018 DOCP Report.

3. WATER QUALITY MONITORING

3.1 Field Techniques

The 2018 monitoring program followed the monitoring program outlined in the amended OC. In 2018, two new shallow groundwater wells located downstream of the 2018 construction were added to detect possible leachate impact from altered discharge patterns. These new wells are SGW-4, and SGW-5. As in previous years, the water quality monitoring in 2018 was conducted by RDKS personnel. Monitoring locations are shown in Figure 3 (Appendix A).

The methods used to develop and sample each monitoring well and surface water station are outlined within the British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air Emissions, Water, Wastewater, Soil, Sediment and Biological Samples (BC 2013)".

3.2 Quality Assurance and Quality Control

The OC 17226 stipulates that the operational certificate holder is required to conduct a Quality Assurance and Control Program to determine the acceptability of data required by the OC 17226 and Section 2(d) of the Environmental Data Quality Assurance Regulation. The OC 17226 stipulates the terms of the quality assurance program under Section 13.5.4 of the permit (Appendix D).

As part of the program the operational certificate holder must report the results of their field duplicate in terms of the degree of variation as the relative percent difference. The calculation of the relative percent difference is provided below for reference:

$$RPD = \frac{D1 - D2}{\frac{D1 + D2}{2}} X\ 100\%$$

Where:

RPD = Relative Percent Difference
D1 = Measured value of the first duplicate
D2 = Measured value of the second duplicate

3.3 Water Quality Sampling Background

The analytical results presented in this report have been tabulated and compared to the "British Columbia Approved Water Quality Guidelines Criteria" (BCWQG) last updated in March 2018. The Water Quality Criteria presents both Drinking Water (DW) and Aquatic Life (AW) Guidelines. Following our standard procedure, parameters not listed in the Criteria were compared to benchmark (working) guidelines approved by the Ministry. These working guidelines are entitled "A Compendium of Working Water Quality Guidelines for British Columbia". With regards to groundwater, exceedances of AW guidelines (highlighted in blue in the tables) are a regulatory concern only if impacted groundwater reaches surface water. This would be the case if contaminated groundwater is not adequately diluted before reaching a surface water body. However, it is unlikely that impacted groundwater will reach surface waters at the Hazelton Landfill; therefore, exceedances of AW guidelines are noted for discussion and reference purposes only. Furthermore, as per the amended OC, the groundwater water quality results were

compared to the "Contaminated Sites Regulation Schedule 3.2[1] Drinking Water Standards" (CSR-DW). The OC states that select groundwater wells SGW-2, SGW-4, SGW-5, BH-03, and BH-5B should be in compliance with the CSR-DW. Therefore, exceedances of the CSR-DW standards for all other wells are for discussion and reference purposes only.

Complete water quality results for groundwater and surface water are summarized in Tables 1, 2, 3, and 4 (Appendix B). Some parameter guidelines are dependent upon hardness or pH which was taken into account when determining if there was an exceedance.

It should be noted that the BCWQG and CSR standards were updated in 2018 and therefore 2018 water quality data has been compared to the new criteria. Historical exceedances of past criteria remain highlighted in the water quality tables.

3.4 Water Quality Results

Landfill leachate typically has elevated concentrations of several indicator parameters. Conductivity is a parameter indicative of the total amount of dissolved minerals in a water sample and higher conductivity levels (>500 µS/cm) are often indicative of leachate impact. Chloride is also used as a leachate indicator at municipal landfills since chlorine is a common constituent of materials disposed of in municipal solid waste. Chloride has low affinity to soil or other matter meaning that it remains dissolved in solution after it enters a water system. Raw leachate from municipal landfills typically has very high chloride concentrations that typically occur in the range of 1,000 mg/l to 3,000 mg/l. Chloride concentrations typically decrease as the leachate mixes with the groundwater and gets diluted. Ammonia is another indicator of landfill impacts.

3.4.1 Surface Water Monitoring Stations

The surface water monitoring schedule as per the amended OC is shown below in Table 3-1.

Table 3-1: Surface Water Monitoring Schedule as per the amended OC

Location	Parameters	Frequency
SW-01 SW-02 SW-05 SW-06	Lab: total metals, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, COD, BOD, pH	Minimum Annually[3] and once during Spring, Summer, Fall if discharging during these seasons
SW-07 SW-08 SW-09[2] SW-10	Field: Conductivity, temperature, turbidity, flow rate, pH, dissolved oxygen	Minimum annually[3] and once during Spring, Summer, Fall if discharging during these seasons

Monitoring locations SW-09 and SW-10 were not sampled in 2018 as the sites were dry during the sampling event. A brief description of each sampling location is presented in Table 3-2. Charts 1 to 5,

[1] CSR standards have been updated and Schedule 3.2 replaced the redacted Schedule 6
[2] SW-09 as near to property boundary as possible but at a location where discernible flow begins in ephemeral creek drainage.
[3] Annual sample should be consistent year to year, preferably taken in fall.

at the end of the report, show surface water quality trends, and Figure 3 depicts the location of the monitoring sites.

Table 3-2: Description of Surface Water Sampling Locations

Monitoring Locations	UTM Coordinates (+/- 5 m)	Description	2018 Sampling Notes
SW-01	593039.945 E 6121908.659 N	South Surface Water Monitoring Station: Measures background concentrations of inflowing surface water from off site. It is upstream of landfill	Sampled May 28, 2018
SW-02	593239.518 E 6122034.517 N	Southeast Surface Water Monitoring Station: Measures background concentrations of inflowing surface water from off site. It is upstream of landfill	Sampled May 28, 2018
SW-03	592818.141 E 6122443.381 N	Leachate seep: Measures raw leachate collected from the side slopes of the landfill.	No longer a sampling location
SW-04	592783.492 E 6122484.465 N	Log Weir: Measures surface water quality at the outlet of a wetland which directly receives flows from SW-03. Flows then converge with Rossvale Creek Tributary II.	No longer a sampling location
SW-05	592835.423 E 6122608.111 N	Beaver Pond Outlet: Downstream of landfill. Flows converge with Rossvale Creek Tributary II.	Sampled May 28, 2018
SW-06	593046.194 E 6122745.85 N	Highway Inlet to Beaver Pond: Measures water on the south side of the highway, entering the inlet of Beaver Pond.	Sampled May 28, 2018
SW-07	591675.005 E 6123069.601 N	On Rossvale Creek Tributary II above the downstream road crossing culvert: Measures surface water flows that converge from SW-05 and SW-04 to form Rossvale Creek Tributary II.	Sampled May 28, 2018
SW-08	593090.039 E 6122786.348 N	Upgradient of landfill: Measures background water quality entering Beaver Pond.	Sampled May 28, 2018
SW-09	592180.986 E 6123775.729 N	Downstream on Rossvale Creek	Not sampled in 2018.
SW-10	N/A	Downstream of BH-03	Not sampled in 2018.
Wetland 4	N/A	Wetland 4	Sampled September 13, 2018. Not an OC sampling location.

3.4.1.1 SW-01 and SW-02

Sampling locations SW-01 and SW-02, located at the south and south-east corners of the landfill property, were sampled once on May 28, 2018. Surface water flows are from off-site sources which allow the samples at these locations to be representative of background concentrations.

As in the past, there were exceedances for metals of the BC WQG AW and DW at both locations during 2018. Specifically, aluminum, iron, manganese, and phosphorus were in exceedance of either criteria. In general, total metal concentrations at SW-01 and SW-02 were similar to previous sampling events.

Field pH readings at these locations are acidic, with pH readings of 5.5 and 6.0, for SW-01 and SW-02, respectively. These values are out of range of both the AW and DW criteria. Field conductivity was

recorded as 28 µS/cm at SW-01 and 21 µS/cm at SW-02. These low conductivity values are representative of naturally occurring water with conductivity less than 200 µS/cm that is impacted by metals naturally mobilized due to acidic conditions.

3.4.1.2 SW-03

Sampling location SW-03 is no longer an active surface water sampling location due to the Environmental Upgrades Project. This sampling location (leachate seep) was located at the toe of the north side of the landfill and surface water from the slopes of the landfill and seeping leachate were the sources of flow at this location. Water quality at SW-03 is the most representative of raw leachate that is slightly diluted from surface runoff.

3.4.1.3 SW-04 Log Weir

Sampling location SW-04 is no longer an active surface water sampling location because of redirection of leachate flow, resulting from the Environmental Upgrades Project. This sampling location measured surface water quality in close proximity to the landfill. It was located at a log weir at the north-west corner of the landfill. Surface water that flowed at SW-04 originated from the slopes of the landfill which was initially sampled at the Leachate Seep (SW-03). This dynamic allowed raw leachate to be diluted and attenuated in the wetland before being sampled at SW-04.

3.4.1.4 SW-05 Beaver Pond Outlet

The SW-05 sampling location is located at the outlet of the Beaver Pond which is north of the Hazelton WMF. Before the Environmental Upgrades project, a small portion of the runoff from the landfill flowed into a smaller pond before flowing into the Beaver Pond. This is no longer the case because all runoff is contained at site. Furthermore, the Beaver Pond receives flow from a ditch that flows along the north side of Highway 16.

Sampling location SW-05 was sampled once in May 2018 and the sample exceeded the AW and DW guidelines for aluminum (AW only), iron, manganese (DW only), and phosphorus. As this sampling location no longer receives runoff from the landfill, the exceedances at this location imply that there are exceedances in background concentrations entering the pond.

Field readings at this location indicate that the water is acidic (6.2 pH) and out of range of the AW and DW criteria. Field conductivity was recorded as 107 µS/cm and is representative of naturally occurring water with conductivity less than 200 µS/cm.

3.4.1.5 SW-06

The SW-06 sampling location is located south of Highway 16 at the inlet to the Beaver Pond. Flows originate from a culvert that flows under Highway 16 and are sampled downstream of SW-08. In general, exceedances at this location are similar to SW-08.

Iron and phosphorus concentrations exceeded the DW and AW guidelines. Manganese concentrations exceeded the DW criteria only and aluminum concentrations exceeded the AW criteria only.

Field readings at this location indicate that water is acidic (6.2 pH) and out of range of the AW and DW criteria. Field conductivity at this location was elevated during the May 2018 sampling event and was recorded as 531 µS/cm. In comparison, past conductivities recorded at this location typically range from

121 – 173 µS/cm. The elevated conductivity at this location could be due to runoff from the highway in the spring. However, if this was the case then one would expect SW-08 to have elevated conductivity as well and the conductivity recorded at SW-08 was 102 µS/cm. Therefore, the cause of the elevated conductivity at this location is unknown at this time. This sampling location should be monitored to confirm that conductivity returns to normal levels in future years.

3.4.1.6 SW-07

The SW-07 sampling location is located on Rossvale Creek Tributary II above the downstream road crossing culvert near Hwy 16. Surface water flows originate from the flow from SW-05, which converges to form Rossvale Creek Tributary II. This location represents water concentrations downstream of the Beaver Pond.

Aluminum exceeded the AW criteria during the sampling event. Iron and manganese exceeded the DW criteria only. In general, exceedances are consistent with the past two years. Water quality at this location has improved compared to years prior to 2016.

The field pH at this location is acidic (6.4 pH) and is out of range of both the AW and DW criteria. Field conductivity at this location is low and was recorded as 109 µS/cm during the sampling event. Conductivity at this location is similar to background concentrations noted at SW-08 and SW-05 and is representative of naturally occurring water with conductivity less than 200 µS/cm. Therefore, no signs of leachate impact at this monitoring location.

3.4.1.7 SW-08 Highway 16 East Culvert

The water sample for SW-08 is collected from a culvert that passes underneath Highway 16. Runoff from the road and the road side ditch make up the majority of the flow in the stream. This sampling location is upstream of the WMF and is used to represent background water.

Iron and phosphorus concentrations exceeded the AW and DW guidelines during the sampling event. Manganese concentrations exceeded the DW guidelines only and aluminum exceeded the AW criteria only. The exceedances at this location indicate that background water has naturally elevated levels of metals.

The field pH at this location is acidic at 5.7 pH and conductivity is low at 102 µS/cm. The acidic nature of the water at this location is likely contributing to the elevated metal concentrations.

3.4.1.8 Wetland #4

Wetland #4 is located on the west side of the landfill as seen in Figure 3. Surface water samples were collected from Wetland #4 in September 2018. There was no authorized discharge via Wetland #4 for 2018. However, leachate was pumped to Wetland #4 due to a misunderstanding; leachate should have been pumped directly to the EQ pond. Due to this, an unknown volume of leachate was released. Once the issue was identified, the discharge was stopped and directed to the EQ pond. The RDKS collected surface water samples, including an acute toxicity sample, from Wetland #4. This water quality analysis is representative of dilute leachate, as samples were not collected directly from the discharge but were collected from the diluted water contained in Wetland #4. The analytical results have been tabulated in Table 4 and the results of the acute toxicity test are presented in Appendix E. The water quality sample and acute toxicity sample collected were both in compliance with the OC discharge criteria.

Water quality results from Wetland #4 have also been compared to the BCWQG-DW and BCWQG-AW for discussion and reference purposes. There were elevated levels of total organic carbon and chloride at this location and both parameters exceeded the BCWQG-DW. There were also various exceedances of the BCWQG-DW and AW for metals such as arsenic, boron, chromium, manganese, phosphorus, and sodium. It is clear from the water quality results that this location was impacted by leachate, which is to be expected given that leachate was mistakenly pumped to this location without undergoing treatment. Furthermore, the sample was taken in September after a relatively dry summer period, and therefore it is reasonable to assume that minimal dilution from precipitation occurred.

3.4.2 Groundwater Monitoring Wells

The groundwater monitoring well network at the Hazelton WMF consists of groundwater wells and shallow groundwater (SGW) wells. The groundwater monitoring schedule as per the amended OC is shown below in Table 3-3.

Table 3-3: Groundwater Monitoring Schedule as per Amended OC

Location	Parameters	Frequency
BH-01 BH-02 BH-03 BH-4B BH-5B	Lab: Dissolved metals, alkalinity, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, TOC, COD, VOCs[5], pH	Quarterly → Annually[6]
SGW-1 SGW-2 SGW-3 SGW-4[4] SGW-5[3]	Field: Conductivity, temperature, water elevation[7]	Monthly → Quarterly[6]

The five groundwater wells (BH-01, BH-02, BH-03, BH-04, BH-05) were drilled by Agra in 2009. It is our understanding that the SGW wells (SGW-1, SGW-2, SGW-3, SGW-4, SGW-5) were pushed/dug into the bank of the streams to represent the ephemeral creek water. The wells do not have a sand pack around the slots of the well piezometers, which means there is a higher potential for sedimentation infiltration into the wells. A brief description of the groundwater and SGW sampling locations is presented in Table 3-4. The locations of the Hazelton WMF groundwater sampling locations are shown in Figure 3. Groundwater table elevations are shown in Table 3-5.

[4] Wells must be installed by September 30, 2018
[5] One-time sample of VOC's for background levels, taken during first sampling event 2018.
[6] Quarterly reduced to annually and monthly reduced to quarterly following two complete years of sampling.
[7] Water elevation quarterly.

Table 3-4: Description of Groundwater Sampling Locations

Monitoring Locations	UTM Coordinates (+/- 5m)	Description	2018 Sampling Notes
BH-01	593609.194 E 6121753.831 N	South east of the Landfill and considered to be up-gradient and thus represents background groundwater quality	Sampled May 30, 2018 July 11, 2018 and September 11, 2018
BH-02	593264.351 E6121910.517 N	South east of the Landfill and considered to be up-gradient and thus represents background groundwater quality	Sampled May 30, 2018 July 11, 2018 and September 11, 2018
BH-03	592642.79 4E 6122053.098 N	Located 330 m west of the Iron Pond , and is between the Landfill and the closest public drinking water well which is approximately 2 km south west from the Landfill	Sampled May 30, 2018 and September 11, 2018
BH-4A	593506.8 E 6122164.167 N	Deep piezometer in BH-04. South east of the Landfill and considered to be up-gradient and thus represents background groundwater quality	Sampled Sept 11, 2018.
BH-4B	593506.8 E 6122164.167 N	Shallow piezometer in BH-04. South east of the Landfill and considered to be up-gradient and thus represents background groundwater quality	Sampled May 30, 2018 and July 11, 2018
BH-5A	592591.139 E6123018.88 N	Deep piezometer in BH-05 and historically dry. Directly downgradient of the landfill and is situated near the intersection of the landfill access road and Highway 16	Not sampled in 2018. Dry.
BH-5B	592591.139 E 6123018.88 N	Shallow piezometer in BH-05. Directly downgradient of the landfill and is situated near the intersection of the landfill access road and Highway 16	Sampled May 30, 2018 July 11, 2018 and September 11, 2018
SGW-1	592698.027 E 6 6122231.314 N	Downstream of the SW corner of the Phytoremediation perimeter ditch	Sampled May 30, 2018 July 10, 2018 and September 11, 2018
SGW-3	592673.678 E 6122409.984 N	Downstream of the NW corner of the WMF site, downstream of the Wetland #4 discharge rock infiltration trench	Sampled May 30, 2018 July 10, 2018 and September 12, 2018
SGW-2	592533.158 E 6122444.271 N	Downstream of SGW-3	Sampled May 30, 2018 and July 10, 2018
SGW-4	592524.282 E 6122701.595 N	Downstream of Beaver Pond	Sampled July 10, 2018 and September 11, 2018
SGW-5	592525.999 E 6122269.748 N	Downstream of SGW-1	Sampled May 30, 2018, July 10, 2018 and September 11, 2018

Table 3-5: Groundwater Table Elevations, July 30, 2014

GW Wells	Ground Elev.	Stick Up (m)	Well Depth (m)	WL Depth (m)	GW Elev. (m)
BH-01	141.77	0.36	44.50	21.32	120.81
BH-02	141.84	0.32	33.24	21.30	120.86
BH-03	114.9	0.44	60.05	56.65	58.69
BH-4A	122.31	0.92	17.59	14.58	108.65
BH-4B	122.31	1.02	3.00	2.68	120.65
BH-5A	93.94	0.51	18.53	dry	dry
BH-5B	93.94	0.49	5.60	3.56	90.87

Note: Agra surveyed borehole elevations to an arbitrary datum.

SHA estimates that actual elevations are 330 m higher than Agra's reported values in this Table.

3.4.3 Shallow Ground Water Quality Results

Shallow groundwater quality results are tabulated in Table 2 (Appendix B). Charts 6 to 11 show the overall shallow groundwater quality trends. This year, all SGW wells were sampled for dissolved metals. Last year, it should be noted that all the SGW wells were sampled for total metals rather than dissolved metals and as such, any sediments stirred up during well purging would have affected the results. Therefore, charts for shallow groundwater metals only show results for the 2018 year (dissolved metals).

3.4.3.1 SGW-1

Shallow ground water well SGW-1 is located in an ephemeral creek which is similar to the wetland areas bordering the landfill site. Currently, run-on flowing into the creek is from the perimeter ditch bordering the south and west sides of the Phase 2 expansion area, and the south phytoremediation perimeter ditch. Pooling leachate runoff from the Phase 2A expansion area was spilling into the ditch and flowing into the ephemeral creek. However, this was stopped in July of 2018 because a leachate collector was installed as part of the Environmental Upgrades which now captures this leachate.

Samples at this location showed elevated conductivity, chlorides, total organic carbon (TOC), and total hardness. Field conductivity ranged from 963 to 1846 µS/cm from April 2018 to November 2018. This range is well above the conductivity of naturally occurring water (<200 µS/cm). Chlorides were compliant with values ranging from 98 to 105 mg/L, but these values still indicate leachate impact. Total organic carbon ranged from 75 – 342 mg/L and exceeded the BCWQG-DW. The hardness ranged from 611 to 1080 mg/L. These values are consistent with those measured in 2017.

There were consistent exceedances of BCWQG-DW and BCWQG-AW for several metals. Metals exceeding either criteria in one or more case include aluminum, arsenic, iron, manganese, and phosphorous. At this time, it is not viable to determine long-term trends for these parameters since 2018 was the first year that dissolved metals were analyzed in the shallow groundwater samples.

3.4.3.2 SGW-3

Shallow groundwater well SGW-3 is also located in an ephemeral creek which enters the area northwest of Wetland #4 at the NW corner at site. Two sources of flow will flow through this monitoring location. Firstly, SGW-3 is downstream of the Wetland #4 rock infiltration trenches which will contribute conditioned leachate flows when a controlled discharge event takes place. Secondly, run-on water flows

into the ephemeral creek via perimeter ditch sections north of Wetland #3 and #4, and west of the Phytoremediation area.

In the past, leachate from the toe of Phase 1 was spilling into the Wetland #3 excavation and entering the perimeter ditch via a gravel seam in Wetland #3. To cease this leachate flow, a leachate collection system was installed at Phase 1 and Wetland #3 has been plugged with clay. These actions are part of the Environmental Upgrades project.

Samples at this location showed elevated conductivity, chlorides, total organic carbon (TOC), and total hardness. Field conductivity ranged from 540 to 940 µS/cm from April 2018 to November 2018. This range is well above the conductivity of typical surface water (<200 µS/cm). There appears to be a slight improvement in conductivity at SGW-3 compared to 2017 when conductivity ranged from 685-1850 200 µS/cm. Chlorides were compliant with values ranging from 43.9 to 49.2 mg/L, but these values are still elevated. Total organic carbon ranged from 51 – 160 mg/L and exceeded the BCWQG-DW. The hardness ranged from 421 to 714 mg/L. These values are consistent with 2017 data.

There were consistent exceedances of BCWQG-DW and BCWQG-AW for several metals. Metals exceeding either criteria in one or mores case include aluminum, arsenic, chromium, iron, manganese, phosphorous and vanadium. At this time, it is not viable to determine long-term trends for these parameters since 2018 was the first year that dissolved metals were analyzed in the shallow groundwater samples.

3.4.3.3 SGW-2

Shallow groundwater well SGW-2 is located within the ephemeral creek downstream of SGW-3, as observed in Figure 3. This monitoring location is situated near the property boundary. In general, improved water quality is observed at this location when compared to SGW-3.

Samples from this location showed elevated conductivity and total organic carbon (TOC). Field conductivity ranged from 676 to 2050 µS/cm from April 2018 to November 2018, this range is well above the conductivity of typical surface water (<200 µS/cm). Chlorides were in compliance with values ranging from 4.6 to 7.6 mg/L which is roughly an 85 % decrease when compared to chloride concentrations of 19 mg/L to 45.1 mg/L at SGW-3. Total organic carbon ranged from 88 – 249 mg/L and exceeded the BCWQG-DW. The hardness ranged from 175 to 339 mg/L compared to 504 – 749 mg/L at SGW-3. The significant decrease in leachate indicator parameters compared to SGW-3 shows natural attenuation of potential leachate impact. It is surprising, however, that conductivity at downstream SGW-2 is higher than upstream SGW-3. One would expect the conductivity to be lower at SGW-2, especially when the other parameters decreased as a result of attenuation. The reason for the elevated conductivity at this location is unknown at this time.

There were consistent exceedances of BCWQG-DW and BCWQG-AW for several metals. Metals exceeding either criteria in one or more case include aluminum, arsenic, chromium, iron, manganese, and phosphorous. At this time, it is not viable to determine long-term trends for these parameters since 2018 was the first year that dissolved metals were analyzed in the shallow groundwater samples.

Of importance, there were two parameters which exceeded the CSR-DW at this location. Iron and manganese concentrations exceeded the criteria at both sampling events. As per the OC, the operational certificate holder must implement the Groundwater Quality Exceedances Response Plan (Response Plan)

if exceedances of the CSR DW are found at SGW-2. However, the Response Plan cannot be conducted yet as the Phytoremediation system is still undergoing construction. This location should continue to be monitored for exceedances of the CSR-DW in the future.

3.4.3.4 SGW-4

Shallow groundwater well SGW-4 is located within the ephemeral creek downstream of Beaver Pond, as observed in Figure 3. This monitoring location is situated near the property boundary and 2018 was the first year that samples were collected from this location.

Samples from this location showed elevated conductivity, total organic carbon (TOC), and total hardness. Field conductivity ranged from 388 – 1278 µS/cm from April 2018 to November 2018, this range is well above the conductivity of typical surface water (<200 µS/cm). Total organic carbon was lower at this location than others but still exceeded the BCWQG-DW criteria and ranged from 9 – 10.6 mg/L. Hardness ranged from 494 – 656 mg/L.

There were consistent exceedances of BCWQG-DW and BCWQG-AW for several metals. Metals exceeding either criteria in one or more case include aluminum, arsenic, iron, and manganese.

Of importance, the iron concentration exceeded the CSR-DW at this location during the September sampling event. As per the OC, the operational certificate holder must implement the Groundwater Quality Exceedances Response Plan if exceedances of the CSR DW are found at SGW-4. However, the Response Plan cannot be conducted yet as the Phytoremediation system is still undergoing construction. This location should continue to be monitored for exceedances of the CSR-DW in the future.

At this time, it is not viable to determine long-term trends for leachate parameters at SGW-4 since 2018 was the first year that SGW-4 was sampled.

3.4.3.5 SGW-5

Shallow groundwater well SGW-5 is located within the ephemeral creek downstream of SGW-1, as observed in Figure 3. This monitoring location is situated near the property boundary and 2018 was the first year that samples were collected from this location.

Samples from this location showed elevated conductivity, total organic carbon (TOC), and total hardness. Field conductivity ranged from 334 – 737 µS/cm from April 2018 to November 2018, and this range is above the conductivity of typical surface water (<200 µS/cm). Conductivity at this location is much lower than SGW-1 (963 to 1846 µS/cm). Total organic carbon ranged from 6 to 27.4 mg/L and exceeded the BCWQG-DW. Chlorides were below the guidelines and ranged from 4 – 6.99 mg/L. Chlorides at this location are 93 % lower compared to chloride reading of 98.1 to 105 mg/L at SGW-1, indicating natural attenuation of potential leachate impact.

There were consistent exceedances of BCWQG-DW and BCWQG-AW for several metals. Metals exceeding either criteria in one or more case include aluminum, iron, and manganese. In general, metals at SGW-5 are lower than upstream SGW-1.

No exceedances of the BC-CSR were found at this location in 2018.

At this time, it is not viable to determine long-term trends for leachate parameters at SGW-5 since 2018 was the first year that SGW-5 was sampled.

3.4.4 Groundwater Quality Results

Groundwater quality results are tabulated in Table 3 in Appendix B. Charts 12 to 18 in Appendix C show the overall groundwater quality trends.

3.4.4.1 Background Groundwater Quality

Groundwater monitoring locations BH-01, BH-02, and BH-04 are all up gradient of the landfill and are assumed to represent background water quality. Monitoring well BH-04 has nested piezometers with one deep, and one shallow piezometer. These are labelled BH-4A and BH-5B. These samples show that the groundwater in the area tends to exceed AW and DW standards for several parameters.

Deep wells, BH-02 and BH-4A have high conductivity, ranging from 674 - 931 µs/cm and 597 to 760 µs/cm, respectively. Both wells had hard water (total hardness) ranging from 479 to 482 mg/L and 203 mg/L for BH-02 and BH-4A, respectively. Similarly, the shallow piezometer BH-4B had elevated conductivity ranging from 628 – 666 µs/cm and hardness ranging from 354 – 355 mg/L.

Upstream BH-01 has lower conductivity than BH-02, BH-4A, and BH-4B; however, it is still relatively high, ranging from 383 to 526 µs/cm. The water at BH-01 was also hard, ranging from 266 to 329 mg/L.

There were exceedances for several metal concentrations at the background wells. Monitoring wells BH-4A, BH-4B and BH-02 exceed either the AW or DW guidelines for cadmium and manganese concentrations. Furthermore, aluminum, arsenic, iron, and manganese concentrations exceeded either the AW or DW guidelines at BH-01.

Volatile Organic Compounds (VOCs) were sampled in May 2018 and all results are below the criteria.

3.4.4.2 Groundwater Quality Downgradient of Landfill

Monitoring well BH-05 has nested piezometers with one deep, and one shallow piezometer. These are labelled BH-5A and BH-5B. BH-5A has historically been dry and is not a sampling location as per the amended OC. The groundwater elevation in 5B is typically about 30 m below the groundwater elevation in the majority of the other wells (with the exception of BH-03 and BH-4B). This disparity in water table elevation could partly contribute to the difference in sampling results.

The groundwater from BH-5B was typically very hard, has high conductivity, and has higher chloride concentrations than most of the background wells, as shown in Charts 12, 13, and 16 in Appendix C. These elevated parameters are typical of groundwater that is affected by leachate. However, as mentioned above, the background groundwater has naturally occurring high conductivity and hardness concentrations (BH-02). Nevertheless, the concentrations at BH-5B are clearly above the levels in BH-02, suggesting leachate impact. The high chloride levels at this well (205 mg/L) are more indicative of leachate impact as they are comparable to the leachate seep (270-344 mg/L). Another possible source of chloride at this well location could be runoff from the highway in spring months. There appears to have been a sharp decrease in chloride concentration during the May and July 2018 sampling events and then concentrations returned to elevated levels in the subsequent sampling event. At this time, it is not clear what caused the large fluctuation.

There were metals in exceedance of both the BCWQG-DW and BCWQG-AW. Exceedances of the AW limits were observed for arsenic. Exceedances of both DW and AW were observed for manganese, iron, and phosphorus.

Of importance, there were exceedances of the CSR-DW standards at BH-5B for arsenic, cobalt, iron, and manganese concentrations at this location in 2018. As per the OC, the operational certificate holder must implement the Groundwater Quality Exceedances Response Plan if exceedances of the CSR DW are found at BH-5B. However, the Response Plan cannot be conducted yet as the Phytoremediation system is still undergoing construction. This location should continue to be monitored for exceedances of the CSR-DW in the future.

VOCs were sampled in May 2018 and all results are below the criteria and similar to background levels.

3.4.4.3 Groundwater Quality Between Landfill and Public Water Well

There were no exceedances of the guidelines at BH-03 in 2018. Furthermore, conductivity has decreased at this location compared to 2017. However, conductivity is still elevated and ranged from 638 to 667 mg/L. Conductivity is similarly high in background wells. Furthermore, leachate indicators were not appreciably elevated above background conditions. Notably, chloride levels were basically equal to those of background concentrations

In conclusion, BH-03 does not appear to be affected by leachate. However, it is important to continue to sample this location because it would intercept any groundwater flowing from the landfill towards the public water well to the southwest of the landfill.

VOCs were sampled in May 2018 and all results are below the criteria and similar to background levels.

4. DISCUSSION ON SURFACE WATER AND GROUNDWATER QUALITY RESULTS

4.1 Surface Water Quality

4.1.1 Surface Water

Surface water entering the site at SW-01 was acidic and had elevated concentrations of aluminum, iron, manganese and phosphorous. These elevated concentrations are regularly in non-compliance with BCWQG-AW and DW criteria. Furthermore, the exceedances in 2018 are consistent with those in 2017. Surface water entering the site at SW-02 was also acidic and had elevated levels of iron, manganese, and phosphorus; at this location there were more exceedances in 2018 compared to 2017. Water quality at SW-02 in 2018 is similar to SW-01, with the exception of aluminum concentrations, which are lower at SW-02. Historically, these locations have shown naturally occurring exceedances of the BCWQ criteria, particularly for metals, likely a result of the acidic waters. Thus, elevated metals at downstream surface water locations are not thought to be due to leachate.

As shown in Charts 1 and 2, SW-03 and SW-04 historically had the highest conductivity and chloride concentrations of all the sampling locations. This is consistent with the fact that SW-03 and SW-04 were located closest to the landfill. Surface water sampling stations SW-03 and SW-04 are no

longer active sampling locations but are useful to use as a reference as these elevated levels are indicative of leachate impact. In 2018, surface water sampling location SW-06 at the inlet to Beaver Pond had the highest conductivity and chloride concentrations of all the sampling locations. Particularly, there was a spike in conductivity at SW-06 during the 2018 sampling event and this location should be monitored to confirm that levels return back to normal in subsequent sampling events. The low conductivity and chloride observed at downstream SW-05 suggests that the Beaver Pond is not impacted by leachate, which is to be expected given that runoff from the landfill is now contained at site and no longer flows into the Beaver Pond. Metal exceedances found at SW-05 are similar to the Beaver Pond inlet locations SW-06 and SW-08, and thus assumed to be naturally occurring.

Surface water sampling location SW-07 is downstream from the other monitoring stations and it appears that its water quality is similar to that of background concentrations and therefore does not show signs of leachate impact.

4.2 Groundwater Quality

4.2.1 Shallow Groundwater Wells

In general, the results from the SGW wells show elevated concentrations of conductivity, chlorides, total organic carbon (TOC), and total hardness in all samples. As seen in Charts 6 and 7, SGW-1 had the highest conductivity and chloride concentrations of all the SGW wells. Sampling location SGW-1 is located downstream of the southwest corner of the Phytoremediation perimeter ditch. In comparison, SGW-5 showed the lowest conductivity and chloride concentrations of all the SGW wells. Sampling location SGW-5 is located downstream of SGW-1 and the lower levels of conductivity and chloride at this location compared to SGW-1 indicate that the water is being highly diluted and/or attenuated by the time it reaches the property boundary. Of note, chloride concentrations decrease significantly between the two locations and levels were below the BCWQG at SGW-1.

Similarly, it appears that shallow groundwater is being diluted and/or attenuated between SGW-3 and SGW-2. Sampling location SGW-3 is located downstream of Wetland #4 discharge rock infiltration trench and SGW-2 is located downstream of SGW-3. Leachate indicator parameters such as chloride, iron, and manganese are all lower at SGW-2 than SGW-3. Interestingly, conductivity is higher at SGW-2 than SGW-3. The reason for this is unknown at this time. Even though significant dilution/attenuation occurred between SGW-3 and SGW-2, there were still exceedances of the CSR-DW found at SGW-2 in 2018 for iron and manganese. Similarly, there was one exceedance of the CSR-DW at SGW-4 in 2018 for manganese. This is important as the OC stipulates that the Groundwater Exceedances Response Plan must be implemented if exceedances of the CSR-DW are found at either SGW-2 or SGW-4.The primary reason for the exceedances is believed to be the result of leachate escaping into the western drainages during initial construction of grading works and septage area clean up before containment berm was constructed.

All shallow groundwater monitoring locations show elevated metal concentrations for aluminum, arsenic, iron, and manganese. SHA suspects that the elevated metals are the result of low-pH groundwater originating from wetlands and are not necessarily related to landfill leachate impacts. Also, the SGW wells are potentially impacted by surface water and therefore exceedances of metals at these

locations could partly be attributed to natural exceedances found in background surface water. It should be noted that charts for shallow groundwater metals show values for the 2018 year only since total metals were sampled in 2017 and dissolved metals were sampled in 2018.

4.2.2 Groundwater Wells

The background groundwater quality around the landfill site was found to have elevated conductivity, hardness, arsenic, iron, and manganese.

The water in BH-03, which would intercept any flow from landfill leachate before it reached the public water well, has water quality that is consistent with background trends. Notably, the chloride concentrations are equivalent which implies that only natural, clean water flows at this location. Furthermore, metal concentrations at BH-03 are all lower than background concentrations and do not indicate leachate impact.

Monitoring location BH-5B is the only well that is downgradient of the landfill. Its results showed potential evidence of leachate impact. It had elevated conductivity values that were higher than background and elevated chloride concentrations that were much higher than background conditions and similar to those found at the leachate seep. However, several of the exceedances are similar to background conditions. Also, it is difficult to determine the portion of contamination resulting from nearby highway operations. For these reasons, it is difficult to determine whether or not the landfill is impacting groundwater at the downstream BH-5B monitoring location.

5. QUALITY ASSURANCE AND QUALITY CONTROL

A quality assurance and quality control (QA/QC) program is a system of procedures, checks, audits and corrective actions that will assist in ensuring that the data generated at the laboratory is of the highest achievable quality. This is of prime importance, as the monitoring data forms the basis for all of the conclusions regarding the impact of the Landfill on the surrounding environment. As per the OC, one duplicate sample should be collected during each sampling event from one of the discharge points. Furthermore, each duplicate sample should be submitted to the laboratory; one of the pair identified as the regular sample, and the other, as a blind sample identified by a fictitious site-name established solely to identify the duplicate sample. The results of the field duplicates in terms of the degree of variation as the relative percent difference should be reported for each parameter, as specified in the OC.

In 2018, duplicate samples were obtained during the May, July, and September groundwater sampling events. The results of the duplicate samples and the degree of variation as the relative percent difference for each parameter are presented in Table 3. A summary of the analytes which were out of compliance (RPD > 20%) are listed below in Table 5-1.

Table 5-1: Summary of Duplicate Sample Non-Compliance

Sampling Location	Monitoring Event	Analyte	RPD
BH-02	May 30, 2018	Aluminum	121%
		Cadmium	73%
		Iron	35%
		Lead	28%
		Nickel	21%
		Zinc	22%
BH-5B	July 11, 2018	Aluminum	84%
		Antimony	64%
		Arsenic	22%
		Copper	35%
BH-5B	September 11, 2018	Aluminum	67%
		Antimony	70%
		Arsenic	33%
		Cobalt	96%
		Copper	91%
		Molybdenum	81%
		Silver	90%
		Nickel	80%
		Zinc	81%

6. CONCLUSIONS AND RECOMMENDATIONS

The Operational Certificate 17226 for the Hazelton Regional Landfill was amended on February 7, 2018 and for this reason, the environmental monitoring program in 2018 followed the amended OC. Two new SGW wells were installed in 2018 and the SGW sampling was undertaken because of altered leachate flow patterns associated with the Environmental Upgrades Project.

Sampling results suggest that the surface water in the area consistently exceeds BCWQG for aluminum, iron, manganese, and phosphorous. This is true of both the background samples taken from SW-1, and SW-2, and the downstream samples from SW-5 and SW-7 and therefore the exceedances are presumed to be naturally occurring. Surface water sampling locations SW-6 and SW-8 come from a culvert that flows underneath Highway 16 and flows into the Beaver Pond. The metals concentration at SW-5 at the outlet of Beaver Pond are similar to SW-6 and SW-8, suggesting no leachate impact at Beaver Pond. This is to be expected given that leachate flows have been redirected such that leachate no longer flows into Beaver Pond.

Shallow groundwater wells appear to have increasing leachate impact with closer proximity to the landfill. But, it has been observed that the impact at the property boundary has been significantly diluted/attenuated. Despite the attenuation, there were exceedances of the CSR-DW for iron and/or manganese at property boundary sampling locations SGW-2 and SGW-4. As per the OC, the exceedances of the CSR-DW at these locations trigger the Groundwater Exceedances Response Plan. However, since the Phytoremediation system is still under construction, the response plan cannot be

implemented at this time. In the meantime, all leachate is now being pumped into the equalization pond to prevent further impact.

The only downgradient groundwater well showing elevated levels of leachate indicators is BH-5. However, several of these exceedances are similar to background conditions. Also, it is difficult to determine the portion of contamination resulting from nearby highway operations. For these reasons, it is difficult to determine whether or not the landfill is impacting groundwater in the vicinity of the Hazelton WMF site. In order to determine if groundwater is in fact impacted by the landfill, at least two more downgradient groundwater monitoring wells are required. Furthermore, these wells should have nested wells with shallow and a deep well to partition perched water table effects and deep groundwater effects.

The water in BH-03, which would intercept any flow from landfill leachate before it reached the public water well, has water quality that is consistent with background trends and implies that only natural, clean water flows at this location.

There was no authorized discharge via Wetland #4 for 2018. However, leachate was pumped to Wetland #4 due to a misunderstanding; leachate should have been pumped directly to the EQ pond. Due to this, an unknown volume of leachate was released. Once the issue was identified, the discharge was stopped and directed to the EQ pond. The RDKS collected surface water samples, including an acute toxicity sample, from Wetland #4. This water quality analysis is representative of dilute leachate, as samples were not collected directly from the discharge but were collected from the diluted water contained in Wetland #4. The water quality sample and acute toxicity sample collected were both in compliance with the OC discharge criteria.

After a thorough review of the 2018 monitoring data submitted by RDKS staff, SHA recommends the following:

- Surface water monitoring should continue to be conducted as per the amended OC.
- Groundwater monitoring should continue to be conducted as per the amended OC.
- Continue monitoring water quality at BH-5 and if leachate indicator parameters show an increasing trend, consider installing at least one new groundwater monitoring well downgradient of the landfill. The new well will help to monitor groundwater sufficiently and confirm the direction of groundwater flow. A survey should be completed in conjunction with the installation of any new well(s) to tie into actual datum.
- Ensure that the leachate management system is operated in accordance with the DOCP.
- Monitor for exceedances of the CSR-DW at SGW-2, SGW-4, SGW-5, BH-03, and BH-5B. If exceedances are found, implement the Groundwater Exceedances Response Plan. Ensure that the Operational Certificate holder is familiar with the Response Plan.
- A qualified professional should continue to be retained on an annual basis to evaluate the water quality data.
- The sampling program should follow established handling procedures including preservation of samples and storage to ensure continuity and representativeness of the samples.

7. STATEMENT OF LIMITATIONS

This report has been prepared by Sperling Hansen Associates (SHA) on behalf of the Regional District of Kitimat-Stikine in accordance with generally accepted engineering practices to a level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions in British Columbia, subject to the time limits and financial and physical constraints applicable to the services.

The report, which specifically includes all tables and figures, is based on engineering analysis by SHA staff of data compiled during the course of the project. Except where specifically stated to the contrary, the information on which this study is based has been obtained from external sources. This external information has not been independently verified or otherwise examined by Sperling Hansen Associates to determine its accuracy and completeness. Sperling Hansen Associates has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the reports as a result of omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation.

The report is intended solely for the use of the Regional District of Kitimat-Stikine. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Sperling Hansen Associates does not accept any responsibility for other uses of the material contained herein nor for damages, if any, suffered by any third party because of decisions made or actions based on this report. Copying of this intellectual property for other purposes is not permitted.

The findings and conclusions of this report are valid only as of the date of this report. The interpretations presented in this report and the conclusions and recommendations that are drawn are based on information that was made available to Sperling Hansen Associates during the course of this project. Should additional new data become available in the future, Sperling Hansen Associates should be requested to re-evaluate the findings of this report and modify the conclusions and recommendations drawn, as required.

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Bioresource Engineer

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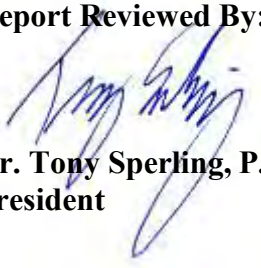
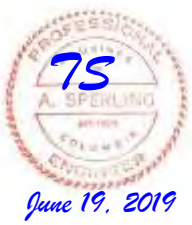
Environmental Engineer

Report Reviewed By:



Dr. Tony Sperling, P.Eng.
President



8. REFERENCES

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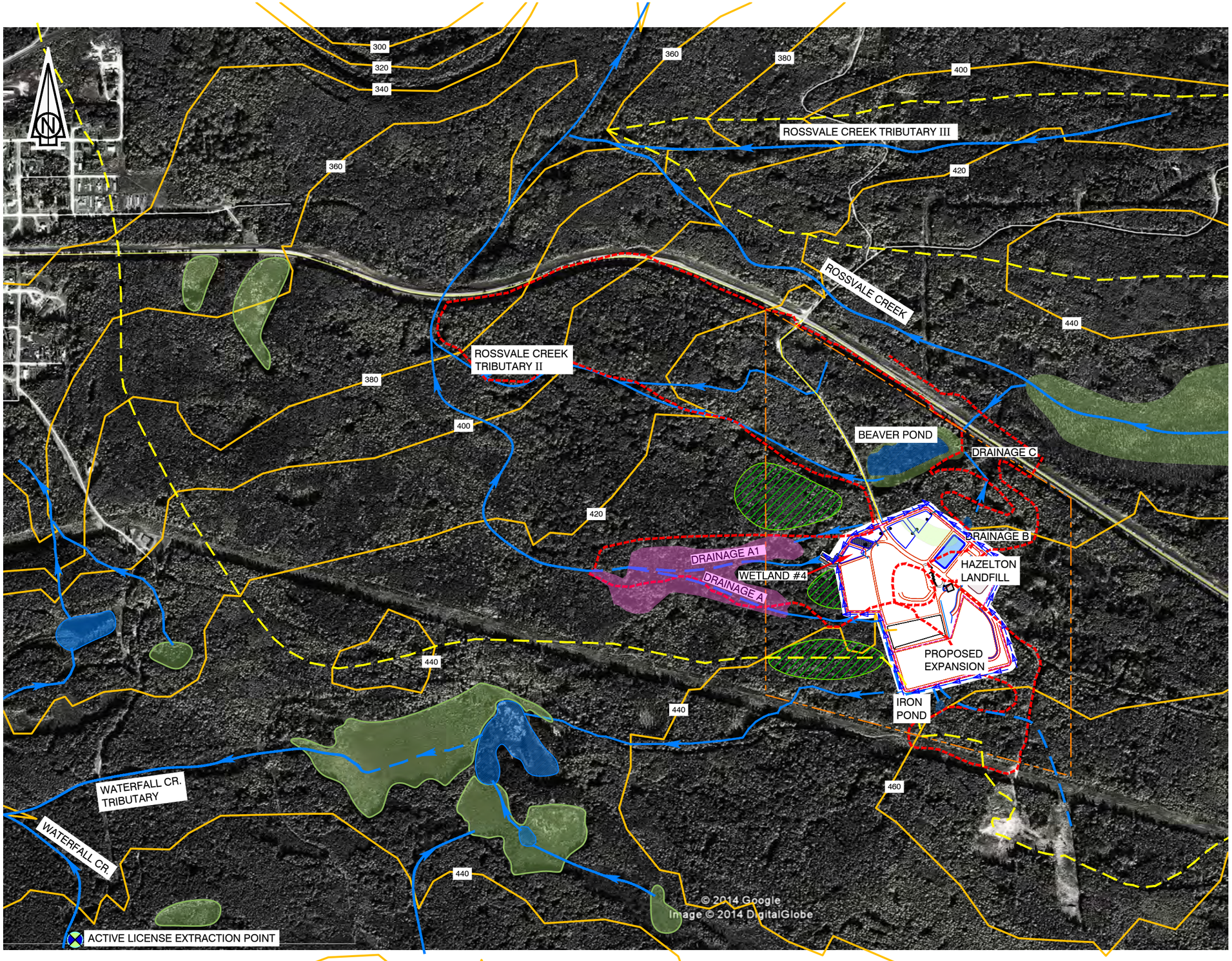
Sperling Hansen Associates. Hazelton Landfill Annual Report 2017 PRJ18020..

Appendix A: Figures



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- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

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LEGEND:

- POND
- WETLAND
- HIGHER GROUND
- CREEK
- INTERMITTENT CREEK
- LANDFILL LEASE PROPERTY BOUNDARY
- PERIMETER DITCH
- EXISTING TOPO CONTOUR 20m INTERVAL
- SURFACE WATER FLOW DIVIDE
- GROUND PROOFING TRAVERSE

CLIENT: Regional District of Kitimat-Stikine

PROJECT: HAZELTON WMF ANNUAL MONITORING REPORT

TITLE: **STREAMS, WETLANDS AND FLOW DIVIDES IN VICINITY OF HAZELTON LANDFILL**

SCALE:	DATE:	PROJECT NO:
1:10.000	2019/02/22 yyyy/mm/dd	PRJ 19009

DESIGNED	TS	DRAWING NO: **FIGURE 2**
DRAWN	AD	
CHECKED	TS	

TO BULKLEY RIVER
SW-09
ROSSVALE CREEK TRIBUTARY III
ROSSVALE CREEK
SW-07
BH-05
ROSSVALE CREEK
TRIBUTARY II
SW-08
SW-06
BEAVER POND
SGW-4
SW-05
SW-04
SW-03
SGW-2
SGW-3
HAZELTON
LANDFILL
WETLAND #4
SGW-5
SGW-1
BH-04
PROPOSED
EXPANSION
SW-02
BH-03
IRON
POND
SW-01
BH-02
BH-01
WATERFALL CR.
TRIBUTARY
WATERFALL CR.
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SPERLING HANSEN ASSOCIATES

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LEGEND:
- POND
- CREEK
- INTERMITTENT CREEK
- SURFACE WATER MONITORING LOCATION
- GROUNDWATER MONITORING WELL
- PROPERTY LINE
- SHALLOW GROUNDWATER WELL
- CULTURALLY MODIFIED TREE

CLIENT: Regional District of Kitimat-Stikine

PROJECT: HAZELTON WMF ANNUAL MONITORING REPORT

TITLE: **HAZELTON MONITORING WELLS AND SAMPLING LOCATIONS**

SCALE:	DATE:	PROJECT NO:
N.T.S.	2019/02/22 yyyy/mm/dd	PRJ 19009
DESIGNED	TS	DRAWING NO:
DRAWN	AD	**FIGURE 3**
CHECKED	TS	

Appendix B: Tables

Table 1. Hazelton Surface Water Quality Data

Parameters	Units	BC MoE Guidelines: Freshwater Aquatic Life (1) (2)	BC MoE Guidelines: Drinking Water (2) (3)	SW-01					SW-02					SW-03 Leachate Seep						
Date				16-Apr-16	7-Jul-16	25-Oct-16	14-Jun-17	28-May-18	16-Apr-16	7-Jul-16	25-Oct-16	14-Jun-17	28-May-18	26-Jul-04	25-May-06	10-Jun-08	16-Apr-16	7-Jul-16	25-Oct-16	14-Jun-17
Total Hardness	mg/L	-	-	18	41	23	22	16	22	21	26	14	12				1090	726	814	805
Dissolved Hardness (CaCO3)	mg/L	-	-																	
Alkalinity (Total as CaCO3)	mg/L	-	-	17	10	23	20		21	22	31	17		1,090	961	1,300	900	570	940	1,000
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0	12.3	41.8	17.6	1.0		9.4	9.1	10.1	1.3					43.2	29.2	33.1	34.3
Alkalinity (PP as CaCO3)	mg/L	-	-																	
Bicarbonate (HCO3)	mg/L	-	-																	
Carbonate (CO3)	mg/L	-	-																	
Hydroxide (OH)	mg/L	-	-																	
Chemical Oxygen Demand (COD)	mg/L	-	-	42	145	50	92	45	33	38	35	46	27	119	146	113	203	125	117	83
Biological Oxygen Demand (BOD)	mg/L	-	-	<5.0	28	6.6	4.4	<2.0	<5.0	<4.0	<4.0	<4.0	<2.0	6	16	>71	16	22	9.6	11
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	<1.0	8.8	<1.0	<1.0	<0.30	<1.0	<1.0	<1.0	<1.0	<0.30	2.9	6.7	10.5	13.1	20.8	18.4	17.8
Chloride (Cl)	mg/L	600	250, AO	<1.0	<1.0	2	<1.0	<0.50	<1.0	<1.0	1	<1.0	<0.50	279	270	270	301	344	291	308
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5					0.032					0.024							
Total Kjeldahl Nitrogen	mg/L	-	-											28.1	22	30.7				
Ammonia (N)	mg/L	0.681-28.7 (d)	-	<0.03	0.11	<0.03	<0.03	0.0121	<0.03	<0.03	<0.03	<0.03	0.0107	27.7	24.6	9.9	17	5.42	23	24.8
Nitrate plus Nitrite (N)	mg/L	-	-	0.014	0.011	<0.010	<0.010	<0.0071	0.011	<0.010	0.012	<0.010	<0.0060				6.8	4.46	3.38	0.4
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0	<0.01	<0.01	<0.01	<0.01	<0.0010	<0.01	<0.01	<0.01	<0.01	<0.0010				0.039	0.6	0.011	0.02
Nitrate (N)	mg/L	32.8	10 MAC	0.014	0.01	<0.01	<0.01	0.0061	0.011	<0.01	0.012	<0.01	<0.0050				6.76	<0.04	3.37	0.38
Conductivity	uS/cm	-	-	34	44	51	44		44	45	64	33		2,620	2,160	1,970	2,350	1,920	2,400	2,570
Field Conductivity	uS/cm	-	-					28					21							
pH	pH Units	6.5 - 9.0	7.0-10.5	6.2	5.2	6.5	6.1		6.4	6.3	7.0	6.6		7.0	7.2	7.2	7.6	7.6	7.6	7.4
Field pH	pH Units	6.5 - 9.0	7.0-10.5					5.5					6.0							
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO																	
Total Metals																				
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	0.325	11.1	0.275	0.155	0.115	0.475	1.640	0.031	0.047	0.033	0.080	0.380	0.011	8.330	9.020	1.340	0.715
Total Antimony (Ab)	mg/L	0.009	0.006	0.0001	0.0005	0.0003	<0.00010	<0.00010	0.0002	0.0004	0.0002	<0.00010	<0.00010	<0.05	ND	ND	0.0015	0.0012	0.0007	0.00031
Total Arsenic (As)	mg/L	0.005	0.01 MAC	0.0008	0.0064	0.0024	0.00078	0.00053	0.001	0.0015	0.0009	0.00066	0.00048	<0.05	0.12	0.003	0.016	0.0132	0.0037	0.00977
Total Barium (Ba)	mg/L	1	1.0	0.014	0.173	0.020	0.014	0.012	0.014	0.024	0.014	0.007	0.008	1.090	1.290	0.201	1.720	1.020	0.573	0.885
Total Beryllium (Be)	mg/L	0.00013	-	<0.0001	0.0003	<0.0001	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.0002	ND	ND	0.0002	0.0002	<0.0001	<0.00010
Total Bismuth (Bi)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.00010	<0.000050	<0.0001	<0.0001	<0.0001	<0.00010	<0.000050	<0.05	ND	ND	<0.0001	<0.0001	<0.0001	<0.00010
Total Boron (B)	mg/L	1.2	5.0, MAC	0.005	0.045	<0.004	0.005	<0.010	0.004	0.015	<0.004	0.005	<0.010	1.9	1.94	1.31	3.33	1.98	2.4	2.94
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC	0.00007	0.00325	0.00017	0.000047	0.0000481	0.00004	0.00051	0.00004	0.000027	0.0000052	<0.002	ND	0.00052	0.00067	0.00038	0.00027	0.00009
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	5.6	11.9	7.1	6.7	4.76	6.2	6.2	7.3	4.04	3.44	240	229	101	318	214	220	228
Total Cesium (Cs)	mg/L	-	-					<0.000010					<0.000010							
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	0.0007	0.0105	0.0009	0.00067	0.0004	0.0007	0.0021	<0.0005	<0.00050	0.00018	<0.005	0.01	0.001	0.0124	0.0104	0.0034	0.00238
Total Cobalt (Co)	mg/L	0.11	-	0.00082	0.0125	0.00272	0.00111	0.00072	0.00068	0.00082	0.00022	0.00014	0.0003	<0.005	ND	0.001	0.00896	0.00792	0.00346	0.00402
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	0.0028	0.0318	0.0017	0.00161	0.00122	0.004	0.0066	0.0004	0.00075	<0.00050	<0.005	0.008	0.0022	0.0318	0.0238	0.0093	0.00325
Total Iron (Fe)	mg/L	1	0.3, AO	1.10	24.80	3.47	1.30	0.66	1.10	2.07	0.84	0.31	0.54	51.30	102.00	0.44	154.00	86.50	8.16	16.20
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.0002	0.0061	<0.0001	<0.00010	0.000059	0.0003	0.0006	<0.0001	<0.00010	<0.000050	<0.03	ND	ND	0.0215	0.016	0.0033	0.00036
Total Lithium (Li)	mg/L	-	-	0.0002	0.0046	0.0001	0.00011	<0.0010	0.0003	0.0008	0.0001	0.0001	<0.0010	ND	ND	ND	0.0115	0.0082	0.005	0.00358
Total Magnesium (Mg)	mg/L	-	-	1.06	2.81	1.36	1.19	1.06	1.51	1.27	1.94	0.89	0.793	66	54.8	29.9	70.4	46.2	63.9	57.1
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	0.183	1.63	0.554	0.165	0.126	0.129	0.123	0.101	0.0304	0.117	5.06	6.82	2.03	8.51	3.43	7.13	5.23
Total Mercury (Hg)	mg/L	0.0001	0.001	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.00005	ND	ND(1)	<0.00002	<0.00002	<0.00002	<0.00002
Total Molybdenum (Mo)	mg/L	2	0.25	0.0002	0.0019	0.0002	0.00012	0.000153	0.0002	0.0002	<0.0001	<0.00010	0.000095	<0.005	ND	ND	0.0006	0.0005	0.0009	0.00122
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.0011	0.0164	0.0016	0.0011	0.00108	0.0012	0.0021	0.0002	<0.00020	<0.00050	0.008	ND	ND	0.0305	0.0223	0.0219	0.0157
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	0.09	1.69	0.1	0.06	0.08	0.07	0.11	0.14	<0.050	0.079	0.10	0.30		1.78	0.56	0.12	0.076
Total Potassium (K)	mg/L	-	-	0.79	1.71	1.14	0.66	0.172	0.93	0.89	3.19	0.86	0.732	54	50	34	63.6	35.5	51.3	54.2
Total Rubidium (Rb)	mg/L							0.00025					0.00049							
Total Selenium (Se)	mg/L	0.002	0.01, MAC	<0.0005	<0.0005	<0.0005	<0.00050	<0.000050	<0.0005	<0.0005	<0.0005	<0.00050	<0.000050	<0.03	ND	ND	<0.0005	<0.0005	<0.0005	<0.00050
Total Silicon (Si)	mg/L	-	-	3.7	15.3	4.8	3.5	1.63	4.8	5	2.7	2	1.64	<0.01	16	6.74	34.4	26.5	12.9	14.9
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	<0.00005	0.00026	<0.00005	<0.000050	<0.000010	<0.00005	<0.00005	<0.00005	<0.000050	<0.000010	229	ND	0.00009	0.00013	0.00009	<0.00005	<0.000050
Total Sodium (Na)	mg/L	-	<200, AO	1.45	1.1	1.47	1.47	1.49	1.81	1.02	1.15	0.72	0.795	1.62	189	126	289	153	233	249
Total Strontium (Sr)	mg/L	-	-	0.038	0.082	0.06	0.0424	0.034	0.04	0.035	0.055	0.026	0.0225	2.3	1.45	0.724	2.03	1.35	1.82	1.63
Total Sulphur (S)	mg/L	-	-	<1	3	<1	<3.0	<0.50	<1	<1	<1	<3.0	<0.50	<0.05	4.4	1.8	9	10	10	7.6
Total Tellurium (Te)	mg/L		-	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020				<0.0002	<0.0002	<0.0002	<0.00020
Total Thallium (Tl)	mg/L	0.0008	-	<0.00002	0.00005	<0.00002	<0.000020	<0.000010	<0.00002	<0.00002	<0.00002	0.000048	<0.000010	<0.03	ND	ND	0.00006	0.00006	<0.00002	<0.000020
Total Thorium (Th)	mg/L	-	-	<0.0001	0.00	<0.0001	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010				0.00	0.00	<0.0001	<0.00010
Total Tin (Sn)	mg/L	-	-	<0.0002	<0.0002	<0.0002	<0.00020	<0.00010	<0.0002	<0.0002	<0.0002	<0.00020	<0.00010	<0.02	ND	ND	0.0004	0.0003	0.0003	0.00025
Total Tungsten (W)	mg/L							0.00134					0.00096							
Total Titanium (Ti)	mg/L	-	-	0.007	0.121	<0.005	<0.0050	<0.00010	0.009	0.034	<0.005	<0.0050	<0.00010	<0.003	ND	ND	0.172	0.189	0.035	0.021
Total Uranium (U)	mg/L	0.0085	0.02	<0.00002	0.00027	<0.00002	<0.000020	<0.000010	<0.00002	0.00003	<0.00002	<0.000020	<0.000010	ND	ND	ND	0.00048	0.00036	0.00036	0.000548
Total Vanadium (V)	mg/L	-	-	<0.001	0.024	0.001	<0.0010	<0.00050	0.002	0.003	<0.001	<0.0010	<0.00050	<0.005	ND	ND	0.021	0.018	0.004	0.0025
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	0.008	0.056	0.008	0.0051	0.0033	0.006	0.009	0.009	<0.0040	0.0054	<0.005	0.055	0.005	0.334	0.163	0.054	0.0094
Total Zirconium (Zr)	mg/L	-	-	0.0003	0.0009	0.0002	0.0002	0.000148	0.0003	0.0014	<0.0001	<0.00010	<0.000060	<0.005	ND	ND	0.0024	0.0018	0.0005	0.00065

Notes:

2018 data compared to 2018 criteria

A shaded value means exceeded the freshwater aquatic life criteria

A shaded value means reading exceeded the drinking water quality criteria.

A shaded value means exceeded both the aquatic life and drinking water criteria.

A shaded value means reading had detection limit exceeding criteria.

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

j. at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.

k. Limit for dissolved metals, not total metals

Table 1. Hazelton Surface Water Quality Data

Parameters	Units	BC MoE Guidelines: Freshwater Aquatic Life (1) (2)	BC MoE Guidelines: Drinking Water (2) (3)	SW-04: Log Weir																		
Date				26-May-06	8-Aug-07	10-Jun-08	25-Aug-09	16-Mar-10	22-Jun-10	30-Sep-10	28-Feb-12	14-Aug-12	4-Oct-12	27-Mar-13	17-Oct-13	7-Jul-14	25-Nov-14	26-May-15	1-Nov-15	16-Apr-16	7-Jul-16	25-Oct-16	25-Oct-16	14-Jun-17
Total Hardness	mg/L	-	-					398	313	504	403	826	105	594	472	352	293	292	326	549	306	359	359	394
Dissolved Hardness (CaCO3)	mg/L	-	-											160		336								
Alkalinity (Total as CaCO3)	mg/L	-	-	366	480	403	305	473	414	460	440	210	400	640	503	415	316	310	370	530	340	370	370	420
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0													15.5				26.9	14.1	14.1	14.1	14.8
Alkalinity (PP as CaCO3)	mg/L	-	-																					
Bicarbonate (HCO3)	mg/L	-	-																					
Carbonate (CO3)	mg/L	-	-																					
Hydroxide (OH)	mg/L	-	-																					
Chemical Oxygen Demand (COD)	mg/L	-	-	52	62	66	185	38	67	76	86	52	ND	41	34	73	37	42	146	105	50	39	39	<20
Biological Oxygen Demand (BOD)	mg/L	-	-	7	ND	6.5	25	ND	5.3	ND	10	ND	ND	ND	5.5	ND	16.0	4.000	35.000	6.900	7.200	4.800	4.800	<4.0
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	13.3	3.4	ND	1,100	46	3.0	130	25.1	678	46.8	22.3	4.5	ND	23.4	14.1	6.8	30.4	17.9	6.8	6.8	13.7
Chloride (Cl)	mg/L	600	250, AO	137	186	140	67	106	139	173	90	72	140	248	140	139	94	77	110	193	15	167	167	140
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5																					
Total Kjeldahl Nitrogen	mg/L	-	-	2.9	3.3(1)	4.62(2)	2.7	3.52	2.09	1.6	1.13	1.61	1.12	1.86	1.27	1.92	1.93	1.300	7.930					
Ammonia (N)	mg/L	0.681-28.7 (d)	-	1.69	1.6	3.3	1.2	2.9	ND	0.04	0.27	0.33	ND	0.07	0.06	0.45	0.12	0.250	0.067	0.190	0.550	0.120	0.120	1.1
Nitrate plus Nitrite (N)	mg/L	-	-														ND			3.020	0.036	0.014	0.014	0.011
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0													ND				<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate (N)	mg/L	32.8	10 MAC													ND				3.020	0.040	0.014	0.014	0.011
Conductivity	uS/cm	-	-	963	1,290	1,070	2,320	1,247	1,160	1,550	1,040	1,710	1,250	1,816	1,330	1,150	895	826	1010	1530	1070	1090	1090	1,210
Field Conductivity	uS/cm	-	-																					
pH	pH Units	6.5 - 9.0	7.0-10.5	7.5	7.7	7.6	7.0	7.5	7.4	7.6	7.2	7.3	7.4	7.8	7.3	7.8	7.3	7.4	7.2	7.8	7.8	7.8	7.8	7.5
Field pH	pH Units	6.5 - 9.0	7.0-10.5																					
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO													8.1								
Total Metals																								
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	0.060	0.020	0.007	10.4	0.014	0.025	0.050	7.60	0.027	0.007	0.143	0.067		1.40	0.174	1.020	5.990	0.012	0.015	0.015	0.098
Total Antimony (Ab)	mg/L	0.009	0.006	ND	ND	ND	0.0018	ND	0.0003	0.0005	0.00071	0.00071	ND	ND	ND		ND	0.00020	0.00020	0.00030	0.00020	0.00040	0.00040	0.0002
Total Arsenic (As)	mg/L	0.005	0.01 MAC	ND	ND	0.0021	0.0239	0.0017	0.0047	0.0052	0.00607	0.00237	0.00036	0.00057	0.00372		0.00301	0.00210	0.00720	0.00180	0.00240	0.00330	0.00330	0.00286
Total Barium (Ba)	mg/L	1	1.0	0.128	0.201	0.145	0.381	0.164	0.197	0.176	0.214	0.328	0.032	0.159	0.224		0.137	0.10400	0.19800	0.19000	0.07600	0.20100	0.20100	0.190
Total Beryllium (Be)	mg/L	0.00013	-	ND	ND	ND	0.0003	ND	ND	ND	0.00017	ND	ND	ND	ND		ND	<0.0001	<0.0001	0.00010	<0.0001	<0.0001	<0.0001	<0.00010
Total Bismuth (Bi)	mg/L	-	-	ND	ND	ND	ND	ND	ND	ND	0.00006	ND	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010
Total Boron (B)	mg/L	1.2	5.0, MAC	1.02	1.31	1.3	0.993	1.01	1.54	1.39	0.69	2.03	0.255	1.17	1.16		0.638	0.83	0.72	1.74	1.17	0.99	0.99	1.18
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC	ND	ND	0.00014	0.00149	0.00014	0.00131	0.00018	0.000605	0.000279	0.000039	0.000077	0.000092		0.000264	0.00034	0.00025	0.00033	0.00002	0.00003	0.00003	0.000027
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	79.8	101	93.1	514	114	74.7	145	109	248	29.9	160	134		81.1	80.90	93.20	152.00	90.00	97.30	97.30	114
Total Cesium (Cs)	mg/L	-	-																					
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	ND	ND	0.001	0.012	ND	0.0013	0.001	0.009	ND	ND	ND	ND		0.0018	0.00070	0.00170	0.00590	<0.0005	<0.0005	<0.0005	0.00056
Total Cobalt (Co)	mg/L	0.11	-	ND	ND	0.0007	0.0197	0.0018	0.00131	0.0028	0.00645	0.00177	ND	0.00069	0.00217		0.00262	0.00113	0.00536	0.00269	0.00081	0.00172	0.00172	0.00209
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	ND	ND	0.0013	0.0469	0.0016	0.008	0.0038	0.0226	0.00294	0.00088	0.00279	0.00098		0.00721	0.00270	0.00590	0.01840	0.00050	0.00050	0.00050	0.00063
Total Iron (Fe)	mg/L	1	0.3, AO	0.30	0.44	0.22	22.70	0.41	0.60	0.40	12.7	0.233	0.02	0.16	0.97		2.46	0.56	4.22	5.31	0.24	0.83	0.83	0.98
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	ND	ND	ND	0.0122	ND	0.00044	ND	0.00515	ND	ND	ND	ND		0.00139	0.00020	0.00130	0.00320	<0.0001	<0.0001	<0.0001	0.00017
Total Lithium (Li)	mg/L	-	-			ND	0.011	ND	ND	ND	0.0072	ND	ND	ND	ND		ND	0.0015	0.0022	0.0033	0.0012	0.0016	0.0016	0.00172
Total Magnesium (Mg)	mg/L	-	-	22.3	29.9	25.1	58.8	27.4	30.8	34.5	31.7	49.9	7.31	47.5	33.4		22	21.90	22.50	41.40	19.70	28.30	28.30	26.6
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.12	2.03	0.123	28.5	1.57	0.5	5.73	1.95	2.09	0.221	0.0112	2.77		1.89	0.52	5.63	0.14	0.57	2.65	2.65	2.99
Total Mercury (Hg)	mg/L.	0.0001	0.001	ND	ND	ND	ND	ND	ND	0.00023	ND	ND	ND	ND	ND		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Total Molybdenum (Mo)	mg/L	2	0.25	ND	ND	ND	0.011	ND	0.0007	0.012	0.00182	0.0027	ND	0.001	ND		ND	0.0005	0.0006	0.0006	0.0003	0.0010	0.0010	0.00038
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	ND	ND	0.005	0.029	0.005	0.007	0.009	0.0161	0.0056	0.0015	0.0083	0.0066		0.007	0.0045	0.0066	0.0146	0.0046	0.0050	0.0050	0.00546
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	0.10	ND	ND	ND	ND	ND	ND		0.069	0.017	0.022	0.054		0.337	0.10	0.25	0.21	0.06	0.05	0.05	0.086
Total Potassium (K)	mg/L	-	-	23	34	34.2	27.8	22.8	32.9	39.5	22.7	24	6.98	23	31.4		17	18.4	19.8	24.6	18.2	23.1	23.1	22.3
Total Rubidium (Rb)	mg/L																							
Total Selenium (Se)	mg/L	0.002	0.01, MAC	ND	ND	ND	0.0004	ND	ND	ND	0.00017	ND	ND	0.00013	0.0001		ND	0.00080	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050
Total Silicon (Si)	mg/L	-	-	4.29	6.74	3.74	19.8	5.64	4.48	8.83	16.4	6.2	1.95	4.08	9.55		7.68	7.3	7.5	12.8	12.2	9.5	9.5	9.9
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	ND	ND	0.000006	ND	ND	ND	0.000013	0.000065	ND	ND	ND	ND		0.000029	<0.00005	<0.00005	0.00012	<0.00005	<0.00005	<0.00005	<0.000050
Total Sodium (Na)	mg/L	-	<200, AO	98.7	126	110	64.3	93.4	132	134	72.4	71.9	24.8	164	124		77.1	72.7	82.8	152.0	85.3	88.3	88.3	92.1
Total Strontium (Sr)	mg/L	-	-	0.536	0.724	0.689	2.08	0.724	0.637	0.856	0.705	1.66	0.213	1.1	0.879		0.552	0.59	0.57	0.91	0.54	0.79	0.79	0.772
Total Sulphur (S)	mg/L	-	-	5.1	1.8	12	468	17	ND	44	ND	245	ND	6.3	ND		8.4	10.0	3.0	13.0	7.0	3.0	3.0	4.2
Total Tellurium (Te)	mg/L		-															<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020
Total Thallium (Tl)	mg/L	0.0008	-	ND	ND	ND	0.00015	ND	ND	ND	0.000064	ND	ND	ND	ND		ND	<0.00002	<0.00002	0.00003	<0.00002	<0.00002	<0.00002	<0.000020
Total Thorium (Th)	mg/L	-	-															<0.0001	<0.0001	0.00010	<0.0001	<0.0001	<0.0001	<0.00010
Total Tin (Sn)	mg/L	-	-	ND	ND	ND	ND	ND	0.0001	ND	0.0004	ND	ND	ND	ND		ND	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020
Total Tungsten (W)	mg/L																							
Total Titanium (Ti)	mg/L	-	-	ND	ND	ND	0.313	ND	ND	0.005	0.131	ND	ND	ND	ND		0.0258	<0.005	0.014	0.084	<0.005	<0.005	<0.005	<0.0050
Total Uranium (U)	mg/L	0.0085	0.02			0.0001	0.0028	0.0005	0.00013	0.0017	0.000341	0.00135	0.00013	0.00346	0.00017		0.00036	0.0002	0.0002	0.0024	0.0001	0.0003	0.0003	0.000207
Total Vanadium (V)	mg/L	-	-	ND	ND	ND	0.023	ND	ND	ND	0.0175	ND	ND	ND	ND		ND	<0.001	0.003	0.009	<0.001	<0.001	<0.001	<0.0010
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	0.007	0.005	0.008	0.131	0.01	0.0144	0.006	0.043	0.0082	ND	ND	ND		0.0161	0.006	0.019	0.031	<0.004	<0.004	<0.004	<0.0040
Total Zirconium (Zr)	mg/L	-	-	ND	ND	ND	0.0012	ND	ND	ND	0.0005	ND	ND	ND	ND		ND	0.000	0.000	0.002	<0.0001	<0.0001	<0.0001	<0.00010

Notes:

2018 data compared to 2018 criteria

A shaded value means exceeded the freshwater aquatic life criteria

A shaded value means reading exceeded the drinking water quality criteria.

A shaded value means exceeded both the aquatic life and drinking water criteria.

A shaded value means reading had detection limit exceeding criteria.

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

j. at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.

k. Limit for dissolved metals, not total metals

Table 1. Hazelton Surface Water Quality Data

Parameters	Units	BC MoE Guidelines		SW-05																					
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	Beaver Pond Outlet																					
Date				26-Jul-04	25-May-06	8-Aug-07	10-Jun-08	25-Aug-09	16-Mar-10	22-Jun-10	30-Sep-10	28-Feb-12	14-Aug-12	4-Oct-12	27-Mar-13	17-Oct-13	7-Jul-14	25-Nov-14	26-May-15	1-Nov-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	28-May-18
Total Hardness	mg/L	-	-						41	46	50	43	40	46	103	49	38	59	33	42	35	46	33	33	51	32
Dissolved Hardness (CaCO3)	mg/L	-	-												31		48									
Alkalinity (Total as CaCO3)	mg/L	-	-	24	21	28	22	20	21	23	32	19	23	34	45	44	17	35	16	23	17	22	21	21	34	
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0														24.9				35.5	30.4	40.6	23.0	23.7	
Alkalinity (PP as CaCO3)	mg/L	-	-																							
Bicarbonate (HCO3)	mg/L	-	-																							
Carbonate (CO3)	mg/L	-	-																							
Hydroxide (OH)	mg/L	-	-																							
Chemical Oxygen Demand (COD)	mg/L	-	-	73	61	88	74	81	53	91	64		120	74	126	65	69	71	83	107	87	70	86	74	80	69
Biological Oxygen Demand (BOD)	mg/L	-	-	<6	ND	ND	ND	ND	ND	ND	ND	ND	7.6	4.2	21	ND	ND	8.5	6.800	<4.0	<5.0	<4.0	<4.0	<4.0	<4.0	2.5
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	<0.5	ND	ND	ND	ND	2.9	ND	0.8	ND	ND	ND	ND	ND	ND	ND (1)	<1.0	2.1	<1.0	<1.0	<1.0	<1.0	1.4	<0.30
Chloride (Cl)	mg/L	600	250, AO	60	45	43	39	41	41	47	56	59	37	52	158	54	34	58	34	33	29	52	24	29	30	16
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5																							0.040
Total Kjeldahl Nitrogen	mg/L	-	-	0.88	0.96	1.2	0.93	0.82	0.9	1.37	1.3	0.72	2.16	1.42	2.83	1.21	1.03	1.43	1.080	1.220						
Ammonia (N)	mg/L	0.681-28.7 (d)	-	0.06	ND	ND	0.04	0.03	0.05	ND	0.03	0.07	0.04	ND	0.69	0.05	0.04	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.039	<0.03	0.0085
Nitrate plus Nitrite (N)	mg/L	-	-															ND			<0.010	0.011	0.014	0.013	0.014	<0.0060
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0														ND				<0.01	<0.01	<0.01	<0.01	<0.01	<0.0010
Nitrate (N)	mg/L	32.8	10 MAC														ND				<0.01	0.010	0.014	0.013	0.014	<0.0050
Conductivity	uS/cm	-	-	257	176	193	149	173	187	220	259	243	182	261	602	278	162	271	136	162	130	219	119	152	170	
Field Conductivity	uS/cm	-	-																							107
pH	pH Units	6.5 - 9.0	7.0-10.5	6.5	6.6	6.5	6.2	6.9	6.1	6.3	6.7	5.9	6.4	6.4	5.9	6.6	6.5	6.0	6.3	6.1	6.4	6.3	6.7	6.3	6.6	
Field pH	pH Units	6.5 - 9.0	7.0-10.5																							6.2
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO														3.8									
Total Metals																										
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	0.070	0.200	0.240	0.193	0.363	0.238	0.120	0.050	0.323	0.330	0.222	1.190	0.227		0.345	0.258	0.267	0.216	0.102	0.301	0.238	1.420	0.619
Total Antimony (Ab)	mg/L	0.009	0.006	<0.05	ND	ND	ND	ND	ND	0.00008	ND	0.00006	ND	ND	ND	ND		ND	0.00010	<0.0001	<0.0001	<0.0001	0.00020	<0.00010	0.00018	<0.00010
Total Arsenic (As)	mg/L	0.005	0.01 MAC	<0.05	ND	ND	0.0007	0.001	0.0004	0.00093	0.0006	0.00058	0.00102	0.00066	0.00117	0.00055		0.0008	0.00060	<0.0005	0.00060	0.00070	0.00060	0.00094	0.0021	0.00224
Total Barium (Ba)	mg/L	1	1.0	0.024	0.014	0.024	0.018	0.016	0.019	0.016	0.024	0.022	0.020	0.021	0.066	0.019		0.031	0.01100	0.01500	0.01000	0.02300	0.01500	0.01790	0.033	0.019
Total Beryllium (Be)	mg/L	0.00013	-	<0.0002	ND	ND	ND	ND	ND	0.00001	ND	ND	ND	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Total Bismuth (Bi)	mg/L	-	-	<0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050
Total Boron (B)	mg/L	1.2	5.0, MAC	<0.008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	0.00900	0.00600	0.00700	0.00800	0.09100	0.01000	0.038	<0.010
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC	<0.002	ND	ND	0.00006	0.00002	0.00004	0.000298	ND	0.000044	0.000145	0.000023	0.000071	0.000012		0.000021	0.00009	0.00002	0.00021	<0.00001	0.00004	0.000011	0.000025	0.0000202
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	16.3	12.7	13.2	11.8	11.2	12.2	13.1	14.9	12.8	11.8	13.2	31.3	14.9		17.4	9.4	12.5	10.1	14.5	9.4	9.8	15	9.42
Total Cesium (Cs)	mg/L	-	-																							0.000057
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	<0.005	ND	ND	0.001	ND	ND	0.0008	ND	0.0008	ND	ND	0.0015	ND		ND	0.0005	0.0006	0.0005	<0.0005	0.0006	0.0005	0.00168	0.00087
Total Cobalt (Co)	mg/L	0.11	-	<0.005	ND	ND	ND	ND	ND	0.000156	ND	0.00031	0.00083	ND	0.00157	ND		0.00125	0.0001	0.0003	0.0001	0.0002	0.0002	0.0005	0.00099	0.00098
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	<0.005	ND	0.007	0.0023	0.0067	0.0021	0.0033	0.0014	0.0027	0.00232	0.00174	0.00335	0.00118		0.00227	0.0028	0.0016	0.0036	0.0004	0.0016	0.0023	0.00452	0.00214
Total Iron (Fe)	mg/L	1	0.3, AO	0.62	0.42	2.13	0.50	0.67	0.60	0.31	0.79	1.11	1.18	0.61	4.25	0.73		2.1	0.43	0.82	0.42	0.54	0.65	0.86	2.46	1.62
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	<0.03	ND	ND	ND	0.0004	0.0005	0.000188	ND	0.00027	0.0005	0.00029	0.00139	0.0002		0.00032	0.00010	0.00010	0.00030	<0.0001	0.00010	0.00030	0.00163	0.000597
Total Lithium (Li)	mg/L	-	-				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	0.00030	0.00030	0.00020	0.00030	0.00030	0.00020	0.0011	<0.0010
Total Magnesium (Mg)	mg/L	-	-	3.25	2.63	2.53	2.44	2.61	2.56	3.11	3.14	2.6	2.5	3.22	5.92	2.94		3.71	2.39000	2.68000	2.33000	2.28000	2.31000	2.16000	3.34	2.13
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	0.06	0.021	0.17	0.05	0.041	0.067	0.0152	0.075	0.0736	0.188	0.114	0.53	0.0755		0.653	0.03240	0.07060	0.026	0.060	0.031	0.132	0.172	0.236
Total Mercury (Hg)	mg/L.	0.0001	0.001	<0.00005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050
Total Molybdenum (Mo)	mg/L	2	0.25	<0.005	ND	ND	ND	ND	ND	0.00011	ND	0.00092	ND	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	0.00010	0.00018	0.00023	0.000107
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	<0.008	ND	ND	0.001	ND	ND	0.00098	0.001	0.0011	ND	ND	0.0022	ND		0.0014	0.00090	0.00130	0.00100	0.00050	0.00080	0.00097	0.00248	0.00164
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	<0.1	ND	ND	ND	ND	ND	ND	ND		0.176	0.08	0.222	0.058		0.087	0.0490	0.0300	<0.02	0.0300	<0.02	0.077	0.069	0.083
Total Potassium (K)	mg/L	-	-	<1	ND	ND	0.71	0.32	0.85	0.48	1.36	0.8	0.638	1.54	2.04	0.848		1.18	0.52	0.39	0.51	0.11	0.48	2.47	1.26	1.09
Total Rubidium (Rb)	mg/L																									0.00091
Total Selenium (Se)	mg/L	0.002	0.01, MAC	<0.03	ND	ND	ND	ND	ND	0.00006	ND	0.00007	ND	ND	ND	ND		ND	0.00060	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.000054
Total Silicon (Si)	mg/L	-	-	<0.01	0.36	0.41	0.486	0.547	2.95	ND	0.135	4.15	0.481	1.24	6.22	1.78		3.19	1.40	3.00	1.10	0.60000	2.90	1.60	3.6	2.35
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	32.4	ND	ND	0.000006	ND	ND	ND	ND	0.000006	ND	ND	0.000024	ND		0.000026	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010
Total Sodium (Na)	mg/L	-	<200, AO	0.114	21.7	23.3	16.3	21.9	19.5	27.5	30	27.9	21	39.2	75.7	40.7		29.8	16.2	15.0	16.5	21.9	11.7	16.7	13.6	9.11
Total Strontium (Sr)	mg/L	-	-	0.3	0.076	0.09	0.075	0.08	0.076	0.0924	0.106	0.077	0.0827	0.105	0.202	0.0671		0.108	0.063	0.068	0.057	0.09000	0.070	0.064	0.0931	0.0649
Total Sulphur (S)	mg/L	-	-	<0.05	0.3	0.7	ND	ND	3	ND	ND	ND	ND	ND	ND	ND		ND	4.00000	<1	<1	1.00000	<1	<3.0	<3.0	<0.50
Total Tellurium (Te)	mg/L		-												<0.0002	<0.0002			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
Total Thallium (Tl)	mg/L	0.0008	-	<0.03	ND	ND	ND	ND	ND	ND	ND	0.000004	ND	ND	ND	ND		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010
Total Thorium (Th)	mg/L	-	-												<0.0001	<0.0001			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Total Tin (Sn)	mg/L	-	-	<0.02	ND	ND	ND	ND	ND	0.00003	ND	0.0002	ND	ND	ND	ND		ND	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010
Total Tungsten (W)	mg/L																									0.00853
Total Titanium (Ti)	mg/L	-	-	<0.003	ND	ND	ND	0.01	ND	0.0013	ND	ND	0.0064	ND	0.0156	ND		ND	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	0.0231	<0.00010
Total Uranium (U)	mg/L	0.0085	0.02				ND	ND	ND	0.000007	ND	0.000014	ND	ND	ND	ND		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	0.000028	0.000017
Total Vanadium (V)	mg/L	-	-	<0.005	ND	ND	ND	ND	ND	ND	ND	0.0007	ND	ND	ND	ND		ND	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	0.0033	0.00142
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	<0.005	0.01	0.023	0.014	0.01	0.028	0.0061	0.006	0.008	0.0096	0.0056	0.0151	ND		0.0112	0.00800	0.00800	0.01000	<0.004	0.00500	0.00510	0.0105	0.0072
Total Zirconium (Zr)	mg/L	-	-	<0.005	ND	ND	ND	ND	ND	0.0001	ND	0.0003	ND	ND	ND	ND		ND	0.00030	0.00030	0.00030	<0.0001	0.00020	0.00026	0.00031	0.000228

Notes:

2018 data compared to 2018 criteria

A shaded value means exceeded the freshwater aquatic life criteria

A shaded value means reading exceeded the drinking water quality criteria.

A shaded value means exceeded both the aquatic life and drinking water criteria.

A shaded value means reading had detection limit exceeding criteria.

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

j. at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.

k. Limit for dissolved metals, not total metals

Table 1. Hazelton Surface Water Quality Data

Parameters	Units	BC MoE Guidelines		SW-06						SW-07 Beaver Pond Stream															
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)																						
Date				16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	28-May-18	26-Jul-04	8-Aug-07	25-Aug-09	16-Mar-10	22-Jun-10	30-Sep-10	28-Feb-12	14-Aug-12	4-Oct-12	27-Mar-13	17-Oct-13	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	28-May-18
Total Hardness	mg/L	-	-	31	51	34	32	30	36				44	112	307	32	165	19	64	51	42	74	40	38	42	52
Dissolved Hardness (CaCO3)	mg/L	-	-																16							
Alkalinity (Total as CaCO3)	mg/L	-	-	12	26	16	18	11		132	38	174	14	63	200	10	92	18	33	19	31	67	33	33	44	
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0	42.7	57.7	39.3	20.6	48.6													30.2	14.2	27.9	15.5	15.8	
Alkalinity (PP as CaCO3)	mg/L	-	-																							
Bicarbonate (HCO3)	mg/L	-	-																							
Carbonate (CO3)	mg/L	-	-																							
Hydroxide (OH)	mg/L	-	-																							
Chemical Oxygen Demand (COD)	mg/L	-	-	94	128	165	62	98	113	54	114	246	84	140	71	95	112	120	101	144	69	36	67	<20	53	42
Biological Oxygen Demand (BOD)	mg/L	-	-	<5.0	<4.0	<4.0	<4.0	<4.0	<2.0	<6	ND	11	ND	ND	ND	ND	8.9	4.9	7.3	ND	<5.0	<4.0	<4.0	<4.0	<4.0	<2.0
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	<1.0	<1.0	<1.0	<1.0	<1.0	<0.30	5.6	ND	15.0	ND	1.1	22.0	ND	ND	ND (1)	ND	ND	<1.0	2.5	<1.0	<1.0	<1.0	1.8
Chloride (Cl)	mg/L	600	250, AO	28	33	31	31	28	27	405	49	590	39	84	355	27	240	42	73	29	24	63	19	24	10	15
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5						0.035																	0.033
Total Kjeldahl Nitrogen	mg/L	-	-							1.25	1.92	1.18	0.96	1.97	0.9	0.71	1.46	1.61	1.16	1.65						
Ammonia (N)	mg/L	0.681-28.7 (d)	-	0.030	0.053	<0.03	0.310	0.1	0.138	0.05	ND	0.3	ND	0.07	0.07	0.09	0.06	0.11	0.12	0.04	<0.03	0.037	<0.03	0.032	<0.03	0.0155
Nitrate plus Nitrite (N)	mg/L	-	-	0.020	0.046	0.016	0.090	0.035	0.1152												<0.010	0.019	0.012	0.043	0.012	<0.105
Nitrite (N)	mg/L	0.06 -0.6 (e)	1.0	<0.01	<0.01	<0.01	<0.01	<0.01	0.0042												<0.01	<0.01	<0.01	<0.01	<0.01	<0.0010
Nitrate (N)	mg/L	32.8	10 MAC	0.020	0.050	0.016	0.090	0.035	0.111												<0.01	0.02	0.012	0.043	0.012	0.0095
Conductivity	uS/cm	-	-	121	173	132	153	128		1,480	230	2,050	163	421	1,540	118	1,020	196	313	147	132	327	122	142	124	
Field Conductivity	uS/cm	-	-						531																	109
pH	pH Units	6.5 - 9.0	7.0-10.5	6.1	6.4	6.5	5.9	5.9		7.0	6.4	6.7	5.8	6.2	7.0	5.8	6.6	6.1	6.5	6.2	7.1	7.1	7.1	6.4	7.0	
Field pH	pH Units	6.5 - 9.0	7.0-10.5						6.2																	6.4
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO																							
Total Metals																										
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	0.190	0.249	0.273	0.258	0.221	0.333	0.060	0.850	3.84	0.27	0.38	0.58	0.25	0.94	0.18	1.32	1.27	0.64	1.10	0.58	0.32	0.328	0.620
Total Antimony (Ab)	mg/L	0.009	0.006	<0.0001	<0.0001	0.00020	<0.00010	<0.00010	<0.00010	<0.05	ND	0.0009	ND	0.00015	ND	ND	ND	ND	ND	ND	0.0001	0.0001	0.0003	<0.00010	0.0001	0.0001
Total Arsenic (As)	mg/L	0.005	0.01 MAC	0.00050	0.00140	0.00080	0.00057	0.00088	0.00154	<0.05	ND	0.0391	0.0005	0.00191	0.0023	0.00058	0.00748	0.00037	0.0013	0.00341	0.0006	0.0015	0.0007	<0.00050	0.00054	0.0009
Total Barium (Ba)	mg/L	1	1.0	0.01000	0.01800	0.01600	0.01600	0.012	0.014	0.129	0.052	0.695	0.017	0.055	0.173	0.011	0.173	0.009	0.035	0.033	0.019	0.035	0.018	0.014	0.015	0.022
Total Beryllium (Be)	mg/L	0.00013	-	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.0002	ND	0.0001	ND	0.00003	ND	ND	ND	ND	ND	ND	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Total Bismuth (Bi)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<0.05	ND	ND	ND	0.000011	ND	ND	ND	ND	ND	ND	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050
Total Boron (B)	mg/L	1.2	5.0, MAC	<0.004	0.01000	0.02700	<0.004	0.005	<0.010	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.028	0.014	0.039	0.026	0.048	0.024
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC	0.00004	0.00002	0.00005	0.00001	0.000016	0.0000239	<0.002	0.002	0.00041	0.00019	0.000212	0.00008	0.000052	0.000296	0.000021	0.000077	0.000066	0.00011	0.00005	0.00005	0.000011	<0.000010	0.0000151
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	8.7	15.6	9.5	9.4	8.45	10.2	77.6	21.9	130	12	34.3	98	9	53.6	5.61	18.7	14.7	11.9	22.6	11.1	10.6	12	14.5
Total Cesium (Cs)	mg/L	-	-						0.00002																	0.000053
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	<0.0005	0.0006	0.0006	<0.00050	<0.00050	0.00051	<0.005	ND	0.005	ND	0.0015	0.002	0.0007	0.0015	ND	0.002	0.0019	0.0009	0.0013	0.0009	0.00055	0.00055	0.00076
Total Cobalt (Co)	mg/L	0.11	-	0.0003	0.0008	0.0004	0.0005	0.00049	0.00106	<0.005	0.007	0.0233	0.0005	0.00707	0.0015	0.00049	0.00651	ND	0.00188	0.00196	0.00024	0.00125	0.00025	0.00017	0.00017	0.00067
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	0.0019	0.0010	0.0010	0.0022	0.00073	0.00108	<0.005	0.006	0.0156	0.0023	0.00512	0.0045	0.0021	0.00464	0.00128	0.00914	0.00289	0.0058	0.003	0.004	0.00237	0.00207	0.00233
Total Iron (Fe)	mg/L	1	0.3, AO	0.65	1.74	0.97	0.68	0.80	1.65	1.37	10.90	180.00	0.58	4.20	17.00	1.12	15.70	0.49	2.84	8.57	0.57	2.17	0.60	0.34	0.27	0.84
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.00040	0.00040	0.00030	0.00016	0.00022	0.000711	<0.03	ND	0.0119	0.0003	0.00092	0.0011	0.00053	0.00191	0.00026	0.00202	0.00213	0.0008	0.0015	0.0002	0.00012	<0.00010	0.000278
Total Lithium (Li)	mg/L	-	-	0.00030	0.00040	0.00040	0.00031	0.00029	<0.0010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0003	0.0007	0.0003	0.00016	0.00013	<0.0010
Total Magnesium (Mg)	mg/L	-	-	2.29000	2.97000	2.57000	1.98000	2.1	2.5	11.1	4.1	16.3	3.29	6.48	15.1	2.4	7.47	1.32	4.3	3.34	2.88	4.18	2.86	2.72	2.94	3.71
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	0.060	0.183	0.100	0.115	0.128	0.304	0.421	1.78	4.49	0.218	2.47	0.648	0.143	5.16	0.0465	0.433	0.344	0.0177	0.329	0.0264	0.0231	0.0293	0.222
Total Mercury (Hg)	mg/L	0.0001	0.001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.00005	ND	ND	ND	ND	ND	0.0000021	ND	ND	ND	ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050
Total Molybdenum (Mo)	mg/L	2	0.25	<0.0001	0.00010	0.00020	0.00014	0.00015	0.000097	<0.005	ND	0.002	ND	0.00022	ND	0.00085	ND	ND	ND	ND	<0.0001	0.0002	0.0002	0.00012	<0.00010	0.000103
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.00070	0.00080	0.00080	0.00092	0.00056	0.00111	<0.008	ND	0.006	0.001	0.00266	0.002	0.0008	0.0023	ND	0.0023	0.002	0.0016	0.002	0.0015	0.00109	0.00107	0.00167
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	<0.02	0.050	<0.02	<0.050	<0.050	0.119	<0.1	0.1	ND	ND	ND	ND		0.23	0.03	0.08	0.15	0.02	0.09	0.03	<0.050	<0.050	<0.050
Total Potassium (K)	mg/L	-	-	0.35	0.40	0.23	1.61	0.81	0.56	2.00	ND	1.94	1.24	0.55	2.34	ND	1.36	0.302	0.962	0.53	1.06	1.09	0.74	1.37	1.19	1.1
Total Rubidium (Rb)	mg/L								0.00076																	0.00072
Total Selenium (Se)	mg/L	0.002	0.01, MAC	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.000053	<0.03	ND	0.0001	ND	0.00009	ND	0.00006	ND	ND	ND	0.00016	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.000098
Total Silicon (Si)	mg/L	-	-	2.50	3.50	3.20	2.10	2.4	2.31	<0.01	4.63	11.8	3.16	3.27	4.7	3.78	5.2	1.29	5.15	4.61	3.9	5.7	4.1	3	3.8	4.6
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010	221	ND	0.07	ND	0.000006	0.00002	0.000006	0.000027	ND	0.000022	ND	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000020
Total Sodium (Na)	mg/L	-	<200, AO	13.3	15.7	14.8	15.5	13	14.7	0.444	25.4	253	15.3	44.1	176	11.2	134	8.68	32.4	15.9	16	34	11	14.3	8.58	11.6
Total Strontium (Sr)	mg/L	-	-	0.054	0.082	0.075	0.059	0.0573	0.0696	2.4	0.136	0.767	0.075	0.207	0.624	0.0556	0.352	0.041	0.122	0.0924	0.072	0.115	0.082	0.0687	0.0766	0.0953
Total Sulphur (S)	mg/L	-	-	<1	1.0	<1	<3.0	<3.0	<0.50	<0.05	0.9	9.0	3.0	ND	5.0	ND	ND	ND	ND	ND	<1	2.0	<1	<3.0	<3.0	<0.50
Total Tellurium (Te)	mg/L		-	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020												<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
Total Thallium (Tl)	mg/L	0.0008	-	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	<0.03	ND	ND	ND	0.000003	ND	0.000003	ND	ND	ND	ND	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010
Total Thorium (Th)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010												<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Total Tin (Sn)	mg/L	-	-	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010	<0.02	ND	ND	ND	0.00002	ND	ND	ND	ND	ND	ND	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010
Total Tungsten (W)	mg/L								0.00438																	0.0104
Total Titanium (Ti)	mg/L	-	-	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00010	<0.003	0.009	0.081	ND	0.0055	0.007	ND	0.0121	ND	0.0266	0.019	0.007	0.016	0.006	0.0055	<0.0050	<0.00010
Total Uranium (U)	mg/L	0.0085	0.02	<0.00002	<0.00002	<0.00002	0.00003	<0.000020	0.000011	ND	ND	0.0003	ND	0.00007	0.0002	0.000009	ND	ND	ND	ND	0.00003	0.00004	0.00003	0.000024	0.000026	0.000025
Total Vanadium (V)	mg/L	-	-	<0.001	<0.001	<0.001	<0.0010	0.0011	0.00106	<0.005	0.006	0.025	ND	0.0022	ND	0.0007	ND	ND	ND	ND	0.001	0.002	<0.001	<0.0010	<0.0010	0.00136
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	0.01200	0.00500	0.00500	<0.0040	0.0059	0.0055	<0.005	0.038	0.186	0.013	0.0148	0.028	0.005	0.033	ND	0.0243	0.0181	0.01	0.007	<0.004	<0.0040	<0.0040	0.01
Total Zirconium (Zr)	mg/L	-	-	0.00020	0.00010	0.00020	0.00030	0.00015	0.000183	<0.005	ND	0.0006	ND	0.0005	ND	0.0002	ND	ND	ND	ND	0.0007	0.0006	0.0004	0.00046	0.00053	0.000382

Notes:

2018 data compared to 2018 criteria

A shaded value means exceeded the freshwater aquatic life criteria

A shaded value means reading exceeded the drinking water quality criteria.

A shaded value means exceeded both the aquatic life and drinking water criteria.

A shaded value means reading had detection limit exceeding criteria.

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

j. at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.

k. Limit for dissolved metals, not total metals

Table 1. Hazelton Surface Water Quality Data

Parameters	Units	BC MoE Guidelines: Freshwater Aquatic Life (1) (2)	BC MoE Guidelines: Drinking Water (2) (3)	SW-08: Hwy 16 East Culvert														SW-09: Rossvale Creek Downstream
Date				26-Jul-04	25-May-06	8-Aug-07	10-Jun-08	7-Jul-14	25-Nov-14	26-May-15	1-Nov-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	28-May-18	7-Jul-14
Total Hardness	mg/L	-	-					129	59	35	38	31	47	31	25	30	40	56
Dissolved Hardness (CaCO3)	mg/L	-	-					126										50
Alkalinity (Total as CaCO3)	mg/L	-	-	107	39	64	50	57	26	11	14	12	22	11	12	11		60
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0					27.8				42.0	65.7	40.1	29.5	38.3		15.1
Alkalinity (PP as CaCO3)	mg/L	-	-															
Bicarbonate (HCO3)	mg/L	-	-															
Carbonate (CO3)	mg/L	-	-															
Hydroxide (OH)	mg/L	-	-															
Chemical Oxygen Demand (COD)	mg/L	-	-	129	49	38	50	99	87	101	108	91	133	98	88	137	102	28
Biological Oxygen Demand (BOD)	mg/L	-	-	6.0	ND	ND	ND	ND	ND	<4.0	<4.0	<5.0	5.600	<4.0	<4.0	<4.0	<2.0	ND
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	1.7	0.9	ND	ND	ND	ND	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.30	ND
Chloride (Cl)	mg/L	600	250, AO	41	47	43	25	123	57	33	35	24	31	27	27	27	29	32
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5														0.038	
Total Kjeldahl Nitrogen	mg/L	-	-	1.74	0.76	0.83	0.65	1.05	1.8	0.980	1.100							0.609
Ammonia (N)	mg/L	0.681-28.7 (d)	-	0.24	ND	ND	ND	0.04	0.03	<0.03	0.055	0.030	0.054	0.033	0.470	0.1	0.0572	0.05
Nitrate plus Nitrite (N)	mg/L	-	-						0.039			0.019	0.060	0.019	0.019	0.029	0.067	
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0					ND				<0.01	<0.01	<0.01	<0.01	0.02	0.0022	ND
Nitrate (N)	mg/L	32.8	10 MAC					ND				0.019	0.060	0.019	0.019	<0.01	0.0648	0.042
Conductivity	uS/cm	-	-	336	227	249	143	519	262	134	144	118	148	117	123	128		224
Field Conductivity	uS/cm	-	-														102	
pH	pH Units	6.5 - 9.0	7.0-10.5	6.9	7.2	7.1	6.8	6.8	6.2	6.0	6.0	6.0	6.3	6.2	5.6	5.9		7.1
Field pH	pH Units	6.5 - 9.0	7.0-10.5														5.7	
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO					8.6	-									ND
Total Metals																		
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	5.00	0.50	0.20	0.41		1.76	0.29	0.29	0.19	0.86	0.24	0.19	0.24	0.31	
Total Antimony (Ab)	mg/L	0.009	0.006	<0.05	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	0.00030	<0.00010	<0.00010	0.00012	
Total Arsenic (As)	mg/L	0.005	0.01 MAC	<0.05	ND	ND	0.0008		0.0026	0.00070	0.00060	<0.0005	0.00150	0.00070	0.00053	0.00099	0.00173	
Total Barium (Ba)	mg/L	1	1.0	0.101	0.021	0.024	0.022		0.045	0.01300	0.01300	0.01000	0.02400	0.01200	0.00890	0.012	0.019	
Total Beryllium (Be)	mg/L	0.00013	-	<0.0002	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	
Total Bismuth (Bi)	mg/L	-	-	<0.05	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	
Total Boron (B)	mg/L	1.2	5.0, MAC	0.013	0.023	ND	ND		ND	0.00600	<0.004	<0.004	0.00700	0.01600	<0.004	<0.004	<0.010	
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC	<0.002	ND	ND	0.00006		0.000117	0.00009	0.00001	0.00002	0.00004	0.00085	<0.00010	0.000023	0.0000279	
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	35.8	14.4	19.6	13.6		17.0	9.5	10.6	8.7	14.0	8.5	7.0	8.48	11.7	
Total Cesium (Cs)	mg/L	-	-														0.00002	
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	0.007	ND	ND	0.001		0.0022	<0.0005	0.00070	<0.0005	0.00100	0.00090	<0.00050	<0.00050	0.00051	
Total Cobalt (Co)	mg/L	0.11	-	0.005	ND	ND	0.0006		0.00182	0.00025	0.00041	0.00024	0.00087	0.00033	0.00038	0.00054	0.00095	
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	0.01	ND	0.0090	0.0034		0.0072	0.0018	0.0012	0.0013	0.0019	0.0032	0.0010	0.00064	0.00145	
Total Iron (Fe)	mg/L	1	0.3, AO	10.00	0.61	0.63	0.65		4.70	0.71	1.07	0.65	2.31	0.88	0.63	0.88	1.87	
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	<0.03	ND	ND	0.0005		0.00299	0.0003	0.0005	0.0003	0.0012	0.0003	0.0002	0.00029	0.000621	
Total Lithium (Li)	mg/L	-	-	ND	ND	ND	ND		ND	0.0004	0.0005	0.0003	0.0007	0.0004	0.0003	0.0003	<0.0010	
Total Magnesium (Mg)	mg/L	-	-	7.9	3	4.1	3.04		4.01	2.69	2.69	2.36	2.88	2.35	1.80	2.13	2.72	
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	5.05	0.036	0.631	0.21		0.344	0.069	0.105	0.059	0.139	0.078	0.099	0.144	0.406	
Total Mercury (Hg)	mg/L.	0.0001	0.001	<0.00005	ND	ND	ND		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.0000051	
Total Molybdenum (Mo)	mg/L	2	0.25	<0.005	ND	ND	ND		ND	<0.0001	<0.0001	<0.0001	<0.0001	0.00010	<0.00010	<0.00010	0.000119	
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.01	ND	ND	0.002		0.0036	0.00070	0.00100	0.00060	0.00130	0.00070	0.00056	0.00059	0.00125	
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	0.30	ND	ND	ND		0.14	0.03	<0.02	<0.02	0.12	<0.02	<0.050	<0.050	0.103	
Total Potassium (K)	mg/L	-	-	2	1	2	0.94		0.898	0.50000	0.13000	0.31000	0.36000	0.26000	2.26000	0.82	0.741	
Total Rubidium (Rb)	mg/L																0.00071	
Total Selenium (Se)	mg/L	0.002	0.01, MAC	<0.03	ND	ND	0.0001		ND	0.00060	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.000083	
Total Silicon (Si)	mg/L	-	-	<0.01	2.59	3.67	3.94		5.23	2.40	2.60	2.50	4.00	3.20	1.50	2.6	2.14	
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	28.9	ND	ND	0.000027		0.000061	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010	
Total Sodium (Na)	mg/L	-	<200, AO	0.219	31.3	25.5	15.5		30.7	15.1	13.4	13.8	13.1	12.6	12.5	13.2	16.1	
Total Strontium (Sr)	mg/L	-	-	0.8	0.084	0.119	0.088		0.11	0.067	0.061	0.056	0.076	0.066	0.046	0.0577	0.0793	
Total Sulphur (S)	mg/L	-	-	<0.05	0.5	0.6	ND		ND	2.00000	<1	<1	1.00000	<1	<3.0	<3.0	<0.50	
Total Tellurium (Te)	mg/L		-						<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	
Total Thallium (Tl)	mg/L	0.0008	-	<0.03	ND	ND	ND		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	
Total Thorium (Th)	mg/L	-	-						<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	
Total Tin (Sn)	mg/L	-	-	<0.02	ND	ND	ND		ND	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010	
Total Tungsten (W)	mg/L																0.00386	
Total Titanium (Ti)	mg/L	-	-	0.064	0.003	ND	0.007		0.0238	<0.005	<0.005	<0.005	0.01200	<0.005	<0.0050	<0.0050	<0.00010	
Total Uranium (U)	mg/L	0.0085	0.02	ND	ND	ND	ND		ND	<0.00002	<0.00002	<0.00002	0.00003	<0.00002	<0.000020	<0.000020	0.000017	
Total Vanadium (V)	mg/L	-	-	0.008	ND	ND	ND		0.0058	0.00100	0.00100	<0.001	0.00200	<0.001	<0.0010	0.0011	0.0011	
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	0.025	0.006	0.021	0.007		0.027	0.00600	0.00700	0.00600	0.00900	0.00800	<0.0040	0.0046	0.148	
Total Zirconium (Zr)	mg/L	-	-	<0.005	ND	ND	0.0005		ND	0.00020	0.00020	0.00010	0.00020	0.00010	0.00012	0.00014	0.000214	

Notes:

2018 data compared to 2018 criteria

A shaded value means exceeded the freshwater aquatic life criteria

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A shaded value means exceeded both the aquatic life and drinking water criteria.

A shaded value means reading had detection limit exceeding criteria.

(AO - Aesthetic Objective)

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2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
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c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

j. at pH less than 6.5, limit is determined by regression equation, else limit is 0.1 mg/L.

k. Limit for dissolved metals, not total metals

Table 2. Hazelton Shallow Groundwater Quality Data

Parameters	Units	BC MoE Guidelines		BC CSR Standards	SGW-1											
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)												
Date					14-Jun-17	7-Jul-17	13-Jul-17	20-Jul-17	27-Jul-17	1-Aug-17	9-Aug-17	16-Aug-17	5-Oct-17	30-May-18	10-Jul-18	11-Sep-18
Total Hardness	mg/L	-	-	-	103	507	1050	712	1110	954	977	880	299	1080	611	878
Dissolved Hardness (CaCO3)	mg/L	-	-	-												
Alkalinity (Total as CaCO3)	mg/L	-	-	-	91	560	690	520	790	720	750	770		707	854	934
Total Organic Carbon (C)	mg/L	-	4.0	-	26.8	89	395	136	279	224	210	152	68	342	245	75
Alkalinity (PP as CaCO3)	mg/L	-	-	-									230			
Bicarbonate (HCO3)	mg/L	-	-	-												
Carbonate (CO3)	mg/L	-	-	-												
Hydroxide (OH)	mg/L	-	-	-												
Chemical Oxygen Demand (COD)	mg/L	-	-	-	83	770	944	902	900	681	570	350	160	1050	672	255
Biological Oxygen Demand (BOD)	mg/L	-	-	-	6.9	230.000	590	200	430	390	390	330	<38			
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	500	<1.0	1.2	<1.0	1.8	1.1	1.2	2.2	<1.0	51.7	<3.0	<3.0	<3.0
Chloride (Cl)	mg/L	600	250, AO	250	2	122	123	132	152	145	152	142	58.1	105	98.1	98.3
Total Kjeldahl Nitrogen	mg/L	-	-	-												
Ammonia (N)	mg/L	0.681-28.7 (d)	-	-	0.14	0.33	1.04	0.4	0.54	0.53	0.43	0.39	0.08	3.09	1.28	1.2
Nitrate plus Nitrite (N)	mg/L	-	-	-	<0.010	0.0149	0.0107	0.0361	0.0832	0.0635	<0.0100	0.0729	0.0296	<0.060	<0.060	0.077
Nitrite (N)	mg/L	0.06 -0.6 (max) (c)	1.0	1.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.010	0.013
Nitrate (N)	mg/L	32.8	10 MAC	10	<0.01	0.015	0.011	0.036	0.083	0.064	<0.01	0.073	0.03	<0.050	<0.050	0.064
Conductivity	uS/cm	-	-	-	185	1350	1660	1220	1860	1760	1780	1860	704			
Field Conductivity	uS/cm	-	-	-											1470	1124
pH	pH Units	6.5 - 9.0	7.0-10.5	-	6.8	6.6	6.4	6.8	6.4	6.5	6.5	6.5	7			
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO	-												
Dissolved Metals																
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5										0.0421	0.0217	0.16
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006										0.00018	<0.00050	<0.00050
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01										0.00904	0.00448	0.0116
Dissolved Barium (Ba)	mg/L	1	1.0	1										0.499	0.282	0.47
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008										<0.00010	<0.00050	<0.00050
Dissolved Bismuth (Bi)	mg/L	-	-	-										<0.000050	<0.00025	<0.00025
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00										0.107	0.127	0.212
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005										<0.0000050	0.00003	<0.000025
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-										287	162	237
Dissolved Cesium (Cs)	mg/L	-		-										<0.000010	<0.000050	<0.000050
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)										0.00042	<0.00050	0.00071
Dissolved Cobalt (Co)	mg/L	0.11	-	0.0010										0.0193	0.0037	0.0063
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5										<0.00050	<0.0010	<0.0010
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5										80.3	37.8	73
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01										<0.000050	<0.00025	<0.00025
Dissolved Lithium (Li)	mg/L	-	-	0.008										0.0019	<0.0050	<0.0050
Dissolved Magnesium (Mg)	mg/L	-	-	-										89	50	70
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5										19.4	13.3	14.1
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001										<0.0000050	<0.0000050	<0.000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25										0.00063	0.00112	0.00052
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08										0.00627	0.0026	0.0043
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-										0.174	<0.25	<0.25
Dissolved Potassium (K)	mg/L	373-432	-	-										12.4	8.83	12.9
Dissolved Rubidium (Rb)	mg/L	-	-	-										0.00115	0.0011	0.0011
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01										0.00020	<0.00025	<0.00025
Dissolved Silicon (Si)	mg/L	-	-	-										14.1	8.4	12.0
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02										<0.000010	<0.000050	<0.000050
Dissolved Sodium (Na)	mg/L	-	<200, AO	200										49.9	32.2	51.2
Dissolved Strontium (Sr)	mg/L	-	-	-										2.22	1.27	1.76
Dissolved Sulphur (S)	mg/L	-	-	-										0.9	<2.5	<2.5
Dissolved Tellurium (Te)	mg/L			-										<0.00020	<0.0010	<0.0010
Dissolved Thallium (Tl)	mg/L	0.0017	-	-										<0.000010	<0.000050	<0.000050
Dissolved Thorium (Th)	mg/L	-	-	-										<0.00010	<0.00050	<0.00050
Dissolved Tin (Sn)	mg/L	-	-	2.5										0.00031	<0.00050	<0.00050
Dissolved Titanium (Ti)	mg/L	2	-	-										0.00	<0.0015	<0.0045
Dissolved Tungsten (W)	mg/L	-		0.003										<0.00010	<0.00050	<0.00050
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02										0.0006	0.000614	0.000581
Dissolved Vanadium (V)	mg/L	0.006	-	0.02										0.0037	<0.0025	0.0032
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5.0, AO	3										0.0031	<0.0050	0.0060
Dissolved Zirconium (Zr)	mg/L	-	-	-										0.0010	0.0005	0.0014
Total Metals																
Total Aluminum	mg/L	-	9.5		0.40	18.40	11.50	88.10	30.30	11.00	5.17	4.25	25.20			
Total Antimony (Ab)	mg/L	0.270	0.006		0.00016	0.0005	0.0006	0.00105	0.00082	0.00045	0.00033	0.00034	0.00073			
Total Arsenic (As)	mg/L	0.005	0.01 MAC		0.00381	0.0201	0.02	0.042	0.0245	0.0154	0.0168	0.0146	0.0186			
Total Barium (Ba)	mg/L	1	1.0		0.0325	0.44	0.479	1.08	0.637	0.385	0.31	0.289	0.391			
Total Beryllium (Be)	mg/L	0.00013	-		<0.00010	0.00066	0.00029	0.00229	0.00073	0.00025	0.00012	0.00012	0.00050			
Total Bismuth (Bi)	mg/L	-	-		<0.00010	0.00012	<0.00010	0.00052	0.00018	<0.00010	<0.00010	<0.00010	0.00019			
Total Boron (B)	mg/L	1.2	5.0, MAC		0.039	0.114	0.11	0.498	0.258	0.0995	0.1	0.0891	0.233			
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC		0.000042	0.000787	0.000359	0.00149	0.000614	0.000316	0.00055	0.000098	0.000836			
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-		30	124	273	162	287	246	241	220	81.8			
Total Cesium (Cs)	mg/L	-	-													
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC		0.00074	0.0203	0.0115	0.0971	0.0318	0.0145	0.0061	0.00495	0.0282			
Total Cobalt (Co)	mg/L	0.11	-		0.0019	0.0174	0.0337	0.0533	0.0388	0.0242	0.0223	0.0173	0.0185			
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO		0.00208	0.0572	0.0229	0.21	0.0668	0.0243	0.0142	0.0103	0.0779			
Total Iron (Fe)	mg/L	1	0.3, AO		1.08	35.40	43.10	124.00	69.70	44.10	36.60	30.20	37.60			
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01		<0.00010	0.00964	0.00401	0.0312	0.0115	0.00398	0.00221	0.0009	0.0128			
Total Lithium (Li)	mg/L	-	-		0.00017	0.0163	0.011	0.0711	0.0332	0.0108	0.00688	0.00672	0.0168			
Total Magnesium (Mg)	mg/L	-	700		6.9	47.8	88.7	74.7	95.4	82.1	90.9	80.4	22.9			
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO		1.14	5.89	22.7	8.9	19.7	16.9	16.7	14.6	3.11			
Total Mercury (Hg)	mg/L.	0.0001	0.001		<0.00002	<0.000020	<0.000020	0.000021	0.000039	0.00005	0.000018	0.00002	0.000041			
Total Molybdenum (Mo)	mg/L	2	0.25		0.00038	0.00064	0.00056	0.00165	0.00068	0.00061	0.00065	0.00068	0.00201			
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-		0.002	0.0369	0.0267	0.143	0.0541	0.0411	0.0163	0.0129	0.0444			
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO		0.072	1.210	0.649	3.790	1.310	0.573	0.381	0.278	1.080			
Total Potassium (K)	mg/L	-	-		2.44	7.94	11.5	16.5	12.3	8.3	8.38	6.46	8.12			
Total Rubidium (Rb)	mg/L	-	-													
Total Selenium (Se)	mg/L	0.002	0.01, MAC		<0.00050	<0.00050	<0.00050	0.00143	<0.00050	<0.00050	<0.00050	<0.00050	0.0005			
Total Silicon (Si)	mg/L	-	-		6.2	32.4	24.2	111	49.5	26.1	19.2	18.4	36.3			
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-		<0.000050	0.000299	0.000156	0.000923	0.000384	0.000126	<0.000050	0.000196	0.000331			
Total Sodium (Na)	mg/L	-	<200, AO		3.96	48.2	51.4	75.6	59.1	53.9	57.5	49.4	35.6			
Total Strontium (Sr)	mg/L	-	-		0.175	1.04	2.1	1.25	2.11	1.86	1.84	1.8	0.495			
Total Sulphur (S)	mg/L	-	-		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	13.9			
Total Tellurium (Te)	mg/L		-		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00050	<0.00050			
Total Thallium (Tl)	mg/L	0.0008	-		<0.000020	0.000086	0.000046	0.000319	0.000119	0.000037	<0.000020	0.000028	0.000137			
Total Thorium (Th)	mg/L	-	-		<0.00010	0.00051	0.00044	0.00242	0.00107	0.00052	0.00025	0.00041	0.00083			
Total Tin (Sn)	mg/L	-	-		<0.00020	0.00031	0.00029	0.00071	0.0004	0.0003	0.00021	<0.00020	0.00034			
Total Tungsten (W)	mg/L															
Total Titanium (Ti)	mg/L	-	-		0.0055	0.212	0.204	0.804	0.351	0.189	0.121	0.104	0.308			
Total Uranium (U)	mg/L	0.0085	0.02		0.000059	0.00318	0.00147	0.00844	0.00231	0.00167	0.00109	0.0011	0.00172			
Total Vanadium (V)	mg/L	-	-		0.0014	0.043	0.024	0.180	0.060	0.026	0.0123	0.0098	0.057			
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO		<0.0040	0.0886	0.0472	0.347	0.13	0.0437	0.027	0.0185	1.68			
Total Zirconium (Zr)	mg/L	-	-		0.00058	0.0022	0.0027	0.00723	0.00408	0.00262	0.00058	0.00047	0.00242			

Notes:

2018 data compared to updated criteria

A shaded value means exceeded the BC WQG freshwater aquatic life criteria

A shaded value means reading exceeded the BC WQG drinking water quality criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria.

A shaded value means exceeded more than one criteria.

A shaded value means reading had detection limit exceeding criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria for sampling stations that trigger the Ground Water Quality Exceedances Response Plan

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 , last updated January 2019

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

Table 2. Hazelton Shallow Groundwater Quality Data

Parameters	Units	BC MoE Guidelines		BC CSR Standards	SGW-3											
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)												
Date					14-Jun-17	7-Jul-17	13-Jul-17	20-Jul-17	27-Jul-17	1-Aug-17	9-Aug-17	16-Aug-17	5-Oct-17	30-May-18	10-Jul-18	12-Sep-18
Total Hardness	mg/L	-	-	-	827	486	661	760	1020	461	1030	1050	360	714	421	498
Dissolved Hardness (CaCO3)	mg/L	-	-	-												
Alkalinity (Total as CaCO3)	mg/L	-	-	-	640	320	540	680	810	440	800	930		749	557	504
Total Organic Carbon (C)	mg/L	-	4.0	-	104.0	60	199	196	322	134	390	372	67	160	114	51
Alkalinity (PP as CaCO3)	mg/L	-	-	-									240			
Bicarbonate (HCO3)	mg/L	-	-	-												
Carbonate (CO3)	mg/L	-	-	-												
Hydroxide (OH)	mg/L	-	-	-												
Chemical Oxygen Demand (COD)	mg/L	-	-	-	326	502	518	609	938	385	1100	1000	291	554	365	163
Biological Oxygen Demand (BOD)	mg/L	-	-	-	170	76	200	340	530	210	640	630	<38			
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	500	2	<1.0	<1.0	<1.0	<1.0	1.4	1.3	<1.0	7.4	<1.5	13.9	6.4
Chloride (Cl)	mg/L	600	250, AO	250	150	45.1	45.7	48.7	49.2	25.9	43.9	46.3	87	43.9	44.3	49.2
Total Kjeldahl Nitrogen	mg/L	-	-	-												
Ammonia (N)	mg/L	0.681-28.7 (d)	-	-	0.09	0.39	0.4	0.38	0.67	0.38	1.03	0.49	0.09	0.677	0.694	1.05
Nitrate plus Nitrite (N)	mg/L	-	-	-	0.082	0.0596	0.014	<0.0100	0.0309	0.0132	0.0163	0.0174	0.129	<0.030	<0.030	<0.205
Nitrite (N)	mg/L	0.06 -0.6 (max) (c)	1.0	1.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0050	<0.0050	<0.0050
Nitrate (N)	mg/L	32.8	10 MAC	10	0.082	0.06	0.014	<0.01	0.031	0.013	0.016	0.017	0.13	<0.025	<0.025	0.2
Conductivity	uS/cm	-	-	-	1580	685	1090	1360	1620	914	1630	1850	705			
Field Conductivity	uS/cm	-	-	-											663	811
pH	pH Units	6.5 - 9.0	7.0-10.5	-	6.7	6.7	6.6	6.7	6.5	6.6	6.4	6.5	6.9			
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO	-												
Dissolved Metals																
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5										9.33	0.0522	0.0583
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006										0.00044	0.00064	0.0004
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01										0.0384	0.0224	0.0278
Dissolved Barium (Ba)	mg/L	1	1.0	1										0.277	0.149	0.161
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008										0.00024	<0.00020	<0.00020
Dissolved Bismuth (Bi)	mg/L	-	-	-										<0.000050	<0.00010	<0.00010
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00										0.164	0.288	0.191
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005										0.0000597	0.000013	<0.000010
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-										189	116	131
Dissolved Cesium (Cs)	mg/L	-		-										0.000229	<0.000020	<0.000020
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)										0.01090	0.00023	0.00064
Dissolved Cobalt (Co)	mg/L	0.11	-	0.0010										0.020	0.008	0.011
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5										0.0181	<0.00040	0.00052
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5										61.6	24.4	42.2
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01										0.00337	<0.00010	<0.00010
Dissolved Lithium (Li)	mg/L	-	-	0.008										0.006400	<0.0020	<0.0020
Dissolved Magnesium (Mg)	mg/L	-	-	-										59	32	41
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5										15.5	8.95	11.5
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001										0.000012	<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25										0.000311	0.00068	0.00043
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08										0.0	0.0	0.0
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-										0.274	<0.10	<0.10
Dissolved Potassium (K)	mg/L	373-432	-	-										4.92	3.2	2.64
Dissolved Rubidium (Rb)	mg/L	-	-	-										0.0021	0.0005	<0.00040
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01										0.0003	0.0003	0.0002
Dissolved Silicon (Si)	mg/L	-	-	-										21.3	8.26	9.76
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02										<0.000010	<0.000020	<0.000020
Dissolved Sodium (Na)	mg/L	-	<200, AO	200										41.7	34.2	30.1
Dissolved Strontium (Sr)	mg/L	-	-	-										1.240	0.768	0.887
Dissolved Sulphur (S)	mg/L	-	-	-										<0.50	8.7	1.2
Dissolved Tellurium (Te)	mg/L			-										<0.00020	<0.00040	<0.00040
Dissolved Thallium (Tl)	mg/L	0.0017	-	-										0.00001	<0.000020	<0.000020
Dissolved Thorium (Th)	mg/L	-	-	-										0.00024	<0.00020	<0.00020
Dissolved Tin (Sn)	mg/L	-	-	2.5										<0.00010	<0.00020	<0.00020
Dissolved Titanium (Ti)	mg/L	2	-	-										0.03	0.003	0.01
Dissolved Tungsten (W)	mg/L	-		0.003										<0.00010	<0.00020	<0.00020
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02										0.00076	0.000684	0.000403
Dissolved Vanadium (V)	mg/L	0.006	-	0.02										0.024	0.004	0.006
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5.0, AO	3										0.04	0.0036	<0.0020
Dissolved Zirconium (Zr)	mg/L	-	-	-										0.00239	0.00093	0.00131
Total Metals																
Total Aluminum	mg/L	-	9.5		0.48	50.80	23.10	31.10	19.40	16.30	15.80	20.20	67.00			
Total Antimony (Ab)	mg/L	0.270	0.006		0.00015	0.00057	0.00067	0.00082	0.00071	0.00064	0.00067	0.00074	0.00054			
Total Arsenic (As)	mg/L	0.005	0.01 MAC		0.01	0.0239	0.028	0.032	0.032	0.0184	0.043	0.046	0.025			
Total Barium (Ba)	mg/L	1	1.0		0.196	0.644	0.348	0.398	0.361	0.226	0.349	0.414	0.74			
Total Beryllium (Be)	mg/L	0.00013	-		<0.00010	0.00139	0.00059	0.00063	0.00045	0.0003	0.0004	0.00055	0.00137			
Total Bismuth (Bi)	mg/L	-	-		<0.00010	0.00044	0.00018	0.00018	0.00014	0.0001	0.00011	0.00016	0.00053			
Total Boron (B)	mg/L	1.2	5.0, MAC		0.208	0.234	0.173	0.17	0.177	0.153	0.142	0.12	0.35			
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC		0.000186	0.000585	0.000258	0.000257	0.000296	0.000109	0.000291	0.000445	0.000441			
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-		201	119	175	199	283	124	273	284	75.3			
Total Cesium (Cs)	mg/L	-	-													
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC		0.00097	0.0572	0.023	0.0299	0.019	0.0166	0.017	0.0228	0.0737			
Total Cobalt (Co)	mg/L	0.11	-		0.0105	0.0321	0.0236	0.0259	0.0291	0.0128	0.0354	0.0355	0.0396			
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO		0.00366	0.0948	0.0395	0.0417	0.0312	0.0229	0.0298	0.0385	0.136			
Total Iron (Fe)	mg/L	1	0.3, AO		16.80	82.20	56.60	61.50	65.00	33.00	73.80	80.10	95.50			
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01		0.00014	0.0202	0.00746	0.00801	0.00595	0.00333	0.0051	0.00572	0.0227			
Total Lithium (Li)	mg/L	-	-		0.00253	0.0444	0.0175	0.0215	0.0148	0.0105	0.0113	0.0172	0.0419			
Total Magnesium (Mg)	mg/L	-	700		79.1	45.7	54.2	64	76.5	36.8	83.5	82.3	41.6			
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO		11.4	5.67	11.7	13.0	18.4	8.1	23.7	24.1	3.78			
Total Mercury (Hg)	mg/L.	0.0001	0.001		<0.00002	0.000062	<0.000020	0.000029	0.000026	0.00007	0.000045	0.000014	0.000084			
Total Molybdenum (Mo)	mg/L	2	0.25		0.00016	0.00063	0.00053	0.00085	0.00063	0.00079	0.00066	0.00092	0.00071			
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-		0.00459	0.0771	0.0351	0.0392	0.0309	0.0192	0.0304	0.0362	0.0991			
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO		0.081	1.180	0.731	0.705	0.644	0.314	0.597	0.563	1.220			
Total Potassium (K)	mg/L	-	-		6.84	5.5	4.17	5.63	4.55	3.61	4.84	3.68	8.2			
Total Rubidium (Rb)	mg/L	-	-													
Total Selenium (Se)	mg/L	0.002	0.01, MAC		<0.00050	<0.00050	0.00052	0.00055	<0.00050	<0.00050	0.00061	0.00057	<0.00050			
Total Silicon (Si)	mg/L	-	-		11.7	72.2	36.2	62	38.2	32.8	33.8	41.3	81.3			
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-		<0.000050	0.000445	0.000221	0.00023	0.000224	0.000132	0.000147	0.000333	0.000464			
Total Sodium (Na)	mg/L	-	<200, AO		55.8	28.5	35.2	46	52	31.1	58.9	52.4	46.5			
Total Strontium (Sr)	mg/L	-	-		1.64	0.778	1.08	1.16	1.56	0.76	1.59	1.73	0.551			
Total Sulphur (S)	mg/L	-	-		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0			
Total Tellurium (Te)	mg/L		-		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00050	<0.00050			
Total Thallium (Tl)	mg/L	0.0008	-		<0.000020	0.000156	0.000075	0.000123	0.000064	0.000066	0.00003	0.000068	0.000177			
Total Thorium (Th)	mg/L	-	-		<0.00010	0.00167	0.00087	0.00121	0.00065	0.0007	0.00072	0.00127	0.00225			
Total Tin (Sn)	mg/L	-	-		<0.00020	0.00041	0.00028	0.00053	0.00029	0.00028	0.00024	0.00034	0.0003			
Total Tungsten (W)	mg/L															
Total Titanium (Ti)	mg/L	-	-		0.0113	0.362	0.306	0.689	0.308	0.37	0.223	0.294	0.321			
Total Uranium (U)	mg/L	0.0085	0.02		0.00119	0.00246	0.00139	0.00233	0.00137	0.00114	0.00116	0.00164	0.00202			
Total Vanadium (V)	mg/L	-	-		0.0047	0.114	0.050	0.066	0.041	0.036	0.038	0.049	0.138			
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO		0.0065	0.161	0.0697	0.076	0.0592	0.035	0.0513	0.0624	0.206			
Total Zirconium (Zr)	mg/L	-	-		0.00059	0.00375	0.00314	0.00957	0.00335	0.00854	0.00185	0.00221	0.00261			

Notes:

2018 data compared to updated criteria

A shaded value means exceeded the BC WQG freshwater aquatic life criteria

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A shaded value means reading exceeded the CSR drinking water quality criteria for sampling stations that trigger the Ground Water Quality Exceedances Response Plan

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 , last updated January 2019

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

Table 2. Hazelton Shallow Groundwater Quality Data

Parameters	Units	BC MoE Guidelines		BC CSR Standards	SGW-2										
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)											
Date					14-Jun-17	7-Jul-17	13-Jul-17	20-Jul-17	27-Jul-17	1-Aug-17	9-Aug-17	16-Aug-17	5-Oct-17	30-May-18	10-Jul-18
Total Hardness	mg/L	-	-	-	159	410	443	477	531	309	710	630	329	175	339
Dissolved Hardness (CaCO3)	mg/L	-	-	-											
Alkalinity (Total as CaCO3)	mg/L	-	-	-	160	340	340	290	460	260	600	690		215	428
Total Organic Carbon (C)	mg/L	-	4.0	-	46.3	50	100	75	75.5	51	136	94	56	249	88
Alkalinity (PP as CaCO3)	mg/L	-	-	-									150		
Bicarbonate (HCO3)	mg/L	-	-	-											
Carbonate (CO3)	mg/L	-	-	-											
Hydroxide (OH)	mg/L	-	-	-											
Chemical Oxygen Demand (COD)	mg/L	-	-	-	128	465	266	509	427	288	528	249	350	854	300
Biological Oxygen Demand (BOD)	mg/L	-	-	-	15	96	84	79	92	35	110	94	<20		
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	500	<1.0	3	<1.0	3.3	<1.0	<1.0	<1.0	<1.0	1.1	<0.30	<1.5
Chloride (Cl)	mg/L	600	250, AO	250	19	12	10.5	12	14.2	10.1	17.6	17.8	7.5	4.66	7.6
Total Kjeldahl Nitrogen	mg/L	-	-	-											
Ammonia (N)	mg/L	0.681-28.7 (d)	-	-	0.11	2.18	1.74	0.87	2.04	1.09	2.39	2.5	0.47	1.2	3.07
Nitrate plus Nitrite (N)	mg/L	-	-	-	<0.010	0.0207	0.0468	0.046	0.0488	0.0136	0.0105	0.023	0.209	<0.0060	<0.30
Nitrite (N)	mg/L	0.06 -0.6 (max) (c)	1.0	1.0	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.0010	<0.0050
Nitrate (N)	mg/L	32.8	10 MAC	10	<0.01	<0.01	0.047	0.046	0.049	0.014	0.01	0.013	0.21	<0.0050	<0.025
Conductivity	uS/cm	-	-	-	352	643	613	586	830	505	1060	1240	294		
Field Conductivity	uS/cm	-	-	-											1142
pH	pH Units	6.5 - 9.0	7.0-10.5	-	7	6.6	7	7.1	6.6	6.9	6.7	6.6	6.6		
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO	-											
Dissolved Metals															
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5										0.125	0.0099
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006										0.0002	<0.00010
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01										0.00821	0.00703
Dissolved Barium (Ba)	mg/L	1	1.0	1										0.0527	0.098
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008										<0.00010	<0.00010
Dissolved Bismuth (Bi)	mg/L	-	-	-										<0.000050	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00										0.012	0.017
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005										0.0000084	0.0000063
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-										48.8	89.8
Dissolved Cesium (Cs)	mg/L	-		-										<0.000010	<0.000010
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)										0.00021	0.00014
Dissolved Cobalt (Co)	mg/L	0.11	-	0.0010										0.004	0.005
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5										0.00121	0.00501
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5										7.56	36.2
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01										0.000083	0.000295
Dissolved Lithium (Li)	mg/L	-	-	0.008										<0.0010	<0.0010
Dissolved Magnesium (Mg)	mg/L	-	-	-										13	28
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5										4.3	9.3
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001										<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25										0.000647	0.0021
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08										0.0026	0.0037
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-										<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-										2.54	3.7
Dissolved Rubidium (Rb)	mg/L	-	-	-										0.00055	0.00085
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01										0.0001	0.0001
Dissolved Silicon (Si)	mg/L	-	-	-										5.55	5.47
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02										<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200										5.83	10.30
Dissolved Strontium (Sr)	mg/L	-	-	-										0.2970	0.5690
Dissolved Sulphur (S)	mg/L	-	-	-										<0.50	<0.50
Dissolved Tellurium (Te)	mg/L			-										<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-										<0.000010	<0.000010
Dissolved Thorium (Th)	mg/L	-	-	-										<0.00010	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5										<0.00010	<0.00010
Dissolved Titanium (Ti)	mg/L	2	-	-										0.0038	0.0005
Dissolved Tungsten (W)	mg/L	-		0.003										<0.00010	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02										0.000244	0.000154
Dissolved Vanadium (V)	mg/L	0.006	-	0.02										0.0020	0.0007
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5.0, AO	3										0.0030	0.0066
Dissolved Zirconium (Zr)	mg/L	-	-	-										0.000529	0.000197
Total Metals															
Total Aluminum	mg/L	-	9.5		1.08	24.8	56.1	97.3	46.1	28.2	76.5	9.7	103		
Total Antimony (Ab)	mg/L	0.270	0.006		0.00018	0.00049	0.00049	0.00069	0.00061	0.00039	0.00061	0.00048	0.00057		
Total Arsenic (As)	mg/L	0.005	0.01 MAC		0.00595	0.0171	0.0175	0.032	0.0189	0.0134	0.029	0.0197	0.0237		
Total Barium (Ba)	mg/L	1	1.0		0.0474	0.356	0.605	0.914	0.558	0.352	0.866	0.257	1.07		
Total Beryllium (Be)	mg/L	0.00013	-		<0.00010	0.00055	0.00129	0.00189	0.0009	0.00062	0.00155	0.00022	0.00188		
Total Bismuth (Bi)	mg/L	-	-		<0.00010	0.00019	0.00038	0.00057	0.00027	0.00018	0.00047	<0.00010	0.00067		
Total Boron (B)	mg/L	1.2	5.0, MAC		0.227	0.0293	0.0245	0.0365	0.0456	0.0277	0.0272	0.0218	0.032		
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC		0.000035	0.00226	0.00119	0.0009	0.000521	0.000256	0.000877	0.000244	0.00120		
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-		44.6	108	109	105	138	80.9	172	170	57.5		
Total Cesium (Cs)	mg/L	-	-												
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC		0.0014	0.0286	0.0580	0.0971	0.0444	0.0325	0.0805	0.0101	0.1180		
Total Cobalt (Co)	mg/L	0.11	-		0.00228	0.017	0.0295	0.0448	0.0247	0.0155	0.0433	0.0136	0.0574		
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO		0.0028	0.0403	0.0792	0.144	0.069	0.0446	0.124	0.0203	0.223		
Total Iron (Fe)	mg/L	1	0.3, AO		2.51	38.60	72.90	123.00	61.30	41.20	96.60	28.90	139.00		
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01		0.00019	0.0072	0.0141	0.0191	0.00879	0.00624	0.016	0.0015	0.0302		
Total Lithium (Li)	mg/L	-	-		0.00073	0.0216	0.0436	0.0766	0.0328	0.0204	0.0503	0.00746	0.0662		
Total Magnesium (Mg)	mg/L	-	700		11.4	33.9	41.1	52.1	45.4	25.8	68.2	49.5	45		
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO		1.01	5.2	7.2	6.4	8.1	5.7	11.6	10.9	5.4		
Total Mercury (Hg)	mg/L.	0.0001	0.001		<0.00002	0.000025	0.000024	<0.000020	0.000064	0.000075	0.000034	0.000022	0.000153		
Total Molybdenum (Mo)	mg/L	2	0.25		0.00031	0.00083	0.00061	0.00142	0.00071	0.00073	0.00117	0.00106	0.00082		
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-		0.00408	0.0395	0.0778	0.135	0.0594	0.0374	0.105	0.0161	0.16		
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO		0.145	0.911	1.780	2.670	1.420	0.829	2.420	0.477	3.030		
Total Potassium (K)	mg/L	-	-		4.44	8.24	8.04	10.6	8.4	6.15	10.8	6.79	6.73		
Total Rubidium (Rb)	mg/L	-	-												
Total Selenium (Se)	mg/L	0.002	0.01, MAC		<0.00050	<0.00050	0.00062	0.00083	<0.00050	<0.00050	0.00073	<0.00050	0.00074		
Total Silicon (Si)	mg/L	-	-		7.8	41.6	60.4	126	58.6	41.5	86	24.2	104		
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-		<0.000050	0.000332	0.00059	0.000768	0.000424	0.000244	0.000692	0.000197	0.000847		
Total Sodium (Na)	mg/L	-	<200, AO		14.8	11.6	10.2	11.2	12.6	7.85	17.3	17	5.74		
Total Strontium (Sr)	mg/L	-	-		0.276	0.68	0.678	0.682	0.788	0.481	1.06	1.01	0.457		
Total Sulphur (S)	mg/L	-	-		<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0		
Total Tellurium (Te)	mg/L		-		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00050	<0.00050		
Total Thallium (Tl)	mg/L	0.0008	-		<0.000020	0.000109	0.000208	0.000347	0.000159	0.0001	0.000218	0.000044	0.000353		
Total Thorium (Th)	mg/L	-	-		<0.00010	0.00044	0.00087	0.00214	0.00085	0.00058	0.00128	0.00042	0.00269		
Total Tin (Sn)	mg/L	-	-		<0.00020	0.00068	0.00033	0.00081	0.00041	0.00026	0.00051	0.00038	0.00026		
Total Tungsten (W)	mg/L														
Total Titanium (Ti)	mg/L	-	-		0.024	0.319	0.331	0.983	0.327	0.336	0.489	0.155	0.382		
Total Uranium (U)	mg/L	0.0085	0.02		0.000145	0.000834	0.00153	0.00221	0.00114	0.00079	0.00194	0.000544	0.00209		
Total Vanadium (V)	mg/L	-	-		0.0035	0.055	0.104	0.192	0.078	0.060	0.149	0.020	0.207		
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO		0.0052	0.0944	0.182	0.3	0.138	0.0825	0.235	0.035	0.384		
Total Zirconium (Zr)	mg/L	-	-		0.00067	0.0014	0.00259	0.00616	0.00416	0.00455	0.00228	0.00084	0.00215		

Notes:

2018 data compared to updated criteria

A shaded value means exceeded the BC WQG freshwater aquatic life criteria

A shaded value means reading exceeded the BC WQG drinking water quality criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria.

A shaded value means exceeded more than one criteria.

A shaded value means reading had detection limit exceeding criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria for sampling stations that trigger the Ground Water Quality Exceedances Response Plan

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 , last updated January 2019

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

Table 2. Hazelton Shallow Groundwater Quality Data

Parameters	Units	BC MoE Guidelines		BC CSR Standards	SGW-4		SGW-5		
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)					
Date					10-Jul-18	11-Sep-18	30-May-18	10-Jul-18	11-Sep-18
Total Hardness	mg/L	-	-	-	494	656	256	254	318
Dissolved Hardness (CaCO3)	mg/L	-	-	-					
Alkalinity (Total as CaCO3)	mg/L	-	-	-	454	547	217	276	343
Total Organic Carbon (C)	mg/L	-	4.0	-	10.6	9	27.4	26.7	6
Alkalinity (PP as CaCO3)	mg/L	-	-	-					
Bicarbonate (HCO3)	mg/L	-	-	-					
Carbonate (CO3)	mg/L	-	-	-					
Hydroxide (OH)	mg/L	-	-	-					
Chemical Oxygen Demand (COD)	mg/L	-	-	-	55	24	90	121	<20
Biological Oxygen Demand (BOD)	mg/L	-	-	-					
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	500	23.4	13.9	5.59	2.78	2.91
Chloride (Cl)	mg/L	600	250, AO	250	13	12.7	5.62	4	6.99
Total Kjeldahl Nitrogen	mg/L	-	-	-					
Ammonia (N)	mg/L	0.681-28.7 (d)	-	-	0.0298	0.0689	0.0179	0.0669	0.183
Nitrate plus Nitrite (N)	mg/L	-	-	-	<0.03	<0.03	<0.0060	<0.0121	<0.0083
Nitrite (N)	mg/L	0.06 -0.6 (max) (c)	1.0	1.0	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010
Nitrate (N)	mg/L	32.8	10 MAC	10	<0.025	<0.025	<0.0050	0.012	0.0073
Conductivity	uS/cm	-	-	-					
Field Conductivity	uS/cm	-	-	-	762	710		422	500
pH	pH Units	6.5 - 9.0	7.0-10.5	-					
TSS	mg/L	25 mg/L (background 25-250 mg/l)) (i)	<500, AO	-					
Dissolved Metals									
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5	0.0571	0.278	0.469	0.0061	0.0026
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	0.00011	0.00012	0.00016	0.0001	0.00012
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00351	0.00994	0.0018	0.00418	0.00417
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.0997	0.169	0.0775	0.0698	0.0849
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00	0.017	0.024	<0.010	<0.010	0.01
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	0.000030	0.0000538	0.000076	<0.0000050	<0.0000050
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	110.0	148	61.3	62.1	79.7
Dissolved Cesium (Cs)	mg/L	-		-	0.0	0.000039	0.00008	<0.000010	<0.000010
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)	<0.00010	0.00023	0.00053	<0.00010	<0.00010
Dissolved Cobalt (Co)	mg/L	0.11	-	0.0010	0.00842	0.009	0.005	0.00273	0.019
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	0.00720	0.00212	0.00212	0.00040	0.00032
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	0.159	2.81	0.851	0.918	0.371
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01	0.000399	0.000705	0.000802	<0.000050	<0.000050
Dissolved Lithium (Li)	mg/L	-	-	0.008	0.0022	0.002900	0.002000	0.0015	0.001800
Dissolved Magnesium (Mg)	mg/L	-	-	-	53.5	70	25	23.9	29
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	1.70	3.02	0.718	1.06	2.00
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001	0.0000162	0.0000133	0.0000057	<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.00447	0.00411	0.00169	0.00363	0.00381
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	0.00377	0.00452	0.00267	0.00176	0.00432
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-	2.690	3.22	2	2.070	2.26
Dissolved Rubidium (Rb)	mg/L	-	-	-	0.000	0.00048	0.00042	0.000	0.00054
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	0.000053	0.00007	<0.000050	0.000056	<0.000050
Dissolved Silicon (Si)	mg/L	-	-	-	5.36	6.93	4.36	4.94	4.97
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.000010	0.000019	<0.000010	<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	13.7	16.50	9.48	8.3	9.52
Dissolved Strontium (Sr)	mg/L	-	-	-	1.1200	1.5500	0.5660	0.5880	0.7440
Dissolved Sulphur (S)	mg/L	-	-	-	6.96	3.34	1.67	0.52	0.99
Dissolved Tellurium (Te)	mg/L			-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Thorium (Th)	mg/L	-	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Titanium (Ti)	mg/L	2	-	-	0.00142	<0.0060	0.01	<0.00030	<0.00030
Dissolved Tungsten (W)	mg/L	-		0.003	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.000984	0.0012	0.000407	0.000489	0.000512
Dissolved Vanadium (V)	mg/L	0.006	-	0.02	<0.00050	0.0009	0.00115	<0.00050	<0.00050
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5.0, AO	3	0.0063	0.0027	0.0036	<0.0010	<0.0010
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.000060	0.000221	<0.000060	<0.000060	<0.000060
Total Metals									
Total Aluminum	mg/L	-	9.5						
Total Antimony (Ab)	mg/L	0.270	0.006						
Total Arsenic (As)	mg/L	0.005	0.01 MAC						
Total Barium (Ba)	mg/L	1	1.0						
Total Beryllium (Be)	mg/L	0.00013	-						
Total Bismuth (Bi)	mg/L	-	-						
Total Boron (B)	mg/L	1.2	5.0, MAC						
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC						
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-						
Total Cesium (Cs)	mg/L	-	-						
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC						
Total Cobalt (Co)	mg/L	0.11	-						
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO						
Total Iron (Fe)	mg/L	1	0.3, AO						
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01						
Total Lithium (Li)	mg/L	-	-						
Total Magnesium (Mg)	mg/L	-	700						
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO						
Total Mercury (Hg)	mg/L.	0.0001	0.001						
Total Molybdenum (Mo)	mg/L	2	0.25						
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-						
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO						
Total Potassium (K)	mg/L	-	-						
Total Rubidium (Rb)	mg/L	-	-						
Total Selenium (Se)	mg/L	0.002	0.01, MAC						
Total Silicon (Si)	mg/L	-	-						
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-						
Total Sodium (Na)	mg/L	-	<200, AO						
Total Strontium (Sr)	mg/L	-	-						
Total Sulphur (S)	mg/L	-	-						
Total Tellurium (Te)	mg/L		-						
Total Thallium (Tl)	mg/L	0.0008	-						
Total Thorium (Th)	mg/L	-	-						
Total Tin (Sn)	mg/L	-	-						
Total Tungsten (W)	mg/L								
Total Titanium (Ti)	mg/L	-	-						
Total Uranium (U)	mg/L	0.0085	0.02						
Total Vanadium (V)	mg/L	-	-						
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO						
Total Zirconium (Zr)	mg/L	-	-						

Notes:

2018 data compared to updated criteria

A shaded value means exceeded the BC WQG freshwater aquatic life criteria

A shaded value means reading exceeded the BC WQG drinking water quality criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria.

A shaded value means exceeded more than one criteria.

A shaded value means reading had detection limit exceeding criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria for sampling stations that trigger the Ground Water Quality Exceedances Response Plan

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 , last updated January 2019

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO^3$

Table 3. Hazelton Groundwater Quality Data

Analyte	Units	BC MoE Guidelines		BC CSR Standards	BH 01										BH 02												
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)																					Duplicate		
					7-Jul-14	26-May-15	16-Nov-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	30-May-18	11-Jul-18	11-Sep-18	7-Jul-14	26-May-15	16-Nov-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	30-May-18	30-May-18	RPD(%)	11-Jul-18	11-Sep-18
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-	<0.005											<0.005												
Cyanide, total	mg/L	-	-	-		<0.010	<0.010										<0.010	<0.010										
Alkalinity (CaCO3)	mg/L	-	-	-	>1250	210	210.0	220.0	220.0	220.0	220	220	276	379	392	1,095	530	>930	500	490	500	480	490	355	384	8%	462	501
Dissolved Hardness (CaCO3)	mg/L	-	-	-	148	158	165									485	521	533										
Hardness, Total (Total as CaCO3)	mg/L		-	-				171	154	175	149	158	266	270	329				548	503	550	497	508	482	509	5%	479	481
Chloride (Cl)	mg/L	600	250, AO	250	<1.0	2.2	5.5	3.3	3.5	14.7	3.5	2.4	0.7	0.6	<2.5	1.0	2.0	<1.0	1.5	1.9	1.2	1.5	1.1	<2.5	<2.5		<2.5	<2.5
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5									0.097	0.086	<0.10									<0.10	<0.10		<0.10	<0.10
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	9.4	<1.0	<1.0	<1.0	<1.0	<1.0	1	<1.0	15.4	18.2	27.7	69.5	63	55.1	59.8	60.3	59.3	64.1	66.5	59.7	60.2	1%	59.5	65.8
Conductivity	uS/cm	-	-	-	464	387	404	394	396	428	404	400				938	947	941	949	944	947	936	946					
Field Conductivity	uS/cm	-	-	-										526	463									837			752	704
Ammonia (N)	mg/L	0.68-28.7 (d)	-	-	0.07	<0.03	0.064	0.08	<0.03	<0.03	<0.03	<0.03	0.426	0.314	0.297	0.07	0.068	0.46	<0.03	0.033	0.036	<0.03	<0.03	0.199	0.19	5%	0.0513	0.159
Nitrate (N)	mg/L	32.8	10 MAC	10.0	0.033	0.040	0.370	0.210	0.460	0.220	0.189	0.018	<0.0050	0.025	<0.025	0.119	0.250	0.060	0.460	0.290	0.150	0.153	0.067	<0.025	0.026		0.139	<0.025
Nitrite (N)	mg/L	0.06-0.6 (c)	1.0	1	<0.01	<0.01	<0.01	0.014	<0.01	0.01	<0.01	<0.01	<0.0010	0.0026	<0.0050	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0050	<0.0050		0.0056	<0.0050
Nitrate+Nitrite (N)	mg/L	-	-	-		0.041	0.373	0.224	0.219	0.23	0.189	0.018	<0.0060	0.0276	<0.030		0.253	0.055	0.459	0.286	0.146	0.153	0.067	<0.030			0.1446	<0.030
Total Kjeldahl Nitrogen (N)	mg/L	-	-	-	0.607	<0.5	0.370									0.502	1.350	2.680										
Total Phosphorous (P)	mg/L	-	0.01	-	21.9	0.2	0.2									3.16	3.83	10.3										
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	43,000	72	72									11,000	2900	7000										
Total Dissolved Solids	mg/L	-	-	-	289	190	220									591	1.8	570										
pH	pH units	6.5 - 9.0	7.0-10.5	-	7.9	8.1	8.1	8.2	8.1	8.2	8.1	8.4				7.5	7.8	7.6	7.5	7.5	7.8	7.4	7.5					
Field pH	pH units	6.5 - 9.0	7.0-10.5	-											8.36													8.19
Volatiles																												
Vinyl chloride	ug/L				<0.50								<0.00040			<0.50								<0.00040				
Dichloromethane	ug/L	98.1	-		<2.0								<0.0050			<2.0								<0.0050				
Benzene	ug/L	40 (a)	5 (a)		<0.4								<0.00050			<0.4								<0.00050				
Toluene	ug/L	0.5 (a)	-		<0.4								0.00058			<0.4								0.00057				
1,4-dichlorobenzene	ug/L	26	-		<0.5								<0.0010			<0.5								<0.0010				
Misc. Organics																												
Chemical Oxygen Demand	mg/L	-	-	-	471	33	<20	<20	<20	<20	<20	<20	605.00	366.00	<20	123	136	242	25	<20	<20	<20	<20	162.00	177.00	9%	<20	<20
Biochemical Oxygen Demand	mg/L	-	-	-																								
Dissolved Organic Carbon (C)	mg/L	-	-	-	0.69	1.00	2.60									<0.5	1.8	4.3										
Phenols	mg/L	50	-	1.0	<0.001											<0.001												
Dissolved Metals																												
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5	0.0190	0.0050	<0.005	0.0150	0.0070	0.0150	<0.0050	0.0075	0.0049	0.2880	0.0942	0.0030	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	0.0042	0.0172	121%	0.0023	0.0067
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	0.00058	0.00060	<0.0001	0.00010	0.00010	0.00030	<0.00010	0.00021	0.00016	0.00018	<0.00010	<0.005	0.0005	<0.0001	0.0003	<0.0001	0.0002	<0.00010	0.0003	<0.00010	<0.00010		<0.00010	0.00013
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00053	0.00180	0.00160	0.00210	0.00160	0.00200	0.00160	0.00181	0.00927	0.00691	0.01650	0.00088	0.00130	0.00120	0.00070	0.00070	0.00080	0.00076	0.00078	0.00088	0.00087	1%	0.00073	0.00078
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.320	0.212	0.262	0.242	0.218	0.243	0.1970	0.2370	0.1130	0.1810	0.1920	0.0665	0.1470	0.0650	0.0600	0.0640	0.0680	0.0520	0.0591	0.0635	0.0668	5%	0.0681	0.0576
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010
Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<0.000050		<0.000050	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00	0.066	0.069	0.065	0.069	0.076	0.072	0.073	0.065	0.084	0.083	0.11	0.079	0.107	0.078	0.097	0.100	0.098	0.099	0.091	0.079	0.081	3%	0.074	0.087
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	<0.00001	0.0002	0.00068	0.00003	0.0009	0.00099	0.000239	0.000365	0.0000058	0.0000162	0.0000063	0.00018	0.00022	0.00008	0.00024	0.00263	0.00002	0.000539	0.000456	0.0000174	0.0000372	73%	0.000643	0.0000442
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	18	18	20	20	20	20	18	20	46.8	44.6	57.8	83	87	91	92	86	87	85	88	84	89	6%	78	80
Dissolved Cesium (Cs)	mg/L	-	-	-									<0.000010	0.000023	0.000016									<0.000010	0		<0.000010	0
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	<0.00050	<0.00050	<0.00010	0.00031	0.00013	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00010	<0.00010		<0.00010	<0.00010
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	<0.0050	<0.00005	0.00011	<0.00005	<0.00005	0.0001	<0.00010	<0.00010	0.00021	0.00042	0.00017	0.00053	0.00063	0.00058	<0.00005	<0.00005	0.00045	<0.00010	<0.00010	0.0006	0.00066	10%	<0.00010	0.0005
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	<0.0050	0.0024	0.0023	0.0014	0.0029	0.0048	0.00213	0.00137	0.00204	0.00073	0.00094	0.00132	0.02220	0.00170	0.00230	0.00320	0.00040	0.00345	0.00171	0.00251	0.00185	30%	0.00428	0.00053
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	<0.01	<0.010	<0.010	0.019	<0.010	<0.010	<0.010	0.021	0.217	0.395	0.858	<0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.058	0.083	35%	<0.010	0.077
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01	<0.0002	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	0.000104	0.000091	<0.0002	0.0002	<0.0001	0.0003	<0.0001	<0.0001	<0.00010	<0.00010	0.000124	0.000094	28%	<0.000050	<0.000050
Dissolved Lithium (Li)	mg/L	-	-	0.008	<0.005	0.0003	0.0003	0.0003	0.0004	0.0004	0.0005	0.0003	0.0014	0.0015	0.002	<0.005	0.0043	0.0042	0.0046	0.0046	0.0044	0.00434	0.00428	0.004	0.0042	5%	0.0039	0.0042
Dissolved Magnesium (Mg)	mg/L	-	-	-	25.3	27.3	28.4	29.1	25.5	30.6	25.2	26.3	36.1	38.4	44.9	67.2	73.9	74.3	77.5	70.1	80.9	69.0	70.0	66.2	69.6	5%	69.0	68.5
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	0.0363	0.1280	0.0026	0.0999	0.0009	0.0069	0.0015	0.0926	0.131	0.159	0.175	0.131	0.128	0.158	0.007	0.031	0.119	0.0058	0.0033	0.1660	0.1790	8%	0.1070	0.1550
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	0.0000131	<0.0000050	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.0000050		<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.0095	0.0027	0.0100	0.0100	0.0100	0.0107	0.0097	0.0095	0.00604	0.00467	0.00339	0.0027	0.0027	0.0025	0.0024	0.0026	0.0026	0.0024	0.0023	0.0023	0.0023	1%	0.0022	0.0023
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	<0.001	0.0016	0.0012	0.0004	0.0018	0.0047	0.00053	0.00084	<0.00050	0.00085	<0.00050	0.0013	0.0016	0.0009	0.0007	0.0032	0.0020	0.00092	0.00095	0.00086	0.00106	21%	0.00177	0.00111
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	0.011	<0.02	0.050	0.070	0.040	0.060	<0.050	<0.050	<0.050	<0.050	<0.050	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.050	<0.050	<0.050	<0.050		<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-	1.83	3.50	2.49	2.05	2.03	2.40	2.01	2.02	2.01	2.32	1.97	2.70	3.50	2.87	3.27	2.65	2.87	2.67	2.83	2.58	2.71	5%	2.68	2.67
Dissolved Rubidium (Rb)	mg/L	-	-	-									0.0004	0.00061	0.00043									0.00	0.00	2%	0.00	0.00
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	<0.0001	0.0009	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.000050	<0.000050	<0.000050	0.00013	0.00090	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.000050	<0.000050		0.00027	0.00011
Dissolved Silicon (Si)	mg/L	-	-	-	1.22	9.30	1.10	1.30	1.20	1.30	1.20	1.30	4.23	4.6	6.48	7.72	9.30	7.70	9.00	8.40	8.90	8.20	9.20	7.96	7.90	1%	8.07	7.43
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.00002	<0.00005	<0.00005	<0.00005	<0.00005	0.00023	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.00002	<0.00005	<0.00005	<0.00005	<0.00005	0.00011	<0.000050	<0.000050	<0.000010	<0.000010		<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	27.2	32.0	35.6	33.0	30.3	41.2	30.5	30.0	31.5	30.9	29.8	25.1	28.8	27.2	29.3	26.0	28.2	25.5	25.3	23.7	24.8	5%	24.7	23.7
Dissolved Strontium (Sr)	mg/L	-	-	-	0.709	0.672	0.682	0.705	0.642	0.761	0.609	0.694	1.120	1.080	1.370	2.06	1.87	1.96	2.05	1.88	2.19	1.750	1.980	1.950	2.050	5%	1.750	1.890
Dissolved Sulphur (S)	mg/L	-	-	-	<3.0	2	<1	<1	2	<1	<3.0	<3.0	5.1	6.6	9.3	20.0	25.0	21.0	23.0	21.0	23.0	19.5	21.3	22.5	21.6	4%	22.5	21.2
Dissolved Tellurium (Te)	mg/L	-	-	-		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020		<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.000005	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000005	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010		0.000015	<0.000010
Dissolved Thorium (Th)	mg/L	-	-	-		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5	<0.005	<0.0002	<0.0002	<0.0002	0.0002	0.0002	<0.00020	<0.00020	<0.00010	0.00035	<0.00010	<0.005	<0.0002	<0.0002	0.0003	0.0004	<0.0002	<0.00020	0.00027	<0.00010	0.00016		<0.00010	<0.00010
Dissolved Titanium (Ti)	mg/L	2	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030	<0.0063	0.00164	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030	0.00038		<0.00030	<0.00030
Dissolved Tungsten (W)	mg/L	-	-	0.003									<0.00010	<0.00010	<0.00010									<0.00010	<0.00010		<0.00010	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.00027	0.00004	0.00004	0.00005	0.00005	0.00005	0.00006	0.00006	0.00051	0.00075	0.00105	0.00125	0.00118	0.00118	0.00110	0.00116	0.00113	0.00112	0.00114	0.00113	0.00122	8%	0.00101	0.00114
Dissolved Vanadium (V)	mg/L	0.006	-	0.02	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.00050	0.00084	<0.00050	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.00050	<0.00050		0.00087	<0.00050
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5 AO	3	<0.005	0.004	0.027	<0.004	<0.004	0.027	<0.0040	0.0108	<0.0010	0.002	0.0026	<0.005	0.029	<0.004	0.004	0.008	0.01	0.0147	0.0112	0.0028	0.0035	22%	0.0035	<0.0010
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.0005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000060	0.000157	<0.000060	<0.0005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	0.000066	0.000077	15%	0.000095	<0.000060

Notes:

2018 data compared to updated criteria

A shaded value means exceeded the freshwater aquatic life criteria

A shaded value means reading exceeded the drinking water quality criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria.

A shaded value means exceeded more than one criteria.

A shaded value means reading had detection limit exceeding criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria for sampling stations that trigger the Ground Water Quality Exceedances Response Plan

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum, Cadmium, and Iron (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 , last updated January 2019

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO_3$

j. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 - Stage 11 Amendments, last updated March 2019

Table 3. Hazelton Groundwater Quality Data

Analyte	Units	BC MoE Guidelines		BC CSR Standards	BH 03									BH 4A								
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)																		
					7-Jul-14	26-May-15	16-Nov-15	16-Apr-16	25-Oct-16	24-Apr-17	14-Jun-17	30-May-18	11-Sep-18	7-Jul-14	26-May-15	16-Nov-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	11-Sep-18
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-	<0.005									<0.005								
Cyanide, total	mg/L	-	-	-		<0.010	<0.010								<0.010	<0.010						
Alkalinity (CaCO3)	mg/L	-	-	-	265	240		250	250	240	240	207	200	273	270	270	270	270	270	270	260	277
Dissolved Hardness (CaCO3)	mg/L	-	-	-	216	557	239							210	103	217						
Hardness, Total (Total as CaCO3)	mg/L	-	-	-				247	236	220	242	228	177				225	208	222	202	207	203
Chloride (Cl)	mg/L	600	250, AO	250	2.8	3.9		3.7	3.4	2.7	2.5	1.75	<2.5	1.6	2.5	1.2	1.6	2.0	1.6	1.7	1.5	<2.5
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5								0.080	<0.10									<0.10
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	176	180		184	181	184	223	185	199	147	141	142	135	133	129	139	148	142
Conductivity	uS/cm	-	-	-	837	817		829	819	813	831			751	773	756	762	760	760	760	765	
Field Conductivity	uS/cm	-	-	-								667	638									624
Ammonia (N)	mg/L	0.68-28.7 (d)	-	-	0.07	0.04	0.04	<0.03	<0.03	<0.03	<0.03	0.0056	0.0067	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.0050
Nitrate (N)	mg/L	32.8	10 MAC	10.0	0.404	0.310	0.320	0.320	0.250	0.246	0.130	0.288	<0.025	0.528	0.420	0.560	0.520	0.220	0.340	0.462	0.160	0.458
Nitrite (N)	mg/L	0.06-0.6 (c)	1.0	1	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.0010	<0.0050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0050
Nitrate+Nitrite (N)	mg/L	-	-	-		0.311	0.32	0.319	0.254	0.246	0.128	<0.289	<0.030		0.424	0.555	0.523	0.464	0.341	0.462	0.157	<0.463
Total Kjeldahl Nitrogen (N)	mg/L	-	-	-	0.176	0.370	0.100							0.136	0.330	0.260						
Total Phosphorous (P)	mg/L	-	0.01	-	0.15	0.32	<0.1							0.14	0.13	0.2						
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	300	170								18	38	23						
Total Dissolved Solids	mg/L	-	-	-	542	1.3								481	2	480						
pH	pH units	6.5 - 9.0	7.0-10.5	-	7.9	7.7		7.7	7.8	8	7.6			7.7	7.6	7.9	7.7	7.8	8	7.7	7.8	
Field pH	pH units	6.5 - 9.0	7.0-10.5	-									8.25									8.36
Volatiles																						
Vinyl chloride	ug/L				<0.50							<0.00040		<0.50								
Dichloromethane	ug/L	98.1	-		<2.0							<0.0050		<2.0								
Benzene	ug/L	40 (a)	5 (a)		<0.4							<0.00050		<0.4								
Toluene	ug/L	0.5 (a)	-		<0.4							0.0112		<0.4								
1,4-dichlorobenzene	ug/L	26	-		<0.5							<0.0010		<0.5								
Misc. Organics																						
Chemical Oxygen Demand	mg/L	-	-	-	<20	<20	<20	<20	<20	36.00	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Biochemical Oxygen Demand	mg/L	-	-	-																		
Dissolved Organic Carbon (C)	mg/L	-	-	-	<0.5	1.3								0.82	2.00	1.80						
Phenols	mg/L	50	-	1.0	<0.001									0.0011								
Dissolved Metals																						
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5	0.0058	<0.005	<0.005	<0.005	<0.005	<0.0050	0.0059	0.0074	0.0060	0.0054	0.0080	<0.005	<0.005	<0.005	0.0190	<0.0050	0.0066	0.0018
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	<0.005	0.0005	0.0001	0.0005	0.0005	0.00029	0.00063	0.00043	0.00036	<0.005	0.0003	<0.0001	0.0002	0.0002	0.0004	0.00021	0.00036	0.00021
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00048	0.00210	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.00040	0.00032	0.00048	0.00070	0.00060	0.00050	<0.0005	0.00060	<0.00050	<0.00050	0.00046
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.0347	0.3860	0.0320	0.0320	0.0350	0.0281	0.0327	0.03590	0.03090	0.0629	0.1310	0.0710	0.0670	0.0670	0.0710	0.0575	0.0653	0.0753
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<0.000050	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00	0.056	0.040	0.059	0.072	0.073	0.069	0.07	0.06100	0.06700	<0.05	0.02	0.051	0.062	0.062	0.065	0.06	0.055	0.051
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	0.00006	0.00007	0.00015	0.00023	0.00032	0.000141	0.000186	0.00012	0.00012	0.000164	0.00005	0.00009	0.00005	0.00011	0.00007	0.000066	0.000066	0.00005
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	64	141	71	72	67	65	72	68	48	57	29	58	59	56	57	54	55	53
Dissolved Cesium (Cs)	mg/L	-	-	-								<0.000010	<0.000010									<0.000010
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00010	<0.00010	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00010
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	<0.0050	0.00783	<0.00005	0.00009	<0.00005	<0.00010	<0.00010	0.00012	<0.00010	<0.0050	0.0141	0.00019	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	0.00128	0.00520	0.00350	0.00270	0.00230	0.00069	0.00376	0.00162	0.00109	0.00060	0.00490	0.00090	0.00140	0.00090	0.00090	0.00075	0.00065	0.00225
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	<0.01	0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.01	4.25	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01	<0.0002	<0.0001	<0.0001	0.0004	<0.0001	<0.00010	<0.00010	0.00006	<0.000050	<0.0002	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.00010	<0.00010	0.000063
Dissolved Lithium (Li)	mg/L	-	-	0.008	<0.005	0.002	0.0017	0.0019	0.0025	0.00161	0.00191	0.00180	0.00180	<0.005	0.0026	0.0012	0.0013	0.0012	0.0013	0.00109	0.00121	0.0012
Dissolved Magnesium (Mg)	mg/L	-	-	-	13.7	49.9	15.1	16.3	16.3	14.0	15.0	14.1	14.1	16.6	7.3	17.5	18.9	16.8	19.3	16.2	16.8	17.0
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	0.0020	3.97	0.0011	0.0439	0.0046	0.0014	0.0035	0.03180	0.02310	0.0011	3.17	0.0512	0.0003	0.0034	0.0009	0.0004	0.0051	0.0005
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.0000050	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.0071	0.0012	0.0051	0.0059	0.0060	0.0057	0.0060	0.00534	0.00513	0.0043	0.0007	0.0036	0.0037	0.0037	0.0035	0.0034	0.0033	0.0033
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	<0.001	0.0126	0.001	0.0016	0.0021	0.00041	0.00073	0.00077	0.00055	<0.001	0.0181	0.0009	0.0006	0.0004	0.0013	0.00052	0.00596	0.00057
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	0.035	<0.02	<0.02	0.020	0.030	<0.050	<0.050	<0.050	<0.050	0.035	<0.02	<0.02	0.040	0.030	0.040	<0.050	<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-	2.13	3.56	2.15	2.25	2.31	1.98	2.23	2.08	1.90	1.74	1.85	1.76	1.85	1.63	1.86	1.71	1.85	1.58
Dissolved Rubidium (Rb)	mg/L	-	-	-								0.00049	0.00051									0.00
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	0.00033	0.00080	0.00050	0.00060	0.00050	<0.00050	0.00050	0.00053	0.00059	0.00086	0.00060	0.00120	0.00170	0.00130	0.00160	0.00142	0.00155	0.00139
Dissolved Silicon (Si)	mg/L	-	-	-	4.01	10.20	3.70	4.40	4.10	3.90	4.60	3.96000	3.69000	4.00	8.70	3.60	4.40	4.40	4.30	4.10	4.60	3.80
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.00002	<0.00005	<0.00005	<0.00005	0.00008	<0.000050	<0.000050	<0.000010	<0.000010	<0.00002	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	113	87	100	107	103	94.4	99.6	92.6	93.9	89.0	7.5	98.5	106.0	95.7	106.0	94.2	94.9	91.1
Dissolved Strontium (Sr)	mg/L	-	-	-	0.912	1.030	0.893	0.949	1.010	0.829	0.956	0.912	0.846	0.821	0.133	0.750	0.792	0.751	0.868	0.702	0.797	0.795
Dissolved Sulphur (S)	mg/L	-	-	-	57.1	7.0	63.0	71.0	68.0	59.3	69.7	69.5	66.4	40.4	2.0	46.0	53.0	46.0	54.0	44.8	49.5	47.3
Dissolved Tellurium (Te)	mg/L	-	-	-		<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.00005	<0.00002	<0.00002	0.00002	0.00003	<0.000020	<0.000020	<0.000010	0.00001	<0.00005	<0.00002	<0.00002	<0.00002	<0.00002	0.00002	<0.000020	<0.000020	0.000011
Dissolved Thorium (Th)	mg/L	-	-	-		<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5	<0.005	<0.0002	0.0006	0.0004	<0.0002	<0.00020	<0.00020	0.00734	<0.00010	<0.005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010
Dissolved Titanium (Ti)	mg/L	2	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030	<0.00030	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030
Dissolved Tungsten (W)	mg/L	-	-	0.003								0.00019	0.00031									<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.00245	0.00071	0.00231	0.00239	0.00239	0.00233	0.00250	0.00238	0.00215	0.00370	0.00007	0.00351	0.00338	0.00363	0.00357	0.00338	0.00346	0.00331
Dissolved Vanadium (V)	mg/L	0.006	-	0.02	<0.005	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.00050	<0.00050	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.00050
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5 AO	3	<0.005	0.037	0.006	<0.004	0.045	<0.0040	0.006	0.0027	0.0015	<0.005	0.024	<0.004	<0.004	<0.004	<0.004	<0.0040	<0.0040	0.0041
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.0005	0.0002	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000060	<0.000060	<0.0005	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000060

Notes:
2018 data compared to updated criteria

A shaded value means exceeded the freshwater aquatic life criteria
A shaded value means reading exceeded the drinking water quality criteria.
A shaded value means reading exceeded the CSR drinking water quality criteria.
A shaded value means exceeded more than one criteria.
A shaded value means reading had detection limit exceeding criteria.
A shaded value means reading exceeded the CSR drinking water quality criteria for sampling stations that trigger the Ground Water Quality Exceedances Response Plan

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum, Cadmium, and Iron (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 , last updated January 2019
c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)
d. Limit pH and temperature dependent.
e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.
f. Limit for chromium (IV)
g. Limit for total, no dissolved concentrations
h.copper (mg/L) =(0.094* Hardness)/1000
i. Limit for hardness based on total dissolved $CaCO_3$
j. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 - Stage 11 Amendments, last updated March 2019

Table 3. Hazelton Groundwater Quality Data

Analyte	Units	BC MoE Guidelines		BC CSR Standards	BH 4B								BH 5B												
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)																	Duplicate			Duplicate	
					26-May-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	30-May-18	11-Jul-18	7-Jul-14	26-May-15	16-Nov-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	30-May-18	11-Jul-18	11-Jul-18	RPD (%)	11-Sep-18	11-Sep-18	RPD (%)
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-									<0.005													
Cyanide, total	mg/L	-	-	-	<0.010									<0.010	<0.010											
Alkalinity (CaCO3)	mg/L	-	-	-	120	63	190	84	19	120	290	404	784	540	800	710	910	330	560	560	232	795	810	2%	801	779	3%
Dissolved Hardness (CaCO3)	mg/L	-	-	-	223								756	239	853											
Hardness, Total (Total as CaCO3)	mg/L		-	-		47	163	70	9	103	354	355				885	898	502	608	665	311	892	903	1%	825	799	3%
Chloride (Cl)	mg/L	600	250, AO	250	1.1	<1.0	1.2	1.1	<1.0	1.0	0.6	1.2	140	114	177	204	198	259	243.0	236.0	21.4	244.0	244.0	0%	205.0	195.0	5%
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5							0.215	0.176									0.119	<0.20	<0.20		<0.20	<0.20	
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	<1.0	<1.0	<1.0	1.3	1.9	<1.0	0.78	1.96	3.5	5.5	10.4	2	2.2	21.6	1.1	1.4	23.3	<3.0	<3.0		5.2	6.7	
Conductivity	uS/cm	-	-	-	228	122	352	170	43.1	240	666	628	1,700	128	1,880	1,740	1,990	1,360	1650	1620							
Field Conductivity	uS/cm	-	-	-																		1409			1154		
Ammonia (N)	mg/L	0.68-28.7 (d)	-	-	<0.03	0.03	0.059	<0.03	<0.03	0.24	0.0136	0.048	0.29	<0.03	0.29	<0.03	<0.03	0.042	<0.03	<0.03	0.0302	0.0217	0.0248	13%	0.0486	0.0413	16%
Nitrate (N)	mg/L	32.8	10 MAC	10.0	<0.01	0.012	0.450	<0.01	0.023	0.012	0.021	0.018	<0.02	0.01	<0.01	0.014	<0.01	0.029	<0.01	<0.01	<0.0050	<0.050	<0.050		<0.050	<0.050	
Nitrite (N)	mg/L	0.06-0.6 (c)	1.0	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	<0.01	<0.01	<0.0010	<0.010	<0.010		<0.010	<0.010	
Nitrate+Nitrite (N)	mg/L	-	-	-	<0.010	0.012	0.037	<0.010	0.023	0.012	<0.022	<0.019		0.013	<0.010	0.014	<0.010	0.029	<0.010	<0.010	<0.006	<0.060			<0.060		
Total Kjeldahl Nitrogen (N)	mg/L	-	-	-	1.020								1.060	0.580	2.630												
Total Phosphorous (P)	mg/L	-	0.01	-	0.34								0.42	0.35	3.2												
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	200								340	200	430												
Total Dissolved Solids	mg/L	-	-	-	11.4								928	16.4	1000												
pH	pH units	6.5 - 9.0	7.0-10.5	-	6.7	6.4	6.7	6.7	5.7	6.3			7.1	6.9	7.3	6.8	6.9	7.2	6.5	6.8					7.73	7.79	
Field pH	pH units	6.5 - 9.0	7.0-10.5	-																							
Volatiles																											
Vinyl chloride	ug/L										<0.00040		<0.50								<0.0004						
Dichloromethane	ug/L	98.1	-								<0.0050		<2.0								<0.0050						
Benzene	ug/L	40 (a)	5 (a)								<0.00050		<0.4								<0.00050						
Toluene	ug/L	0.5 (a)	-								<0.00045		<0.4								0.00291						
1,4-dichlorobenzene	ug/L	26	-								<0.0010		<0.5								<0.0010						
Misc. Organics																											
Chemical Oxygen Demand	mg/L	-	-	-	63.00	64.00	59.00	65.00	<20	61.00	53	81	62	59	164	58	49	48	60.00	60.00	220.00	50.00	55.00	10%	31.00	35.00	12%
Biochemical Oxygen Demand	mg/L	-	-	-																							
Dissolved Organic Carbon (C)	mg/L	-	-	-	11.40								10.8	16.4	21.3												
Phenols	mg/L	50	-	1.0									0.0065														
Dissolved Metals																											
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5	0.0060	0.0410	0.0060	0.1670	0.0606	0.1400	0.0320	0.0125	<0.003	<0.005	<0.005	<0.005	<0.005	0.007	<0.0050	0.0154	0.0076	0.0054	0.0022	84%	0.0024	0.0048	67%
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	0.0005	0.0001	0.0002	0.0004	<0.00010	0.00087	0.00027	0.00021	<0.005	0.0005	0.0002	0.0003	0.0003	0.0006	0.00041	0.00056	0.00015	0.00031	0.00016	64%	0.00023	0.00048	70%
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	<0.0005	0.00130	0.00060	0.00290	<0.00050	0.00257	0.00372	0.00281	0.00346	<0.0005	0.01020	0.00410	0.00240	0.00410	0.00230	0.00394	0.00111	0.00918	0.00739	22%	0.01130	0.01570	33%
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.0670	0.0290	0.0700	0.2380	0.0694	0.0501	0.1050	0.1120	0.179	0.032	0.336	0.196	0.179	0.639	0.2810	0.1550	0.0658	0.2890	0.2850	1%	0.2880	0.2930	2%
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	
Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<0.000050	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050		<0.000050	<0.000050	
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00	0.059	0.005	0.011	0.033	0.02	0.006	<0.010	<0.010	<0.05	0.07	0.024	0.014	0.015	0.048	0.027	0.014	0.015	0.01	0.01	0%	0.015	0.016	6%
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	0.00029	0.00028	0.00096	0.00043	0.000439	0.000356	0.000124	0.000709	0.000041	0.000320	0.000020	0.000010	0.000100	0.000270	0.000089	0.000051	0.000019	0.000117	0.000127	8%	<0.0000050	0.000907	
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	58	13	48	19	3	31	109	109	205	70	220	228	236	126	162	180	71	229	231	1%	205	199	3%
Dissolved Cesium (Cs)	mg/L	-	-	-							<0.000010	<0.000010									<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)	<0.0005	<0.0005	0.0006	0.0009	<0.00050	0.00057	0.00011	<0.00010	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	<0.00005	0.0113	0.00973	0.0119	0.00077	0.0158	0.00887	0.00731	0.0134	<0.00005	0.0121	0.0183	0.0368	0.0108	0.013	0.013	0.011	0.00645	0.00562	14%	0.00301	0.00857	96%
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	0.00250	0.00370	0.00410	0.04020	0.02260	0.00700	0.00243	0.00256	<0.0050	0.0027	0.0014	0.0014	<0.0002	0.0133	0.02670	0.00024	0.00235	0.00050	0.00071	35%	0.00026	0.00069	91%
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	<0.010	4.51	0.103	10.9	0.214	10.1	5.51	3.86	0.109	<0.010	13.0	15.8	0.017	2.3	5.1	10.7	0.02	10.9	10.9	0%	12.4	13.3	7%
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01	<0.0001	0.0005	<0.0001	0.0012	0.00016	0.00051	0.000181	0.000053	<0.0002	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.00010	<0.00010	0.000089	<0.000050	<0.000050		<0.000050	<0.000050	
Dissolved Lithium (Li)	mg/L	-	-	0.008	0.0017	0.0038	0.0034	0.0056	0.00319	0.0034	0.0024	0.0024	<0.005	0.0018	0.0031	0.0025	0.0033	0.0025	0.00207	0.00237	0.002	0.0028	0.0028	0%	0.0029	0.003	3%
Dissolved Magnesium (Mg)	mg/L	-	-	-	19.4	3.5	10.1	5.2	0.5	6.2	20.1	20.2	59.0	15.6	74.1	76.5	75.2	45.3	49.5	52.5	32.4	77.6	79.3	2%	76.0	73.4	3%
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	0.0070	2.06	3.36	1.49	0.17	2.93	3.19	3.63	4.57	0.0135	5.35	5.98	5.96	2.38	5.07	5.81	1.74	5.01	5.04	1%	4.51	4.24	6%
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.0000050	<0.00001	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.0000082	<0.0000050	<0.0000050		<0.0000050	<0.0000050	
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.0042	0.0002	0.0008	0.0003	<0.00010	0.0003	0.0006	0.0007	0.0036	0.0063	0.0073	0.0019	0.0025	0.0016	0.0016	0.0004	0.0047	0.0011	0.0006	50%	0.0011	0.0026	81%
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	0.0009	0.0193	0.0195	0.0405	0.00707	0.0457	0.0227	0.0154	0.0141	0.0008	0.0173	0.0233	0.0306	0.0284	0.0183	0.0195	0.00381	0.00811	0.0056	37%	0.00513	0.0136	90%
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	0.020	0.030	<0.02	0.060	<0.050	<0.050	<0.050	<0.050	<0.01	0.03	<0.02	<0.02	<0.02	<0.02	<0.050	<0.050	<0.050	<0.050	<0.050		0.111	0.093	18%
Dissolved Potassium (K)	mg/L	373-432	-	-	2.26	0.62	1.85	1.35	0.25	1.20	2.05	2.80	4.22	2.65	5.39	4.39	4.36	4.78	2.41	2.50	2.13	3.58	3.74	4%	3.37	3.29	2%
Dissolved Rubidium (Rb)	mg/L	-	-	-							0.0010	0.0012									0.00	0.00	0.00	7%	0.00	0.00	4%
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	0.00210	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.00011	0.00011	<0.0001	0.0012	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.00011	0.00011	0.00010	10%	0.00009	0.00010	5%
Dissolved Silicon (Si)	mg/L	-	-	-	4.70	7.70	8.70	7.90	5.10	8.60	6.13	5.99	8.89	4.60	9.60	11.10	10.70	9.10	9.50	11.30	3.21	10.10	9.53	6%	8.75	9.13	4%
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	0.00002	<0.000010	<0.00002	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010		0.000028	0.000012	80%
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	105.0	7.0	8.8	11.2	6.1	10.1	11.2	12.3	77.0	105.0	115.0	111.0	105.0	113.0	94.8	94.5	12.4	106.0	108.0	2%	95.7	90.6	5%
Dissolved Strontium (Sr)	mg/L	-	-	-	0.820	0.064	0.237	0.112	0.021	0.161	0.483	0.532	1.61	0.89	1.67	1.68	1.69	1.06	1.040	1.230	0.713	1.680	1.670	1%	1.700	1.770	4%
Dissolved Sulphur (S)	mg/L	-	-	-	56.0	<1	2.0	<1	<3.0	<3.0	<0.50	0.8	<3.0	75	1	<1	3	9	<3.0	<3.0	8.8	1.2	1.0	19%	3.1	3.2	4%
Dissolved Tellurium (Te)	mg/L	-	-	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020		<0.00020	<0.00020	
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.00002	0.00002	0.00005	0.00002	<0.000020	0.000031	0.000018	0.000021	<0.00005	<0.00002	<0.00002	<0.00002	0.00004	<0.00002	<0.000020	0.000021	<0.000010	<0.000010	<0.000010		<0.000010	<0.000010	
Dissolved Thorium (Th)	mg/L	-	-	-	<0.0001	<0.0001	<0.0001	0.0003	<0.00010	0.00018	<0.00010	<0.00010		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	
Dissolved Tin (Sn)	mg/L	-	-	2.5	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	0.00245	0.00149	<0.005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	
Dissolved Titanium (Ti)	mg/L	2	-	-	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0030	0.00035	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030		<0.00030	<0.00030	
Dissolved Tungsten (W)	mg/L	-	-	0.003							<0.00010	<0.00010									<0.00010	<0.00010	<0.00010		<0.00010	<0.00010	
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.00352	0.00009	0.00046	0.00040	0.00006	0.00044	0.00247	0.00177	0.00063	0.00231	0.00210	0.00047	0.00051	0.00235	0.00070	0.00108	0.00065	0.00175	0.00166	5%	0.00221	0.00200	10%
Dissolved Vanadium (V)	mg/L	0.006	-	0.02	<0.001	<0.001	<0.001	0.002	<0.0010	0.0013	0.00141	0.0008	<0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050		<0.00050	0.00063	
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5 AO	3	0.005	0.007	0.007	0.12	0.0819	0.0132	0.0048	0.0124	<0.005	<0.004	0.032	<0.004	0.005	0.211	0.0953	0.0054	0.002	0.0079	0.0067	16%	0.0017	0.004	81%
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.0001	0.0007	0.0002	0.0012	0.0004	0.00099	0.000864	0.000481	<0.0005	<0.0001	0.0011	0.0002	0.0001	0.0002	0.00019	0.00023	<0.000060	0.000536	0.00048	11%	0.000496	0.000494	0%

Notes:

2018 data compared to updated criteria

A shaded value means exceeded the freshwater aquatic life criteria

A shaded value means reading exceeded the drinking water quality criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria.

A shaded value means exceeded more than one criteria.

A shaded value means reading had detection limit exceeding criteria.

A shaded value means reading exceeded the CSR drinking water quality criteria for sampling stations that trigger the Ground Water Quality Exceedances Response Plan

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum, Cadmium, and Iron (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 , last updated January 2019

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.

f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved $CaCO_3$

j. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2 - Stage 11 Amendments, last updated March 2019

Table 4. Wetland #4 Water Quality Data

Parameters	Units	BC MOE OC Criteria	BC MoE Guidelines (a) Freshwater Aquatic Life	BC MoE Guidelines (a) Drinking Water	Wetland 4
Date					13-Sep-18
Total Hardness	mg/L		-	-	390
Dissolved Hardness (CaCO3)	mg/L		-	-	
Alkalinity (Total as CaCO3)	mg/L		-	-	518
Total Organic Carbon (C)	mg/L		+/- 20% of background	4.0	52
Alkalinity (PP as CaCO3)	mg/L		-	-	
Bicarbonate (HCO3)	mg/L		-	-	
Carbonate (CO3)	mg/L		-	-	
Hydroxide (OH)	mg/L		-	-	
Chemical Oxygen Demand	mg/L		-	-	
BOD	mg/L		-	-	
Dissolved Sulphate (SO4)	mg/L		128-429 (e)	500, AO	17.2
Dissolved Chloride (Cl)	mg/L	3750	600	250, AO	286
Total Kjeldahl Nitrogen	mg/L	60	-	-	
Ammonia (N)	mg/L	30	0.681-28.7 (d)	-	8.61
Nitrate plus Nitrite (N)	mg/L		-	-	0.186
Nitrite (N)	mg/L		0.06 -0.6 (c)	1.0	0.114
Nitrate (N)	mg/L		32.8	10 MAC	0.072
Conductivity	uS/cm		-	-	
pH	pH Units	6.5 - 8.5	6.5 - 9.0	7.0-10.5	7.9
TSS	mg/L		25 mg/L (background 25-250 mg/l)) (i)	<500, AO	
Dissolved Metals					
Dissolved Aluminum (Al)	mg/L		0.023-0.1 (b,c)	9.5	0.0185
Dissolved Antimony (Sb)	mg/L		0.009	0.006	0.00096
Dissolved Arsenic (As)	mg/L		0.005	0.01 MAC	0.0221
Dissolved Barium (Ba)	mg/L		1	1.0	0.895
Dissolved Beryllium (Be)	mg/L		0.00013	-	<0.00010
Dissolved Bismuth (Bi)	mg/L		-	-	<0.000050
Dissolved Boron (B)	mg/L		1.20	5.0, MAC	2.24
Dissolved Cadmium (Cd)	mg/L		0.000027 - 0.00280 (e)	0.005	0.000006
Dissolved Calcium (Ca)	mg/L		<4 sensitive to acid input	-	73.9
Dissolved Cesium (Cs)	mg/L		-	-	0.000062
Dissolved Chromium (Cr)	mg/L		0.001 (e, f)	0.05, MAC	0.00182
Dissolved Cobalt (Co)	mg/L		0.11	-	0.002
Dissolved Copper (Cu)	mg/L		0.0032-0.0396 (e)	1.0, AO	0.00031
Dissolved Iron (Fe)	mg/L		0.35	0.3, AO	0.263
Dissolved Lead (Pb)	mg/L		0.011-0.402 (e)	0.01	<0.000050
Dissolved Lithium (Li)	mg/L		0.008	-	<0.0010
Dissolved Magnesium (Mg)	mg/L		-	-	50
Dissolved Manganese (Mn)	mg/L		1.5	0.05, AO	2.12
Dissolved Mercury (Hg)	mg/L		0.0001, MAC	0.001	0.0000083
Dissolved Molybdenum (Mo)	mg/L		2	0.25	0.0028
Dissolved Nickel (Ni)	mg/L		0.025-0.15 (e)	-	0.018
Dissolved Phosphorus (P)	mg/L		0.005-0.015 (for lakes only)	0.01, AO	0.051
Dissolved Potassium (K)	mg/L		373-432	-	45.2
Dissolved Rubidium (Rb)	mg/L		-	-	0.00618
Dissolved Selenium (Se)	mg/L		0.002	0.01, MAC	0.00024
Dissolved Silicon (Si)	mg/L		-	-	6.66
Dissolved Silver (Ag)	mg/L		0.001-0.003 (e)	-	<0.000010
Dissolved Sodium (Na)	mg/L		-	<200, AO	248
Dissolved Strontium (Sr)	mg/L		-	-	0.9920
Dissolved Sulphur (S)	mg/L		-	-	8.52
Dissolved Tellurium (Te)	mg/L		-	-	<0.00020
Dissolved Thallium (Tl)	mg/L		0.0017	-	<0.000010
Dissolved Thorium (Th)	mg/L		-	-	<0.00010
Dissolved Tin (Sn)	mg/L		-	-	0.00018
Dissolved Titanium (Ti)	mg/L		2	-	<0.00090
Dissolved Tungsten (W)	mg/L		0.003	-	0.0002
Dissolved Uranium (U)	mg/L		0.3	0.02	0.000671
Dissolved Vanadium (V)	mg/L		0.006	-	0.0013
Dissolved Zinc (Zn)	mg/L		0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5 AO	0.0016
Dissolved Zirconium (Zr)	mg/L		-	-	0.000448
Total Metals					
Total Aluminum	mg/L		-	9.5	0.53
Total Antimony (Ab)	mg/L		0.270	0.006	0.00085
Total Arsenic (As)	mg/L		0.005	0.01 MAC	0.0278
Total Barium (Ba)	mg/L		1	1.0	0.953
Total Beryllium (Be)	mg/L		0.00013	-	<0.00010
Total Bismuth (Bi)	mg/L		-	-	<0.000050
Total Boron (B)	mg/L		1.2	5.0, MAC	2.42
Total Cadmium (Cd)	mg/L	0.1	0.000027 - 0.00280 (e)	0.005, MAC	0.00001
Total Calcium (Ca)	mg/L		<4 sensitive to acid input	-	69.2
Total Cesium (Cs)	mg/L		-	-	0.000085
Total Chromium (Cr)	mg/L		0.001 (f)	0.05, MAC	0.0022
Total Cobalt (Co)	mg/L		0.11	-	0.002
Total Copper (Cu)	mg/L		0.0032-0.0396 (e)	1.0, AO	0.00197
Total Iron (Fe)	mg/L	4.5	1	0.3, AO	2.17
Total Lead (Pb)	mg/L		0.011-0.402 (e)	0.01	0.00022
Total Lithium (Li)	mg/L		-	-	<0.0010
Total Magnesium (Mg)	mg/L		-	-	49.5
Total Manganese (Mn)	mg/L		0.8-3.4 (e)	0.05, AO	2.1
Total Mercury (Hg)	mg/L.		0.0001	0.001	0.000008
Total Molybdenum (Mo)	mg/L		2	0.25	0.00264
Total Nickel (Ni)	mg/L		0.025-0.15 (e)	-	0.0173
Total Phosphorus (P)	mg/L		0.005-0.015 (for lakes only)	0.01, AO	0.222
Total Potassium (K)	mg/L		-	-	38.8
Total Rubidium (Rb)	mg/L				0.00559
Total Selenium (Se)	mg/L		0.002	0.01, MAC	0.000223
Total Silicon (Si)	mg/L		-	-	7.31
Total Silver (Ag)	mg/L		0.0001-0.003 (e)	-	<0.000010
Total Sodium (Na)	mg/L		-	<200, AO	225
Total Strontium (Sr)	mg/L		-	-	0.867
Total Sulphur (S)	mg/L		-	-	8.54
Total Tellurium (Te)	mg/L			-	<0.00020
Total Thallium (Tl)	mg/L		0.0008	-	<0.000010
Total Thorium (Th)	mg/L		-	-	<0.00010
Total Tin (Sn)	mg/L		-	-	0.00017
Total Tungsten (W)	mg/L				0.00807
Total Titanium (Ti)	mg/L		-	-	0.00014
Total Uranium (U)	mg/L		0.0085	0.02	0.000631
Total Vanadium (V)	mg/L		-	-	0.004
Total Zinc (Zn)	mg/L	75	0.033-0.34 (e)	5.0, AO	0.0049
Total Zirconium (Zr)	mg/L		-	-	0.000425

Notes:

A shaded value means exceeded the freshwater aquatic life criteria

A shaded value means reading exceeded the drinking water quality criteria.

A shaded value means exceeded both the aquatic life and drinking water criteria.

A shaded value means exceeded the OC discharge criteria.

A shaded value means reading had detection limit exceeding criteria.

(AO - Aesthetic Objective)

1. BC Environment Approved and Working Criteria for Water Quality, last updated March 2018
2. All criteria limits for BCWQG - based on Total Metal Concentration except Aluminum and Cadmium (Dissolved)
3. BC Environment Drinking Water Guidelines and Canadian Drinking Water Standards
4. BC Contaminated Sites Regulation for Drinking Water (BC-CSR-DW) Schedule 3.2, last updated January 2019

c. Limit dependent on chloride concentration. (MAC - Maximum Acceptable Concentration)

d. Limit pH and temperature dependent.

e. Limit dependant on hardness. Range given for hardness 50 to 1,000 mg/L.

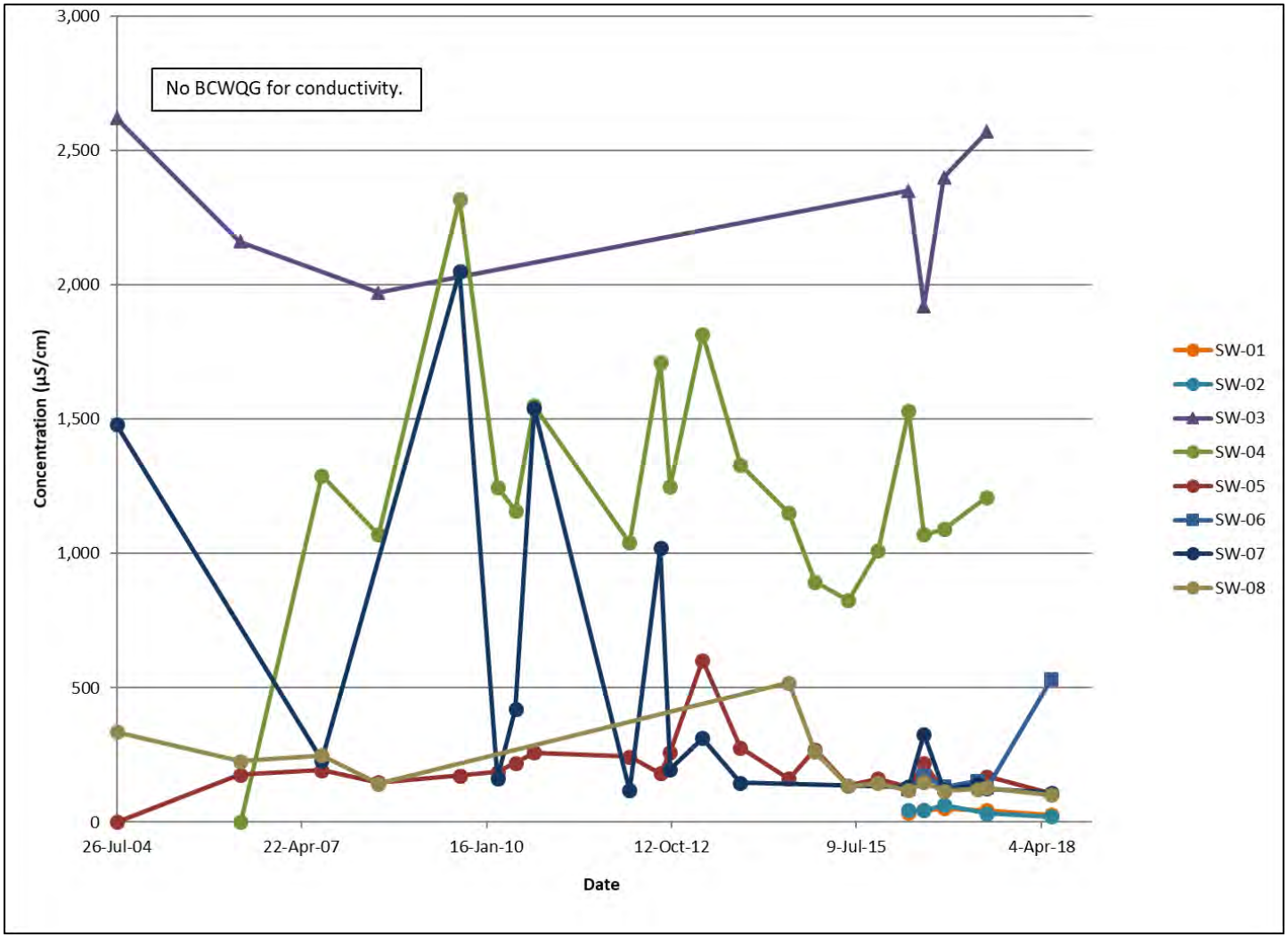
f. Limit for chromium (IV)

g. Limit for total, no dissolved concentrations

h.copper (mg/L) =(0.094* Hardness)/1000

i. Limit for hardness based on total dissolved CaCO3

Appendix C: Charts



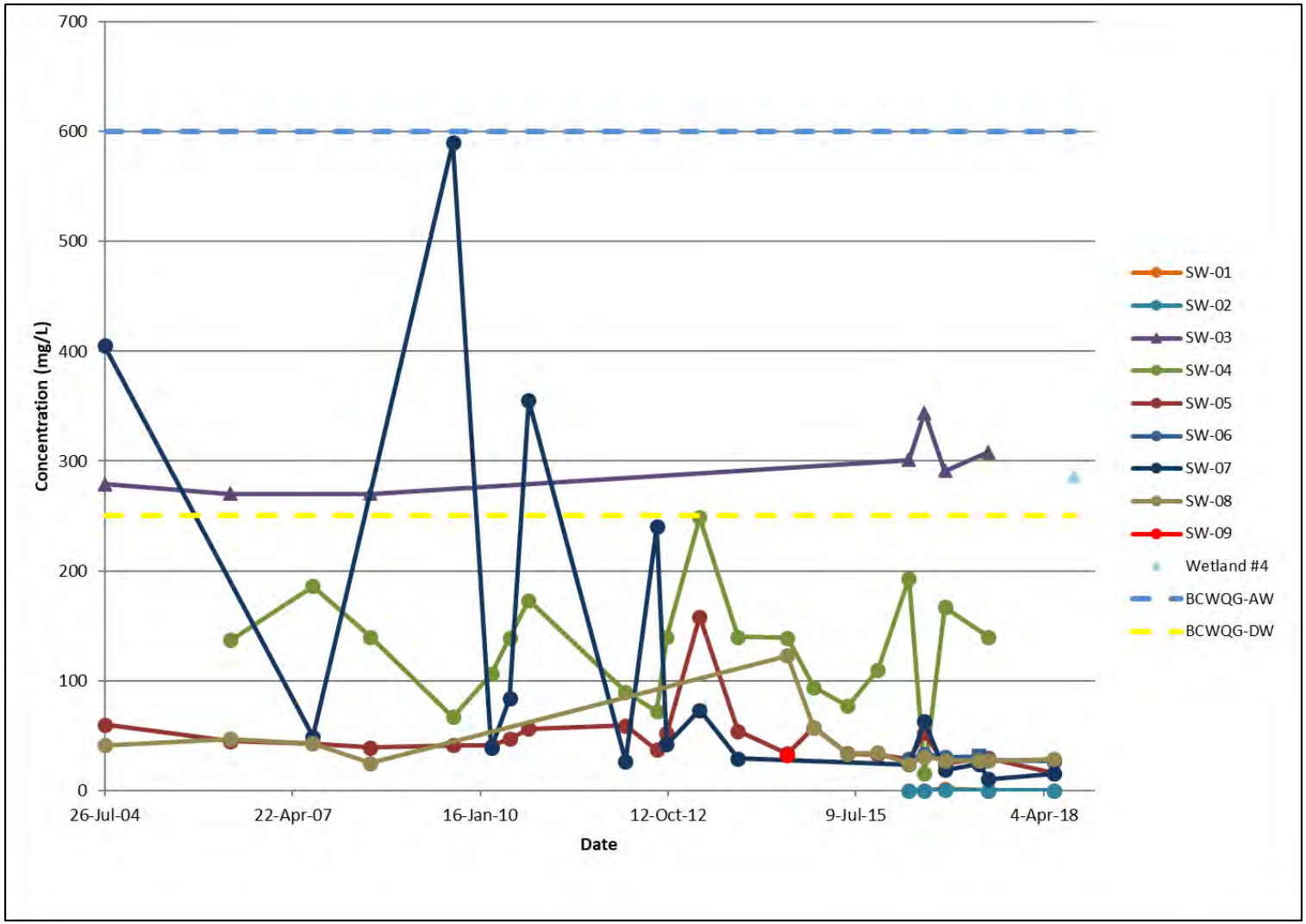
SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

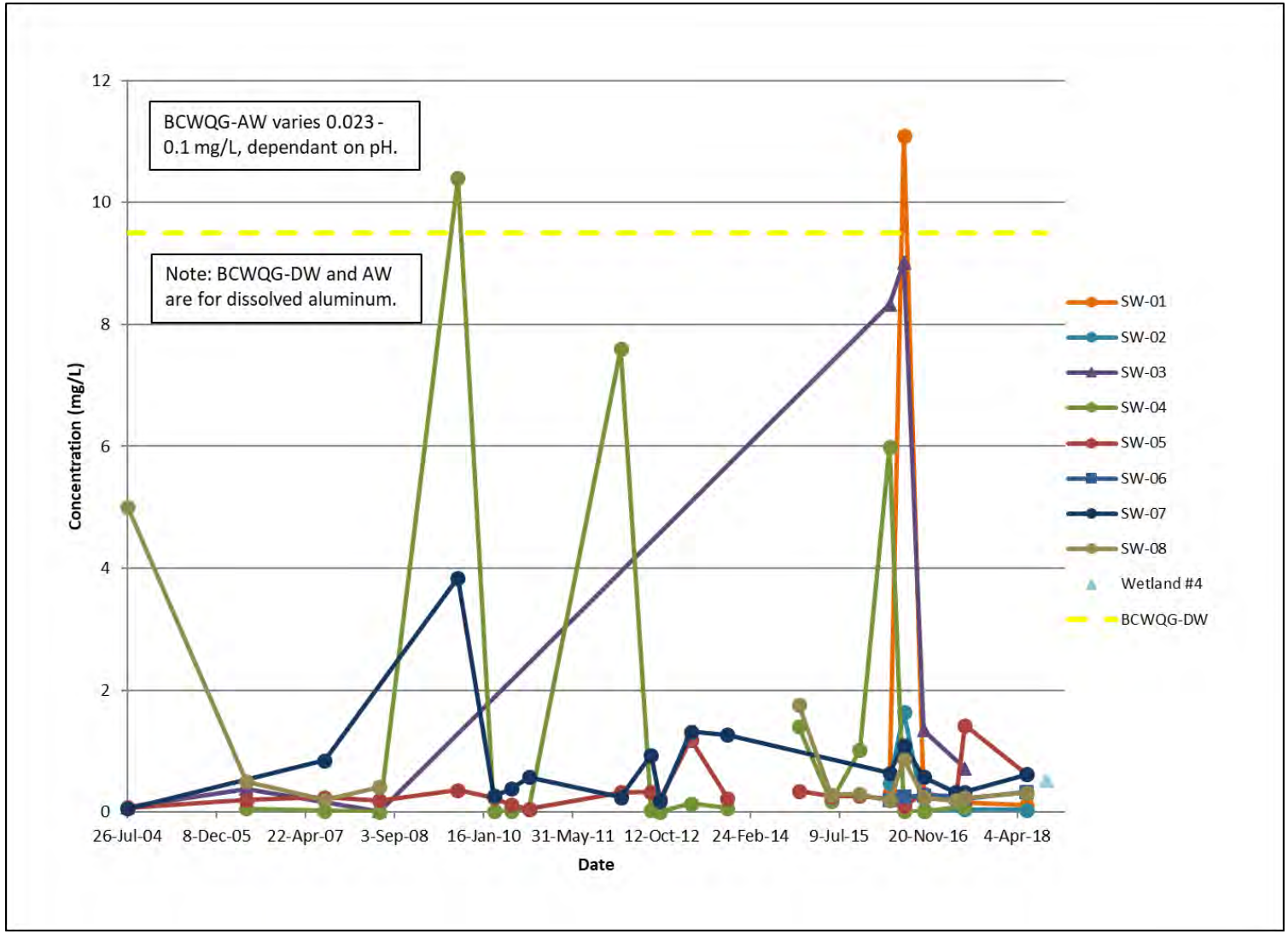
PROJECT: Hazelton WMF Annual Monitoring Report

TITLE: Surface Water Conductivity

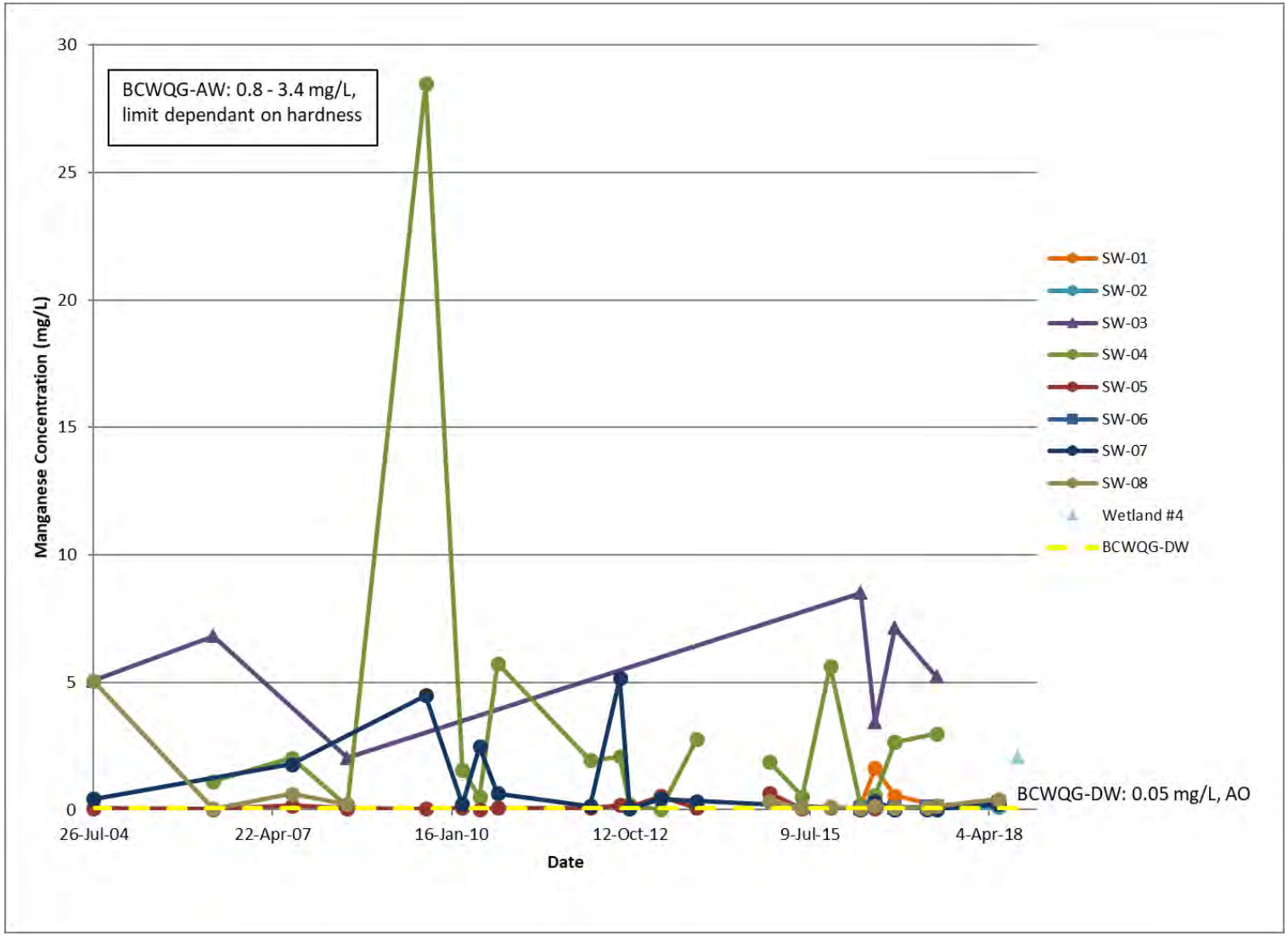
SCALE:	DATE:	PROJECT NO:
N/A	2019/02/22 yyyy/mm/dd	PRJ19009
DESIGNED	AM	DRAWING NO:
DRAWN	AM	Chart 1
CHECKED	DK	



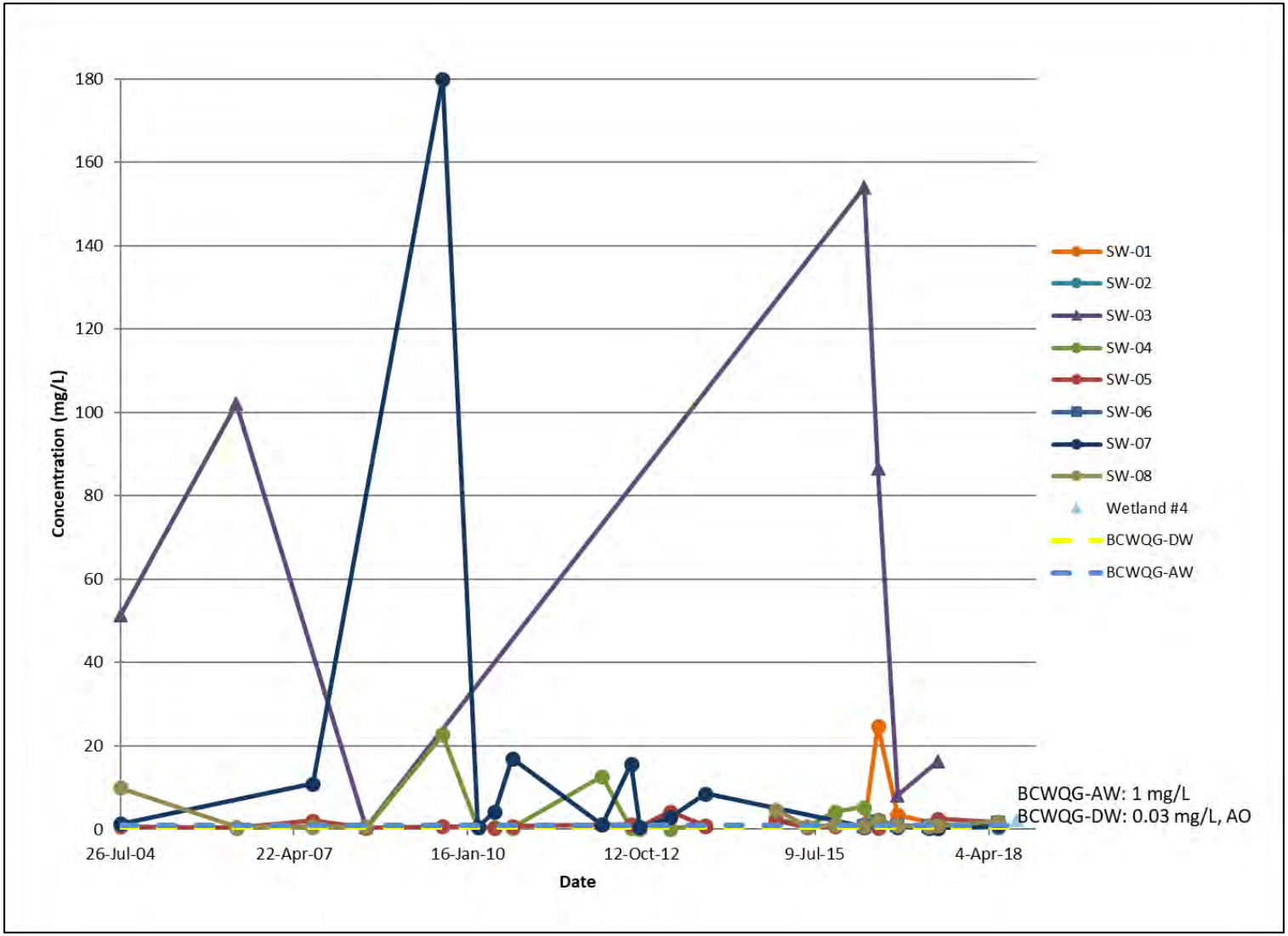
Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Surface Water Chloride	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: Chart 2



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Surface Water Total Aluminum	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: Chart 3



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Surface Water Total Manganese	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: Chart 4



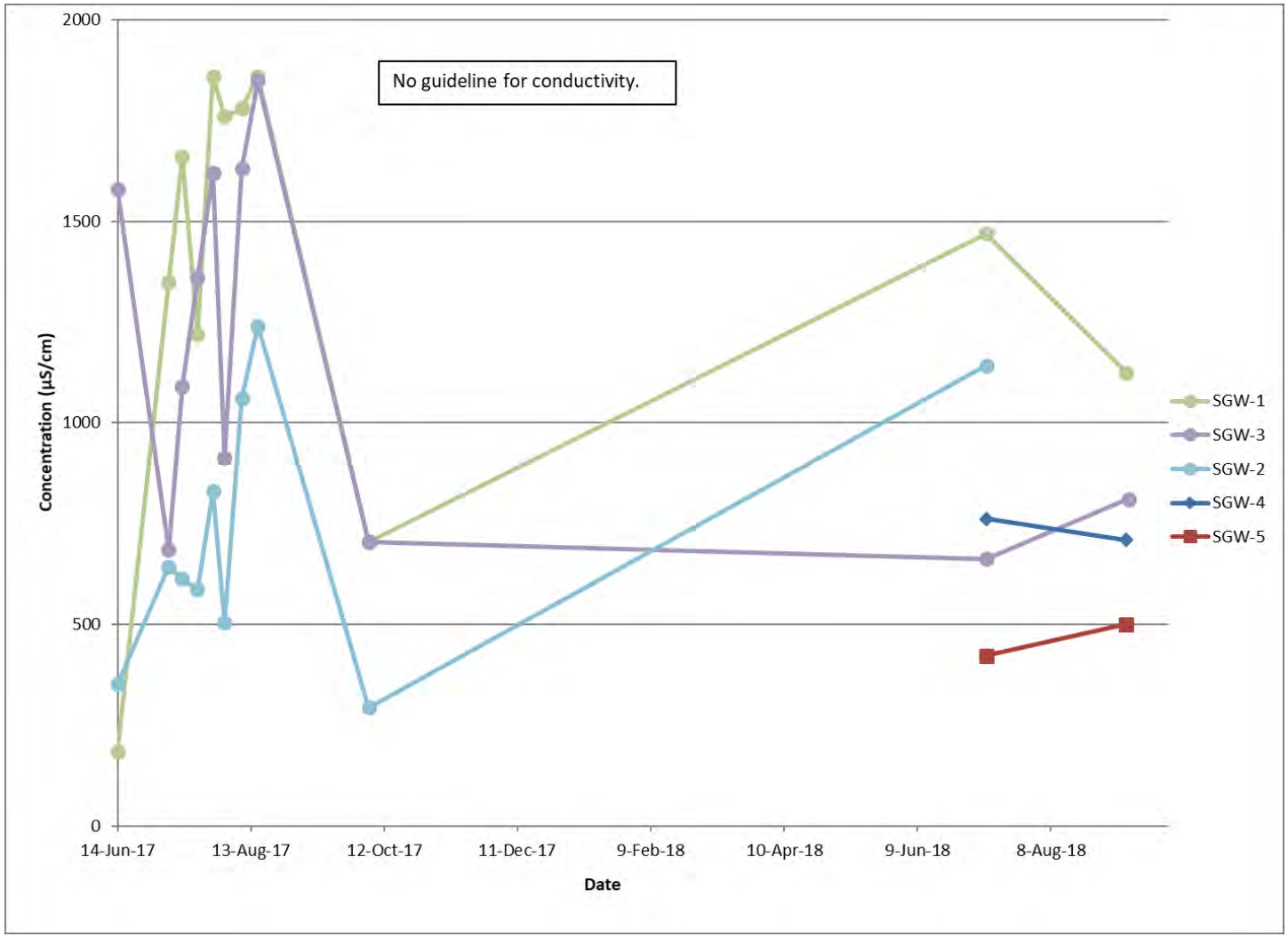
SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

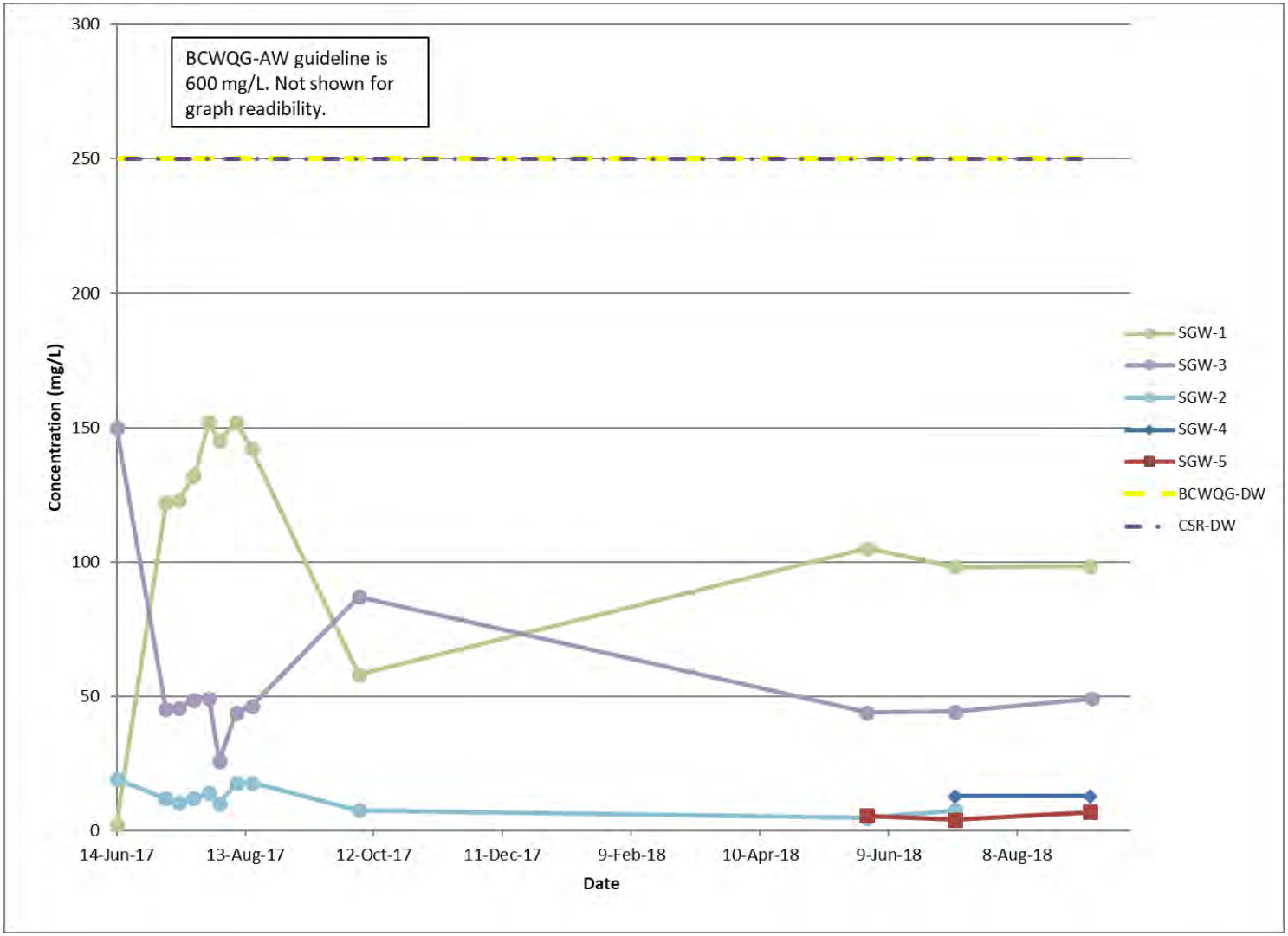
PROJECT: **Hazelton WMF Annual Monitoring Report**

TITLE: **Surface Water Total Iron**

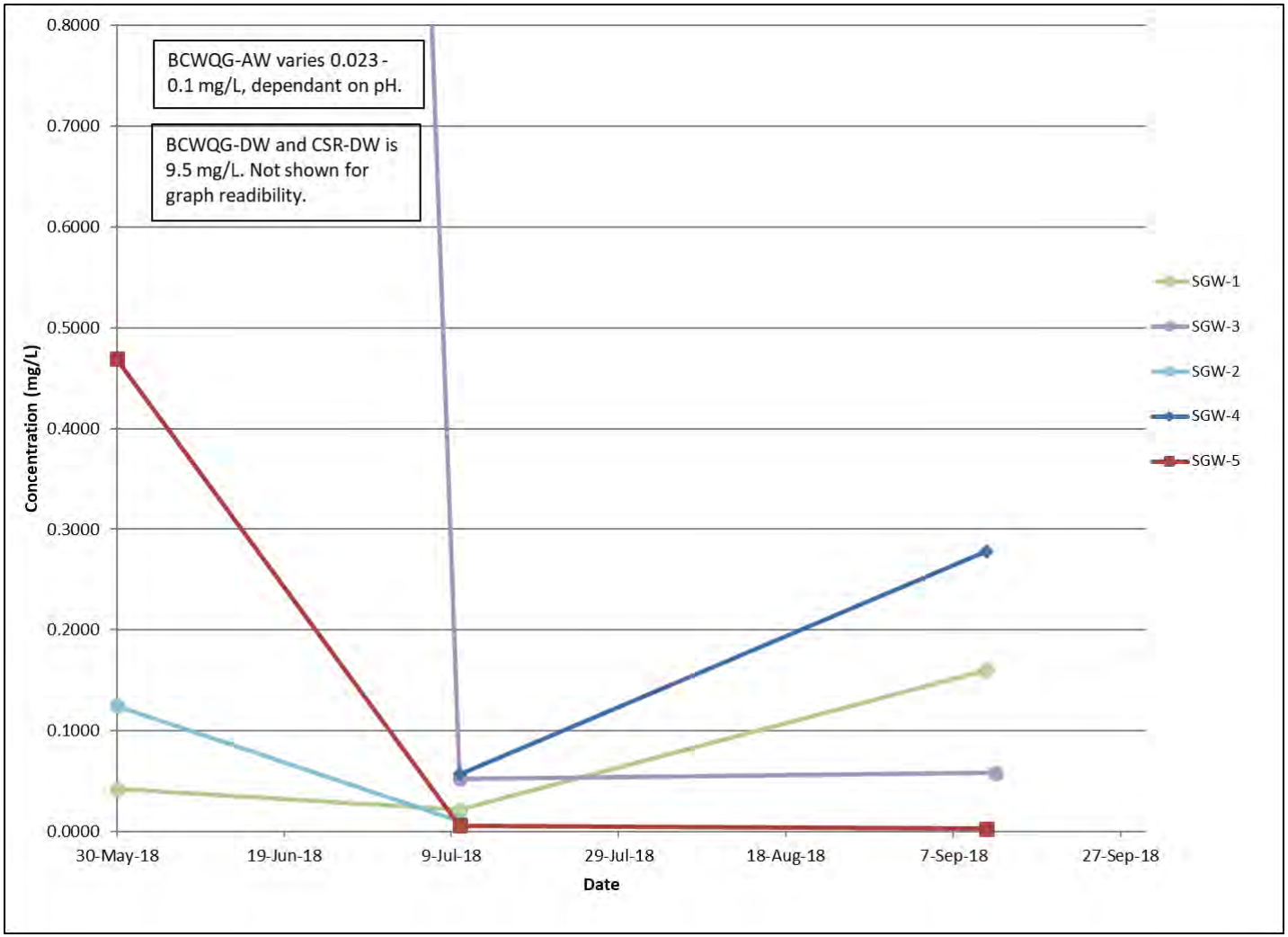
SCALE:	DATE:	PROJECT NO:
N/A	2019/02/22 yyyy/mm/dd	PRJ19009
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 5**
CHECKED	DK	



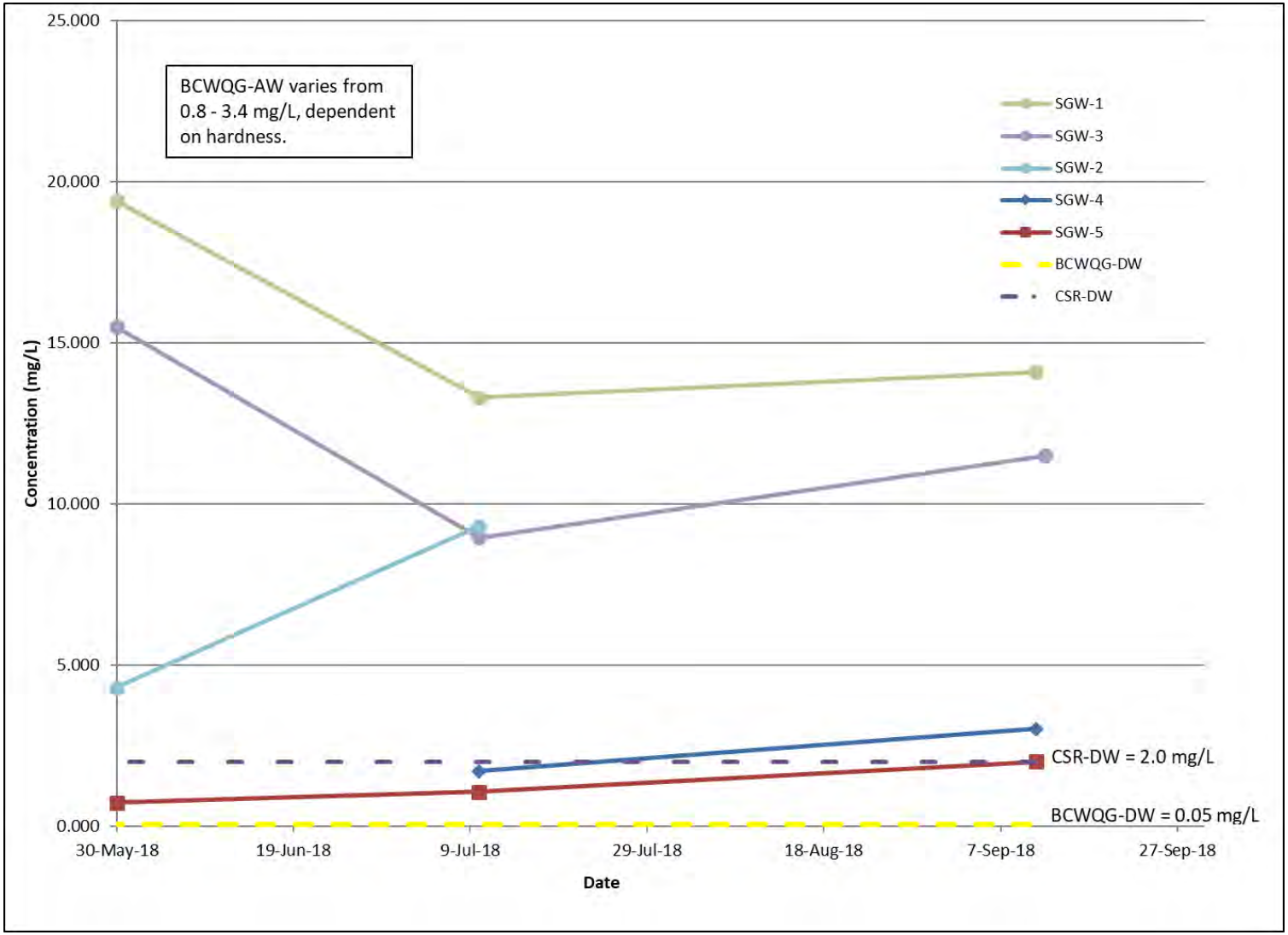
Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Conductivity	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: Chart 6



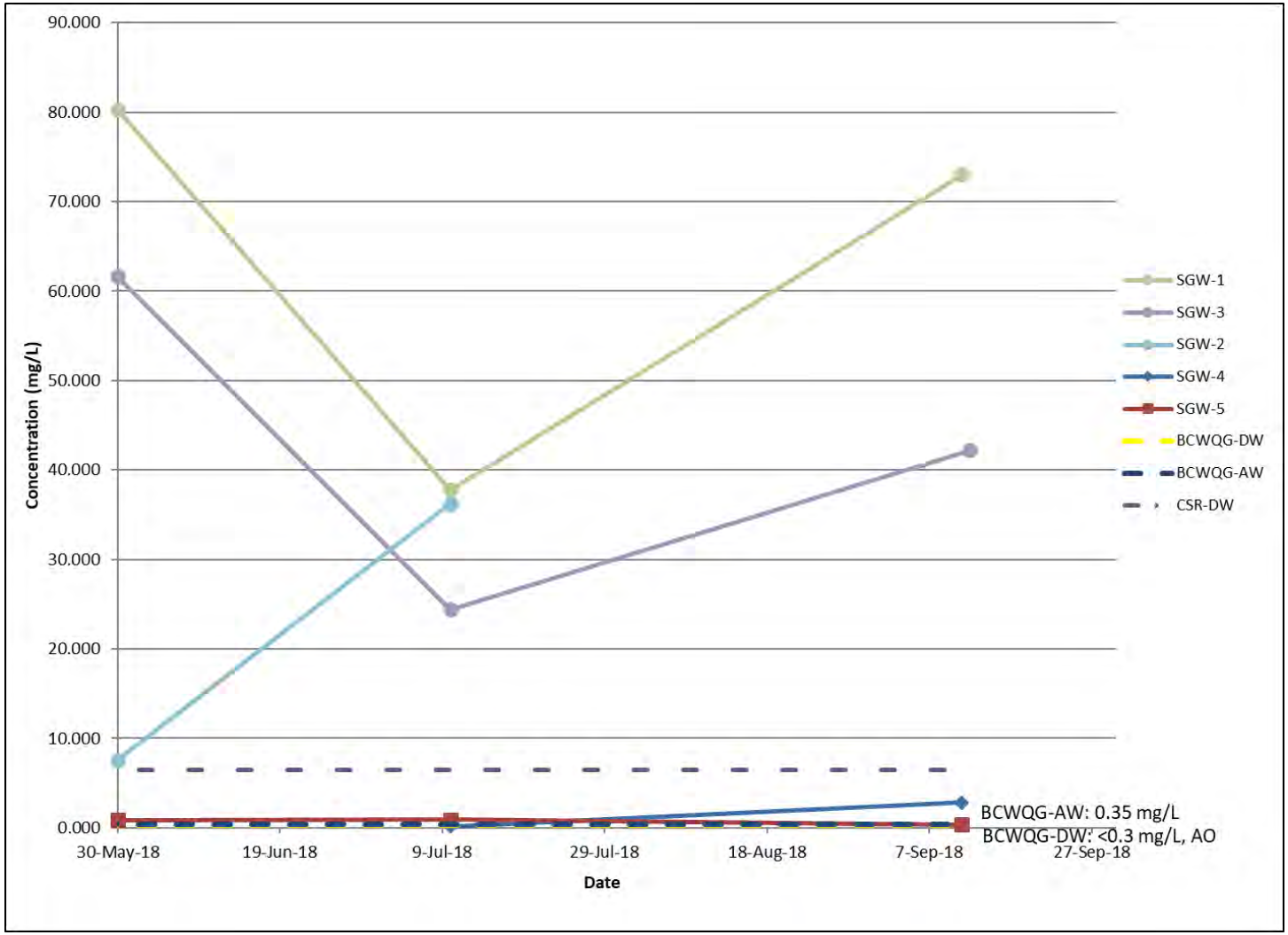
Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Chloride	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED AM; DRAWN AM; CHECKED DK; DRAWING NO: Chart 7



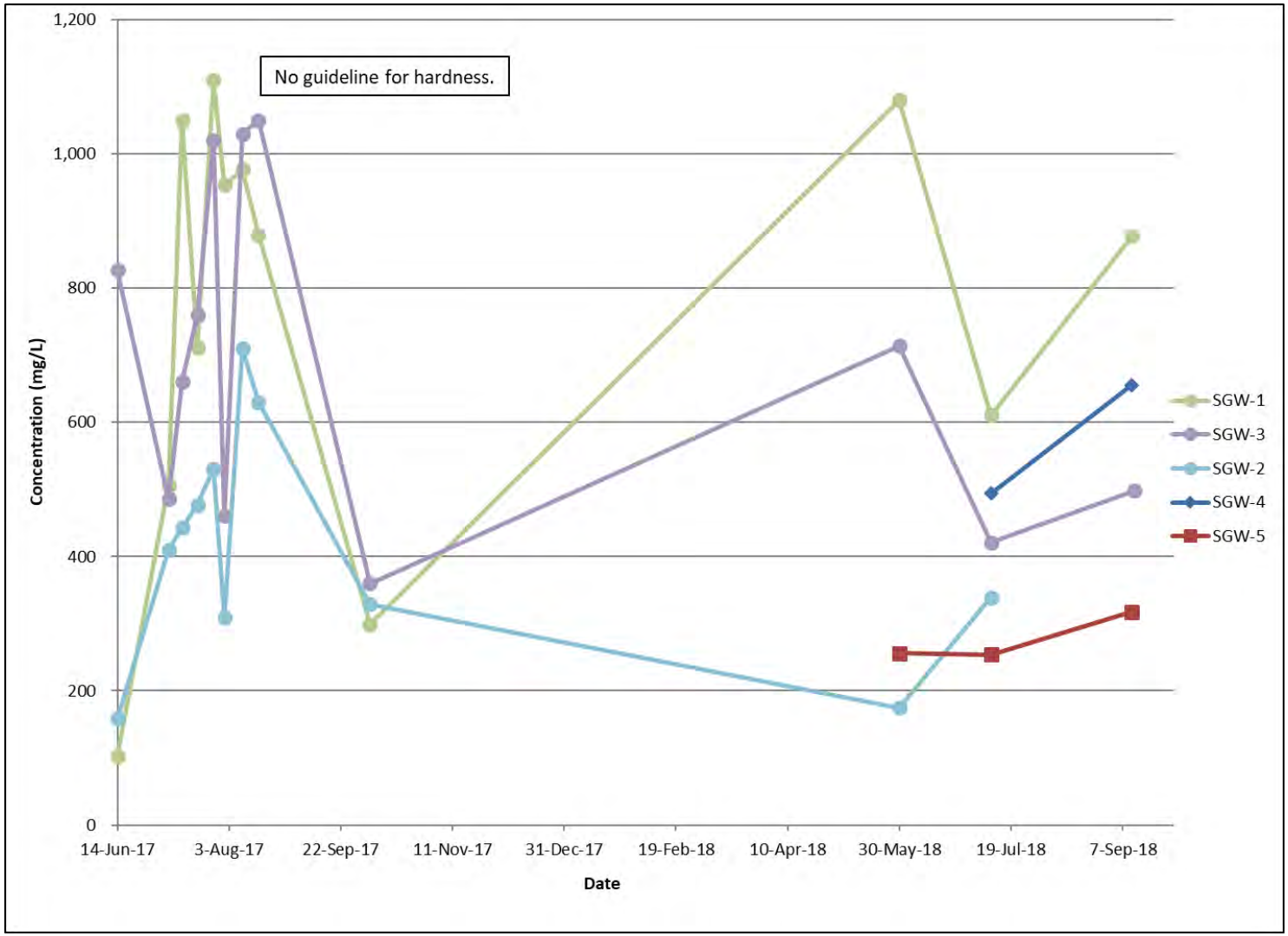
Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Dissolved Aluminum	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED AM; DRAWN AM; CHECKED DK; DRAWING NO: Chart 8



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Dissolved Manganese	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED AM; DRAWN AM; CHECKED DK; DRAWING NO: Chart 9



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Dissolved Iron	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: Chart 10



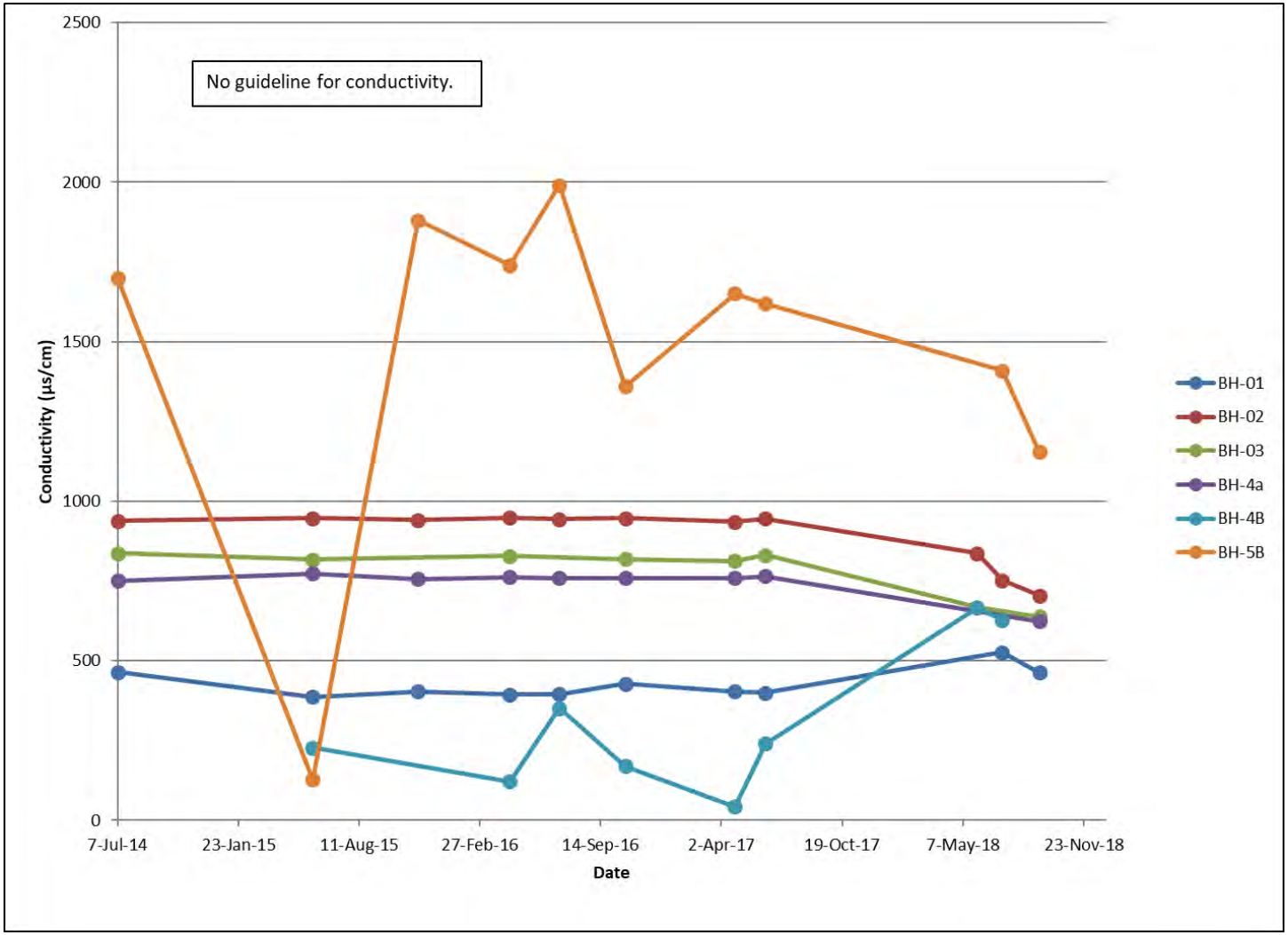
Sperling Hansen Associates

Regional District of Kitimat-Stikine

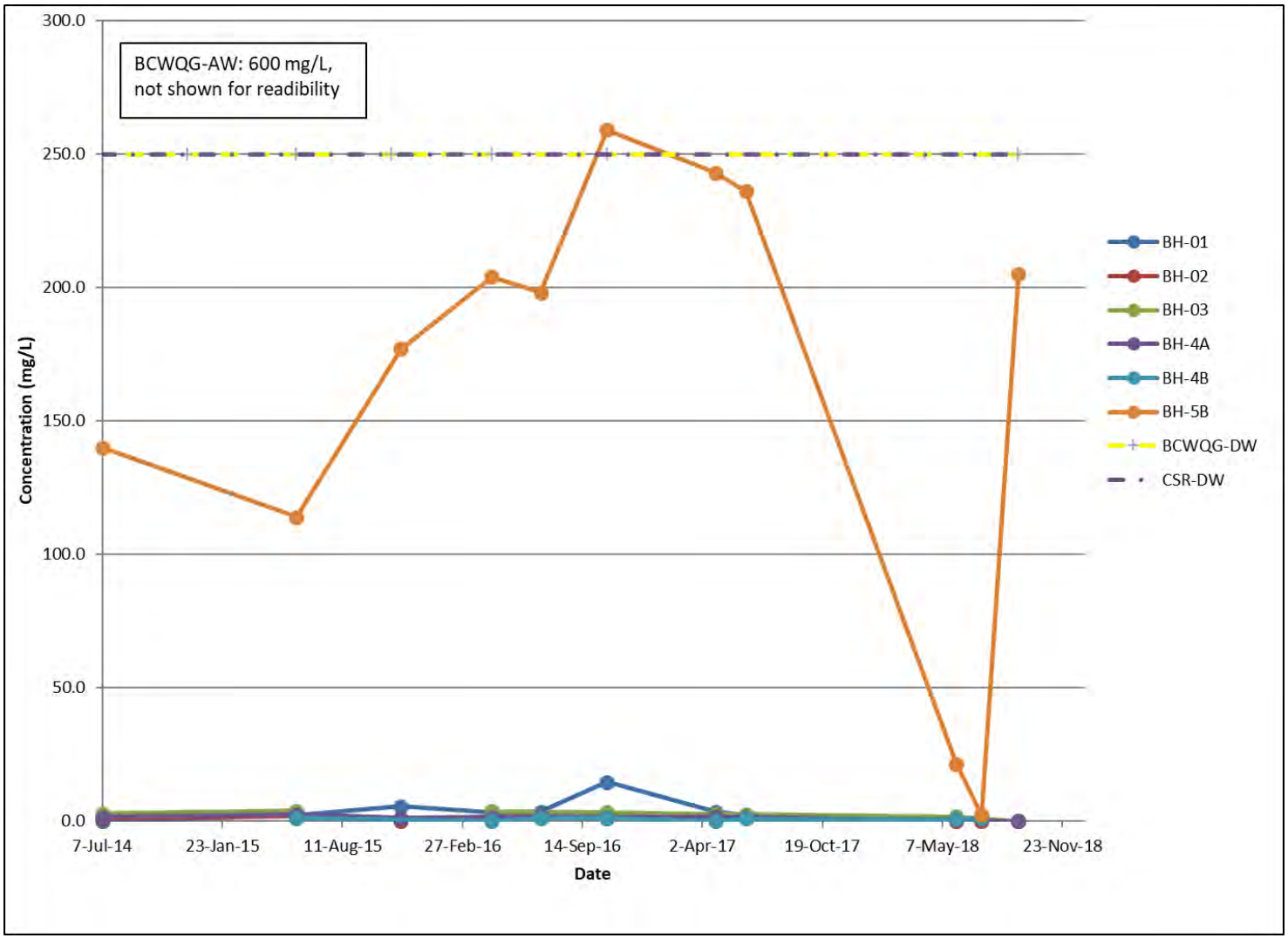
PROJECT: **Hazelton WMF Annual Monitoring Report**

TITLE: **Shallow Groundwater Hardness**

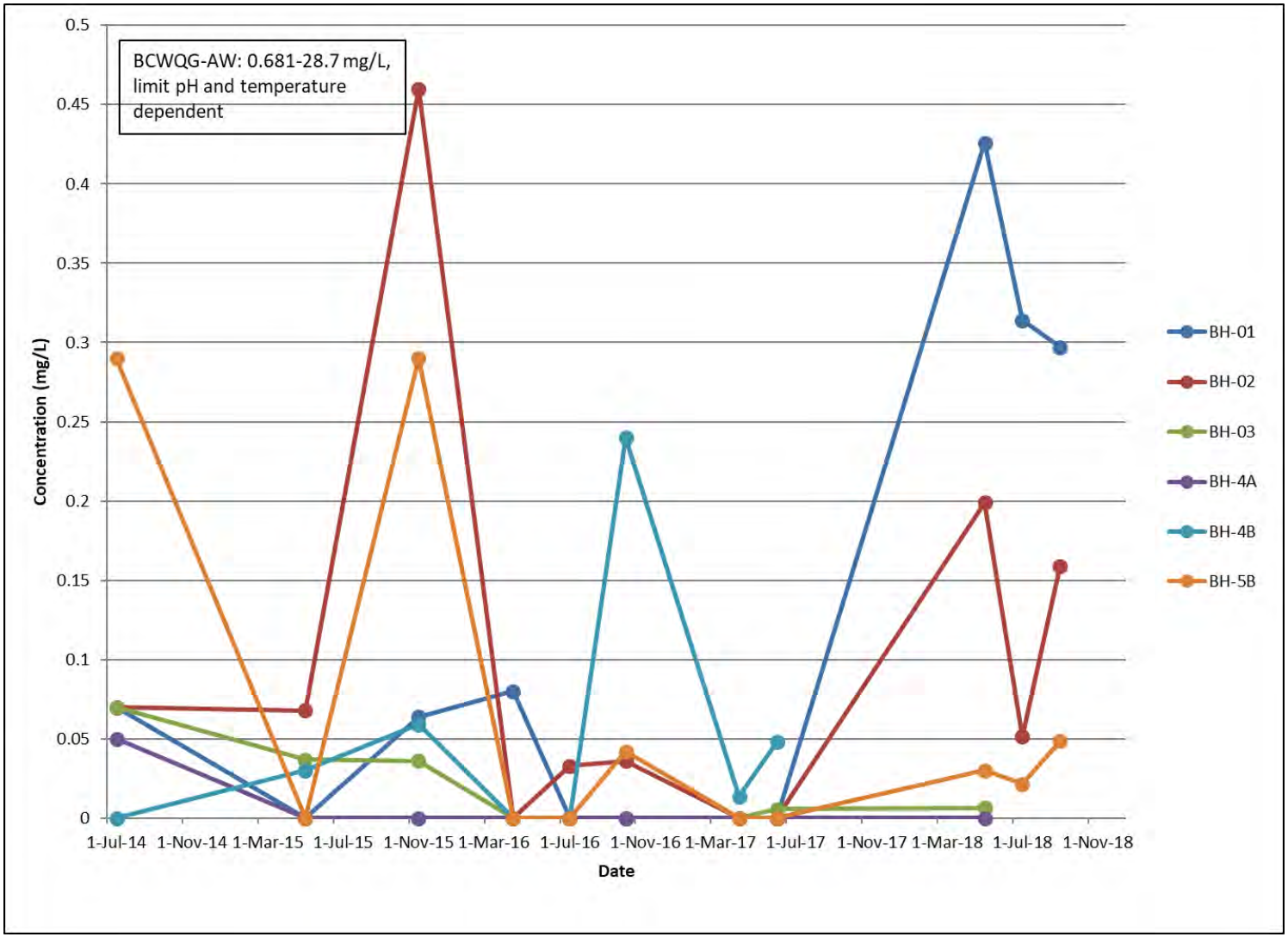
SCALE:	DATE:	PROJECT NO:
N/A	2019/02/22 yyyy/mm/dd	PRJ19009
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 11**
CHECKED	DK	



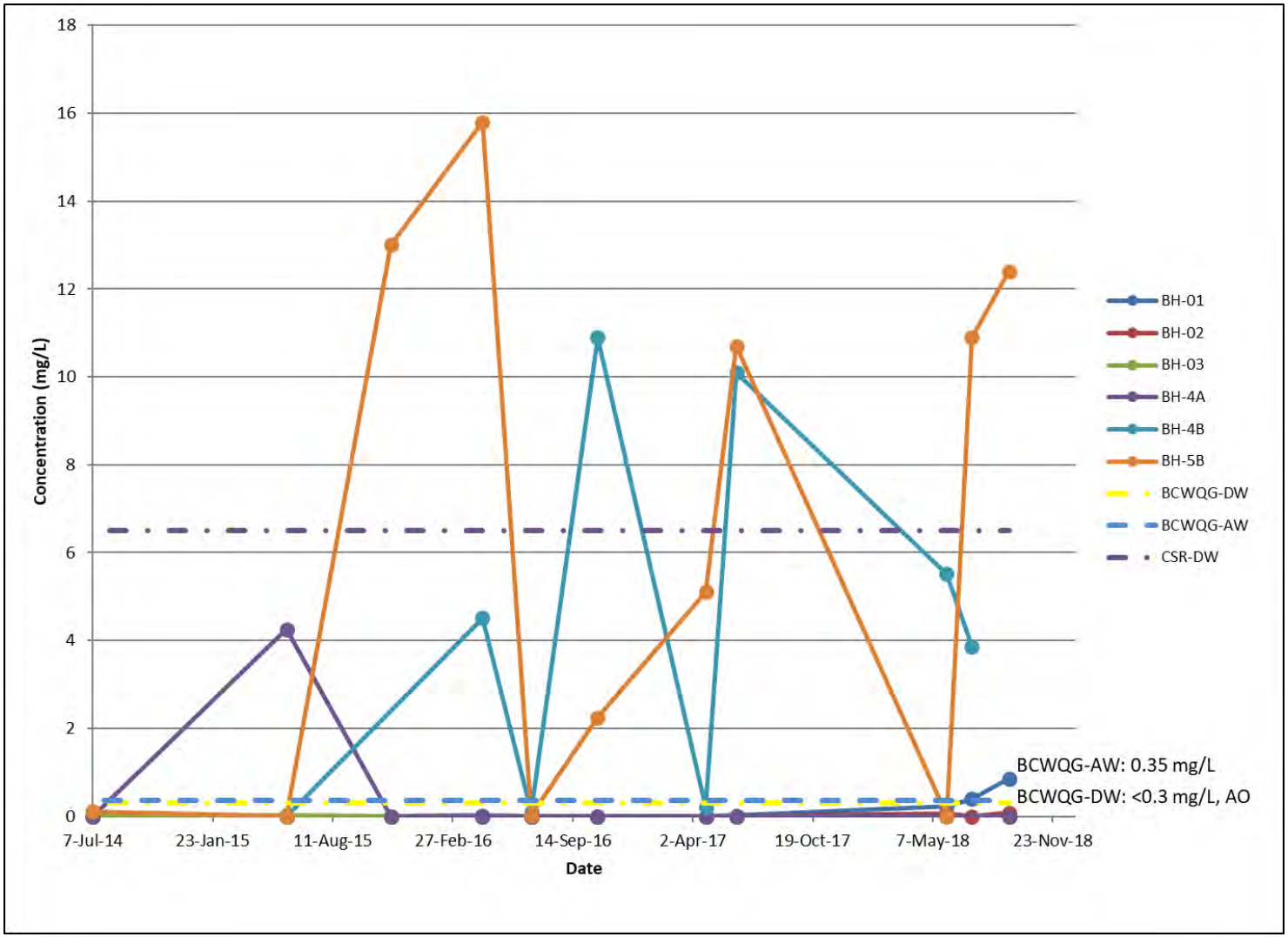
Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Groundwater Conductivity	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED AM; DRAWN AM; CHECKED DK; DRAWING NO: Chart 12



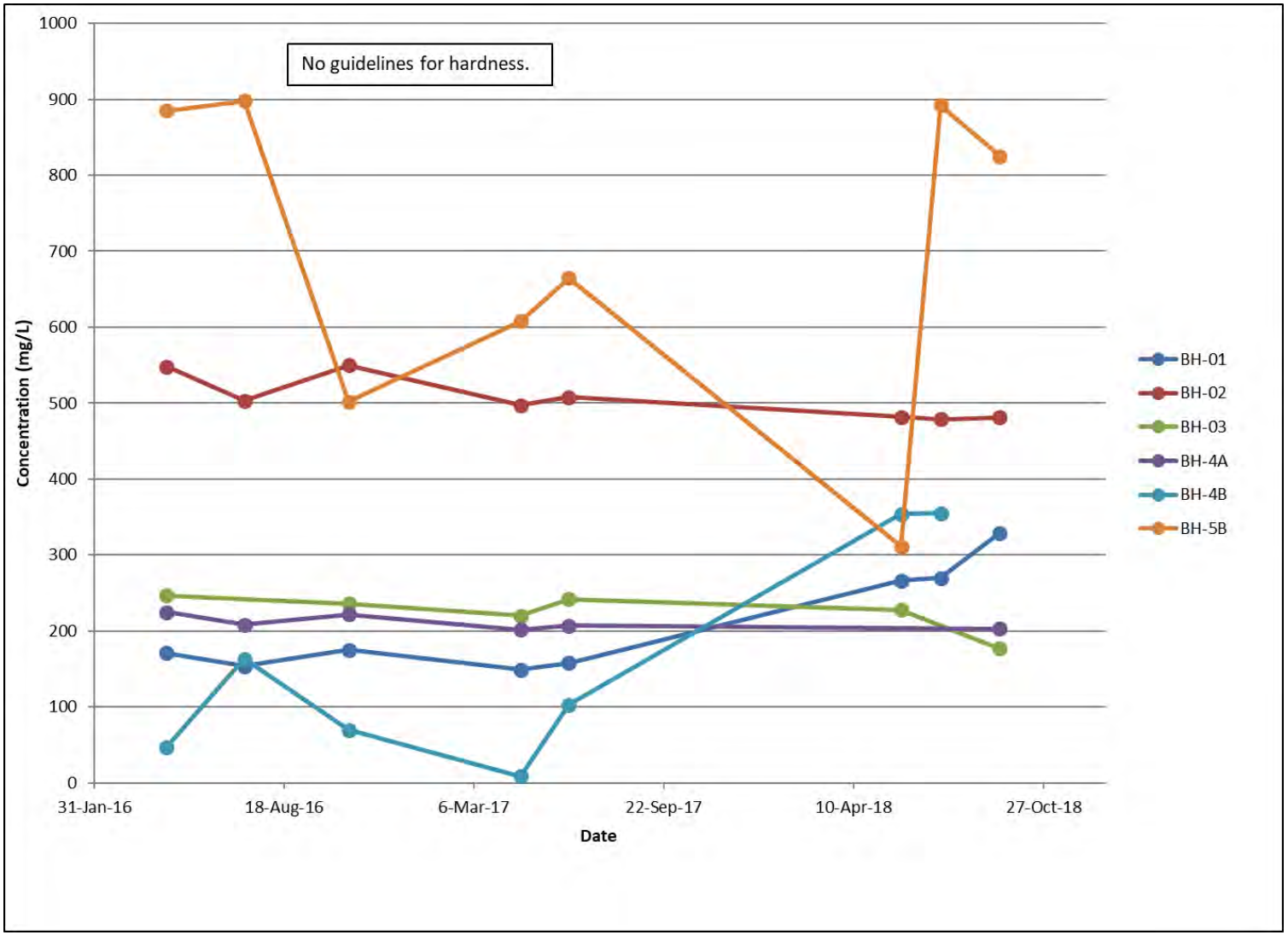
Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Groundwater Chloride	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED AM; DRAWN AM; CHECKED DK; DRAWING NO: Chart 13



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Groundwater Ammonia	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: Chart 14



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Groundwater Dissolved Iron	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: Chart 15



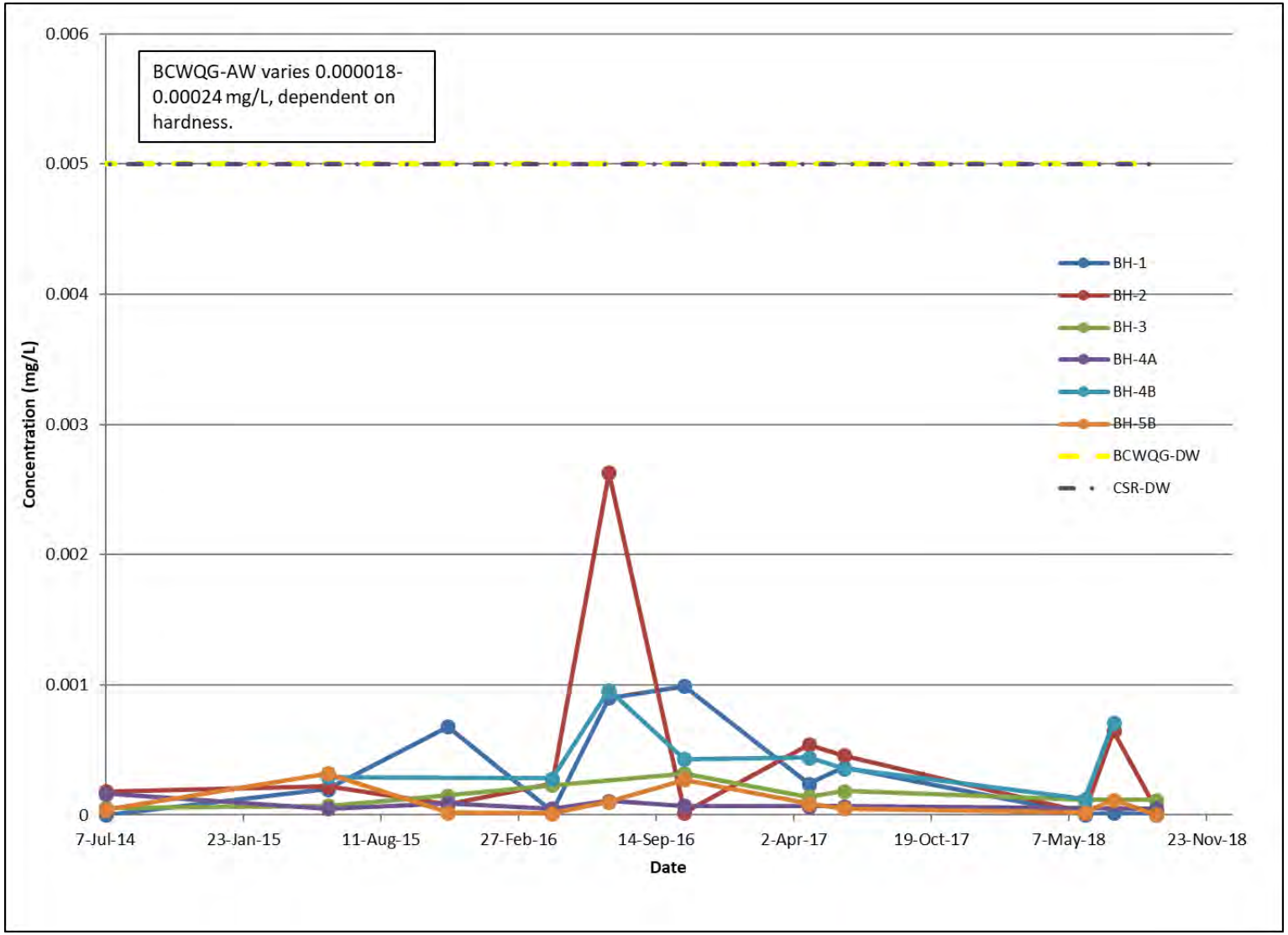
Sperling Hansen Associates

Regional District of Kitimat-Stikine

PROJECT: Hazelton WMF Annual Monitoring Report

TITLE: Groundwater Hardness

SCALE:	DATE:	PROJECT NO:
N/A	2019/02/22 yyyy/mm/dd	PRJ19009
DESIGNED	AM	DRAWING NO:
DRAWN	AM	Chart 16
CHECKED	DK	



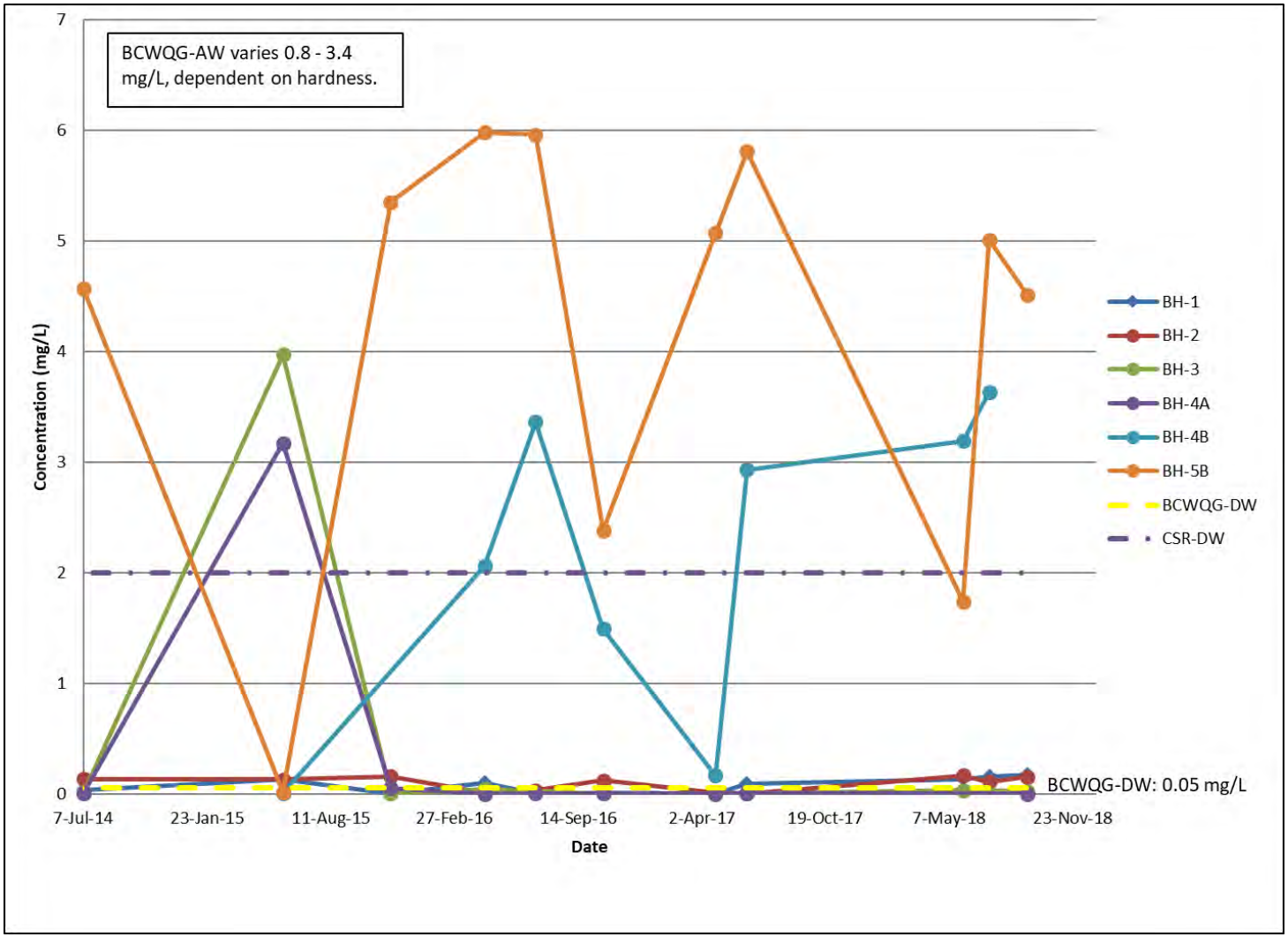
Sperling Hansen Associates

Regional District of Kitimat-Stikine

PROJECT: **Hazelton WMF Annual Monitoring Report**

TITLE: **Groundwater Dissolved Cadmium**

SCALE:	DATE:	PROJECT NO:
N/A	2019/02/22 yyyy/mm/dd	PRJ19009
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 17**
CHECKED	DK	



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Groundwater Dissolved Manganese	SCALE: N/A; DATE: 2019/02/22 yyyy/mm/dd; PROJECT NO: PRJ19009; DESIGNED AM; DRAWN AM; CHECKED DK; DRAWING NO: Chart 18

Appendix D: Operational Certificate MR-17226 for the Hazelton Regional Landfill (amended Feb 7, 2018)

February 8, 2018

Tracking Number: 333329
Authorization Number: 17226

REGISTERED MAIL

REGIONAL DISTRICT OF KITIMAT-STIKINE
300 4545 LAZELLE AVENUE
TERRACE, BC
V8G 4E1

Dear Operational Certificate Holder:

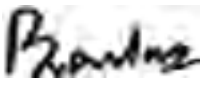
Enclosed is Operational Certificate 17226 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate.

This operational certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority rests with the operational certificate holder. It is also the responsibility of the operational certificate holder to ensure that all activities conducted under this authorization are carried out with regard to the rights of third parties, and comply with other applicable legislation that may be in force.

This decision may be appealed to the Environmental Appeal Board in accordance with Part 8 of the *Environmental Management Act*. An appeal must be delivered within 30 days from the date that notice of this decision is given. For further information, please contact the Environmental Appeal Board at (250) 387-3464.

Administration of this operational certificate will be carried out by staff from the Environmental Protection Division's Regional Operations Branch. Plans, data, reports, non-compliance notifications and non-compliance reports pertinent to the permit are to be submitted to the Environmental Protection Division via email or other electronic means as directed in the following web link: https://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions

Yours truly,



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Authorizations - North Region

Environmental Protection Division
Ministry of Environment
3726 Alfred Avenue
Smithers, BC, V0J 2N0
Authorizations - North Region
Telephone: (250) 847-7260
Facsimile: (250) 847-7591

Enclosure

cc: Environment Canada

MINISTRY OF ENVIRONMENT

OPERATIONAL CERTIFICATE

17226

for the

HAZELTON REGIONAL LANDFILL

Under the Provisions of the Environmental Management Act and in accordance with the Regional District of Kitimat-Stikine's Solid Waste Management Plan, the

REGIONAL DISTRICT OF KITIMAT-STIKINE

Suite 300 – 4545 Lazelle Avenue

Terrace, British Columbia

V8G 4E1

is authorized to store, handle, treat and discharge municipal waste from Hazelton, Kitwanga and surrounding areas at the Hazelton Regional Landfill subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

1. LOCATION OF LANDFILL PROPERTY

The location of the property where discharges are authorized to occur is the SW ¼ Part of District Lot 1574, Cassiar Land District.

2. DESIGN, OPERATIONS and CLOSURE PLAN

The landfill and associated works must be designed by qualified professionals [such as engineer(s) and/or geoscientist(s)] registered in the Province of British Columbia who have expertise in the field of landfill design. These details must be incorporated into a "Design, Operations, and Closure Plan" (DOCP) and must be reviewed, updated and submitted to the Director for approval by March 9, 2018.

Date issued: May 30, 2013
Date amended: February 7, 2018
(most recent)

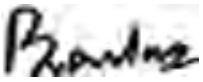
Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Authorizations - North Region

The approved DOCP must subsequently be reviewed, updated and submitted to the Director for approval every 5 years thereafter. The landfill must be operated at all times in accordance with the approved DOCP.

The DOCP must include, at a minimum:

- extent and location of each disposal area, clearly shown on a site plan;
- quantities of wastes (solid, liquid and leachate) discharged;
- works associated with each disposal area;
- any proposed restrictions on salvaging by the public;
- scaled site plan accurately showing the legal survey, the engineered final design footprint, and final design contours;
- proposed litter control measures on-site and at neighbouring properties;
- proposed measures to meet the Landfill Gas Regulation and landfill gas health and safety requirements;
- proposed surface and groundwater management plan including an assessment of the adequacy of the number and location of groundwater monitoring wells;
- proposed preliminary water quality exceedance response plans;
- proposed maximum lift height of compacted waste;
- proposed leachate system design and management plan, including the priority of and circumstances dictating when effluent is sent to the phytoremediation stand and when it is sent to the infiltration trench;
- proposed maximum allowable surface area of exposed waste;
- proposed maximum volume of waste in a cell at any given time;
- proposed method, coverage (area) and timing of progressive closure;

Date issued: May 30, 2013
Date amended: February 7, 2018
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Authorizations - North Region

- design, construction and operation of the liquid waste (septic tank pumpage) disposal lagoon(s);
- signage and fencing at and around the liquid waste disposal lagoon(s);
- nature/volume of wastes to be discharged at the liquid waste lagoon(s);
- location of the designated wood residue open burning area;
- groundwater model that, in relation to the final landfill design:
    - (i) is developed by a qualified professional (experienced in groundwater hydrogeology);
    - (ii) outlines the groundwater regime including flow directions, estimated rates, inferred leachate plume, etc. at and in the surrounding area of the landfill site influenced by landfill leachate;
    - (iii) appropriately assesses the correct number and location of wells such that groundwater can be intercepted and assessed to determine groundwater quality and flow direction;
    - (iv) estimates the loadings of Potential Contaminants of Concern (PCOC)'s from landfill leachate to the environment. The groundwater model and PCOC loading estimates must be updated with each review of the DOCP.
- maximum allowable slopes of the various disposal areas;
- engineered final design footprint delineating the maximum extent of solid waste disposal allowable at the facility horizontally and vertically;
- engineered excavation grade for municipal solid waste;
- landfill design waste density;

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- proposed notification schedule for closure;
- proposed closure plan including:

  i) intended end-use of the landfill property after closure;

  ii) anticipated total waste volume, tonnage, and life remaining of the landfill;

  iii) a topographic plan showing the final elevation contours of the landfill and surface water diversion and drainage controls;

  iv) design of the final cover suited to the intended end-use of the site, including the thickness and permeability of barrier layers and drainage layers, and information on topsoil, vegetative cover and erosion prevention controls;

  v) procedures for notifying the public about the closure and about alternative waste disposal facilities;

  vi) nuisance wildlife control procedures;

  vii) a comprehensive long term monitoring plan by a qualified professional, including groundwater monitoring, surface water monitoring, aquatic effects monitoring (including acute and chronic toxicity testing if determined to be necessary), landfill gas monitoring, leachate monitoring, final cover monitoring, and erosion and settlement monitoring, for a minimum post-closure period of 25 years;

  viii) design, if necessary, for the collection, storage and treatment/use of landfill gas for a minimum 25 year post-closure period

  ix) plan for the operation of any required pollution abatement engineering works such as leachate collection and treatment systems, for a minimum post-closure period of 25 years; and

x) an estimated cost, updated every five years, to carry out closure and post-closure activities for a minimum period of 25 years.

3. DISCHARGE OF MUNICIPAL SOLID WASTE

Municipal solid waste is authorized to be discharged to ground in accordance with the approved DOCP. The site reference number for this discharge is E288569.

4. STORAGE AND HANDLING OF WASTES FOR SALVAGE AND RECYCLING

Wastes are authorized to be stored and handled for salvage and recycling in accordance with the approved DOCP.

5. DISCHARGE OF MUNICIPAL LIQUID WASTE

Municipal liquid waste is authorized to be discharged to an appropriate discharge facility in accordance with the approved DOCP. The site reference number for this discharge is E288571.

6. DISCHARGE OF TREATED EFFLUENT TO PHYTOREMEDIATION STAND

Treated effluent is authorized to be discharged to the Phytoremediation Stand in accordance with the approved DOCP and Section 9. The site reference number for this discharge is E288572.

7. DISCHARGE OF TREATED EFFLUENT TO WETLAND #4 INFILTRATION TRENCH

Treated effluent is authorized to be discharged to the Wetland #4 Infiltration Trench within the Ephemeral Creek Drainage in accordance with the approved DOCP and Section 9. The site reference number for this discharge is E309786.

8. DISCHARGE OF AIR CONTAMINANTS FROM OPEN BURNING OF WOOD RESIDUE

Air contaminants are authorized to be released from the open burning of wood residue in accordance with this section and the approved DOCP. The site reference number for this discharge is E288570.

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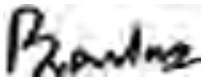

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8.1 Location

Any open burning of selected wastes must be restricted to the designated open burning area as shown on the attached site plan and as identified on-site. Signs which identify the nature of the waste acceptable at the designated open burning area must be erected and maintained.

8.2 Quantity, Timing, and Duration of Discharge

The maximum authorized quantity of wood residue to be open burned during each event is that which has accumulated at the time of burn initiation.

The maximum authorized duration of each burn must be limited to the period between two hours after sunrise on the day of ignition, and sunset on the following day. Each open burn must be completely extinguished at the end of the authorized burn duration.

Should a condition arise which prevents the burn pile(s) from being burned within this period, the Director must be notified in accordance with this authorization.

8.3 Nature of Wastes

Acceptable materials for burning may only include dry, unpainted, untreated demolition, construction and packing-related wood residue, clean stumps, prunings, vegetative debris and brush, but must exclude nuisance-causing combustibles such as glue-containing wood, painted and treated wood, sawdust , mulch, wood chips, rubber, plastics, tars, insulation, roofing material, asphalt shingles, etc.

8.4 Favourable Weather for Smoke Dispersion

Open burning must not proceed unless the recorded Environment Canada Ventilation Index Forecast for Smithers is greater than 55 (GOOD) for both days of the proposed burn.

The contact number for the forecast is 1-888-281-2992. Ventilation index forecasts can also be obtained after 7:00 a.m. from the following Environment Canada website:
http://www.weatheroffice.gc.ca/forecast/textforecast_e.html?Bulletin=flcn39.cwvr

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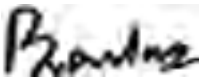

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A burn registration number must be obtained from the Ministry of Forests (1-888-797-1717) prior to ignition.

Open burning of wood residue must not be initiated or continued if the local air flow will cause the smoke to negatively impact a nearby population or cause pollution. No burning must occur during periods of fire hazard or when burning is prohibited by other agencies.

8.5 Minimization of Smoke

Each burn must be tended in a manner that ensures minimization of smoke emissions. Measures to minimize smoke must include, but not necessarily be limited to: stacking of waste in a manner that eliminates inclusion of dirt; waiting to burn until wastes are reasonably dry after any significant precipitation event; and using adequate equipment and staff.

8.6 Extinguishment Contingency Plan

Prior to burning, a contingency plan must be in place detailing how the open burn will be extinguished in the event of any of the following occurring:

i) Inadequate smoke dispersion in the surrounding environment;

ii) wood continues to smoulder after the authorized burn period; and,

ii) the Director requires that the open burn be extinguished for environmental protection reasons

8.7 Extinguishment

All combustion must be completely extinguished at the end of the authorized period as set out in Section 8.2

9. LEACHATE MANAGEMENT REQUIREMENTS

9.1 Leachate Management

9.1.1 Leachate Containment

A leachate containment and appropriate barrier system must be utilized. The barrier system must consist of a minimum of 2 metres of natural *in-situ* clay with a hydraulic conductivity of 1 x 10^{-6} cm/s or less. Alternatively, an engineered barrier may be used provided it is equivalent to or better than the natural clay barrier specified above.

9.1.2 Leachate Collection

A leachate collection system must be utilized. A continuous drainage blanket must be established beneath all landfill phases. The drainage blanket must consist of, or be equivalent to, a minimum 300 mm thick layer of clean gravel with an effective hydraulic conductivity exceeding 1 x 10^{-1} cm/s. The leachate collection system must be designed such that the hydraulic head on top of the barrier layer does not exceed 300 mm at any time.

9.1.3 Quantity of the Discharge

The maximum authorized quantity of discharge is indeterminate.

9.1.4 Timing of the Discharge

The discharge may occur 24 hours/day, 7 days/week, 365 days/year if in accordance with Sections 9.1.5, 11.1 and 11.2.

9.1.5 Characteristics of the Discharge

Acceptable constituents of the effluent include landfill leachate, liquid waste from the septage facility, site storm water, and run-off from the Phytoremediation Stand. The effluent must be directed in order of priority to the Phytoremediation Stand (Section 6), or to Wetland #4 Infiltration Trench within the Ephemeral Creek Drainage (Section 7) and as established in the DOCP.

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The characteristics of the effluent discharged to the Phytoremediation Stand (Section 6) or Wetland #4 Infiltration Trench within the Ephemeral Creek drainage (Section 7) must not exceed the following limits:

Daphnia magna acute lethality*,[1]	50% survival in 100% concentration, Minimum
Total Nitrogen	60 mg/L
Ammonia	30 mg/L
pH	6.5 to 8.5
Chloride	3750 mg/L
Total Iron	4.5 mg/L
Total Zinc	75 mg/L
Total Cadmium	0.1 mg/L

* not applicable if discharge only occurs to the Phytoremediation Stand

[1] this limit becomes effective June 30 2019 to allow for commissioning of the works and an assessment of the first year of monitoring data and effectiveness to occur as required in Section 12.2(iii)

9.1.6 Site Water Balance Model and Phytoremediation Stand Uptake Review

By December 31 2023 a qualified professional must re-evaluate the site water balance model including the rate of effluent uptake by the trees in the Phytoremediation Stand. Recommendations for any alterations to the discharge requirements in this section must be submitted to the Director by June 30 2024.

9.1.7 Authorized Works

The authorized works include storm water collection infrastructure, leachate collection and treatment facilities including an equalization basin, 4 engineered wetlands, and a sand filter and related appurtenances, with the final point of discharge being to either the Phytoremediation Stand or to the Wetland #4 Infiltration Trench within the Ephemeral Creek drainage approximately as shown on the attached Site Plan A. It is permissible to bypass one or more components of the authorized works in order to achieve improved effluent quality through recirculation or additional

retention time. In all cases, Section 9.1.5 must be met prior to discharge.

9.1.8 Authorized Works Functionality

The operational certificate holder must not discharge under this authorization unless the authorized works are complete and fully functional according to the treatment flow options as established in the DOCP.

10. GENERAL REQUIREMENTS

10.1 Lethal Toxicity of the Discharge

Commencing July 1, 2019 (post facility commissioning period) for any discharge to the Wetland #4 Infiltration Trench within the Ephemeral Creek Drainage (Section 7) the treated effluent and storm water must not be lethally toxic to aquatic organisms at the point of discharge (Wetland #4 Outlet Culvert) For the purposes of this 48 hour test, in >95% effluent concentration, there must be a minimum 50% survival of Daphnia magna. This Section does not apply to discharges of effluent to the Phytoremediation Stand (Section 6).

10.2 Prohibited Wastes

No wastes as defined by the Hazardous Waste Regulation (B.C. Reg. 243/2016, November 1, 2017) must be treated or disposed of at this site except as authorized by the Director. Materials which are regulated under the Recycling Regulation must not be treated or disposed of at this site if local marshalling and recycling facilities are available.

10.3 Waste Asbestos

Notwithstanding Section 10.2 of this operational certificate, the disposal of waste asbestos under Section 3 of this operational certificate and in compliance with the requirements of Section 40 of the Hazardous Waste Regulation is hereby authorized.

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10.4 **Contaminated Soil**

Soil that contains contaminants in concentrations less than "Hazardous Waste" as defined by the Hazardous Waste Regulation may be disposed at the landfill site. Disposal does not include use as final cover material.

10.5 **Waste Measurement**

The quantity of waste material landfilled at the site must be measured or estimated on an annual basis. This data must be made available for inspection upon request.

10.6 **Surface Water Quality Exceedances Response Plan**

The operational certificate holder must submit to the Director, a response plan detailing how the operational certificate holder will report and respond to:

- exceedances at sampling station SW-09 of the British Columbia Water Quality Guidelines for the Protection of Aquatic Life (BCWQGAL)

The response plan must be submitted a minimum of 60 days prior to the commissioning (first discharge) of the leachate treatment system. Upon completion, the response plan must also form a part of the approved DOCP.

10.7 **Surface Water Quality Assessment**

If, during the course of monitoring under Section 11.4, surface water quality measured at the property boundary (SW-09) exceeds the BCWQGAL then the operational certificate holder must implement the Surface Water Quality Exceedances Response Plan required in Section 10.6. The Director must be notified within 24 hours of the operational certificate holder triggering the response plan required in Section 10.6.

10.8 **Ground Water Quality Exceedances Response Plan**

The operational certificate holder must submit to the Director, a response plan detailing how the operational certificate holder will report and respond to:

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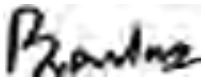

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- exceedances at sampling stations SGW-2, SGW-4, SGW-5, BH-3 and BH-5B of the Contaminated Sites Regulation Schedule 6 Drinking Water Standards

The response plan must be submitted a minimum of 60 days prior to the commissioning (first discharge) of the leachate treatment system. Upon completion, the response plan must also form a part of the approved DOCP.

10.9 Ground Water Quality Assessment

If, during the course of monitoring under Section 11.3, ground water quality measured at sampling stations SGW-2, SGW-4, SGW-5, BH-3 and BH-5B exceeds the Contaminated Sites Regulation Schedule 6 Drinking Water Standards then the operational certificate holder must implement the Ground Water Quality Exceedances Response Plan required in Section 10.8. The Director must be notified within 24 hours of the operational certificate holder triggering the response plan required in Section 10.8.

10.10 Electric Fencing

10.10.1 Design, Construction and Maintenance

Wherever required, electric fencing and gate systems at the landfill must be designed, constructed, and maintained such that bears are prevented from entering into the landfill through any portion of the fence or gates at any time of the day.

10.10.2 Fence Type

Fencing may be either high tensile smooth wire or fence fabric (e.g., mesh-wire, page-wire, chainlink or the like). The configuration of a high tensile smooth wire fence must consist of a minimum of eight strands, with four energized strands alternating with four grounded strands as follows: the bottom strand must be a grounded (-) strand and must not be more than 10 cm from the earth at any location; and thence starting from the bottom strand, the other seven strands must be spaced 15 ± 2 cm, 15 ± 2 cm, 15 ± 2 cm, 20 ± 2 cm, 20 ± 2 cm, 20 ± 2 cm, and 25 ± 2 cm. Additional strands to this minimum configuration may be used.

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A fence fabric may be used instead of high tensile smooth wire. The fence fabric must: be a minimum of 1.22 metre high; be constructed of a minimum wire thickness of 11 gauge, and have a maximum mesh size of 15 cm. The bottom of the fabric must not be more than 10 cm from the earth at any location. Any uncharged fence fabric must have a minimum of four strands of charged wires on an outrigger system, spaced as follows: the first strand must not be higher than 25 cm from the earth; and each of the remaining three strands must be spaced approximately 25 cm apart from adjacent charged strands.

10.10.3 Wire Tension

For a high tensile smooth wire fence construction, all strands must be tightened to a minimum of 125 lbs tension at 20°C. The required tension is to be corrected for temperature by use of the following formula for 12-½ gauge high tensile steel wire:

$$Tension = 125 - 2.5(Temperature - 20)$$

where: *Tension* is in lbs force

Temperature is in °C

10.10.4 Post Spacing

Fence posts must be spaced a maximum of 7.5 metres apart.

10.10.5 Grounding System

A grounding system must be installed consisting of solid grounding rods (i.e., not pipe) with a minimum diameter of 16 mm (5/8 inch) that have a buried length of at least 2 metres. A minimum of three grounding rods (spaced at least 3 metres apart) must be installed and connected to the energizer. Alternative energizer grounding systems (e.g., grounding plates, or a deep-driven grounding system) may be used provided the grounding is equivalent to or better than three grounding rods. A grounding rod (or equivalent) must be installed at least once every 450 metres along the fence and connected to the grounded wire strands or uncharged fence fabric. Additional grounding may be required for dry sites or if other conditions affect proper grounding.

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10.10.6 Period of Operation

Electric fencing must be fully operational during the period of April 1 to October 31 inclusive each year and at any other time of year when there is bear activity in the immediate surrounding area. If snow is present during this period, any electrified strands above the snow line must be isolated from the remainder of the system and energized.

10.10.7 Minimum Voltage

Electric fencing must be operated with a minimum voltage of 6,000 volts.

10.10.8 Gate(s)

Any access through electric fencing for vehicles, equipment and personnel must consist of an electrified gate system that is closed during non-operating hours. The gate system must be electrified to a minimum voltage of 6,000 volts at all times except when being opened or closed. Any gate that is open during operating hours must be periodically checked by the attendant for bear activity during hours of operation. Gaps between the gate and the fence and the earth, and between gate panels (for a double-hung gate), must not exceed 10 cm.

10.10.9 Fence Inspections

The perimeter of the electric fencing must be inspected on every day that the site is open to the public and the voltage of the fencing measured at several points and at each gate using a proper electric fence voltmeter. The results of voltage testing must be recorded in a log book. Any results less than the minimum 6,000 volts must be immediately investigated for the cause of the low voltage (e.g., low battery, litter, vegetation, loose or crossed wires, broken insulators, breaks in the grounding system, etc.). Corrective actions to restore proper voltage must be immediately undertaken.

Any discernible penetrations through electric fencing by bears and other wildlife must be immediately reported to the Conservation Officer Service at 1-877-952-7277 and to the Director at 1-250-847-7260.

In cases of low voltage or signs of penetration attempts, inspections must be increased from once per week to once per day until proper

voltage is fully restored and until there are no new signs of penetration attempts, respectively.

10.11 Dead Animal Disposal

Dead animals and animal parts must be disposed of in the solid waste disposal area and covered as soon as practicable with a minimum of 60 centimetres of soil and/or waste material such that flies and scavenging animals are prevented from accessing the carrion. Disposal of Specified Risk Material from cattle must only be done in accordance with Canadian Food Inspection Agency requirements and procedures.

11. MONITORING REQUIREMENTS

The operational certificate holder must carry out an environmental monitoring program for the locations specified below and as shown on Site Plan "B" as follows:

11.1 Treated Effluent to Phytoremediation Stand

Location	Parameters	Frequency
Effluent: E288572 Treated Leachate Post Sand Filter/Pre Phytoremediation Stand	Lab: total metals, alkalinity, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, total organic carbon, orthophosphorus, COD, BOD, VOCs[1], pH Field: conductivity, temperature, DO, turbidity, volume (flow measurement)	Lab/Field: Once prior to first discharge event of the year (spring) and once per summer and fall Volume: Continuous during discharge
Soil: E309686 Composite Soil Sample[2] from Phytoremediation Stand	Lab: metals, salinity, nutrients, cations, ions	Lab: Once annually, prior to first discharge of the year, as well as baseline data collection prior to very first discharge to the phytoremediation stand soil

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[1] One-time sample of VOCs for background levels, to be taken during first sampling event 2018
[2] Composite sample assembled from 4 locations from a pre-established list of 12 locations

11.2 **Treated Effluent to Wetland #4 Infiltration Trench**

Location	Parameters	Frequency
Effluent: E309786 Treated Leachate at Wetland#4 Outlet	Lab: total metals, alkalinity, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, total organic carbon, orthophosphorus, COD, BOD, VOCs[1], pH	Lab/Field: Once prior to first discharge event of the year (spring) and once per summer and fall. Monthly if discharging at any time during other months
	Field: conductivity, temperature, DO, turbidity, volume (flow measurement), visual[2]	Volume: Continuous during discharge Visual: Traverse area between Wetland # 4 Infiltration Trench and SW-09 twice per week during any period of discharge to identify any surface breakouts of discharge
	Acute Toxicity: Daphnia magna	Acute Toxicity: Once prior to start of each distinct continuous discharge event, or at least once per spring, summer and fall during discharge, whichever is more frequent

[1] One time sample of VOCs for background levels, to be taken during first sampling event 2018
[2] Visual inspection to detect surfacing of effluent between Wetland #4 Infiltration Trench and SW-09. If surface flow of effluent is detected, then the discharge must cease and the Director must be notified within 24 hours

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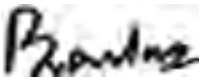

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11.3 Groundwater Monitoring

Location	Parameters	Frequency
E251512 BH-01 E251513 BH-02 E251514 BH-03 E252313 BH-4B E252314 BH-5B E309746 SGW-1 E309747 SGW-2 E309748 SGW-3 E309749 SGW-4[1] E309750 SGW-5[1]	Lab: dissolved metals, alkalinity, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, TOC, COD, VOCs[2], pH	Quarterly→Annually[3]
	Field: conductivity, temperature, water elevation[4]	Monthly→Quarterly[3]

[1] Wells must be installed by September 30 2018
[2] One-time sample of VOCs for background levels, taken during first sampling event 2018
[3] Quarterly reduced to annually and monthly reduced to quarterly following two complete years of sampling
[4] Water elevation quarterly

11.4 Surface Water Monitoring

Location	Parameters	Frequency
E309751 SW-01 E309752 SW-02 E287409 SW-05 E309754 SW-06 E287410 SW-07 E273812 SW-08 E310968 SW-09[1] (property boundary) E310969 SW10 (downstream of BH-03)	Lab: total metals, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, COD, BOD, pH	Minimum annually[2] and once during Spring, Summer, Fall if discharging during these seasons
	Field: conductivity, temperature, turbidity, flow rate, pH, dissolved oxygen	Minimum annually[2] and once during Spring, Summer, Fall if discharging during these seasons

[1] SW-09 as near to property boundary as possible but at a location where discernible flow begins in ephemeral creek drainage
[2] annual sample date should be consistent year to year, and preferably taken in fall

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11.5 Ground and Surface Water Monitoring Procedures

11.5.1 Sampling Procedures

The operational certificate holder must carry out sampling in accordance with the procedures described in the "British Columbia Field Sampling Manual for Continuous Monitoring and the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment, and Biological Samples, 2013 Edition (Permittee)" or most recent edition, or by alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at www.env.gov.bc.ca/epd/wamr/labsys/lab_meth_manual.html

11.5.2 Analytical Procedures

The operational certificate holder must carry out analyses in accordance with procedures described in the "British Columbia Laboratory Manual (2015 Permittee Edition)", or the most recent edition or by alternative procedures as authorized by the Director.

A copy of the above manual is available on the Ministry web page at www.env.gov.bc.ca/epd/wamr/labsys/lab_meth_manual.html

11.5.3 Toxicity Sampling and Analytical Procedures

Samples must be collected from the discharge described in Section 7 and in accordance with Section 10.1 at frequencies established as per the monitoring program specified in Section 11.2 and tested for Daphnia magna acute lethality. Daphnia magna acute lethality test means the test to determine the acute lethality of effluent to Daphnia magna as set out in Reference Method EPS 1/RM/14.

11.5.4 Quality Assurance/Quality Control (QA/QC)

The operational certificate holder is required to conduct the following Quality Assurance and Control Program to determine the acceptability of data required by this permit and Section 2(d) of the Environmental Data Quality Assurance Regulation.

a) Obtain and keep current, the laboratory precision, accuracy and

blank quality control criteria for each laboratory analysed parameter from the analytical laboratory(ies).

b) Collect one duplicate sample during each sampling session from one of the discharge points.

c) Each duplicate sample must be submitted to the laboratory; one of the pair identified as the regular sample, and the other, as a blind sample identified by a fictitious site-name established solely to identify the duplicate sample.

d) For each parameter, report the results of the field duplicates in terms of the degree of variation as the relative percent difference.

e) A sample collection blank must be prepared, containing distilled water, and preservative if required, and submitted as a blank sample with one sample set per session. If any result for any parameter indicates detectable concentrations, then efforts must be made to determine and control the source of contamination.

12 Data Analyses and Reporting

12.1 Log Book

As required by section 10.10.9 (fence inspections), the operational certificate holder must maintain a log book or electronic record. The log book or electronic record must be made available for inspection upon request by Ministry staff.

12.2 Annual Report

The operational certificate holder must collect and maintain data of effluent and soil analyses, and any other records required under this authorization for inspection when requested by Ministry staff and submit the data for the previous calendar year in a form satisfactory to the Director. The operational certificate holder must submit the annual report on or before June 30 each year for the previous calendar year.

The operational certificate holder must submit all data required to be submitted under this section by email to the Ministry's Routine Environmental Reporting Submission Mailbox (RERSM) at

EnvAuthorizationsReporting@gov.bc.ca or as otherwise instructed by the Director. For guidelines on how to properly name the files and email subject lines or for more information visit the Ministry website:

http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/routine-environmental-reporting-submission-mailbox

The annual report must contain at minimum:

i) The type and tonnage or volume of waste received, recycled, composted and landfilled for the year;

ii) Volume of effluent discharged to each of the Phytoremediation Stand and Wetland #4 Infiltration Trench within the Ephemeral Creek Drainage, with tabulation of volume and duration of each discharge event and the total volume discharged per year;

iii) Occurrences or observations of wildlife attempting to access the facility;

iv) The results of all required monitoring programs undertaken by the operational certificate holder for the site. Trend analysis, evaluation of any identified impacts of the discharges on the receiving environment in the previous year, and evaluation of the effectiveness of the established monitoring programs must be carried out by qualified professionals appropriate to the subject matter. Any identified recommendations must be included as they pertain to the ground water, surface water and aquatic effects (including acute toxicity) monitoring programs. Should the parameters and frequencies of the previous year's monitoring programs be identified as being not representative of receiving environment conditions, recommendations must be made for corrective actions that can be taken. Recommendations can be made to either increase or decrease parameters and frequency of any monitoring program

12.3 **Non-Compliance Notification**

The operational certificate holder must immediately notify the Director or designate by email at EnvironmentalCompliance@gov.bc.ca or as otherwise instructed by the Director, of any non-compliance with the

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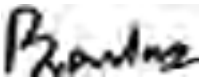

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for Director, *Environmental Management Act*
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requirements of this authorization by the operational certificate holder and take remedial action to remedy any effects of such non-compliance. The operational certificate holder must provide to the Director with written confirmation of all such non-compliance events, including available test results, within 24 hours of the original notification, unless otherwise directed by the Director.

12.4 Non-Compliance Reporting

If the operational certificate holder fails to comply with any of the requirements of this authorization, the operational certificate holder must, within 30 days of such non-compliance, submit a written report that is satisfactory to the Director and includes, but is not necessarily limited to the following:

a. all relevant test results obtained by the operational certificate holder related to the non-compliance,

b. an explanation of the most probable cause(s) of the non-compliance, and,

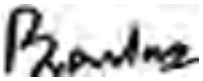
c. a description of remedial action planned and/or taken by the operational certificate holder to prevent similar non-compliances in the future.

The operational certificate holder must submit all non-compliance reporting required to be submitted under this section by email to the Ministry's Compliance Reporting Submission Mailbox (CRSM) at EnvironmentalCompliance@gov.bc.ca or as otherwise instructed by the Director. For guidelines on how to report a non-compliance or for more information visit the Ministry website: http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization/data-and-report-submissions/non-compliance-reporting-mailbox

12.5 Non-compliance Reporting and Exceedances

The operational certificate holder must cause each data submission required by this authorization to include a statement outlining the number of exceedances of permitted discharges that occurred during the reporting period, the dates of each such exceedance, an explanation as to the cause of the exceedances, and a description of the measures taken by the operational certificate holder to rectify the cause of each such exceedance.

Date issued: May 30, 2013
Date amended: February 7, 2018
(most recent)



Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Authorizations - North Region

If no exceedances occurred over the reporting period, the required statement may instead indicate that no exceedance of permitted discharges occurred during the reporting period.

12.6 Toxicity Test Failure Reporting

The operational certificate holder must report any failure of Daphnia magna acute toxicity tests as referenced in Sections 10.1, 11.2 and 11.5.3 to the Director within 24 hours of receiving the test failure result. As required in Section 9.1.5, beginning July 1, 2019, no discharge to the Wetland #4 Infiltration Trench may occur following a failed toxicity test unless there is a successful test result (non-failure) for Daphnia magna toxicity.

13. Closure Requirements

13.1 Notification of Closure

The operational certificate holder must notify the Director in writing of intentions to close the landfill site at least one year prior to closure date.

13.2 Closure Plan

As per Section 2 (Design, Operations and Closure Plan) closure requirements must be included in the DOCP.

13.3 Closure Funding

The operational certificate holder must ensure that sufficient funds will be available to provide for all closure and post-closure requirements as outlined in the closure plan required in Section 2, plus a reasonable contingency for any remediation which may be required.

13.4 Final Cover

The final cover system must be designed by a qualified professional to match the intended end-use of the landfill site and to match the needs of any required environmental management systems (leachate minimization or recirculation, as the case may be, landfill gas collection and treatment, etc.). The final cover must consist of a layer of a minimum 600 mm of low permeability ($<1 \times 10^{-6}$ cm/s) compacted soil followed by a layer of topsoil suitable for establishment of vegetation. Use of higher permeability soil must first be approved by the Director. The final cover

must be constructed with minimum and maximum slopes as specified by a qualified professional in the DOCP to promote runoff and minimize erosion, with appropriate run-on/runoff drainage controls, erosion controls, and gas venting controls. The site must be seeded with a grass/legume mixture suited to the local climate.

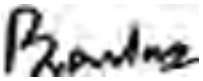
13.5 Progressive Application of Final Cover

Completed portions of the landfill must progressively receive final cover during the active life of the landfill. The maximum area of disposed refuse that has not yet received final cover must not exceed 25% of the total final footprint area. Final cover is to be applied according to the specifications identified in section 13.4.

14. ENVIRONMENTAL IMPACT

Inspections of the discharge will be carried out by Environmental Protection personnel as a part of the routine operational certificate inspection procedure. Based on these inspections and any other information available to the Director on the effect of the discharge on the receiving environment, the operational certificate holder may be required to undertake additional monitoring, install additional pollution control works, or change the method of operation.

Date issued: May 30, 2013
Date amended: February 7, 2018
(most recent)



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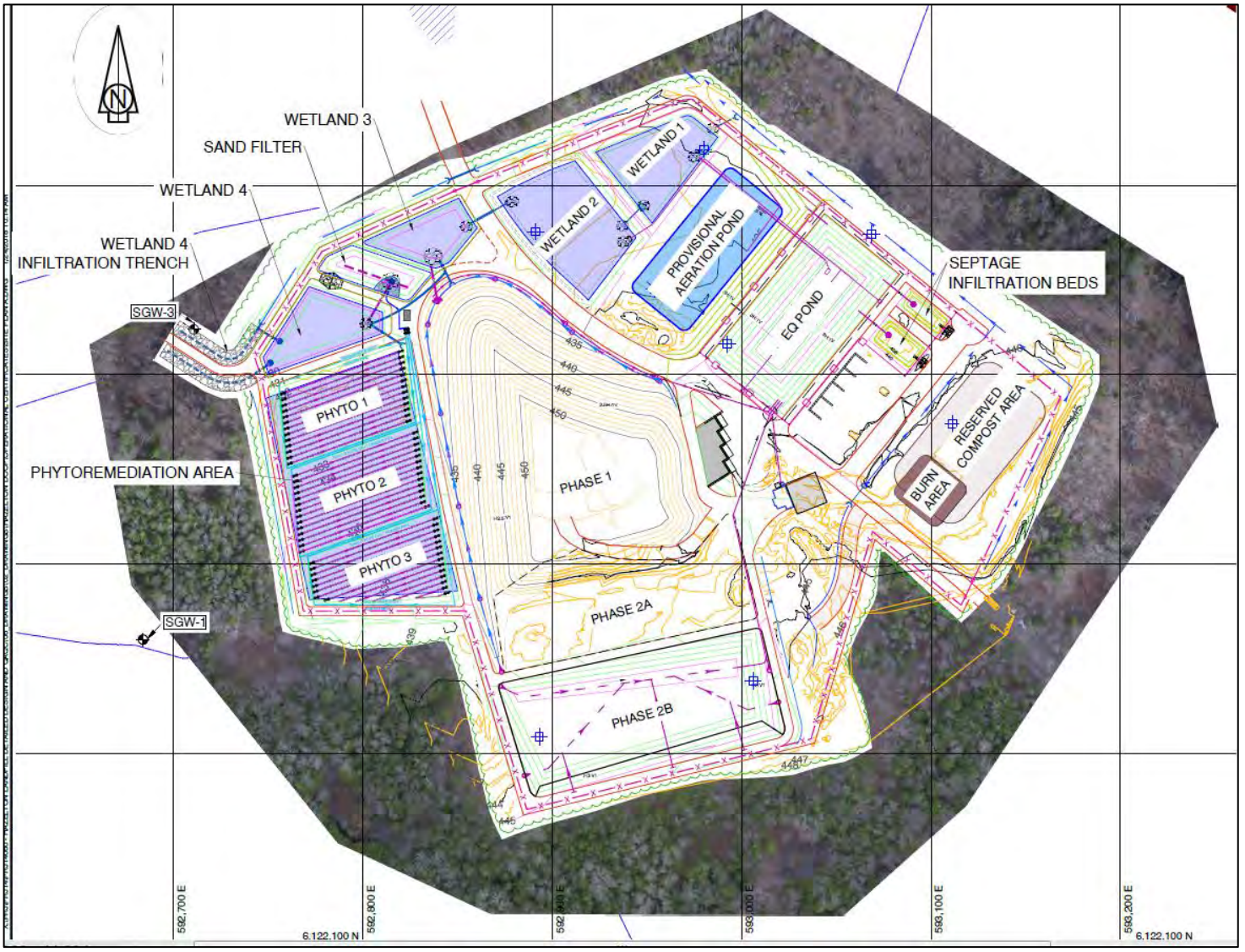
for Director, *Environmental Management Act*
Authorizations - North Region

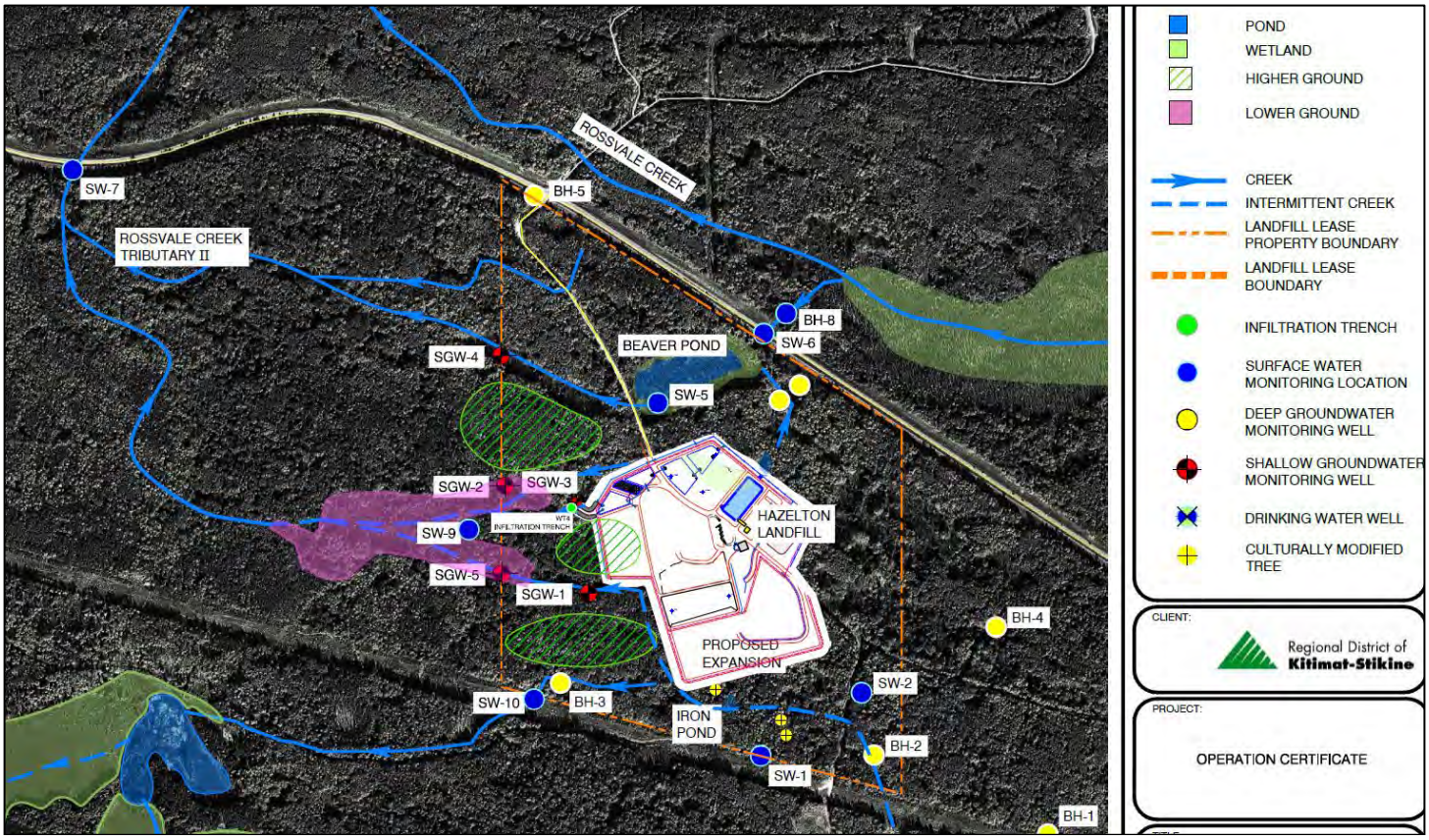
Site Plan A



Date issued: May 30, 2013
Date amended: February 7, 2018
(most recent)

Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Authorizations - North Region

Site Plan B



Date issued: May 30, 2013
Date amended: February 7, 2018
(most recent)

Sajid A. Barlas, Ph.D., P.Ag.
for Director, *Environmental Management Act*
Authorizations - North Region

Appendix E: Acute Toxicity Test Results – Wetland #4

REGIONAL DISTRICT OF KITIMAT-STIKINE
ATTN: Chris Kerr
300 - 4545 Lazelle Avenue
Terrace BC V8G 4E1

Date Received: 14-SEP-18
Report Date: 28-SEP-18 15:25 (MT)
Version: FINAL

Client Phone: 250-615-6100

Certificate of Analysis

Lab Work Order #: L2164893

Project P.O. #: NOT SUBMITTED
Job Reference: HAZELTON LANDFILL
C of C Numbers:
Legal Site Desc:

Amber Springer, B.Sc
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID					
Grouping **Analyte**					

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: REGIONAL DISTRICT OF KITIMAT-STIKINE
300 - 4545 Lazelle Avenue
Terrace BC V8G 4E1
Contact: Chris Kerr

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed

Quality Control Report

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Acute Toxicity Test Results

Sample L2164893-1 WETLAND #4,
collected September 13, 2018

Final Report

September 26, 2018

Submitted to: **ALS Environmental**
Burnaby, BC

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates			Receipt temperature
	Collected	Received	*Daphnia magna* test initiation	
L2164893-1 WETLAND #4	13-Sep-18 at N/A	15-Sep-18 at 1205h	17-Sep-18 at 1300h	8.9°C

N/A = Not available

TEST

- *Daphnia magna* 48-h LC50 test

RESULTS

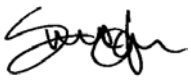
Toxicity test results

Sample ID	LC50 (%v/v)
L2164893-1 WETLAND #4	>100

QA/QC

QA/QC summary	*Daphnia magna*
Reference toxicant LC50 (95% CI)	5.5 (4.4 – 6.9) g/L NaCl[1]
Reference toxicant historical mean (2 SD range)	5.7 (3.9 – 8.2) g/L NaCl
Reference toxicant CV	18%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1] Test date: September 14, 2018, LC = Lethal Concentration, CL = Confidence Limits, SD = Standard Deviation, CV = Coefficient of Variation



Report By:
Yvonne Lam, B.Sc.
Laboratory Biologist

Reviewed By:
Edmund Canaria, R.P.Bio
Senior Analyst

This report has been prepared by Nautilus Environmental Company Inc. based on data and/or samples provided by our client and the results of this study are for their sole benefit. Any reliance on the data by a third party is at the sole and exclusive risk of that party. The results presented here relate only to the samples tested.

APPENDIX A – Summary of test conditions

Table 1. Summary of test conditions: 48-h *Daphnia magna* LC50 test.

Test species	*Daphnia magna*
Organism source	In-house culture
Organism age	<24-hour old neonates
Test type	Static
Test duration	48 hours
Test vessel	250-mL glass beaker
Test volume	200 mL
Test solution depth	6 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Moderately-hard reconstituted water + 2.5 µg/L Se
Test solution renewal	None
Test temperature	20 ± 2°C
Feeding	None
Light intensity	400 to 800 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	None
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity, hardness and alkalinity measured in the undiluted sample at test initiation; conductivity measured at test initiation and termination; survival checked daily
Test protocol	Environment Canada (2000), EPS 1/RM/14, with 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (48-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Sodium chloride (NaCl)

APPENDIX B – Toxicity test data

Daphnia magna Summary Sheet

Client: ALS
Work Order No.: 181552

Start Date/Time: Sep. 17/2018@1300h
Test Species: *Daphnia magna*
Set up by: CW

Sample Information:

Sample ID: L2164893-1 WETLAND #4
Sample Date: Sep. 13/2018
Date Received: Sep. 15/2018
Sample Volume: 2 x 1L

Test Validity Criteria:

≥ 90% mean control survival and/or mobility and ≤2 daphnids exibit immobility and/or mortality in any single control replicate.

WQ Ranges:

T (°C) = 20 ± 2; DO (mg/L) = 3.6 to 9.4; pH = 6 to 8.5

Test Organism Information:

Broodstock No.: 082818A
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 34
Mortality (%) in previous 7 d: 0
Days to first brood: 8

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMDC18
Stock Solution ID: 18NA03
Date Initiated: Sep. 14/2018
48-h LC50 (95% CL): 5.5 (4.4 - 6.9) g/LNaCL

Reference Toxicant Mean and Historical Range: 5.7 (3.9 - 8.2) g/L NaCL
Reference Toxicant CV (%): 18%

Test Results: The 48h LC50 is estimated to be > 100% (v/v).

Reviewed by: [signature]

Date reviewed: Sept. 26, 2018

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: ALS
Sample ID: L2164893-1 WETLAND #4
Work Order No.: 181552

Start Date/Time: Sep. 17/2018 @ 1300h
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: CW

Thermometer: CER#5 pH meter/probe: 3 / 3 DO meter/probe: 3 / 3 Cond./Salinity meter/probe: 3 / 3

Concentration (% v/v)	Rep	Number of Live Organisms 24	Number of Live Organisms 48	No. Immobilized 48	Temperature (°C) 0	Temperature (°C) 24	Temperature (°C) 48	Dissolved oxygen (mg/L) 0	Dissolved oxygen (mg/L) 24	Dissolved oxygen (mg/L) 48	pH 0	pH 24	pH 48	Conductivity (µS/cm) 0	Conductivity (µS/cm) 48
Control	A	10	10	0	19.5	19.5	19.5	8.7	8.3	7.8	7.6	7.5	7.7	341	339
	B														
	C														
	D														
6.25	A	10	10	0	19.5	19.5	19.5	8.7	8.1	7.6	7.6	7.7	7.9	457	454
	B														
	C														
	D														
12.5	A	10	10	0	19.5	19.5	19.5	8.2	8.0	7.3	7.6	7.7	8.0	561	560
	B														
	C														
	D														
25	A	10	10	0	19.5	19.5	19.5	8.0	7.4	7.1	7.6	7.8	8.1	727	721
	B														
	C														
	D														
50	A	10	10	0	19.5	19.5	19.5	7.2	7.3	6.9	7.6	7.9	8.3	1071	1057
	B														
	C														
	D														
100	A	10	10	0	20.0	19.5	19.5	3.6	6.9	6.3	7.6	8.0	8.4	1876	1808
	B														
	C														
	D														
Technician Initials		CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW	CW

Concentration	Hardness*	Alkalinity*
	*(mg/L as CaCo3)	
Control (MHW)	100	76
Highest conc.	490	526
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.0		20.0
DO (mg/L)	1.4	(21 min aeration)	3.6
pH	7.5		7.6
Cond (µS/cm)	1874		1876
Salinity (ppt)	0.9		0.9

Comments: _____ Mortality: Heartbeat checked under microscope No

Sample Description: Clear yellow liquid, no odour, Fluffy brown and grey particulates.

Batch#: 082818A 7-d previous # young/brood: 34 Previous 7-d Mortality (%): 0 Day of 1st Brood: 8

Reviewed by: _____ Date reviewed: Sept. 26, 2018

APPENDIX C – Chain-of-custody form

L2164893

VANCOUVER

ALS Environmental

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NEW Reporting Contacts:
1.Account Manager Listed Below
2.ALSEVDataSublet@ALSGlobal.com (PDF / EXCEL)
3.ALSE.CASDG@ALSGlobal.com (EDD/Database Formats)

NOTES: Please reference on final report and invoice: PO# L2164893
ALS requires QC data to be provided with your final results.

Acute toxicity (Daphnia Magna) LC50

Please see enclosed 1 sample(s) in 2 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2164893-1 WETLAND #4		**9/13/2018**	
	Special Request- Nautilus Environmental (SPECIAL REQUEST-NL 14)	9/24/2018	

Subcontract Info Contact: Walter Lin (604) 253-4188

Analysis and reporting info contact: Amber Springer, B.Sc
8081 LOUGHEED HWY
SUITE 100
BURNABY,BC V5A 1W9
Phone: (604) 253-4188 Email: amber.springer@alsglobal.com

Please email confirmation of receipt to: amber.springer@alsglobal.com

Shipped By: _____ Date Shipped: _____

Received By: A. Dew Date Received: Sept 15/18 @ 1205h

Verified By: _____ Date Verified: _____

Temperature: 6.9 °C

Sample Integrity Issues: 2+1C → ok

Work 181552

END OF REPORT

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2164893-COFC

COC Number: 17 - 698750

Page of

Report To	Contact and company name below will appear on the final report
Company:	Reg. Dist. of Kitimat - Stikine
Contact:	Chris Kerr
Phone:	615-6100
	Company address below will appear on the final report
Street:	Suite 300 4545 Lazelle Ave
City/Province:	Terrace B.C.
Postal Code:	V8G-4E1

Invoice To		
	Same as Report To	☑ YES ☐ NO
	Copy of Invoice with Report	☑ YES ☐ NO
Company:		
Contact:		

Report Format

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☑ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: Rtooms @rdks.bc.ca

Email 2: MHaley @rdks.bc.ca

Email 3: CKerr @ rdks.bc.ca

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: MHaley @rdks.bc.ca

Email 2: Anne-Maries @rdks.bc.ca

...low - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)		EMERGENCY	
4 day [P4-20%] ☐		1 Business day [E-100%] ☐	
3 day [P3-25%] ☐		Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐	
2 day [P2-50%] ☐			

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:

Job #: Hazelton Landfill

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Acute toxicity (Daphnia magna)	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	WETLAND #4	13/9/18	1:10	Water				2

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☑ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C: 9.9°

FINAL COOLER TEMPERATURES °C: 10°C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Chris Kerr	Date: Sept 13/18	Time: 3:55	Received by: [signature]	Date: Sept 13	Time: 8:50	Received by: BB	Date: Sept 14	Time: 9:10PM

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JULY 2017 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

G