Regional District of
Kitimat-Stikine

2019 HAZELTON WASTE MANAGEMENT FACILITY ANNUAL REPORT

June 2020

Prepared for:

British Columbia Ministry of Environment & Climate Change Strategy
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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 greater Hazelton area, which includes the community of South Hazelton east to Witset, and north up the Kispiox Valley. Waste collected at the Kitwanga Transfer Station is consolidated and hauled to the Hazelton WMF for landfilling. The following communities utilize the Kitwanga 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 May 2020, and conducted in accordance with the Design, Operations, and Closure Plan for Hazelton Waste Management Facility, authored by Sperling Hanson and Associates (2019).

This annual report will follow criteria outlined in the amended Operational Certificate that was issued the October 2019.

Figure 1. Location of the Hazelton Waste Management Facility

The Hazelton WMF currently contains septage receiving lagoons, a landfill, an equipment storage building, Z-wall for public drop off of garbage, and U-Bays for residential drop-off of tires and scrap metal including large appliances and propane tanks. The leachate treatment system is near completion, it includes an equalization pond, a series of wetlands and final effluent discharge to a phytoremediation orchard.

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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1.0 Introduction

This annual report covers the period from January 1 to December 31, 2019 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 most recently amended in May 2020. This report follows criteria as outline in the October 2019 amended version of the OC.

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 2019;
- Total volume or tonnage of waste recycled and diverted in 2019;
- Total volume of sewage waste discharged to septage facility in 2019;
- 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 2019 (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 2019 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 2019

Material	2019 Quantity (tonnes)	
Waste Discharge*		
Garbage	3430	
Demolition	428.1	
Hauled from Kitwanga	745.2	
Land Clearing Waste	65.6	
Diverted Wastes		
Tires		11**
Metal		451**
Cardboard		68**
Clean wood		29**
Total Landfilled	**4,668.9**	
Total Materials Diverted		**559**

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.

In 2019, 4,668.9 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 2019.

2.1.2 Effluent Discharged to Phytoremediation or from Wetland #4

The Hazelton Waste Management Facility Phase 2 is almost near construction completion. Two possible locations are authorized for discharge, the phytoremediation orchard and via a weir from Wetland #4. The leachate (collected from the new landfill and the closed Phase I landfill) treatment process begins in the equalization pond, then runs though a serious of three wetlands, then a sand filter prior to discharge to the phytoremediation orchard. Wetland #3 is equipment with an overflow, which goes to Wetland #4, Wetland #4 also collects run-off from the phytoremediation orchard.

Figure 2 Hazelton Wetland #2

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 2019, a total 451 tonnes of metal was collected and diverted at the Hazelton Waste Management Facility.

3.2 Cardboard

To ensure there 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 2019, 68 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 2019, approximately 11 tonnes of tires were collected for recycling through the Tire Stewardship of BC at the Hazelton Waste Management Facility.

3.4 Clean Wood

Clean wood waste is considered any wood product that has not been treated or painted. Clean wood is segregated and burned as prescribed in the Operational Certificate.

In 2019, 29 tonnes total of clean wood waste was collected and diverted.

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 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 appropriate 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 2019 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 2019, 4,668.9 tonnes of total refuse including garbage, construction and demolition materials, consolidated waste from the Kitwanga Transfer Station, and controlled waste was disposed of in the Hazelton landfill. An additional 555 tonnes of material were diverted from the landfill during 2019. These materials include; 451 tonnes of metal, 11 tonnes of tires, 29 tonnes of clean wood, and 68 tonnes of cardboard. The diverted total does not include septage.

There were no mammalian wildlife occurrences at the Hazelton Waste Management Facility during 2019.

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Appendix A Environmental Monitoring Report

Hazelton Waste Management Facility
2019 Annual Monitoring Report
- Final -

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PRJ20010

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Regional District of Kitimat-Stikine

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

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 2019 relative to historical trends. Sampling that occurred in 2019 followed the amended Operational Certificate (OC) 17226. 2019 marks the second year that data has been collected for the new Shallow Groundwater (SGW) wells.

There was a controlled discharge event to the Wetland #4 infiltration trench in 2019. The event started October 8, 2019, and it ceased at the end of November 2019. Prior to discharge, the OC requirements were confirmed for compliance, including LC-50 testing. Also, the Wetland #4 water quality results show lower values and frequency for exceedances when compared to those in the background water quality. This suggests that water in Wetland #4 is predominately sourced from precipitation events. Data that was not collected included visual observations of surface discharge and continuous volume of discharge. In the future, volume of discharge will be monitored with daily observations of flow through a weir. The weir was constructed and installed in 2020. However, earth filled berms were not constructed to channelize flows through the weir due to inclement weather. Completion of these works will take place during 2020.

Generally, shallow groundwater is naturally attenuated and diluted with increasing proximity from the landfill. This dynamic is observed with flows from SGW-1 and SGW-3 flowing to SGW-5 and SGW-2, respectively. Water quality at SGW-5 shows that exceedances at SGW-1 have decreased to compliant levels with the exception of cobalt and iron for BC CSR-DW criteria. However, these exceedances have been observed in background concentrations. Furthermore, leachate discharge to SGW-1 ceased in 2019. This is supported by the general trend of 2019 water quality having less and lower exceedances when compared to 2018 water quality. Thus, exceedances of BC CSR-DW criteria at SGW-5 are not considered to be caused by leachate impact. Water quality at SGW-2 shows conflicting results when compared to SGW-3. In general, water quality of key leachate indicating parameters does decrease at SGW-2 when compared to SGW-3. However, some parameters do not follow this trend with SGW-2 values exceeding those at SGW-3. These varying results are believed to be impacted by swampy waters. Furthermore, BC CSR exceedances at SGW-2 of aluminum, arsenic, cobalt, iron, lithium and manganese do not correlate to the Wetland #4 discharge water quality showing no BC CSR-DW exceedances. For these reasons, SGW-2 water quality is challenging to interpret. It is recommended that the SGW wells be monitored quarterly for another year to establish baseline trends.

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 criteria for cobalt, iron, and manganese concentrations in 2019. In general, it appears water quality at BH-5B is only partially influenced by leachate impact. For instance, a key leachate indicating parameter such as ammonia followed background water quality trends. Furthermore, several of the exceedances are similar to background conditions. Lastly, additional data is required to determine the portion of contamination resulting from nearby highway operations. For these reasons, it is challenging to determine whether or not the landfill is impacting groundwater at the downstream BH-5B monitoring location.

The water in BH-03, which would intercept any flow from landfill leachate before it reached the public water well was dry during all 2019 sampling events. In previous years, there was no concern of leachate impacting this area. For this reason, the risk with this trend changing in 2019 is considered to be low.

In terms of surface water, this year SW-06 and SW-08 showed spikes in the chloride concentrations. These concentrations are not associated with landfill run-off because site run-off is completely contained on-site. At the Beaver Pond outlet, SW-05 metal exceedances are similar to the Beaver Pond inlet locations SW-06 and SW-08, and thus assumed to be naturally occurring. Further downstream at SW-07, water quality is also similar to background. Neither of the downstream surface water locations show signs of leachate impact. Lastly, SW-09 and SW-10 were not sampled during the 2019 year. It is highly recommended that sampling at each location is conducted as specified by the OC. In the case of SW-09, it is a compliance point for surface water quality.

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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 2019 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 2019.

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, amended on February 7, 2018.

The Hazelton WMF is located off 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. In the past, the landfill has been operating as a natural control facility that relies on the native soils and natural attenuation capacity to protect the environment. Currently, landfill closure and expansion upgrades have been completed, and the construction of a leachate treatment system is ongoing. The leachate treatment system construction and commissioning is scheduled for completion in 2020.

Figure 1: Hazelton Landfill Site Location

2. SITE SETTING

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.

In general, the Hazelton WMF site redirects run-on through a perimeter ditch system, and contains any site run-off through the site stormwater management system. The perimeter ditch system can be viewed in Figure 2 (Appendix A). Site runoff is contained by on-site ditching and grading which directs these flows to the on-site wetland system area. 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 2019 monitoring program followed the monitoring program outlined in the amended OC. As in previous years, the water quality monitoring in 2019 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 amended OC specifies groundwater and surface water sampling locations as compliance points for specific water quality criteria. 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), recently updated in 2019. 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. In the case compliance is not achieved at these sample points, recirculation of the leachate is required. Regarding surface water, the updated OC specifies analytic results at SW-09 must be compliant with BCWQG-AL. In the case compliance is not achieved at this sample point, the Surface Water Quality Exceedance Plan.

In addition, the analytical results from all the sample locations have been compared to other working water quality criteria. These criteria include the "British Columbia Approved Water Quality Guidelines Criteria" (BCWQG) last updated in March 2018, for both Drinking Water (DW) and Aquatic Life (AW)

[1] CSR standards have been updated and Schedule 3.2 replaced the redacted Schedule 6

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.

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 BC WQG and BC CSR standards were updated in 2018 and 2019, respectively. As such, the applicable data was compared to the most recent criteria revisions. 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 leachate impact.

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[4] and once during spring, summer, fall if discharging during these seasons
SW-07 SW-08 SW-09[3] 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

[3] SW-09 as near to property boundary as possible but at a location where discernible flow begins in ephemeral creek drainage.
[4] Annual sample should be consistent year to year, preferably taken in fall.

Monitoring locations SW-09 and SW-10 were not sampled in 2019 because they were dry.

A brief description of each sampling location is presented in Table 3-2. Charts 1 to 5, 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	2019 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 November 19, 2019
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 Aug 13, 2019 and November 19, 2019
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 Aug 13, 2019 and November 19, 2019
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 Aug 13, 2019 and November 19, 2019
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 Aug 13, 2019 and November 19, 2019
SW-08	593090.039 E 6122786.348 N	Upgradient of landfill: Measures background water quality entering Beaver Pond.	Sampled Aug 13, 2019 and November 19, 2019
SW-09	592180.986 E 6123775.729 N	Downstream on Rossvale Creek	Dry in 2019
SW-10	N/A	Downstream of BH-03	Dry in 2019

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 both sampled on November 19th, 2019. SW-02 was also sampled on August 13, 2019. 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 2019. Specifically, aluminum, chromium, copper, 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.

The field pH at SW-02 was acidic with a pH reading of 5.6. This value is out of range of both the AW and DW criteria. SW-02 field conductivity was recorded as 88.8 µS/cm. This low conductivity value is 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. As described in previous Hazelton Monitoring Reports, historic 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. As described in previous Hazelton Monitoring Reports, historic water quality data at this location is representative of partially diluted and attenuated leachate in close proximity to the SW-03 leachate seep.

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. The Beaver Pond receives surface water flow from two main areas. Firstly, run-off from a ditch that flows along the north side of Highway 16 enters the beaver pond from the north. Secondly, surface water flows from the run-on ditches bordering the east side of the Hazelton WMF (the site is bisected by the entrance road).

Field readings at this location indicate that the water is acidic (6.4 pH) and out of range of the AW and DW criteria. Field conductivity was recorded as 201.6 µS/cm which is on the high end of the range of naturally occurring water with conductivity less than 200 µS/cm.

SW-05 was sampled once in August 2019 and the sample exceeded the AW and DW guidelines for aluminum (AW only), iron, manganese (DW and AQ), 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. Furthermore, historic exceedances of cadmium and chromium have not been observed since 2017, the year prior to the Environmental Upgrades. However, total metals results for cadmium may not be an exceedance because the BCWQG limits are for dissolved cadmium.

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 DW guidelines. Aluminum concentrations exceeded the AW criteria only during the November sampling event. Lastly, during the August sampling event, sodium exceeded the DW criteria (332 mg/L), and chloride exceeded the AW and DW criteria (634 mg/L)

Field readings at this location indicate that water is acidic (6.5 pH) and out of range of the DW criteria. Field conductivity at this location was elevated during the August sampling event and was recorded as 2306 µS/cm. In comparison, past conductivities recorded at this location typically range from 120 – 206 µS/cm, with an elevated value of 531 µS/cm during the May 2018 event. The elevated conductivity at this location could be due to runoff from the highway. Elevated conductivity levels were also observed at SW-08 (1229 µS/cm).

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 and Chromium exceeded the AW criteria at the 2019 sampling event. Phosphorus exceeded the DW criteria. Iron exceeded the AW and DW criteria. In general, water quality at this location has improved compared to years prior to 2016.

The pH at this location is slightly basic (7.6 pH) and is compliant with both the AW and DW criteria. Conductivity at this location is low and was recorded as 126 µS/cm which is within the conductivity range of naturally occurring water (less than 200 µS/cm). This sample shows a decrease in conductivity when compared to SW-05.

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 Hazelton WMF.

During the August sampling event, iron and phosphorous exceeded both the DW and AW guidelines. These values decreased during the November sampling event with iron only exceeding the DW criteria and phosphorous results being below detection limits (the detection limit is above the DW criteria). Lastly, aluminum exceeded the AW criteria during the November sampling event. The exceedances noted at this location are likely related to highway run-off.

The field pH at this location is acidic at 6.4 pH. Conductivity was elevated with a result of 1229 µS/cm.

3.4.2 Treated Effluent to Wetland #4 Infiltration Trench

The treated effluent to Wetland #4 infiltration trench monitoring schedule as per the amended OC is shown below in Table 3-3.

Table 3-3: Treated Effluent to Wetland #4 Infiltration Trench

Location	Parameters	Frequency
E309786 Treated Leachate at Wetland #4 Outlet	Lab: total metals, alkalinity, chloride, fluoride, sulphate, hardness, ammonia, nitrate, nitrite, total organic carbon, orthophosphorous, COD, BOD, VOC[5] 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 the other months Volume: Continuous during discharge Visual: Transverse area between Wetland #4 Infiltration Trench and SW-09 twice per week during any period of discharge to identify any surface breakouts of discharge
	Field: Conductivity, temperature, DO, turbidity, volume (flow measurement), visual[6]	
	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

Wetland #4 is located on the west side of the landfill as seen in Figure 3. During 2019, a controlled discharge event started October 8, 2019, and it ended during freezing conditions at the end of November 2019. Prior to discharge, the OC requirements were confirmed for compliance, as shown in Table 4: Wetland #4 Water Quality Data. Surface water samples were collected from the surface of Wetland #4 from July 22, 2019 to November 12, 2019. Sampling frequency was conducted as per section 11.2 of the amended OC.

Data that was not collected included visual observations of surface discharge and continuous volume of discharge. In the future, volume of discharge will be monitored with daily observations of flow through a weir. Weir construction was completed in the spring of 2020.

[5] One time sample of VOCs for background levels, to be taken during first sampling event 2018
[6] 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

3.4.2.1 Wetland #4

In general, all water quality results were compliant with the Amended OC Discharge criteria, during the discharge event. For discussion and reference purposes, samples from Wetland #4 have also been compared to the BCWQG-DW and BCWQG-AW. There were elevated levels of total organic carbon (TOC), ammonia and chloride at this location. Only TOC and Ammonia (only for the September 2019 sampling event) exceeded the BCWQG-DW.

There were also various exceedances of the BCWQG-DW and AW for metals such as arsenic, iron, manganese and phosphorus. These metal exceedances were predominately observed during the July 2019 sampling events. For the remaining 2019 sampling events, only iron, manganese and phosphorous exceeded the BCWQG-DW. However, the observed levels are consistent with surface water background values. Furthermore, these results show fewer exceedances in water quality when compared to the September 2018 sample that was influenced by accidental leachate discharge to pond #4. Elevated levels of metals observed during 2018 that are absent in 2019 include boron, chromium and sodium. This improvement in 2019 when compared to 2018 may be attributed to the sources of flow into Wetland #4 being predominantly rainwater.

Water quality results at this location show some leachate impact which is to be expected given that leachate was mistakenly pumped to this location without undergoing treatment during 2018. However, the water quality in Wetland #4 appears to have much fewer exceedances then background surface water at SW-01 and SW-02. Also, LC-50 results show that an LC-50 dose would be greater than 100% of the solution. For these reasons, Wetland #4 water quality is likely the result of significant influences from precipitation inputs to Wetland #4.

3.4.3 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 in Table 3-3.

Table 3-4: 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[7], pH	Quarterly → Annually[8]
SGW-1 SGW-2 SGW-3 SGW-4	Field: Conductivity, temperature, water elevation[9]	Monthly → Quarterly[6]

[7] One-time sample of VOC's for background levels, taken during first sampling event 2018.
[8] Quarterly reduced to annually and monthly reduced to quarterly following two complete years of sampling.
[9] Water elevation quarterly.

SGW-5		

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 3-5. The locations of the Hazelton WMF groundwater sampling locations are shown in Figure 3. Groundwater table elevations are shown in Table 3-4.

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.

Table 3-6: Description of Groundwater Sampling Locations

Monitoring Locations	UTM Coordinates (+/- 5m)	Description	2019 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: April 17, 2019 August 13, 2019 November 20, 2019
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: April 17, 2019 August 13, 2019 November 20, 2019
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, Response Plan Monitoring Location	Dry during: April 17, 2019 August 13, 2019 November 20, 2019
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	Not Sampled in 2019
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: April 17, 2019 August 13, 2019 November 20, 2019
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 2019. 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, Response Plan Monitoring Location	Sampled: April 17, 2019 August 13, 2019 November 20, 2019
SGW-1	592698.027 E 6 6122231.314 N	Downstream of the SW corner of the Phytoremediation perimeter ditch	Sampled: April 17, 2019 August 13, 2019 November 20, 2019
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: April 17, 2019 August 13, 2019 November 20, 2019
SGW-2	592533.158 E 6122444.271 N	Downstream of SGW-3, Response Plan Monitoring Location	Sampled: April 17, 2019 August 13, 2019 November 20, 2019
SGW-4	592524.282 E 6122701.595 N	Downstream of Beaver Pond, Response Plan Monitoring Location	Sampled: April 17, 2019 August 13, 2019 November 20, 2019
SGW-5	592525.999 E 6122269.748 N	Downstream of SGW-1, Response Plan Monitoring Location	Sampled: April 17, 2019 August 13, 2019 November 20, 2019

3.4.4 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. During 2018 and 2019, all SGW wells were sampled for dissolved metals. This round of sampling completes two years of data for the SGW sampling locations. However, 2019 sampling was conducted quarterly instead of monthly.

3.4.4.1 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 when a leachate collector was installed as part of the Environmental Upgrades which now captures this leachate.

Samples at this location showed elevated conductivity, TOC, and total hardness. Field conductivity ranged from 460 to 657 µS/cm from April 2019 to November 2019. This range is lower then the 2018 range by one order of magnitude, but it is still above the conductivity of naturally occurring water (<200 µS/cm). TOC ranged from 9.5 to 24.4 mg/L exceeding the BCWQG-DW criteria. These values also show a reduction when compared to the 2018 TOC range (75 – 342 mg/L). The hardness ranged from 205 to 457 mg/L. These values show a reduction when compared to the 2018 and 2017 data set. Notably, chlorides were compliant with values ranging from 7.1 to 59.9 mg/L which show a decrease from the 2018 range (98.1 to 105 mg/L).

There were exceedances of BCWQG-DW, BCWQG-AW and BC CSR-DW criteria for metals. Metals exceeding any of the criteria in one or more case include aluminum, arsenic, chromium, cobalt, iron, manganese, mercury, phosphorous and Zinc. In general, the sampling results are lower when compared to the 2018 results.

3.4.4.2 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. There are two sources of flow through this monitoring location. Firstly, run-on water that flows into the ephemeral creek via perimeter ditch sections north of Wetland #3 and #4, and west of the phytoremediation area. Secondly, SGW-3 is downstream of the Wetland #4 rock infiltration trenches which will contribute conditioned leachate flows when a controlled discharge event takes place. During 2019, a controlled discharge event started October 8, 2019 and ended during freezing conditions at the end of November 2019 (after the November 19, 2019 sampling event). When comparing the November 2019 sampling results to the April and August 2019 results, the water at SGW-3 does not appear to have been significantly impacted by this discharge event.

Samples at this location showed elevated conductivity, TOC, and total hardness. Field conductivity ranged from 804 to 1126 µS/cm from April 2019 to November 2019. This range is well above the conductivity of typical surface water (<200 µS/cm). Notably, the November 2019 sample conductivity (804 µS/cm) was the lowest recorded value for SGW-3. TOC ranged from 24.7 – 36.9 mg/L and exceeded the BCWQG-DW. This range is an improvement when compared to the 2018 range of 51 – 160 mg/L. Hardness ranged from 623 to 673 mg/L. All 2019 hardness values were within the 2018

hardness range. Lastly, the concentrations of chloride at SGW-3 were consistently less then the 2018 results. The 2019 chloride range was 9.4 to 12.4 mg/l and the 2018 chloride range was 43.9 to 49.2 mg/L.

There were consistent exceedances of BCWQG-DW, BCWQG-AW and BC CSR-DW criteria for several metals. Metals exceeding either criteria in one or mores case include arsenic, cobalt, iron, manganese, and phosphorous. When comparing cobalt, iron, manganese, and phosphorous exceedances to the 2018 data, the 2019 values are similar. Values that have decreased in 2019 when compared to the 2018 data include arsenic, aluminum, chromium and vanadium. Arsenic only exceeded the BCWQG-AW criteria during the August and November sampling events. Whereas, each 2018 sampling event exceeded both the BCWQG-AW and DW criteria. Aluminum, chromium and vanadium had exceedances in 2018, but the concentrations noted in 2019 had decreased to compliant levels for these metals.

3.4.4.3 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. When comparing the November 2019 sampling results to the April and August 2019 results, the groundwater at this location does not appear to be significantly impacted from the Wetland #4 discharge event. In general, the November 2019 sampling results had fewer and lower exceedance values then the two previous sampling events.

Samples from this location showed varying results for key leachate indicating parameters. In general, it is expected that results should decrease at SGW-2 compared to SGW-3. Parameters that have decreased at SGW-2 include conductivity, hardness, and ammonia. Field conductivity ranged from 528 µS/cm in April 2019 to 1053 µS/cm November 2019. This range is well above the conductivity of typical surface water (<200 µS/cm). When compared to SGW-3 conductivity, an expected reduction is observed. Notably, the lowest conductivity was observed in November 2019, likely caused by seasonal rains diluting flows. The hardness ranged from 303 to 582 mg/L which is lower compared to 623 – 673 mg/L at SGW-3. Ammonia ranged from 0.366 to 0.908 mg/L which is roughly a 50% reduction from SGW-3 values.

Two key leachate indicating parameters that had higher values at SGW-3 include TOC and chloride. TOC ranged from 82 – 198 mg/L and exceeded the BCWQG-DW. These values far exceeded those at SGW-3. This could show that samples at this location could be influenced by organic material commonly found in swampy areas (SGW-2 is located in a swampy area). Chloride values were elevated but within limits with values ranging from 51 to 123 mg/L. All 2019 samples exceed the corresponding values at SGW-3. This trend has not been observed in previous years with 2017 and 2018 data always showing higher chloride concentrations at SGW-3. For this reason, the elevated chloride data at SGW-2 is inconclusive and requires further monitoring to assess long term trends of chloride.

There were consistent exceedances of BCWQG-DW, BCWQG-AW and BC CSR-DW criteria for several metals. Metals exceeding either criteria in one or more cases include aluminum, arsenic, beryllium, cadmium, cobalt, iron, lithium, manganese, and phosphorous. In general, there are key leachate indicating parameters which show a decrease in concentration when compared to SGW-3 results. These metals include cobalt, iron and manganese. Notably, iron decreased by roughly 50% during the April 2019 and August 2019 sampling events, and iron decreased by roughly 80% during the

November 2019 sampling event. Other metals exceeding criteria with greater values then corresponding values at SGW-3 include aluminum and arsenic.

Of importance, there were exceedances of the CSR-DW criteria for aluminum, arsenic, cobalt, iron, lithium and manganese. Aluminum exceeded once during the April 2019 sampling event with a value of 20.7 mg/L. This is the highest aluminum value observed at the Hazelton WMF site, including the historic leachate seep at SW-03. Following the April 2019 sampling event, aluminum concentrations decreased to compliant levels in line with background concentrations. Because of this, the spike in April 2019 does not appear to be of concern. Furthermore, this spike does not correspond with discharge from the landfill site. Arsenic levels are elevated compared to background concentrations. However, exceedances of arsenic have been observed in background concentrations at BH-01 and elevated arsenic levels are observed at BH-4B. Cobalt levels are similar to background concentrations at BH-4B. Iron levels during the April 2019 sampling event were elevated to values typically observed at the historic log weir which represents attenuated leachate. However, the August 2019 and November 2019 sampling events show results slightly above background concentrations at BH-4B. Furthermore, iron is commonly observed in background concentrations for groundwater and surface water. For this reason, to completely attribute elevated iron concentrations to leachate discharge would require further investigation. Lithium had one exceedance during the April 2019 sampling event. Following the April 2019 sampling event, lithium concentrations decreased to compliant levels in line with background concentrations. Lastly, manganese levels are elevated with concentrations ranging from 4.85 mg/L to 9.55 mg/L during 2019.

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.

3.4.4.4 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, TOC, and total hardness. Field conductivity ranged from 291 – 644 µS/cm from April 2019 to November 2019. All though this range is well above the conductivity of typical surface water (<200 µS/cm), it is an improvement when compared to the 2018 data (388 – 1278 µS/cm). TOC was lower at this location than the other shallow groundwater wells but still exceeded the BCWQG-DW criteria and ranged from 10.5 – 19.2 mg/L. Hardness ranged from 426 – 506 mg/L which is lower then the 2018 range (494 – 656 mg/L).

There were exceedances of BCWQG-DW, BCWQG-AW and BC CSR-DW criteria for several metals. Metals exceeding either criteria in one or more cases include cobalt, iron, and manganese. Notably, 2019 aluminum and arsenic values have decreased to compliant levels when compared to 2018 values.

Of importance, CSR-DW exceedances include cobalt for all 2019 samples, and manganese for the August sampling event. The 2019 Cobalt range was 0.00107 to 0.00772 mg/L which is lower then the 2018 Cobalt range of 0.00842 to 0.00934 mg/L. Furthermore, BH-4B a shallow piezometer located upstream of the landfill has shown consistent exceedances an order of magnitude greater than the SGW-

4 2019 Cobalt values. The August 2019 manganese result was 1.76 mg/L is similar to background concentrations and it is similar to the lowest value observed in 2018.

3.4.4.5 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 2019 was the second year that samples were collected from this location.

Samples from this location showed elevated conductivity, TOC, and total hardness. Field conductivity ranged from 246 to 476 from April 2019 to November 2019. All though this range is slightly above the conductivity of typical surface water (<200 µS/cm), it is an improvement when compared to the 2018 data (334 – 737 µS/cm). Also, Conductivity at this location is lower than values at SGW-1 (460 to 657 µS/cm µS/cm). TOC ranged from 6.9 to 8.56 mg/L and exceeded the BCWQG-DW. This range shows a decline when compared to the 2018 values. Chloride was below the guidelines and ranged from 3.5 – 4.5 mg/L. Notably, the November sample at SGW-5 was 3.5 mg/L and the corresponding SGW-1 sample was 59.9 mg/L, indicating natural attenuation of potential leachate impact.

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

Of importance, CSR-DW exceedances include cobalt for the April and August 2019 samples, and iron for the November sampling event. The 2019 Cobalt range was 0.00409 to 0.00922. Similar to SGW-4, BH-4B has shown consistent exceedances an order of magnitude greater than the 2019 results. The November 2019 iron result was 13 mg/L. It is unlikely that this value is the result of leachate flows given that leachate was not discharged at this location during 2019. Furthermore, the lack of metal exceedances, low chlorides and low field conductivity during this sampling event would not suggest significant leachate impact.

3.4.5 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. Of importance, BH-03 was dry during each sampling event.

3.4.5.1 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-4B. These samples show that the groundwater in the area tends to exceed BCWQG-AW and DW, and BC CSR-DW standards for several parameters.

Deep wells, BH-02 and BH-4A have high conductivity, ranging from 936 to 949 µs/cm and 751 to 773 µs/cm, respectively. Both wells had hard water (total hardness) ranging from 457 - 482 mg/L and 203 - 225 mg/L for BH-02 and BH-4A, respectively. Similarly, the shallow piezometer BH-4B had elevated conductivity ranging from 43 – 666 µs/cm and hardness ranging from 9 – 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 387 to 537 µs/cm. Notably, the November 2019 sampling event experienced the highest conductivity reading. The water at BH-01 was also hard, ranging from 154 to 329 mg/L.

There were exceedances for several metal concentrations at the background wells. Monitoring wells BH-4A, BH-4B, BH-02 and BH-01 exceed either BC WQG AW and DW, and BC CSR DW guidelines for, aluminum, arsenic, cadmium, cobalt, copper, iron, manganese and phosphorous. Specifically, exceedances of BC CSR DW criteria were experienced for cobalt and iron at BH-04B, the shallow nested piezometer. Cobalt ranges from nondetectable limits to 0.0158 mg/L (June 2017 sampling event). Iron ranges from nondetectable limits to 11.4 mg/L. Notably, the April 2019 sampling event experienced the highest iron reading.

3.4.5.2 Groundwater Quality Downgradient of Landfill

Monitoring well BH-5B is the only groundwater well located downgradient from the landfill. It is located at the NW corner of the Hazelton WMF property boundary, along Highway 16. The groundwater elevation in BH-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 constantly above the levels in BH-02, suggesting leachate impact. The high chloride levels at this well (163 to 226 mg/L, 2019 range) are more indicative of attenuated leachate impact as they are comparable to values observed at SW-04, the historic log weir location. Another possible source of chloride at this well location could be runoff from the highway during salting operations.

Another parameter that is associated with leachate impact is ammonia. The ammonia levels at BH-5B range between 0.029 and 0.078 mg/L which is far below ammonia observations at the historic leachate seep (9.9 to 27.7 mg/L). Also, this range is similar to those observed at background wells BH-01 and BH-02. This information suggests that ammonia concentrations at BH-5B are not influenced by leachate impact.

There were metals in exceedance of both the BCWQG-DW, BCWQG-AW and BC CSR-DW. Exceedances of the AW limits were observed for arsenic. Metals exceeding any criteria in one or more case include arsenic, cobalt, iron, manganese, and phosphorous.

Of importance, there were exceedances of the CSR-DW standards at BH-5B for cobalt, iron, and manganese concentrations in 2019. Cobalt exceedances ranged from 0.00409 to 0.00958 mg/L. This range is similar to background concentrations observed at BH-4B. Furthermore, in May 2015, cobalt at BH-4A was observed to be 0.0141 mg/L. Iron exceedances ranged from 7.1 to 12.2 mg/L. Similar values are observed at BH-4B. Manganese exceedances ranged from 1.83 to 3.62 mg/L. Similar exceedances can be observed at BH-4B, and BH-01 and BH02 experience consistent exceedances of the BCWQG-DW criteria. In general, it appears water quality at BH-5B could be partially influenced by leachate impact and background water quality.

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 had elevated concentrations of aluminum, chromium, copper, iron, manganese and phosphorous. These elevated concentrations are regularly in non-compliance with BCWQG-AW and DW criteria. Furthermore, the exceedances in 2019 are consistent with historic data. Surface water entering the site at SW-02 had elevated levels of aluminum iron, manganese, and phosphorus. 2019 exceedances for these metals were similar to historic data. Water quality at SW-02 in 2019 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 BCWQG criteria, particularly for metals. Thus, elevated metals at downstream surface water locations cannot be solely attributed to leachate impact.

In 2019, surface water sampling location SW-06 at the inlet to Beaver Pond had the highest chloride concentrations of all the sampling locations, including all historic sampling events. This spike in chloride at SW-06 was observed during the August 2019 sampling event. Following this sampling event, the November 2019 sample results for chloride decreased to commonly observed levels. This trend was also observed at SW-08, upstream of SW-06 on the north side of Highway 16. Chloride levels at SW-08 were 30% less then SW-06. However, chloride levels at both SW-06 and SW-08 are above the results from the historic leachate seep, as shown in in Chart 2. For this reason, surface water quality is believed to be impacted by highway run-off opposed to leachate. Furthermore, impacted runoff from the landfill is now contained at site and no longer flows into the Beaver Pond. Lastly, 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 has water quality 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, TOC, and total hardness in all samples.

Sampling location SGW-1 is located downstream of the southwest corner of the Phytoremediation perimeter ditch. When compared to the 2018, SGW-1 data show decreases for key leachate indicating parameters as shown in charts 6, 7, 9, 10, and 11. This is expected given that leachate flows from the new expansion have been redirected to the leachate collection system. Downstream at the property boundary, SGW-5 continued to show improvements in water quality. Of note 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. Furthermore, metals in exceedance of BC CSR-DW criteria

at SGW-1 that have decreased to compliant levels at SGW-5 include cobalt, iron and manganese. Specific exception of this include the April 2019 and August 2019 cobalt results, and the November 2019 iron result. However, these 2019 exceedances have been observed in background concentrations. Also, no impacted runoff from the landfill has been discharged to either SGW-1 and SGW-5 in 2019. For these reasons, it is believed that the few BC CSR-DW exceedance at SGW-5 are not caused by impacted flows from the landfill.

Similarly, the data shows that the shallow groundwater is being diluted and/or attenuated between SGW-3 and SGW-2. However, the 2019 sample results for SGW-2 do not always follow this dynamic making. Because of this additional investigation is required to determine leachate impacts at SGW-2. In summary, key leachate indicating parameters showing expected decreases in concentration include conductivity, hardness, ammonia, cobalt, iron, and manganese. Whereas, conflicting results showing an increase at SGW-2 are TOC, chloride, and aluminum and arsenic. As previously mentioned, these contrasting results are likely influenced by swampy waters. Furthermore, these results do not correlate to the Wetland #4 leachate discharge event. Even though several exceedances of BC CSR-DW criteria were experienced at SGW-2, none of these exceedances were observed in the Wetland #4 sampling events. The 2019 Wetland #4 data shows better water quality then the background water quality, with no exceedances of BC WQG-AW from August 2019 to November 2019. For these reasons, BC CSR-DW exceedances at SGW-2 are not necessarily directly to linked leachate discharge in 2019. Regardless, 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. It is recommended that SGW-2 continue to be monitored for long term water quality trends to confirm if results will form consistent trends.

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.

4.2.2 Groundwater Wells

The background groundwater quality at BH-01 and BH-02 was found to have elevated conductivity, hardness, manganese and phosphorous. Background water quality at BH-4B contrastingly has low conductivity and hardness with far more exceedances of metals including aluminum, cadmium, cobalt, copper, iron, manganese and phosphorous. Furthermore, BH-4B experiences regular BC CSR-DW exceedances for cobalt and iron. The contrast in results is attributed to BH-4B being a shallow well is likely influenced by surficial swamp waters.

The water in BH-03, which would intercept any flow from landfill leachate before it reached the public water well was dry during 2019. In previous years, there was no concern of leachate impacting this area. The risk with this trend changing in 2019 is considered to be low.

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 metal exceedances are less or similar to background conditions. For instance, Ammonia levels at BH-5B are consistently lower than background concentrations at BH-01 and BH-02, as shown in Chart 14. This shows that ammonia

concentrations at BH-5B are similar to background conditions. In general, it is challenging to determine the portion of contamination resulting from leachate or other sources such as nearby highway operations. For these reasons, additional monitoring locations are required to determine whether 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 2019, duplicate samples were obtained during the August and November groundwater sampling events, the November surface water sampling event and the September 16th Wetland #4 sampling event. 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-01	August 13, 2019	Dissolved Aluminum	200%
		Dissolved Barium	39%
		Dissolved Calcium	35%
		Dissolved Cobalt	192%
		Dissolved Iron	196%
		Dissolved Lithium	129%
		Dissolved Manganese	137%
		Dissolved Molybdenum	66%
		Dissolved Rubidium	127%
		Dissolved Silicon	104%
BH-5B	November 20, 2019	Dissolved Aluminum	48%
		Dissolved Copper	75%
		Dissolved Nickel	22%
		Dissolved Selenium	39%
		Dissolved Zinc	80%
SW-05	November 21, 2019	Alkalinity (Total as CaCO3)	89%
		Chemical Oxygen Demand (COD)	54%
		Nitrate (N)	21%
		Total Aluminum	58%
		Total Chromium	26%
		Total Copper	26%
		Total Lead	40%
		Total Rubidium	23%

		Total Vanadium	34%
SW-08	November 21, 2019	Alkalinity (Total as CaCO3)	89%
		Total Aluminum	49%
		Total Arsenic	42%
		Total Barium	38%
		Total Cadmium	24%
		Total Cesium	64%
		Total Chromium	49%
		Total Cobalt	36%
		Total Copper	65%
		Total Iron	40%
		Total Lead	43%
		Total Mercury	31%
		Total Nickel	40%
		Total Potassium	54%
		Total Silicon	23%
		Total Tungsten	56%
		Total Zinc	80%
Wetland #4	September 16, 2019	Total Aluminum	33%
		Total Chromium (Cr)	22%
		Total Manganese (Mn)	145%
		Total Selenium (Se)	25%

Notably, parameters that are out of compliance in two or more instances include aluminum, cobalt, copper, chromium, iron, lead, manganese, nickel, rubidium, selenium, silicon and zinc.

6. CONCLUSIONS AND RECOMMENDATIONS

The Operational Certificate 17226 for the Hazelton Regional Landfill was amended on February 7, 2018. As such, the environmental monitoring program in 2019 followed the amended OC for a second year. This has provided two years of monitoring data for the altered conditions at site result from the Hazelton Environmental Upgrades project.

Sampling results suggest that the surface water in the area consistently exceeds BCWQG for aluminum, cadmium, 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 the Beaver Pond. This is to be expected given that leachate flows have been redirected such that leachate no longer flows into Beaver Pond. Furthermore, SW-06 and SW-08 experienced a spike in chloride concentrations that is not influenced by impacted run-off from the landfill. As such, observed exceedances at SW-05 are likely caused by water quality at highway 16. Lastly, SW-09 and SW-10 were not sampled during the 2019 year because they were dry.

Shallow groundwater wells appear to have increased leachate impact with closer proximity to the landfill. It has been observed that the impact at the property boundary has been significantly diluted/attenuated in the case of flow from SGW-1 to SGW-5. In contrast, flows from SGW-3 to SGW-2 show inconclusive results for some key leachate indicating parameters. This is especially unclear when comparing Wetland #4 water quality to that of SGW-2. For this reason, it is recommended that the SGW wells be monitored for another year to confirm if water quality trends stabilize. Lastly, SGW-4 water quality showed some BC CSR-DW exceedances in 2019 which were also observed in background concentrations. Thus, exceedances of BC CSR-DW at SGW-4 are not considered to be caused by leachate impact, rather naturally occurring exceedances.

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 problematic to determine the portion of contamination resulting from nearby highway operations. For these reasons, it is challenging 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. Moreover, the nested wells would be similar in depth to SGW wells providing data from a similar sources making comparisons more accurate.

The water in BH-03, which would intercept any flow from landfill leachate before it reached the public water well, was dry during 2019. However, the risk of landfill leachate impact is low when considering historical trends. It is recommended that a deeper well be installed at a similar location to allow collection of data to confirm acceptable water quality results. This is important to confirm that the water source for the public water wells is safe for usage.

There was a discharge via Wetland #4 for 2019. It started October 8, 2019, and ended during freezing conditions at the end of November 2019. Prior to discharge, the OC requirements were confirmed for compliance, as shown in Table 4: Wetland #4 Water Quality Data, including lethal toxicity testing. However, the volume of discharge was not recorded, as per the OC. This occurred because the discharge weir was not completely installed. Weir construction will be completed in the 2020 construction season.

After a thorough review of the 2019 monitoring data submitted by RDKS staff, SHA recommends the following:

- Surface water monitoring should continue to be conducted as per the amended OC.
- Shallow groundwater wells are recommended to be sampled quarterly for another year. Although 2019 was the second year of sampling, water quality results show inconsistent results. Because of this, additional data will help determine trends more accurately.
- 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.
- Installation of a deeper well in the vicinity of BH-03 should be conducted to ensure water quality can always be confirmed before reaching the public water wells.
- 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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June 26, 2020

8. REFERENCES

AGRA & Associated Engineering , Proposed Hazelton Landfill Expansion Information in Support of the Applications For a Crown Lease and Landfill Operational Certificate, 2000, File 962576-3-0.

Ministry of Environment. Operational Certificate 17226 for the Hazelton Regional Landfill. Amended Date: February 7, 2018.

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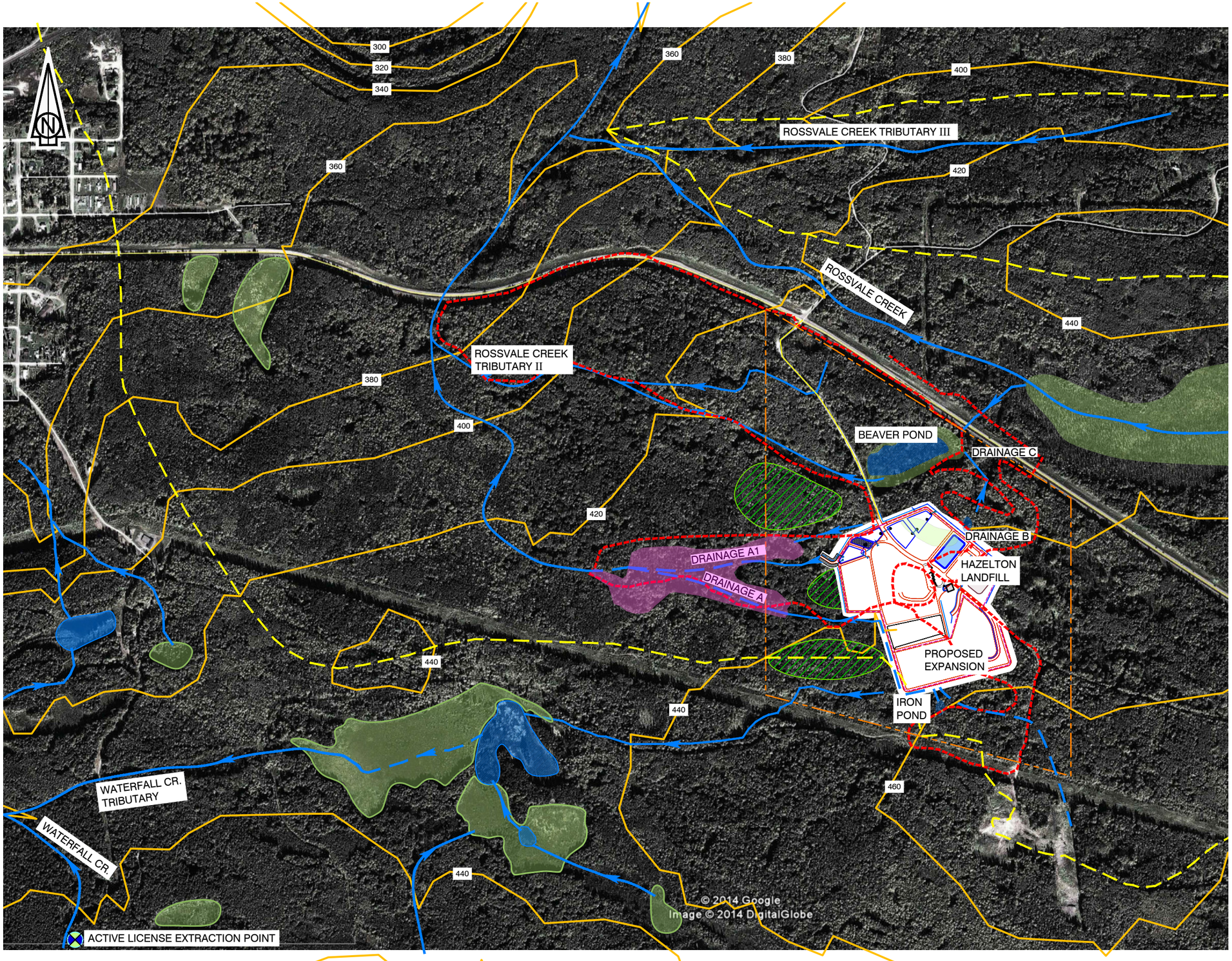
Sperling Hansen Associates. Hazelton Landfill Annual Report 2018 PRJ19009.

Appendix A: Figures



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LEGEND:

- POND
- WETLAND
- HIGHER GROUND
- CREEK
- INTERMITTENT CREEK
- LANDFILL LEASE PROPERTY BOUNDARY
- 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:
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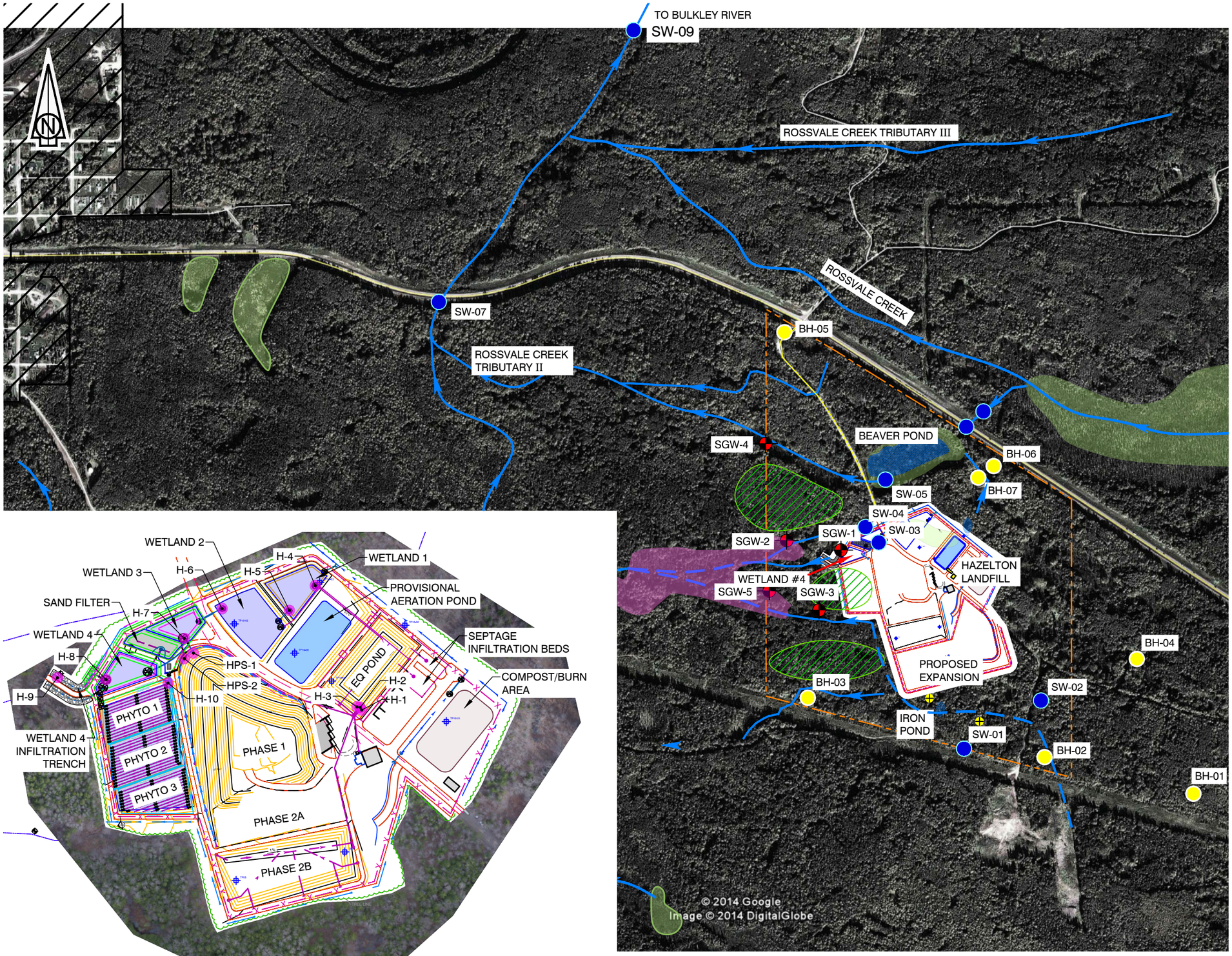

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LEGEND:

- SURFACE WATER MONITORING LOCATION
- GROUNDWATER MONITORING WELL
- PROPERTY LINE
- SHALLOW GROUNDWATER WELL
- CULTURALLY MODIFIED TREE

SAMPLE & MONITOR

- H-1: OFFICE SEPTIC
- H-2: PHASE 2A TO EQ POND
- H-3: LEACHATE MANHOLE TO EQ POND
- H-4: EQ POND DISCHARGE
- H-5: WETLAND #1
- H-6: WETLAND #2
- H-7: WETLAND #3
- H-8: WETLAND #4
- H-9: WETLAND #4 INFILTRATION TRENCH
- H-10: PHYTOREMEDIATION

MONITOR & FLOW MEASUREMENT

- HPS-1
- HPS-2

CLIENT: Regional District of Kitimat-Stikine

PROJECT: HAZELTON WMF ANNUAL MONITORING REPORT

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

SCALE:	DATE:	PROJECT NO:
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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						
Date				16-Apr-16	7-Jul-16	25-Oct-16	14-Jun-17	28-May-18	21-Nov-19	16-Apr-16	7-Jul-16	25-Oct-16	14-Jun-17	28-May-18	13-Aug-19	21-Nov-19
Total Hardness	mg/L	-	-	18	41	23	22	16	17	22	21	26	14	12	33	15
Dissolved Hardness (CaCO3)	mg/L	-	-													
Alkalinity (Total as CaCO3)	mg/L	-	-	17	10	23	20		15	21	22	31	17			21
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0	12.3	41.8	17.6	1.0		17.8	9.4	9.1	10.1	1.3			12.4
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	47	33	38	35	46	27	145	43
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	30.4	
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	<1.0	8.8	<1.0	<1.0	<0.30	<0.30	<1.0	<1.0	<1.0	<1.0	<0.30	<0.30	<0.30
Chloride (Cl)	mg/L	600	250, AO	<1.0	<1.0	2	<1.0	<0.50	1	<1.0	<1.0	1	<1.0	<0.50	1	<0.50
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5					0.032	0.027					0.024	0.025	<0.020
Total Kjeldahl Nitrogen	mg/L	-	-						1.34							1.76
Ammonia (N)	mg/L	0.681-28.7 (d)	-	<0.03	0.11	<0.03	<0.03	0.0121	0.0426	<0.03	<0.03	<0.03	<0.03	0.0107	0.221	0.0549
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		
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0	<0.01	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.01	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.0010
Nitrate (N)	mg/L	32.8	10 MAC	0.014	0.01	<0.01	<0.01	0.0061	<0.0050	0.011	<0.01	0.012	<0.01	<0.0050	<0.0050	<0.0050
Conductivity	uS/cm	-	-	34	44	51	44		38	44	45	64	33			39.80
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		7	6.4	6.3	7.0	6.6		7	7
Field pH	pH Units	6.5 - 9.0	7.0-10.5					5.5						6.0	5.56	
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	1.55	0.475	1.640	0.031	0.047	0.033	1.830	0.189
Total Antimony (Ab)	mg/L	0.009	0.006	0.0001	0.0005	0.0003	<0.00010	<0.00010	0.00022	0.0002	0.0004	0.0002	<0.00010	<0.00010	0.00011	<0.00010
Total Arsenic (As)	mg/L	0.005	0.01 MAC	0.0008	0.0064	0.0024	0.00078	0.00053	0.00083	0.001	0.0015	0.0009	0.00066	0.00048	0.00131	0.00059
Total Barium (Ba)	mg/L	1	1.0	0.014	0.173	0.020	0.014	0.012	0.020	0.014	0.024	0.014	0.007	0.008	0.049	0.009
Total Beryllium (Be)	mg/L	0.00013	-	<0.0001	0.0003	<0.0001	<0.00010	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Total Bismuth (Bi)	mg/L	-	-	<0.0001	<0.0001	<0.0001	<0.00010	<0.000050	<0.000050	<0.0001	<0.0001	<0.0001	<0.00010	<0.000050	<0.000050	<0.000050
Total Boron (B)	mg/L	1.2	5.0, MAC	0.005	0.045	<0.004	0.005	<0.010	<0.010	0.004	0.015	<0.004	0.005	<0.010	<0.010	<0.010
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e) (k)	0.005, MAC	0.00007	0.00325	0.00017	0.000047	0.0000481	0.0000559	0.00004	0.00051	0.00004	0.000027	0.0000052	0.000352	0.000106
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	5.6	11.9	7.1	6.7	4.76	5.04	6.2	6.2	7.3	4.04	3.44	9.28	4.1
Total Cesium (Cs)	mg/L	-	-					<0.000010	0.000084					<0.000010	0.000174	0.000011
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	0.0007	0.0105	0.0009	0.00067	0.0004	0.00157	0.0007	0.0021	<0.0005	<0.00050	0.00018	0.00162	0.00031
Total Cobalt (Co)	mg/L	0.11	-	0.00082	0.0125	0.00272	0.00111	0.00072	0.00049	0.00068	0.00082	0.00022	0.00014	0.0003	0.0012	0.00025
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	0.0028	0.0318	0.0017	0.00161	0.00122	0.00711	0.004	0.0066	0.0004	0.00075	<0.00050	0.00594	0.00136
Total Iron (Fe)	mg/L	1	0.3, AO	1.10	24.80	3.47	1.30	0.66	0.97	1.10	2.07	0.84	0.31	0.54	3.31	0.53
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.0002	0.0061	<0.0001	<0.00010	0.000059	0.00037	0.0003	0.0006	<0.0001	<0.00010	<0.000050	0.000664	0.000182
Total Lithium (Li)	mg/L	-	-	0.0002	0.0046	0.0001	0.00011	<0.0010	<0.0010	0.0003	0.0008	0.0001	0.0001	<0.0010	0.0014	<0.0010
Total Magnesium (Mg)	mg/L	-	-	1.06	2.81	1.36	1.19	1.06	1.26	1.51	1.27	1.94	0.89	0.793	2.35	1.27
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	0.183	1.63	0.554	0.165	0.126	0.0634	0.129	0.123	0.101	0.0304	0.117	0.258	0.180
Total Mercury (Hg)	mg/L.	0.0001	0.001	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	0.0000115	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.000025	<0.0000050
Total Molybdenum (Mo)	mg/L	2	0.25	0.0002	0.0019	0.0002	0.00012	0.000153	0.000113	0.0002	0.0002	<0.0001	<0.00010	0.000095	0.000193	0.000143
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.0011	0.0164	0.0016	0.0011	0.00108	0.00178	0.0012	0.0021	0.0002	<0.00020	<0.00050	0.00276	<0.00050
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	0.10	0.07	0.11	0.14	<0.050	0.079	0.35	0.21
Total Potassium (K)	mg/L	-	-	0.79	1.71	1.14	0.66	0.172	1.44	0.93	0.89	3.19	0.86	0.732	1.83	3.28
Total Rubidium (Rb)	mg/L							0.00025	0.00151					0.00049	0.00241	0.00151
Total Selenium (Se)	mg/L	0.002	0.01, MAC	<0.0005	<0.0005	<0.0005	<0.00050	<0.000050	0.000071	<0.0005	<0.0005	<0.0005	<0.00050	<0.000050	<0.000050	<0.000050
Total Silicon (Si)	mg/L	-	-	3.7	15.3	4.8	3.5	1.63	6.3	4.8	5	2.7	2	1.64	4.36	1.38
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	<0.00005	0.00026	<0.00005	<0.000050	<0.000010	0.000027	<0.00005	<0.00005	<0.00005	<0.000050	<0.000010	0.000028	<0.000010
Total Sodium (Na)	mg/L	-	<200, AO	1.45	1.1	1.47	1.47	1.49	1.37	1.81	1.02	1.15	0.72	0.795	1.07	0.493
Total Strontium (Sr)	mg/L	-	-	0.038	0.082	0.06	0.0424	0.034	0.0351	0.04	0.035	0.055	0.026	0.0225	0.0655	0.0254
Total Sulphur (S)	mg/L	-	-	<1	3	<1	<3.0	<0.50	<0.50	<1	<1	<1	<3.0	<0.50	<0.50	<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	<0.00020
Total Thallium (Tl)	mg/L	0.0008	-	<0.00002	0.00005	<0.00002	<0.000020	<0.000010	<0.000010	<0.00002	<0.00002	<0.00002	0.000048	<0.000010	0.000016	<0.000010
Total Thorium (Th)	mg/L	-	-	<0.0001	0.00	<0.0001	<0.00010	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Total Tin (Sn)	mg/L	-	-	<0.0002	<0.0002	<0.0002	<0.00020	<0.00010	<0.00010	<0.0002	<0.0002	<0.0002	<0.00020	<0.00010	<0.00010	<0.00010
Total Tungsten (W)	mg/L							0.00134	0.0297					0.00096	0.022	0.00728
Total Titanium (Ti)	mg/L	-	-	0.007	0.121	<0.005	<0.0050	<0.00010	<0.00010	0.009	0.034	<0.005	<0.0050	<0.00010	<0.00010	<0.00010
Total Uranium (U)	mg/L	0.0085	0.02	<0.00002	0.00027	<0.00002	<0.000020	<0.000010	0.000044	<0.00002	0.00003	<0.00002	<0.000020	<0.000010	0.000022	<0.000010
Total Vanadium (V)	mg/L	-	-	<0.001	0.024	0.001	<0.0010	<0.00050	0.00285	0.002	0.003	<0.001	<0.0010	<0.00050	0.00306	0.00098
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	0.008	0.056	0.008	0.0051	0.0033	0.0096	0.006	0.009	0.009	<0.0040	0.0054	0.0243	0.0159
Total Zirconium (Zr)	mg/L	-	-	0.0003	0.0009	0.0002	0.0002	0.000148	<0.0012	0.0003	0.0014	<0.0001	<0.00010	<0.000060	<0.00020	<0.00020

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-03							SW-04											
Date				26-Jul-04	25-May-06	10-Jun-08	16-Apr-16	7-Jul-16	25-Oct-16	14-Jun-17	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
Total Hardness	mg/L	-	-				1090	726	814	805					398	313	504	403	826	105	594	472
Dissolved Hardness (CaCO3)	mg/L	-	-																		160	
Alkalinity (Total as CaCO3)	mg/L	-	-	1,090	961	1,300	900	570	940	1,000	366	480	403	305	473	414	460	440	210	400	640	503
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0				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	-	-	119	146	113	203	125	117	83	52	62	66	185	38	67	76	86	52	ND	41	34
Biological Oxygen Demand (BOD)	mg/L	-	-	6	16	>71	16	22	9.6	11	7	ND	6.5	25	ND	5.3	ND	10	ND	ND	ND	5.5
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	2.9	6.7	10.5	13.1	20.8	18.4	17.8	13.3	3.4	ND	1,100	46	3.0	130	25.1	678	46.8	22.3	4.5
Chloride (Cl)	mg/L	600	250, AO	279	270	270	301	344	291	308	137	186	140	67	106	139	173	90	72	140	248	140
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5																			
Total Kjeldahl Nitrogen	mg/L	-	-	28.1	22	30.7					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
Ammonia (N)	mg/L	0.681-28.7 (d)	-	27.7	24.6	9.9	17	5.42	23	24.8	1.69	1.6	3.3	1.2	2.9	ND	0.04	0.27	0.33	ND	0.07	0.06
Nitrate plus Nitrite (N)	mg/L	-	-				6.8	4.46	3.38	0.4												
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0				0.039	0.6	0.011	0.02												
Nitrate (N)	mg/L	32.8	10 MAC				6.76	<0.04	3.37	0.38												
Conductivity	uS/cm	-	-	2,620	2,160	1,970	2,350	1,920	2,400	2,570	963	1,290	1,070	2,320	1,247	1,160	1,550	1,040	1,710	1,250	1,816	1,330
Field Conductivity	uS/cm	-	-																			
pH	pH Units	6.5 - 9.0	7.0-10.5	7.0	7.2	7.2	7.6	7.6	7.6	7.4	7.5	7.7	7.6	7.0	7.5	7.4	7.6	7.2	7.3	7.4	7.8	7.3
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																			
Total Metals																						
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	0.080	0.380	0.011	8.330	9.020	1.340	0.715	0.060	0.020	0.007	10.4	0.014	0.025	0.050	7.60	0.027	0.007	0.143	0.067
Total Antimony (Ab)	mg/L	0.009	0.006	<0.05	ND	ND	0.0015	0.0012	0.0007	0.00031	ND	ND	ND	0.0018	ND	0.0003	0.0005	0.00071	0.00071	ND	ND	ND
Total Arsenic (As)	mg/L	0.005	0.01 MAC	<0.05	0.12	0.003	0.016	0.0132	0.0037	0.00977	ND	ND	0.0021	0.0239	0.0017	0.0047	0.0052	0.00607	0.00237	0.00036	0.00057	0.00372
Total Barium (Ba)	mg/L	1	1.0	1.090	1.290	0.201	1.720	1.020	0.573	0.885	0.128	0.201	0.145	0.381	0.164	0.197	0.176	0.214	0.328	0.032	0.159	0.224
Total Beryllium (Be)	mg/L	0.00013	-	<0.0002	ND	ND	0.0002	0.0002	<0.0001	<0.00010	ND	ND	ND	0.0003	ND	ND	ND	0.00017	ND	ND	ND	ND
Total Bismuth (Bi)	mg/L	-	-	<0.05	ND	ND	<0.0001	<0.0001	<0.0001	<0.00010	ND	ND	ND	ND	ND	ND	ND	0.00006	ND	ND	ND	ND
Total Boron (B)	mg/L	1.2	5.0, MAC	1.9	1.94	1.31	3.33	1.98	2.4	2.94	1.02	1.31	1.3	0.993	1.01	1.54	1.39	0.69	2.03	0.255	1.17	1.16
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e) (k)	0.005, MAC	<0.002	ND	0.00052	0.00067	0.00038	0.00027	0.00009	ND	ND	0.00014	0.00149	0.00014	0.00131	0.00018	0.000605	0.000279	0.000039	0.000077	0.000092
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	240	229	101	318	214	220	228	79.8	101	93.1	514	114	74.7	145	109	248	29.9	160	134
Total Cesium (Cs)	mg/L	-	-																			
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	<0.005	0.01	0.001	0.0124	0.0104	0.0034	0.00238	ND	ND	0.001	0.012	ND	0.0013	0.001	0.009	ND	ND	ND	ND
Total Cobalt (Co)	mg/L	0.11	-	<0.005	ND	0.001	0.00896	0.00792	0.00346	0.00402	ND	ND	0.0007	0.0197	0.0018	0.00131	0.0028	0.00645	0.00177	ND	0.00069	0.00217
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	<0.005	0.008	0.0022	0.0318	0.0238	0.0093	0.00325	ND	ND	0.0013	0.0469	0.0016	0.008	0.0038	0.0226	0.00294	0.00088	0.00279	0.00098
Total Iron (Fe)	mg/L	1	0.3, AO	51.30	102.00	0.44	154.00	86.50	8.16	16.20	0.30	0.44	0.22	22.70	0.41	0.60	0.40	12.7	0.233	0.02	0.16	0.97
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	<0.03	ND	ND	0.0215	0.016	0.0033	0.00036	ND	ND	ND	0.0122	ND	0.00044	ND	0.00515	ND	ND	ND	ND
Total Lithium (Li)	mg/L	-	-	ND	ND	ND	0.0115	0.0082	0.005	0.00358			ND	0.011	ND	ND	ND	0.0072	ND	ND	ND	ND
Total Magnesium (Mg)	mg/L	-	-	66	54.8	29.9	70.4	46.2	63.9	57.1	22.3	29.9	25.1	58.8	27.4	30.8	34.5	31.7	49.9	7.31	47.5	33.4
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	5.06	6.82	2.03	8.51	3.43	7.13	5.23	1.12	2.03	0.123	28.5	1.57	0.5	5.73	1.95	2.09	0.221	0.0112	2.77
Total Mercury (Hg)	mg/L.	0.0001	0.001	<0.00005	ND	ND(1)	<0.00002	<0.00002	<0.00002	<0.00002	ND	ND	ND	ND	ND	ND	0.00023	ND	ND	ND	ND	ND
Total Molybdenum (Mo)	mg/L	2	0.25	<0.005	ND	ND	0.0006	0.0005	0.0009	0.00122	ND	ND	ND	0.011	ND	0.0007	0.012	0.00182	0.0027	ND	0.001	ND
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.008	ND	ND	0.0305	0.0223	0.0219	0.0157	ND	ND	0.005	0.029	0.005	0.007	0.009	0.0161	0.0056	0.0015	0.0083	0.0066
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	0.10	0.30		1.78	0.56	0.12	0.076	0.10	ND	ND	ND	ND	ND	ND		0.069	0.017	0.022	0.054
Total Potassium (K)	mg/L	-	-	54	50	34	63.6	35.5	51.3	54.2	23	34	34.2	27.8	22.8	32.9	39.5	22.7	24	6.98	23	31.4
Total Rubidium (Rb)	mg/L																					
Total Selenium (Se)	mg/L	0.002	0.01, MAC	<0.03	ND	ND	<0.0005	<0.0005	<0.0005	<0.00050	ND	ND	ND	0.0004	ND	ND	ND	0.00017	ND	ND	0.00013	0.0001
Total Silicon (Si)	mg/L	-	-	<0.01	16	6.74	34.4	26.5	12.9	14.9	4.29	6.74	3.74	19.8	5.64	4.48	8.83	16.4	6.2	1.95	4.08	9.55
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	229	ND	0.00009	0.00013	0.00009	<0.00005	<0.000050	ND	ND	0.000006	ND	ND	ND	0.000013	0.000065	ND	ND	ND	ND
Total Sodium (Na)	mg/L	-	<200, AO	1.62	189	126	289	153	233	249	98.7	126	110	64.3	93.4	132	134	72.4	71.9	24.8	164	124
Total Strontium (Sr)	mg/L	-	-	2.3	1.45	0.724	2.03	1.35	1.82	1.63	0.536	0.724	0.689	2.08	0.724	0.637	0.856	0.705	1.66	0.213	1.1	0.879
Total Sulphur (S)	mg/L	-	-	<0.05	4.4	1.8	9	10	10	7.6	5.1	1.8	12	468	17	ND	44	ND	245	ND	6.3	ND
Total Tellurium (Te)	mg/L		-				<0.0002	<0.0002	<0.0002	<0.00020												
Total Thallium (Tl)	mg/L	0.0008	-	<0.03	ND	ND	0.00006	0.00006	<0.00002	<0.000020	ND	ND	ND	0.00015	ND	ND	ND	0.000064	ND	ND	ND	ND
Total Thorium (Th)	mg/L	-	-				0.00	0.00	<0.0001	<0.00010												
Total Tin (Sn)	mg/L	-	-	<0.02	ND	ND	0.0004	0.0003	0.0003	0.00025	ND	ND	ND	ND	ND	0.0001	ND	0.0004	ND	ND	ND	ND
Total Tungsten (W)	mg/L																					
Total Titanium (Ti)	mg/L	-	-	<0.003	ND	ND	0.172	0.189	0.035	0.021	ND	ND	ND	0.313	ND	ND	0.005	0.131	ND	ND	ND	ND
Total Uranium (U)	mg/L	0.0085	0.02	ND	ND	ND	0.00048	0.00036	0.00036	0.000548			0.0001	0.0028	0.0005	0.00013	0.0017	0.000341	0.00135	0.00013	0.00346	0.00017
Total Vanadium (V)	mg/L	-	-	<0.005	ND	ND	0.021	0.018	0.004	0.0025	ND	ND	ND	0.023	ND	ND	ND	0.0175	ND	ND	ND	ND
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	<0.005	0.055	0.005	0.334	0.163	0.054	0.0094	0.007	0.005	0.008	0.131	0.01	0.0144	0.006	0.043	0.0082	ND	ND	ND
Total Zirconium (Zr)	mg/L	-	-	<0.005	ND	ND	0.0024	0.0018	0.0005	0.00065	ND	ND	ND	0.0012	ND	ND	ND	0.0005	ND	ND	ND	ND

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)																					
Date				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	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
Total Hardness	mg/L	-	-	352	293	292	326	549	306	359	359	394						41	46	50	43	40	46	103	49
Dissolved Hardness (CaCO3)	mg/L	-	-	336																				31	
Alkalinity (Total as CaCO3)	mg/L	-	-	415	316	310	370	530	340	370	370	420	24	21	28	22	20	21	23	32	19	23	34	45	44
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	-	-	73	37	42	146	105	50	39	39	<20	73	61	88	74	81	53	91	64		120	74	126	65
Biological Oxygen Demand (BOD)	mg/L	-	-	ND	16.0	4.000	35.000	6.900	7.200	4.800	4.800	<4.0	<6	ND	ND	ND	ND	ND	ND	ND	ND	7.6	4.2	21	ND
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	ND	23.4	14.1	6.8	30.4	17.9	6.8	6.8	13.7	<0.5	ND	ND	ND	ND	2.9	ND	0.8	ND	ND	ND	ND	ND
Chloride (Cl)	mg/L	600	250, AO	139	94	77	110	193	15	167	167	140	60	45	43	39	41	41	47	56	59	37	52	158	54
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5																						
Total Kjeldahl Nitrogen	mg/L	-	-	1.92	1.93	1.300	7.930						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
Ammonia (N)	mg/L	0.681-28.7 (d)	-	0.45	0.12	0.250	0.067	0.190	0.550	0.120	0.120	1.1	0.06	ND	ND	0.04	0.03	0.05	ND	0.03	0.07	0.04	ND	0.69	0.05
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	-	-	1,150	895	826	1010	1530	1070	1090	1090	1,210	257	176	193	149	173	187	220	259	243	182	261	602	278
Field Conductivity	uS/cm	-	-																						
pH	pH Units	6.5 - 9.0	7.0-10.5	7.8	7.3	7.4	7.2	7.8	7.8	7.8	7.8	7.5	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
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		1.40	0.174	1.020	5.990	0.012	0.015	0.015	0.098	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
Total Antimony (Ab)	mg/L	0.009	0.006		ND	0.00020	0.00020	0.00030	0.00020	0.00040	0.00040	0.0002	<0.05	ND	ND	ND	ND	ND	0.00008	ND	0.00006	ND	ND	ND	ND
Total Arsenic (As)	mg/L	0.005	0.01 MAC		0.00301	0.00210	0.00720	0.00180	0.00240	0.00330	0.00330	0.00286	<0.05	ND	ND	0.0007	0.001	0.0004	0.00093	0.0006	0.00058	0.00102	0.00066	0.00117	0.00055
Total Barium (Ba)	mg/L	1	1.0		0.137	0.10400	0.19800	0.19000	0.07600	0.20100	0.20100	0.190	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
Total Beryllium (Be)	mg/L	0.00013	-		ND	<0.0001	<0.0001	0.00010	<0.0001	<0.0001	<0.0001	<0.00010	<0.0002	ND	ND	ND	ND	ND	0.00001	ND	ND	ND	ND	ND	ND
Total Bismuth (Bi)	mg/L	-	-		ND	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Boron (B)	mg/L	1.2	5.0, MAC		0.638	0.83	0.72	1.74	1.17	0.99	0.99	1.18	<0.008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e) (k)	0.005, MAC		0.000264	0.00034	0.00025	0.00033	0.00002	0.00003	0.00003	0.000027	<0.002	ND	ND	0.00006	0.00002	0.00004	0.000298	ND	0.000044	0.000145	0.000023	0.000071	0.000012
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-		81.1	80.90	93.20	152.00	90.00	97.30	97.30	114	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
Total Cesium (Cs)	mg/L	-	-																						
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC		0.0018	0.00070	0.00170	0.00590	<0.0005	<0.0005	<0.0005	0.00056	<0.005	ND	ND	0.001	ND	ND	0.0008	ND	0.0008	ND	ND	0.0015	ND
Total Cobalt (Co)	mg/L	0.11	-		0.00262	0.00113	0.00536	0.00269	0.00081	0.00172	0.00172	0.00209	<0.005	ND	ND	ND	ND	ND	0.000156	ND	0.00031	0.00083	ND	0.00157	ND
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO		0.00721	0.00270	0.00590	0.01840	0.00050	0.00050	0.00050	0.00063	<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
Total Iron (Fe)	mg/L	1	0.3, AO		2.46	0.56	4.22	5.31	0.24	0.83	0.83	0.98	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
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01		0.00139	0.00020	0.00130	0.00320	<0.0001	<0.0001	<0.0001	0.00017	<0.03	ND	ND	ND	0.0004	0.0005	0.000188	ND	0.00027	0.0005	0.00029	0.00139	0.0002
Total Lithium (Li)	mg/L	-	-		ND	0.0015	0.0022	0.0033	0.0012	0.0016	0.0016	0.00172				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Magnesium (Mg)	mg/L	-	-		22	21.90	22.50	41.40	19.70	28.30	28.30	26.6	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
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO		1.89	0.52	5.63	0.14	0.57	2.65	2.65	2.99	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
Total Mercury (Hg)	mg/L.	0.0001	0.001		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Molybdenum (Mo)	mg/L	2	0.25		ND	0.0005	0.0006	0.0006	0.0003	0.0010	0.0010	0.00038	<0.005	ND	ND	ND	ND	ND	0.00011	ND	0.00092	ND	ND	ND	ND
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-		0.007	0.0045	0.0066	0.0146	0.0046	0.0050	0.0050	0.00546	<0.008	ND	ND	0.001	ND	ND	0.00098	0.001	0.0011	ND	ND	0.0022	ND
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO		0.337	0.10	0.25	0.21	0.06	0.05	0.05	0.086	<0.1	ND	ND	ND	ND	ND	ND	ND		0.176	0.08	0.222	0.058
Total Potassium (K)	mg/L	-	-		17	18.4	19.8	24.6	18.2	23.1	23.1	22.3	<1	ND	ND	0.71	0.32	0.85	0.48	1.36	0.8	0.638	1.54	2.04	0.848
Total Rubidium (Rb)	mg/L																								
Total Selenium (Se)	mg/L	0.002	0.01, MAC		ND	0.00080	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.03	ND	ND	ND	ND	ND	0.00006	ND	0.00007	ND	ND	ND	ND
Total Silicon (Si)	mg/L	-	-		7.68	7.3	7.5	12.8	12.2	9.5	9.5	9.9	<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
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-		0.000029	<0.00005	<0.00005	0.00012	<0.00005	<0.00005	<0.00005	<0.000050	32.4	ND	ND	0.000006	ND	ND	ND	ND	0.000006	ND	ND	0.000024	ND
Total Sodium (Na)	mg/L	-	<200, AO		77.1	72.7	82.8	152.0	85.3	88.3	88.3	92.1	0.114	21.7	23.3	16.3	21.9	19.5	27.5	30	27.9	21	39.2	75.7	40.7
Total Strontium (Sr)	mg/L	-	-		0.552	0.59	0.57	0.91	0.54	0.79	0.79	0.772	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
Total Sulphur (S)	mg/L	-	-		8.4	10.0	3.0	13.0	7.0	3.0	3.0	4.2	<0.05	0.3	0.7	ND	ND	3	ND	ND	ND	ND	ND	ND	ND
Total Tellurium (Te)	mg/L		-			<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020												<0.0002	<0.0002
Total Thallium (Tl)	mg/L	0.0008	-		ND	<0.00002	<0.00002	0.00003	<0.00002	<0.00002	<0.00002	<0.000020	<0.03	ND	ND	ND	ND	ND	ND	ND	0.000004	ND	ND	ND	ND
Total Thorium (Th)	mg/L	-	-			<0.0001	<0.0001	0.00010	<0.0001	<0.0001	<0.0001	<0.00010												<0.0001	<0.0001
Total Tin (Sn)	mg/L	-	-		ND	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.02	ND	ND	ND	ND	ND	0.00003	ND	0.0002	ND	ND	ND	ND
Total Tungsten (W)	mg/L																								
Total Titanium (Ti)	mg/L	-	-		0.0258	<0.005	0.014	0.084	<0.005	<0.005	<0.005	<0.0050	<0.003	ND	ND	ND	0.01	ND	0.0013	ND	ND	0.0064	ND	0.0156	ND
Total Uranium (U)	mg/L	0.0085	0.02		0.00036	0.0002	0.0002	0.0024	0.0001	0.0003	0.0003	0.000207				ND	ND	ND	0.000007	ND	0.000014	ND	ND	ND	ND
Total Vanadium (V)	mg/L	-	-		ND	<0.001	0.003	0.009	<0.001	<0.001	<0.001	<0.0010	<0.005	ND	ND	ND	ND	ND	ND	ND	0.0007	ND	ND	ND	ND
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO		0.0161	0.006	0.019	0.031	<0.004	<0.004	<0.004	<0.0040	<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
Total Zirconium (Zr)	mg/L	-	-		ND	0.000	0.000	0.002	<0.0001	<0.0001	<0.0001	<0.00010	<0.005	ND	ND	ND	ND	ND	0.0001	ND	0.0003	ND	ND	ND	ND

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																	
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)																		
Date				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	13-Aug-19	21-Nov-19	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	28-May-18	13-Aug-19	21-Nov-19
Total Hardness	mg/L	-	-	38	59	33	42	35	46	33	33	51	32	50	36	31	51	34	32	30	36	276	28
Dissolved Hardness (CaCO3)	mg/L	-	-	48																			
Alkalinity (Total as CaCO3)	mg/L	-	-	17	35	16	23	17	22	21	21	34			20	12	26	16	18	11			15
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0	24.9				35.5	30.4	40.6	23.0	23.7			41.1	42.7	57.7	39.3	20.6	48.6			37.2
Alkalinity (PP as CaCO3)	mg/L	-	-																				
Bicarbonate (HCO3)	mg/L	-	-																				
Carbonate (CO3)	mg/L	-	-																				
Hydroxide (OH)	mg/L	-	-																				
Chemical Oxygen Demand (COD)	mg/L	-	-	69	71	83	107	87	70	86	74	80	69	59	100	94	128	165	62	98	113	49	94
Biological Oxygen Demand (BOD)	mg/L	-	-	ND	8.5	6.800	<4.0	<5.0	<4.0	<4.0	<4.0	<4.0	2.5	2.1		<5.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	ND	ND (1)	<1.0	2.1	<1.0	<1.0	<1.0	<1.0	1.4	<0.30	<0.30	0.55	<1.0	<1.0	<1.0	<1.0	<1.0	<0.30	<3.0	0.64
Chloride (Cl)	mg/L	600	250, AO	34	58	34	33	29	52	24	29	30	16	49	25	28	33	31	31	28	27	634	13
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5										0.040	0	0.024						0.035	<0.20	0.027
Total Kjeldahl Nitrogen	mg/L	-	-	1.03	1.43	1.080	1.220								1.52								1.78
Ammonia (N)	mg/L	0.681-28.7 (d)	-	0.04	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.039	<0.03	0.0085	0.0123	0.046	0.030	0.053	<0.03	0.310	0.1	0.138	0.0156	0.049
Nitrate plus Nitrite (N)	mg/L	-	-		ND			<0.010	0.011	0.014	0.013	0.014	<0.0060			0.020	0.046	0.016	0.090	0.035	0.1152		
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0	ND				<0.01	<0.01	<0.01	<0.01	<0.01	<0.0010	<0.0010	<0.0010	<0.01	<0.01	<0.01	<0.01	<0.01	0.0042	<0.010	<0.0010
Nitrate (N)	mg/L	32.8	10 MAC	ND				<0.01	0.010	0.014	0.013	0.014	<0.0050	0.0059	<0.0050	0.020	0.050	0.016	0.090	0.035	0.111	<0.050	0.0681
Conductivity	uS/cm	-	-	162	271	136	162	130	219	119	152	170			132	121	173	132	153	128			86
Field Conductivity	uS/cm	-	-										107								531		
pH	pH Units	6.5 - 9.0	7.0-10.5	6.5	6.0	6.3	6.1	6.4	6.3	6.7	6.3	6.6		7.2	7	6.1	6.4	6.5	5.9	5.9		7.74	7.12
Field pH	pH Units	6.5 - 9.0	7.0-10.5										6.2	6.4							6.2	6.5	
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		0.345	0.258	0.267	0.216	0.102	0.301	0.238	1.420	0.619	0.197	0.576	0.190	0.249	0.273	0.258	0.221	0.333	0.012	0.639
Total Antimony (Ab)	mg/L	0.009	0.006		ND	0.00010	<0.0001	<0.0001	<0.0001	0.00020	<0.00010	0.00018	<0.00010	<0.00010	0.0001	<0.0001	<0.0001	0.00020	<0.00010	<0.00010	<0.00010	0.00017	0.00012
Total Arsenic (As)	mg/L	0.005	0.01 MAC		0.0008	0.00060	<0.0005	0.00060	0.00070	0.00060	0.00094	0.0021	0.00224	0.00142	0.00069	0.00050	0.00140	0.00080	0.00057	0.00088	0.00154	0.00064	0.00052
Total Barium (Ba)	mg/L	1	1.0		0.031	0.01100	0.01500	0.01000	0.02300	0.01500	0.01790	0.033	0.019	0.024	0.017	0.01000	0.01800	0.01600	0.01600	0.012	0.014	0.174	0.014
Total Beryllium (Be)	mg/L	0.00013	-		ND	<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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Bismuth (Bi)	mg/L	-	-		ND	<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	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050
Total Boron (B)	mg/L	1.2	5.0, MAC		ND	0.00900	0.00600	0.00700	0.00800	0.09100	0.01000	0.038	<0.010	<0.010	<0.010	<0.004	0.01000	0.02700	<0.004	0.005	<0.010	<0.010	<0.010
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e) (k)	0.005, MAC		0.000021	0.00009	0.00002	0.00021	<0.00001	0.00004	0.000011	0.000025	0.0000202	0.0000072	0.0000147	0.00004	0.00002	0.00005	0.00001	0.000016	0.0000239	<0.0000050	0.0000217
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-		17.4	9.4	12.5	10.1	14.5	9.4	9.8	15	9.42	15.1	10.6	8.7	15.6	9.5	9.4	8.45	10.2	88.3	9.0
Total Cesium (Cs)	mg/L	-	-										0.000057	0.000016	0.00003						0.00002	<0.000010	0.000013
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC		ND	0.0005	0.0006	0.0005	<0.0005	0.0006	0.0005	0.00168	0.00087	0.0003	0.00068	<0.0005	0.0006	0.0006	<0.00050	<0.00050	0.00051	0.00013	0.00079
Total Cobalt (Co)	mg/L	0.11	-		0.00125	0.0001	0.0003	0.0001	0.0002	0.0002	0.0005	0.00099	0.00098	0.00043	0.00025	0.0003	0.0008	0.0004	0.0005	0.00049	0.00106	0.00119	0.00019
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO		0.00227	0.0028	0.0016	0.0036	0.0004	0.0016	0.0023	0.00452	0.00214	0.00084	0.00265	0.0019	0.0010	0.0010	0.0022	0.00073	0.00108	<0.00050	0.00377
Total Iron (Fe)	mg/L	1	0.3, AO		2.1	0.43	0.82	0.42	0.54	0.65	0.86	2.46	1.62	1.00	0.91	0.65	1.74	0.97	0.68	0.80	1.65	0.97	0.52
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01		0.00032	0.00010	0.00010	0.00030	<0.0001	0.00010	0.00030	0.00163	0.000597	0.000231	0.000239	0.00040	0.00040	0.00030	0.00016	0.00022	0.000711	<0.000050	0.000167
Total Lithium (Li)	mg/L	-	-		ND	0.00030	0.00030	0.00020	0.00030	0.00030	0.00020	0.0011	<0.0010	<0.0010	<0.0010	0.00030	0.00040	0.00040	0.00031	0.00029	<0.0010	<0.0010	<0.0010
Total Magnesium (Mg)	mg/L	-	-		3.71	2.39000	2.68000	2.33000	2.28000	2.31000	2.16000	3.34	2.13	3.02	2.51	2.29000	2.97000	2.57000	1.98000	2.1	2.5	13.5	1.7
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO		0.653	0.03240	0.07060	0.026	0.060	0.031	0.132	0.172	0.236	0.105	0.0283	0.060	0.183	0.100	0.115	0.128	0.304	1.37	0.0225
Total Mercury (Hg)	mg/L.	0.0001	0.001		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.0000050	0.0000088	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.0000050	0.0000184
Total Molybdenum (Mo)	mg/L	2	0.25		ND	<0.0001	<0.0001	<0.0001	<0.0001	0.00010	0.00018	0.00023	0.000107	<0.000050	0.000089	<0.0001	0.00010	0.00020	0.00014	0.00015	0.000097	0.000201	0.00009
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-		0.0014	0.00090	0.00130	0.00100	0.00050	0.00080	0.00097	0.00248	0.00164	0.00093	0.00116	0.00070	0.00080	0.00080	0.00092	0.00056	0.00111	0.00098	0.00128
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO		0.087	0.0490	0.0300	<0.02	0.0300	<0.02	0.077	0.069	0.083	0.052	<0.050	<0.02	0.050	<0.02	<0.050	<0.050	0.119	<0.050	0.053
Total Potassium (K)	mg/L	-	-		1.18	0.52	0.39	0.51	0.11	0.48	2.47	1.26	1.09	0.408	0.665	0.35	0.40	0.23	1.61	0.81	0.56	3.92	0.473
Total Rubidium (Rb)	mg/L												0.00091	0.00048	0.0005						0.00076	0.00116	0.00032
Total Selenium (Se)	mg/L	0.002	0.01, MAC		ND	0.00060	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.000054	0.000054	0.000097	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.000053	0.00006	0.000109
Total Silicon (Si)	mg/L	-	-		3.19	1.40	3.00	1.10	0.60000	2.90	1.60	3.6	2.35	1	3.99	2.50	3.50	3.20	2.10	2.4	2.31	3.5	4.99
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-		0.000026	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010	<0.000010	0.000014	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000010	<0.000010	0.000027
Total Sodium (Na)	mg/L	-	<200, AO		29.8	16.2	15.0	16.5	21.9	11.7	16.7	13.6	9.11	20.9	13.6	13.3	15.7	14.8	15.5	13	14.7	332	8
Total Strontium (Sr)	mg/L	-	-		0.108	0.063	0.068	0.057	0.09000	0.070	0.064	0.0931	0.0649	0.103	0.068	0.054	0.082	0.075	0.059	0.0573	0.0696	0.566	0.0548
Total Sulphur (S)	mg/L	-	-		ND	4.00000	<1	<1	1.00000	<1	<3.0	<3.0	<0.50	<0.50	<0.50	<1	1.0	<1	<3.0	<3.0	<0.50	1.12	0.66
Total 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	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Total Thallium (Tl)	mg/L	0.0008	-		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010
Total 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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Tin (Sn)	mg/L	-	-		ND	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010
Total Tungsten (W)	mg/L												0.00853	<0.0039	0.00702						0.00438	<0.00030	0.00655
Total Titanium (Ti)	mg/L	-	-		ND	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	0.0231	<0.00010	<0.00010	<0.00010	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00010	<0.00010	<0.00010
Total Uranium (U)	mg/L	0.0085	0.02		ND	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	0.000028	0.000017	<0.000010	0.000023	<0.00002	<0.00002	<0.00002	0.00003	<0.000020	0.000011	0.000022	0.000037
Total Vanadium (V)	mg/L	-	-		ND	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	0.0033	0.00142	0.00072	0.00117	<0.001	<0.001	<0.001	<0.0010	0.0011	0.00106	<0.00050	0.001
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO		0.0112	0.00800	0.00800	0.01000	<0.004	0.00500	0.00510	0.0105	0.0072	<0.0030	0.0115	0.01200	0.00500	0.00500	<0.0040	0.0059	0.0055	0.0286	0.0071
Total Zirconium (Zr)	mg/L	-	-		ND	0.00030	0.00030	0.00030	<0.0001	0.00020	0.00026	0.00031	0.000228	<0.00020	<0.00060	0.00020	0.00010	0.00020	0.00030	0.00015	0.000183	<0.00020	0.00062

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-07																
Date				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	21-Nov-19
Total Hardness	mg/L	-	-				44	112	307	32	165	19	64	51	42	74	40	38	42	52	38
Dissolved Hardness (CaCO3)	mg/L	-	-										16								
Alkalinity (Total as CaCO3)	mg/L	-	-	132	38	174	14	63	200	10	92	18	33	19	31	67	33	33	44		30
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0												30.2	14.2	27.9	15.5	15.8		28.5
Alkalinity (PP as CaCO3)	mg/L	-	-																		
Bicarbonate (HCO3)	mg/L	-	-																		
Carbonate (CO3)	mg/L	-	-																		
Hydroxide (OH)	mg/L	-	-																		
Chemical Oxygen Demand (COD)	mg/L	-	-	54	114	246	84	140	71	95	112	120	101	144	69	36	67	<20	53	42	70
Biological Oxygen Demand (BOD)	mg/L	-	-	<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	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	2.23
Chloride (Cl)	mg/L	600	250, AO	405	49	590	39	84	355	27	240	42	73	29	24	63	19	24	10	15	18
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5																	0.033	0.029
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							1.84
Ammonia (N)	mg/L	0.681-28.7 (d)	-	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	0.047
Nitrate plus Nitrite (N)	mg/L	-	-												<0.010	0.019	0.012	0.043	0.012	<0.105	
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0												<0.01	<0.01	<0.01	<0.01	<0.01	<0.0010	<0.0010
Nitrate (N)	mg/L	32.8	10 MAC												<0.01	0.02	0.012	0.043	0.012	0.0095	0.0314
Conductivity	uS/cm	-	-	1,480	230	2,050	163	421	1,540	118	1,020	196	313	147	132	327	122	142	124	109	126
Field Conductivity	uS/cm	-	-																		
pH	pH Units	6.5 - 9.0	7.0-10.5	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	6.4	7.55
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																		
Total Metals																					
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	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	1.140
Total Antimony (Ab)	mg/L	0.009	0.006	<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	0.00012
Total Arsenic (As)	mg/L	0.005	0.01 MAC	<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	0.00072
Total Barium (Ba)	mg/L	1	1.0	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	0.021
Total Beryllium (Be)	mg/L	0.00013	-	<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	<0.00010
Total Bismuth (Bi)	mg/L	-	-	<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	<0.000050
Total Boron (B)	mg/L	1.2	5.0, MAC	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.028	0.014	0.039	0.026	0.048	0.024	0.038
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e) (k)	0.005, MAC	<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	0.0000286
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	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	11.7
Total Cesium (Cs)	mg/L	-	-																	0.000053	0.00008
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	<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	0.00112
Total Cobalt (Co)	mg/L	0.11	-	<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	0.00036
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	<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	0.00384
Total Iron (Fe)	mg/L	1	0.3, AO	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	1.04
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	<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	0.000252
Total Lithium (Li)	mg/L	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0003	0.0007	0.0003	0.00016	0.00013	<0.0010	<0.0010
Total Magnesium (Mg)	mg/L	-	-	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	2.9
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	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	0.0153
Total Mercury (Hg)	mg/L.	0.0001	0.001	<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	0.0000124
Total Molybdenum (Mo)	mg/L	2	0.25	<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	0.000114
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	<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	0.00199
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	<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	0.05400
Total Potassium (K)	mg/L	-	-	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	0.9
Total Rubidium (Rb)	mg/L																			0.00072	0.00087
Total Selenium (Se)	mg/L	0.002	0.01, MAC	<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	0.000108
Total Silicon (Si)	mg/L	-	-	<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	5.19
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	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	0.000028
Total Sodium (Na)	mg/L	-	<200, AO	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	11.1
Total Strontium (Sr)	mg/L	-	-	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	0.0724
Total Sulphur (S)	mg/L	-	-	<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	1.01
Total Tellurium (Te)	mg/L		-												<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<0.00020
Total Thallium (Tl)	mg/L	0.0008	-	<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	<0.000010
Total Thorium (Th)	mg/L	-	-												<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010
Total Tin (Sn)	mg/L	-	-	<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	<0.00010
Total Tungsten (W)	mg/L																			0.0104	0.0129
Total Titanium (Ti)	mg/L	-	-	<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	<0.00010
Total Uranium (U)	mg/L	0.0085	0.02	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	0.000042
Total Vanadium (V)	mg/L	-	-	<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	0.00181
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	<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	0.0049
Total Zirconium (Zr)	mg/L	-	-	<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	0.0006

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	13-Aug-19	21-Nov-19	7-Jul-14
Total Hardness	mg/L	-	-					129	59	35	38	31	47	31	25	30	40	246	36	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			7	60
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0					27.8				42.0	65.7	40.1	29.5	38.3			46.3	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	63	114	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	2.4		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	<1.5	<0.30	ND
Chloride (Cl)	mg/L	600	250, AO	41	47	43	25	123	57	33	35	24	31	27	27	27	29	436.0	29	32
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5														0.038	<0.10	<0.020	
Total Kjeldahl Nitrogen	mg/L	-	-	1.74	0.76	0.83	0.65	1.05	1.8	0.980	1.100								2.19	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	0.0067	0.039	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	<0.0050	<0.0010	ND
Nitrate (N)	mg/L	32.8	10 MAC					ND				0.019	0.060	0.019	0.019	<0.01	0.0648	<0.025	0.0071	0.042
Conductivity	uS/cm	-	-	336	227	249	143	519	262	134	144	118	148	117	123	128			130	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		7.41	6.32	7.1
Field pH	pH Units	6.5 - 9.0	7.0-10.5														5.7	6.36		
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	0.0504	0.36	
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	0.00012	<0.00010	
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	0.0015	0.00049	
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	0.113	0.012	
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	<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	<0.000050	<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	<0.010	<0.010	
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e) (k)	0.005, MAC	<0.002	ND	ND	0.00006		0.000117	0.00009	0.00001	0.00002	0.00004	0.00085	<0.000010	0.000023	0.0000279	0.0000273	0.0000187	
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	72.4	10.4	
Total Cesium (Cs)	mg/L	-	-														0.00002	<0.000010	0.000018	
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	0.00021	0.00045	
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	0.00316	0.00018	
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	0.00054	0.00136	
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	2.72	0.63	
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	0.000104	0.000421	
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	0.0013	<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	15.9	2.78	
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	1.75	0.0314	
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	<0.0000050	0.0000074	
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	0.000068	<0.000050	
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	0.00119	0.00077	
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	0.124	<0.050	
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	2.26	0.394	
Total Rubidium (Rb)	mg/L																0.00071	0.00099	0.00045	
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	0.000056	<0.000050	
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	3.42	3.28	
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	<0.000010	<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	189	13.4	
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	0.535	0.0673	
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	0.55	<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	<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	<0.000010	<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	<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	<0.00010	<0.00010	
Total Tungsten (W)	mg/L																0.00386	<0.0012	0.00379	
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	<0.00010	<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	<0.000010	<0.000010	
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	<0.00050	0.00104	
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	0.0034	0.005	
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	<0.00020	<0.00020	

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 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	16-Apr-19	12-Aug-19	21-Nov-19
Total Hardness	mg/L	-	-	-	103	507	1050	712	1110	954	977	880	299	1080	611	878	205	296	457
Dissolved Hardness (CaCO3)	mg/L	-	-	-															
Alkalinity (Total as CaCO3)	mg/L	-	-	-	91	560	690	520	790	720	750	770		707	854	934	237	382	481
Total Organic Carbon (C)	mg/L	-	4.0	-	26.8	89	395	136	279	224	210	152	68	342	245	75	14.1	9.48	24.4
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	91	80	71
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	7.28	6.42	11.3
Chloride (Cl)	mg/L	600	250, AO	250	2	122	123	132	152	145	152	142	58.1	105	98.1	98.3	7.08	11.7	59.9
Total Kjeldahl Nitrogen	mg/L	-	-	-															6.19
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	0.257	0.292	0.335
Nitrate plus Nitrite (N)	mg/L	-	-	10	<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	<0.001	<0.0010	<0.0050
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	<0.0050	<0.0050	<0.025
Conductivity	uS/cm	-	-	-	185	1350	1660	1220	1860	1760	1780	1860	704						915
Field Conductivity	uS/cm	-	-	-											1470	1124	460	657	586
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					7.78	8.14
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	3.1	0.0153	0.0643
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006										0.00018	<0.00050	<0.00050	0.00011	<0.00010	<0.00010
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01										0.00904	0.00448	0.0116	0.00836	0.00466	0.00297
Dissolved Barium (Ba)	mg/L	1	1.0	1										0.499	0.282	0.47	0.234	0.233	0.228
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008										<0.00010	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010
Dissolved Bismuth (Bi)	mg/L	-	-	-										<0.000050	<0.00025	<0.00025	<0.000050	<0.000050	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00										0.107	0.127	0.212	0.101	0.155	0.083
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005										<0.0000050	0.00003	<0.000025	0.00053	<0.0000050	0.0000094
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-										287	162	237	62	87	117
Dissolved Cesium (Cs)	mg/L	-		-										<0.000010	<0.000050	<0.000050	0.000157	<0.000010	<0.000010
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)										0.00042	<0.00050	0.00071	0.00350	<0.00010	0.00015
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001										0.0193	0.0037	0.0063	0.00423	0.00146	0.00272
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5										<0.00050	<0.0010	<0.0010	0.0131	0.00057	0.00107
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5										80.3	37.8	73	59.3	28	34.4
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01										<0.000050	<0.00025	<0.00025	0.002380	0.000058	0.000087
Dissolved Lithium (Li)	mg/L	-	-	0.008										0.0019	<0.0050	<0.0050	0.0025	<0.0010	0.0014
Dissolved Magnesium (Mg)	mg/L	-	-	-										89	50	70	13	19	40
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5										19.4	13.3	14.1	3.03	4	4.15
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001										<0.0000050	<0.0000050	<0.000050	0.00002	<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25										0.00063	0.00112	0.00052	0.00038	0.00038	0.00025
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08										0.00627	0.0026	0.0043	0.00669	0.00091	0.00238
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-										0.174	<0.25	<0.25	0.234	<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-										12.4	8.83	12.9	3.94	6.07	4.31
Dissolved Rubidium (Rb)	mg/L	-	-	-										0.00115	0.0011	0.0011	0.00133	0.0005	0.00032
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01										0.00020	<0.00025	<0.00025	0.000423	0.000154	<0.000050
Dissolved Silicon (Si)	mg/L	-	-	-										14.1	8.4	12.0	7.9	5.6	6.3
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02										<0.000010	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200										49.9	32.2	51.2	13.5	18.0	29.3
Dissolved Strontium (Sr)	mg/L	-	-	2.50										2.22	1.27	1.76	0.42	0.67	0.97
Dissolved Sulphur (S)	mg/L	-	-	-										0.9	<2.5	<2.5	2.64	1.69	3.5
Dissolved Tellurium (Te)	mg/L			-										<0.00020	<0.0010	<0.0010	<0.00020	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-										<0.000010	<0.000050	<0.000050	0.00	<0.000010	<0.000010
Dissolved Thorium (Th)	mg/L	-	-	-										<0.00010	<0.00050	<0.00050	0.00	<0.00010	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5										0.00031	<0.00050	<0.00050	0.00010	<0.00010	0.00013
Dissolved Titanium (Ti)	mg/L	2	-	-										0.00	<0.0015	<0.0045	0.05	0.00	0.00
Dissolved Tungsten (W)	mg/L	-		0.003										<0.00010	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02										0.0006	0.000614	0.000581	0.000289	0.000124	0.000541
Dissolved Vanadium (V)	mg/L	0.006	-	0.02										0.0037	<0.0025	0.0032	0.00844	<0.00050	<0.00050
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5.0, AO	3										0.0031	<0.0050	0.0060	0.20	0.0048	0.0094
Dissolved Zirconium (Zr)	mg/L	-	-	-										0.0010	0.0005	0.0014	0.0009	<0.00020	<0.00020

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	16-Apr-19	12-Aug-19	21-Nov-19
Total Hardness	mg/L	-	-	-	827	486	661	760	1020	461	1030	1050	360	714	421	498	623		673
Dissolved Hardness (CaCO3)	mg/L	-	-	-															
Alkalinity (Total as CaCO3)	mg/L	-	-	-	640	320	540	680	810	440	800	930		749	557	504	606	752	733
Total Organic Carbon (C)	mg/L	-	4.0	-	104.0	60	199	196	322	134	390	372	67	160	114	51	24.7	26.7	36.9
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	120	129	135
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	<1.5	<1.5	<1.5
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	9.4	12.4	9.8
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	0.606	1.45	1.28
Nitrate plus Nitrite (N)	mg/L	-	-	10	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	<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	<0.025	0.046	<0.025
Conductivity	uS/cm	-	-	-	1580	685	1090	1360	1620	914	1630	1850	705					736	1120
Field Conductivity	uS/cm	-	-	-											663	811	1126	919	804
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					7.38	7.67
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	0.0588	0.0208	0.0269
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006										0.00044	0.00064	0.0004	<0.00050	<0.00050	<0.00010
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01										0.0384	0.0224	0.0278	0.00211	0.00913	0.00855
Dissolved Barium (Ba)	mg/L	1	1.0	1										0.277	0.149	0.161	0.129	0.19	0.148
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008										0.00024	<0.00020	<0.00020	<0.00050	<0.00050	<0.00010
Dissolved Bismuth (Bi)	mg/L	-	-	-										<0.000050	<0.00010	<0.00010	<0.00025	<0.00025	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00										0.164	0.288	0.191	<0.050	<0.050	0.014
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005										0.0000597	0.000013	<0.000010	0.000041	0.000034	0.000205
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-										189	116	131	154	184	172
Dissolved Cesium (Cs)	mg/L	-		-										0.000229	<0.000020	<0.000020	<0.000050	<0.000050	<0.000010
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)										0.01090	0.00023	0.00064	<0.00050	<0.00050	0.00016
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001										0.020	0.008	0.011	0.0101	0.00904	0.00983
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5										0.0181	<0.00040	0.00052	<0.0010	<0.0010	0.00064
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5										61.6	24.4	42.2	124	24.9	74.2
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01										0.00337	<0.00010	<0.00010	<0.00025	<0.00025	<0.000050
Dissolved Lithium (Li)	mg/L	-	-	0.008										0.006400	<0.0020	<0.0020	<0.0050	<0.0050	<0.0010
Dissolved Magnesium (Mg)	mg/L	-	-	-										59	32	41	58	67	59
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5										15.5	8.95	11.5	14.5	15.6	13.5
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001										0.000012	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25										0.000311	0.00068	0.00043	0.00153	0.00112	0.00115
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08										0.0	0.0	0.0	0.01120	0.00620	0.00977
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-										0.274	<0.10	<0.10	<0.25	<0.25	0.06
Dissolved Potassium (K)	mg/L	373-432	-	-										4.92	3.2	2.64	2.08	1.95	2.38
Dissolved Rubidium (Rb)	mg/L	-	-	-										0.0021	0.0005	<0.00040	<0.0010	<0.0010	0.00068
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01										0.0003	0.0003	0.0002	<0.00025	<0.00025	0.0002
Dissolved Silicon (Si)	mg/L	-	-	-										21.3	8.26	9.76	6.75	10.1	8.65
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02										<0.000010	<0.000020	<0.000020	<0.000050	<0.000050	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200										41.7	34.2	30.1	14.5	18.8	14.4
Dissolved Strontium (Sr)	mg/L	-	-	2.50										1.240	0.768	0.887	0.953	1.090	1.010
Dissolved Sulphur (S)	mg/L	-	-	-										<0.50	8.7	1.2	<2.5	<2.5	<0.50
Dissolved Tellurium (Te)	mg/L			-										<0.00020	<0.00040	<0.00040	<0.0010	<0.0010	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-										0.00001	<0.000020	<0.000020	<0.000050	<0.000050	<0.000010
Dissolved Thorium (Th)	mg/L	-	-	-										0.00024	<0.00020	<0.00020	<0.00050	<0.00050	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5										<0.00010	<0.00020	<0.00020	<0.00050	<0.00050	0.0003
Dissolved Titanium (Ti)	mg/L	2	-	-										0.03	0.003	0.01	<0.0015	<0.0015	0.00114
Dissolved Tungsten (W)	mg/L	-		0.003										<0.00010	<0.00020	<0.00020	<0.00050	<0.00050	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02										0.00076	0.000684	0.000403	0.000374	0.00143	0.000765
Dissolved Vanadium (V)	mg/L	0.006	-	0.02										0.024	0.004	0.006	<0.0025	<0.0025	0.001
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	<0.0050	<0.0050	0.0043
Dissolved Zirconium (Zr)	mg/L	-	-	-										0.00239	0.00093	0.00131	<0.00030	<0.0010	0.00033

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.

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(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)
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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	16-Apr-19	12-Aug-19	21-Nov-19
Total Hardness	mg/L	-	-	-	159	410	443	477	531	309	710	630	329	175	339	582	303	334
Dissolved Hardness (CaCO3)	mg/L	-	-	-														
Alkalinity (Total as CaCO3)	mg/L	-	-	-	160	340	340	290	460	260	600	690		215	428	488	273	328
Total Organic Carbon (C)	mg/L	-	4.0	-	46.3	50	100	75	75.5	51	136	94	56	249	88	81.8	130	198
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	264	397	355
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	1.6	20.9	4.4
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	123	51.1	75.0
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	0.366	0.908	0.481
Nitrate plus Nitrite (N)	mg/L	-	-	10	<0.010	0.0207	0.0468	0.046	0.0488	0.0136	0.0105	0.023	0.209	<0.0060	<0.30			9.95
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	<0.0050	0.0147	<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	<0.025	0.0717	<0.025
Conductivity	uS/cm	-	-	-	352	643	613	586	830	505	1060	1240	294					799
Field Conductivity	uS/cm	-	-	-											1142	1053	625	528
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				7.24	7.50
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	20.7	0.123	0.0495
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006										0.0002	<0.00010	0.00052	0.0006	0.0002
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01										0.00821	0.00703	0.028	0.0226	0.0134
Dissolved Barium (Ba)	mg/L	1	1.0	1										0.0527	0.098	0.442	0.124	0.104
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008										<0.00010	<0.00010	0.00052	<0.00010	<0.00010
Dissolved Bismuth (Bi)	mg/L	-	-	-										<0.000050	<0.000050	<0.00025	<0.000050	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00										0.012	0.017	0.286	0.185	0.22
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005										0.0000084	0.0000063	0.00037	0.0000236	0.0000066
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-										48.8	89.8	153	80.9	90.6
Dissolved Cesium (Cs)	mg/L	-		-										<0.000010	<0.000010	0.000927	<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	0.01700	0.00043	0.00040
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001										0.004	0.005	0.0197	0.00606	0.00452
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5										0.00121	0.00501	0.0396	0.00165	0.00106
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5										7.56	36.2	49.5	15.6	16
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01										0.000083	0.000295	0.00731	0.000149	0.000053
Dissolved Lithium (Li)	mg/L	-	-	0.008										<0.0010	<0.0010	0.0089	<0.0010	<0.0010
Dissolved Magnesium (Mg)	mg/L	-	-	-										13	28	49	25	26
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5										4.3	9.3	9.55	6.6	4.85
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001										<0.0000050	<0.0000050	0.0000149	0.0000076	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25										0.000647	0.0021	0.00062	0.000581	0.00017
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08										0.0026	0.0037	0.0267	0.0049	0.0034
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-										<0.050	<0.050	0.69	<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-										2.54	3.7	5.66	2.03	3.91
Dissolved Rubidium (Rb)	mg/L	-	-	-										0.00055	0.00085	0.0105	0.00024	0.00042
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01										0.0001	0.0001	<0.00025	0.0002	0.0002
Dissolved Silicon (Si)	mg/L	-	-	-										5.55	5.47	33.9	7.41	6.58
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02										<0.000010	<0.000010	0.000154	<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200										5.83	10.30	64.00	31.40	48.30
Dissolved Strontium (Sr)	mg/L	-	-	2.50										0.2970	0.5690	1.0900	0.5940	0.6000
Dissolved Sulphur (S)	mg/L	-	-	-										<0.50	<0.50	<2.5	4.56	1.64
Dissolved Tellurium (Te)	mg/L			-										<0.00020	<0.00020	<0.0010	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-										<0.000010	<0.000010	0.00	<0.000010	<0.000010
Dissolved Thorium (Th)	mg/L	-	-	-										<0.00010	<0.00010	0.00	<0.00010	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5										<0.00010	<0.00010	<0.00050	0.0001	0.00013
Dissolved Titanium (Ti)	mg/L	2	-	-										0.0038	0.0005	0.5630	0.0062	0.0022
Dissolved Tungsten (W)	mg/L	-		0.003										<0.00010	<0.00010	<0.00050	<0.00010	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02										0.000244	0.000154	0.00108	0.000541	0.000235
Dissolved Vanadium (V)	mg/L	0.006	-	0.02										0.0020	0.0007	0.0489	0.0037	0.0020
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5.0, AO	3										0.0030	0.0066	0.0608	0.0050	0.0041
Dissolved Zirconium (Zr)	mg/L	-	-	-										0.000529	0.000197	0.00574	0.0008	0.00064

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	16-Apr-19	12-Aug-19	21-Nov-19	30-May-18	10-Jul-18	11-Sep-18	16-Apr-19	12-Aug-19	21-Nov-19
Total Hardness	mg/L	-	-	-	494	656	454	506	426	256	254	318	228	312	264
Dissolved Hardness (CaCO3)	mg/L	-	-	-											
Alkalinity (Total as CaCO3)	mg/L	-	-	-	454	547	523	519	418	217	276	343	254	345	288
Total Organic Carbon (C)	mg/L	-	4.0	-	10.6	9	12.6	10.5	19.2	27.4	26.7	6	8.55	7.36	6.90
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	85	72	35	90	121	<20	116	55	23
Biological Oxygen Demand (BOD)	mg/L	-	-	-											
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	500	23.4	13.9	8.2	4.4	8	5.59	2.78	2.91	4.5	5.85	5.05
Chloride (Cl)	mg/L	600	250, AO	250	13	12.7	14.3	8.7	6.3	5.62	4	6.99	3.79	4.50	3.49
Total Kjeldahl Nitrogen	mg/L	-	-	-					-						
Ammonia (N)	mg/L	0.681-28.7 (d)	-	-	0.0298	0.0689	0.078	0.0698	0.0707	0.0179	0.0669	0.183	0.323	0.115	0.299
Nitrate plus Nitrite (N)	mg/L	-	-	10	<0.03	<0.03			2.77	<0.0060	<0.0121	<0.0083			1.07
Nitrite (N)	mg/L	0.06 -0.6 (max) (c)	1.0	1.0	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	0.0305	0.0053	<0.0010
Nitrate (N)	mg/L	32.8	10 MAC	10	<0.025	<0.025	<0.025	<0.025	0.049	<0.0050	0.012	0.0073	0.358	0.013	<0.0050
Conductivity	uS/cm	-	-	-					690						474
Field Conductivity	uS/cm	-	-	-	762	710	421	644	291		422	500	324	475.9	245.6
pH	pH Units	6.5 - 9.0	7.0-10.5	-				7.89	8.07					8.12	8.31
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	0.0051	0.0040	0.0081	0.469	0.0061	0.0026	0.0730	0.0111	0.0023
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	0.00011	0.00012	<0.00010	<0.00010	<0.00010	0.00016	0.0001	0.00012	0.00012	0.00011	<0.00010
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00351	0.00994	0.00100	0.00200	0.00053	0.0018	0.00418	0.00417	0.00129	0.00144	0.00074
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.0997	0.169	0.1030	0.1320	0.104	0.0775	0.0698	0.0849	0.0555	0.0858	0.0486
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<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	<0.000050	<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	0.017	0.02	0.015	<.010	<0.010	0.01	<0.010	0.011	<0.010
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	0.000030	0.0000538	0.000031	0.000017	0.0000781	0.000076	<0.0000050	<0.0000050	0.0000177	0.0000294	0.0000068
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	110.0	148	100.0	109.0	102	61.3	62.1	79.7	53.7	76.9	64.5
Dissolved Cesium (Cs)	mg/L	-		-	0.0	0.000039	<0.000010	<0.000010	<0.000010	0.00008	<0.000010	<0.000010	0.000017	0.000012	<0.000010
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)	<0.00010	0.00023	<0.00010	<0.00010	<0.00010	0.00053	<0.00010	<0.00010	0.00010	<0.00010	<0.00010
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	0.00842	0.00934	0.00772	0.00596	0.00107	0.005	0.00273	0.019	0.00409	0.00922	0.00092
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	0.00720	0.00212	0.00115	0.00053	0.0021	0.00212	0.00040	0.00032	0.00112	0.00102	0.00036
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	0.159	2.81	1.760	0.239	0.03	0.851	0.918	0.371	1.85	0.194	13.900
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01	0.000399	0.000705	<0.000050	<0.000050	<0.000050	0.000802	<0.000050	<0.000050	0.000230	0.000055	<0.000050
Dissolved Lithium (Li)	mg/L	-	-	0.008	0.0022	0.002900	0.002	0.0024	0.002100	0.002000	0.0015	0.001800	0.0012	0.002	0.0016
Dissolved Magnesium (Mg)	mg/L	-	-	-	53.5	70	49.4	57.1	42	25	23.9	29	22.8	29.2	24.9
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	1.70	3.02	1.3	1.76	0.8	0.718	1.06	2.00	0.909	0.975	1.01
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001	0.0000162	0.0000133	<0.0000050	<0.0000050	<0.0000050	0.0000057	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.00447	0.00411	0.00144	0.0024	0.00145	0.00169	0.00363	0.00381	0.00236	0.00259	0.00177
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	0.00377	0.00452	0.00334	0.00317	0.00259	0.00267	0.00176	0.00432	0.00183	0.00304	0.00087
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	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-	2.690	3.22	2.300	2.950	2.41	2	2.070	2.26	1.69	2.21	2.03
Dissolved Rubidium (Rb)	mg/L	-	-	-	0.000	0.00048	0.00034	0.00044	0.00028	0.00042	0.000	0.00054	0.00041	0.00048	0.00044
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	0.000053	0.00007	0.000055	<0.000050	0.00007	<0.000050	0.000056	<0.000050	<0.000050	0.000081	0.000053
Dissolved Silicon (Si)	mg/L	-	-	-	5.36	6.93	4.63	6.39	5.77	4.36	4.94	4.97	3.48	5.9	3.67
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.000010	0.000019	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	13.7	16.50	10.9	12.3	8.24	9.48	8.3	9.52	7.11	9.26	7.30
Dissolved Strontium (Sr)	mg/L	-	-	2.50	1.1200	1.5500	1.0700	1.1900	1.0100	0.5660	0.5880	0.7440	0.513	0.732	0.523
Dissolved Sulphur (S)	mg/L	-	-	-	6.96	3.34	3.41	1.76	2.95	1.67	0.52	0.99	1.50	1.78	1.43
Dissolved Tellurium (Te)	mg/L			-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.000010	<0.000010	<0.000010	0.00001	0.000011	<0.000010	<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	<0.00010	<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	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Titanium (Ti)	mg/L	2	-	-	0.00142	<0.0060	<0.00030	<0.00030	0.0006	0.01	<0.00030	<0.00030	0.00145	0.00043	<0.00030
Dissolved Tungsten (W)	mg/L	-		0.003	<0.00010	<0.00010	<0.00010	<0.00010	<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	0.000984	0.0012	0.000539	0.000867	0.000761	0.000407	0.000489	0.000512	0.000275	0.000623	0.000157
Dissolved Vanadium (V)	mg/L	0.006	-	0.02	<0.00050	0.0009	<0.00050	<0.00050	<0.00050	0.00115	<0.00050	<0.00050	<0.00050	<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	0.0022	<0.0010	0.0011	0.0036	<0.0010	<0.0010	0.0016	0.0016	<0.0010
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.000060	0.000221	<0.000060	<0.00020	<0.00020	<0.000060	<0.000060	<0.000060	<0.000060	<0.00020	<0.00020

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: Freshwater Aquatic Life (1) (2)	BC MoE Guidelines: Drinking Water (2) (3)	BC CSR Standards: BC CSR-DW (4)	BH 01													
					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	17-Apr-19	13-Aug-19	20-Nov-19
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-	<0.005													
Cyanide, total	mg/L	-	-	0.2		<0.010	<0.010											
Alkalinity (CaCO3)	mg/L	-	-	-	>1250	210	210.0	220.0	220.0	220.0	220	220	276	379	392	392	326	325
Dissolved Hardness (CaCO3)	mg/L	-	-	-	148	158	165											
Hardness, Total (Total as CaCO3)	mg/L		-	-				171	154	175	149	158	266	270	329	266	265	260
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	<0.50	<0.50	0.7
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5									0.097	0.086	<0.10	0.083	0.074	0.092
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	13.9	14.4	13.5
Conductivity	uS/cm	-	-	-	464	387	404	394	396	428	404	400						537
Field Conductivity	uS/cm	-	-	-										526	463			
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	0.365	0.276	0.72
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	<0.0050	<0.0050	0.031
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	<0.0010	<0.0010	0.0227
Nitrate+Nitrite (N)	mg/L	-	-	10		0.041	0.373	0.224	0.219	0.23	0.189	0.018	<0.0060	0.0276	<0.030			
Total Kjeldahl Nitrogen (N)	mg/L	-	-	-	0.607	<0.5	0.370											6.500
Total Phosphorous (P)	mg/L	-	0.01	-	21.9	0.2	0.2											
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	43,000	72	72											
Total Dissolved Solids	mg/L	-	-	-	289	190	220											
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					8.38	8.4
Field pH	pH units	6.5 - 9.0	7.0-10.5	-											8.36	7.89	7.32	7.05
Volatiles																		
Vinyl chloride	ug/L			2	<0.50								<0.00040					
Dichloromethane	ug/L	98.1	-	50	<2.0								<0.0050					
Benzene	ug/L	40 (a)	5 (a)	5	<0.4								<0.00050					
Toluene	ug/L	0.5 (a)	-	60	<0.4								0.00058					
1,4-dichlorobenzene	ug/L	26	-	5	<0.5								<0.0010					
Misc. Organics																		
Chemical Oxygen Demand	mg/L	-	-	-	471	33	<20	<20	<20	<20	<20	<20	605.00	366.00	<20	64.00	148.00	309.00
Biochemical Oxygen Demand	mg/L	-	-	-														
Dissolved Organic Carbon (C)	mg/L	-	-	-	0.69	1.00	2.60											
Total Organic Carbon (C)	mg/L															3.61	64.40	737.00
Phenols	mg/L	50	-	1.0	<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	0.8990	0.0022	0.0047
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	0.00021	<0.00010	0.00022
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	0.00845	0.00835	0.00692
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	0.1380	0.1940	0.1400
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	<0.00010	<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	<0.000050	<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	0.082	0.089	0.08
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	0.000017	<0.0000050	0.0000282
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	18	18	20	20	20	20	18	20	46.8	44.6	57.8	46	40.7	43.9
Dissolved Cesium (Cs)	mg/L	-	-	-									<0.000010	0.000023	0.000016	0.000073	<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	0.0006	<0.00050	<0.00050	<0.00010	0.00031	0.00013	0.00087	<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	0.00056	0.00011	0.00028
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	0.00178	<0.00020	0.00047
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	0.903	0.099	0.196
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	0.000345	<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	0.0017	0.0012	0.0012
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	36.6	39.6	36.4
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	0.169	0.135	0.47
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	<0.0000050	<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	0.00345	0.00351	0.00382
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	0.00113	<0.00050	<0.00050
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	0.067	<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	2.17	2.1	1.83
Dissolved Rubidium (Rb)	mg/L	-	-	-									0.0004	0.00061	0.00043	0.00084	0.0004	0.00033
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	<0.000050	<0.000050	<0.000050
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	5.52	3.77	3.78
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	<0.000010	<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	30.8	30.7	29.8
Dissolved Strontium (Sr)	mg/L	-	-	2.50	0.709	0.672	0.682	0.705	0.642	0.761	0.609	0.694	1.120	1.080	1.370	1.190	1.150	1.050
Dissolved Sulphur (S)	mg/L	-	-	-	<3.0	2	<1	<1	2	<1	<3.0	<3.0	5.1	6.6	9.3	5.3	4.8	4.5
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	<0.00020	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.00005	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<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	<0.00010	<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	<0.00010	<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	0.0319	<0.00030	<0.00030
Dissolved Tungsten (W)	mg/L	-	-	0.003									<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	0.00078	0.00066	0.00061
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	0.00204	<0.00050	<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	0.0038	<0.0010	<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	<0.00072	<0.00020	<0.00020

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: Freshwater Aquatic Life (1) (2)	BC MoE Guidelines: Drinking Water (2) (3)	BC CSR Standards: BC CSR-DW (4)	BH 02													
					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	17-Apr-19	13-Aug-19	20-Nov-19
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-	<0.005													
Cyanide, total	mg/L	-	-	0.2		<0.010	<0.010											
Alkalinity (CaCO3)	mg/L	-	-	-	1,095	530	>930	500	490	500	480	490	355	462	501	511	429	476
Dissolved Hardness (CaCO3)	mg/L	-	-	-	485	521	533											
Hardness, Total (Total as CaCO3)	mg/L		-	-				548	503	550	497	508	482	479	481	482	457	478
Chloride (Cl)	mg/L	600	250, AO	250	1.0	2.0	<1.0	1.5	1.9	1.2	1.5	1.1	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5									<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	69.5	63	55.1	59.8	60.3	59.3	64.1	66.5	59.7	59.5	65.8	57.3	64.3	62.4
Conductivity	uS/cm	-	-	-	938	947	941	949	944	947	936	946						812.000
Field Conductivity	uS/cm	-	-	-									837	752	704			
Ammonia (N)	mg/L	0.68-28.7 (d)	-	-	0.07	0.068	0.46	<0.03	0.033	0.036	<0.03	<0.03	0.199	0.0513	0.159	0.103	0.202	0.264
Nitrate (N)	mg/L	32.8	10 MAC	10.0	0.119	0.250	0.060	0.460	0.290	0.150	0.153	0.067	<0.025	0.139	<0.025	0.128	0.050	0.033
Nitrite (N)	mg/L	0.06-0.6 (c)	1.0	1	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0050	0.0056	<0.0050	<0.0050	0.0147	<0.0050
Nitrate+Nitrite (N)	mg/L	-	-	10		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	-	-	-	0.502	1.350	2.680											0.734
Total Phosphorous (P)	mg/L	-	0.01	-	3.16	3.83	10.3											
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	11,000	2900	7000											
Total Dissolved Solids	mg/L	-	-	-	591	1.8	570											
pH	pH units	6.5 - 9.0	7.0-10.5	-	7.5	7.8	7.6	7.5	7.5	7.8	7.4	7.5					8.12	8.11
Field pH	pH units	6.5 - 9.0	7.0-10.5	-											8.19	7.25	7.16	7.31
Volatiles																		
Vinyl chloride	ug/L			2	<0.50								<0.00040					
Dichloromethane	ug/L	98.1	-	50	<2.0								<0.0050					
Benzene	ug/L	40 (a)	5 (a)	5	<0.4								<0.00050					
Toluene	ug/L	0.5 (a)	-	60	<0.4								0.00057					
1,4-dichlorobenzene	ug/L	26	-	5	<0.5								<0.0010					
Misc. Organics																		
Chemical Oxygen Demand	mg/L	-	-	-	123	136	242	25	<20	<20	<20	<20	162.00	<20	<20	38.00	96.00	40.00
Biochemical Oxygen Demand	mg/L	-	-	-														
Dissolved Organic Carbon (C)	mg/L	-	-	-	<0.5	1.8	4.3											
Total Organic Carbon (C)	mg/L															7.83	14.10	83.20
Phenols	mg/L	50	-	1.0	<0.001													
Dissolved Metals																		
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5	0.0030	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	0.0042	0.0023	0.0067	0.0026	0.0128	0.0024
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	<0.005	0.0005	<0.0001	0.0003	<0.0001	0.0002	<0.00010	0.0003	<0.00010	<0.00010	0.00013	0.00016	0.00011	<0.00010
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00088	0.00130	0.00120	0.00070	0.00070	0.00080	0.00076	0.00078	0.00088	0.00073	0.00078	0.00075	0.00100	0.00186
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.0665	0.1470	0.0650	0.0600	0.0640	0.0680	0.0520	0.0591	0.0635	0.0681	0.0576	0.0804	0.0683	0.0568
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	<0.00010	<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	<0.000050	<0.000050	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00	0.079	0.107	0.078	0.097	0.100	0.098	0.099	0.091	0.079	0.074	0.087	0.077	0.081	0.078
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	0.00018	0.00022	0.00008	0.00024	0.00263	0.00002	0.000539	0.000456	0.0000174	0.000643	0.0000442	0.0000097	0.0000232	0.0000463
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	83	87	91	92	86	87	85	88	84	78	80	84	77	82
Dissolved Cesium (Cs)	mg/L	-	-	-									<0.000010	<0.000010	0	<0.000010	0	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	<0.0005	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	0.00053	0.00063	0.00058	<0.00005	<0.00005	0.00045	<0.00010	<0.00010	0.0006	<0.00010	0.0005	0.00072	0.00045	0.00047
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	0.00132	0.02220	0.00170	0.00230	0.00320	0.00040	0.00345	0.00171	0.00251	0.00428	0.00053	0.00070	0.00078	<0.00020
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	<0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.058	<0.010	0.077	0.019	0.071	0.195
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01	<0.0002	0.0002	<0.0001	0.0003	<0.0001	<0.0001	<0.00010	<0.00010	0.000124	<0.000050	<0.000050	<0.000050	0.000064	<0.000050
Dissolved Lithium (Li)	mg/L	-	-	0.008	<0.005	0.0043	0.0042	0.0046	0.0046	0.0044	0.00434	0.00428	0.004	0.0039	0.0042	0.0034	0.004	0.0036
Dissolved Magnesium (Mg)	mg/L	-	-	-	67.2	73.9	74.3	77.5	70.1	80.9	69.0	70.0	66.2	69.0	68.5	66.3	64.6	66.5
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	0.131	0.128	0.158	0.007	0.031	0.119	0.0058	0.0033	0.1660	0.1070	0.1550	0.194	0.176	0.145
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	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.0027	0.0027	0.0025	0.0024	0.0026	0.0026	0.0024	0.0023	0.0023	0.0022	0.0023	0.0024	0.0023	0.0022
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	0.0013	0.0016	0.0009	0.0007	0.0032	0.0020	0.00092	0.00095	0.00086	0.00177	0.00111	0.00164	0.00109	<0.00050
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Potassium (K)	mg/L	373-432	-	-	2.70	3.50	2.87	3.27	2.65	2.87	2.67	2.83	2.58	2.68	2.67	2.84	2.56	2.46
Dissolved Rubidium (Rb)	mg/L	-	-	-									0.00	0.00	0.00	0.00	0.00	0.00
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	0.00013	0.00090	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.000050	0.00027	0.00011	0.00006	0.00006	<0.000050
Dissolved Silicon (Si)	mg/L	-	-	-	7.72	9.30	7.70	9.00	8.40	8.90	8.20	9.20	7.96	8.07	7.43	6.94	7.71	8.17
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.00002	<0.00005	<0.00005	<0.00005	<0.00005	0.00011	<0.000050	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	25.1	28.8	27.2	29.3	26.0	28.2	25.5	25.3	23.7	24.7	23.7	25.0	23.7	24.0
Dissolved Strontium (Sr)	mg/L	-	-	2.50	2.06	1.87	1.96	2.05	1.88	2.19	1.750	1.980	1.950	1.750	1.890	2.030	1.820	1.870
Dissolved Sulphur (S)	mg/L	-	-	-	20.0	25.0	21.0	23.0	21.0	23.0	19.5	21.3	22.5	22.5	21.2	21.0	21.2	22.8
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	<0.00020	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.00005	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.000020	<0.000020	<0.000010	0.000015	<0.000010	<0.000010	<0.000010	<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	<0.00010	<0.00010	<0.00010
Dissolved Tin (Sn)	mg/L	-	-	2.5	<0.005	<0.0002	<0.0002	0.0003	0.0004	<0.0002	<0.00020	0.00027	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<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	<0.00030	<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
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.00125	0.00118	0.00118	0.00110	0.00116	0.00113	0.00112	0.00114	0.00113	0.00101	0.00114	0.00142	0.00115	0.00105
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	0.00087	<0.00050	<0.00050	<0.00050	<0.00050
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5 AO	3	<0.005	0.029	<0.004	0.004	0.008	0.01	0.0147	0.0112	0.0028	0.0035	<0.0010	0.0046	0.0036	0.0012
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.0005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	0.000066	0.000095	<0.000060	0.000088	<0.00020	<0.00020

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.

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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, 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											
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)										Dry	Dry	Dry
					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	17-Apr-19	13-Aug-19	20-Nov-19
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-	<0.005											
Cyanide, total	mg/L	-	-	0.2		<0.010	<0.010									
Alkalinity (CaCO3)	mg/L	-	-	-	265	240		250	250	240	240	207	200			
Dissolved Hardness (CaCO3)	mg/L	-	-	-	216	557	239									
Hardness, Total (Total as CaCO3)	mg/L		-	-				247	236	220	242	228	177			
Chloride (Cl)	mg/L	600	250, AO	250	2.8	3.9		3.7	3.4	2.7	2.5	1.75	<2.5			
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5								0.080	<0.10			
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	176	180		184	181	184	223	185	199			
Conductivity	uS/cm	-	-	-	837	817		829	819	813	831					
Field Conductivity	uS/cm	-	-	-								667	638			
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			
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			
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			
Nitrate+Nitrite (N)	mg/L	-	-	10		0.311	0.32	0.319	0.254	0.246	0.128	<0.289	<0.030			
Total Kjeldahl Nitrogen (N)	mg/L	-	-	-	0.176	0.370	0.100									
Total Phosphorous (P)	mg/L	-	0.01	-	0.15	0.32	<0.1									
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	300	170										
Total Dissolved Solids	mg/L	-	-	-	542	1.3										
pH	pH units	6.5 - 9.0	7.0-10.5	-	7.9	7.7		7.7	7.8	8	7.6					
Field pH	pH units	6.5 - 9.0	7.0-10.5	-									8.25			
Volatiles																
Vinyl chloride	ug/L			2	<0.50							<0.00040				
Dichloromethane	ug/L	98.1	-	50	<2.0							<0.0050				
Benzene	ug/L	40 (a)	5 (a)	5	<0.4							<0.00050				
Toluene	ug/L	0.5 (a)	-	60	<0.4							0.0112				
1,4-dichlorobenzene	ug/L	26	-	5	<0.5							<0.0010				
Misc. Organics																
Chemical Oxygen Demand	mg/L	-	-	-	<20	<20	<20	<20	<20	36.00	<20	<20	<20			
Biochemical Oxygen Demand	mg/L	-	-	-												
Dissolved Organic Carbon (C)	mg/L	-	-	-	<0.5	1.3										
Total Organic Carbon (C)	mg/L															
Phenols	mg/L	50	-	1.0	<0.001											
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			
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			
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			
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			
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			
Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<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			
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			
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	64	141	71	72	67	65	72	68	48			
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)	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00010	<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			
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			
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			
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			
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			
Dissolved Magnesium (Mg)	mg/L	-	-	-	13.7	49.9	15.1	16.3	16.3	14.0	15.0	14.1	14.1			
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			
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			
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			
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			
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			
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			
Dissolved Rubidium (Rb)	mg/L	-	-	-								0.00049	0.00051			
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			
Dissolved Silicon (Si)	mg/L	-	-	-	4.01	10.20	3.70	4.40	4.10	3.90	4.60	3.96000	3.69000			
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			
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	113	87	100	107	103	94.4	99.6	92.6	93.9			
Dissolved Strontium (Sr)	mg/L	-	-	2.50	0.912	1.030	0.893	0.949	1.010	0.829	0.956	0.912	0.846			
Dissolved Sulphur (S)	mg/L	-	-	-	57.1	7.0	63.0	71.0	68.0	59.3	69.7	69.5	66.4			
Dissolved Tellurium (Te)	mg/L	-	-	-		<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<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			
Dissolved Thorium (Th)	mg/L	-	-	-		<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<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			
Dissolved Titanium (Ti)	mg/L	2	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030	<0.00030			
Dissolved Tungsten (W)	mg/L	-	-	0.003								0.00019	0.00031			
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			
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			
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			
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.0005	0.0002	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000060	<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: Freshwater Aquatic Life (1) (2)	BC MoE Guidelines: Drinking Water (2) (3)	BC CSR Standards: BC CSR-DW (4)	BH 4A									BH 4B									
					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	26-May-15	16-Apr-16	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	30-May-18	11-Jul-18	17-Apr-19	13-Aug-19	20-Nov-19
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-	<0.005																		
Cyanide, total	mg/L	-	-	0.2		<0.010	<0.010							<0.010									
Alkalinity (CaCO3)	mg/L	-	-	-	273	270	270	270	270	270	270	260	277	120	63	190	84	19	120	290	404	32	271	40
Dissolved Hardness (CaCO3)	mg/L	-	-	-	210	103	217							223										
Hardness, Total (Total as CaCO3)	mg/L		-	-				225	208	222	202	207	203		47	163	70	9	103	354	355	20	190	24
Chloride (Cl)	mg/L	600	250, AO	250	1.6	2.5	1.2	1.6	2.0	1.6	1.7	1.5	<2.5	1.1	<1.0	1.2	1.1	<1.0	1.0	0.6	1.2	0.6	<2.5	0.6
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5									<0.10							0.215	0.176	0.226	<0.10	0.187
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	147	141	142	135	133	129	139	148	142	<1.0	<1.0	<1.0	1.3	1.9	<1.0	0.78	1.96	1.07	137	1.89
Conductivity	uS/cm	-	-	-	751	773	756	762	760	760	760	765		228	122	352	170	43.1	240	666	628			76.5
Field Conductivity	uS/cm	-	-	-									624											
Ammonia (N)	mg/L	0.68-28.7 (d)	-	-	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.0050	<0.03	0.03	0.059	<0.03	<0.03	0.24	0.0136	0.048	0.0491	<0.0050	0.058
Nitrate (N)	mg/L	32.8	10 MAC	10.0	0.528	0.420	0.560	0.520	0.220	0.340	0.462	0.160	0.458	<0.01	0.012	0.450	<0.01	0.023	0.012	0.021	0.018	0.015	0.460	0.015
Nitrite (N)	mg/L	0.06-0.6 (c)	1.0	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0050	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.0010	<0.0010	0.001	<0.0050	<0.0010
Nitrate+Nitrite (N)	mg/L	-	-	10		0.424	0.555	0.523	0.464	0.341	0.462	0.157	<0.463	<0.010	0.012	0.037	<0.010	0.023	0.012	<0.022	<0.019			
Total Kjeldahl Nitrogen (N)	mg/L	-	-	-	0.136	0.330	0.260							1.020										2.410
Total Phosphorous (P)	mg/L	-	0.01	-	0.14	0.13	0.2							0.34										
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	18	38	23							200										
Total Dissolved Solids	mg/L	-	-	-	481	2	480							11.4										
pH	pH units	6.5 - 9.0	7.0-10.5	-	7.7	7.6	7.9	7.7	7.8	8	7.7	7.8		6.7	6.4	6.7	6.7	5.7	6.3				9	7
Field pH	pH units	6.5 - 9.0	7.0-10.5	-									8.36									6.35	7.00	6.83
Volatiles																								
Vinyl chloride	ug/L			2	<0.50															<0.00040				
Dichloromethane	ug/L	98.1	-	50	<2.0															<0.0050				
Benzene	ug/L	40 (a)	5 (a)	5	<0.4															<0.00050				
Toluene	ug/L	0.5 (a)	-	60	<0.4															<0.00045				
1,4-dichlorobenzene	ug/L	26	-	5	<0.5															<0.0010				
Misc. Organics																								
Chemical Oxygen Demand	mg/L	-	-	-	<20	<20	<20	<20	<20	<20	<20	<20	<20	63.00	64.00	59.00	65.00	<20	61.00	53	81	73	<20	80
Biochemical Oxygen Demand	mg/L	-	-	-																				
Dissolved Organic Carbon (C)	mg/L	-	-	-	0.82	2.00	1.80							11.40										
Total Organic Carbon (C)	mg/L																					21.00	2.53	35.30
Phenols	mg/L	50	-	1.0	0.0011																			
Dissolved Metals																								
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5	0.0054	0.0080	<0.005	<0.005	<0.005	0.0190	<0.0050	0.0066	0.0018	0.0060	0.0410	0.0060	0.1670	0.0606	0.1400	0.0320	0.0125	0.4230	0.0728	0.4400
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	<0.005	0.0003	<0.0001	0.0002	0.0002	0.0004	0.00021	0.00036	0.00021	0.0005	0.0001	0.0002	0.0004	<0.00010	0.00087	0.00027	0.00021	0.00012	0.0002	0.00015
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00048	0.00070	0.00060	0.00050	<0.0005	0.00060	<0.00050	<0.00050	0.00046	<0.0005	0.00130	0.00060	0.00290	<0.00050	0.00257	0.00372	0.00281	0.00288	0.00074	0.00198
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.0629	0.1310	0.0710	0.0670	0.0670	0.0710	0.0575	0.0653	0.0753	0.0670	0.0290	0.0700	0.2380	0.0694	0.0501	0.1050	0.1120	0.0170	0.0821	0.0209
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	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012
Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000050	<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	<0.05	0.02	0.051	0.062	0.062	0.065	0.06	0.055	0.051	0.059	0.005	0.011	0.033	0.02	0.006	<0.010	<0.010	<0.010	0.052	<0.010
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	0.000164	0.00005	0.00009	0.00005	0.00011	0.00007	0.000066	0.000066	0.00005	0.00029	0.00028	0.00096	0.00043	0.000439	0.000356	0.000124	0.000709	0.000139	0.000193	0.00207
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	57	29	58	59	56	57	54	55	53	58	13	48	19	3	31	109	109	6	50	7
Dissolved Cesium (Cs)	mg/L	-	-	-									<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)	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00010	<0.0005	<0.0005	0.0006	0.0009	<0.00050	0.00057	0.00011	<0.00010	0.00088	0.00016	0.00081
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	<0.0050	0.0141	0.00019	<0.00005	<0.00005	<0.00005	<0.00010	<0.00010	<0.00010	<0.00005	0.0113	0.00973	0.0119	0.00077	0.0158	0.00887	0.00731	0.00433	0.00052	0.00488
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	0.00060	0.00490	0.00090	0.00140	0.00090	0.00090	0.00075	0.00065	0.00225	0.00250	0.00370	0.00410	0.04020	0.02260	0.00700	0.00243	0.00256	0.00693	0.00164	0.02130
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	<0.01	4.25	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	4.51	0.103	10.9	0.214	10.1	5.51	3.86	11.4	0.251	3.64
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	0.000063	<0.0001	0.0005	<0.0001	0.0012	0.00016	0.00051	0.000181	0.000053	0.000846	0.000265	0.00097
Dissolved Lithium (Li)	mg/L	-	-	0.008	<0.005	0.0026	0.0012	0.0013	0.0012	0.0013	0.00109	0.00121	0.0012	0.0017	0.0038	0.0034	0.0056	0.00319	0.0034	0.0024	0.0024	0.0032	0.0013	0.004
Dissolved Magnesium (Mg)	mg/L	-	-	-	16.6	7.3	17.5	18.9	16.8	19.3	16.2	16.8	17.0	19.4	3.5	10.1	5.2	0.5	6.2	20.1	20.2	1.4	15.7	1.7
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	0.0011	3.17	0.0512	0.0003	0.0034	0.0009	0.0004	0.0051	0.0005	0.0070	2.06	3.36	1.49	0.17	2.93	3.19	3.63	0.672	0.0454	0.525
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	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.0000050	<0.0000050	0.0000086	<0.0000050	0.0000103
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.0043	0.0007	0.0036	0.0037	0.0037	0.0035	0.0034	0.0033	0.0033	0.0042	0.0002	0.0008	0.0003	<0.00010	0.0003	0.0006	0.0007	0.0004	0.0028	0.0002
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	<0.001	0.0181	0.0009	0.0006	0.0004	0.0013	0.00052	0.00596	0.00057	0.0009	0.0193	0.0195	0.0405	0.00707	0.0457	0.0227	0.0154	0.0133	0.00125	0.0202
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	0.035	<0.02	<0.02	0.040	0.030	0.040	<0.050	<0.050	<0.050	0.020	0.030	<0.02	0.060	<0.050	<0.050	<0.050	<0.050	0.198	0.055	0.067
Dissolved Potassium (K)	mg/L	373-432	-	-	1.74	1.85	1.76	1.85	1.63	1.86	1.71	1.85	1.58	2.26	0.62	1.85	1.35	0.25	1.20	2.05	2.80	0.41	1.59	0.74
Dissolved Rubidium (Rb)	mg/L	-	-	-									0.00							0.0010	0.0012	0.0004	0.0004	0.0006
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	0.00086	0.00060	0.00120	0.00170	0.00130	0.00160	0.00142	0.00155	0.00139	0.00210	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.00011	0.00011	0.00015	0.00113	0.00016
Dissolved Silicon (Si)	mg/L	-	-	-	4.00	8.70	3.60	4.40	4.40	4.30	4.10	4.60	3.80	4.70	7.70	8.70	7.90	5.10	8.60	6.13	5.99	5.86	4.00	7.45
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.00002	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	0.00002	<0.000010	<0.000010	<0.000010	0.000057
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	89.0	7.5	98.5	106.0	95.7	106.0	94.2	94.9	91.1	105.0	7.0	8.8	11.2	6.1	10.1	11.2	12.3	7.6	87.3	9.7
Dissolved Strontium (Sr)	mg/L	-	-	2.50	0.821	0.133	0.750	0.792	0.751	0.868	0.702	0.797	0.795	0.820	0.064	0.237	0.112	0.021	0.161	0.483	0.532	0.034	0.725	0.040
Dissolved Sulphur (S)	mg/L	-	-	-	40.4	2.0	46.0	53.0	46.0	54.0	44.8	49.5	47.3	56.0	<1	2.0	<1	<3.0	<3.0	<0.50	0.8	<0.50	45.2	1.0
Dissolved Tellurium (Te)	mg/L	-	-	-		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	<0.00020	<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	-	-	<0.00005	<0.00002	<0.00002	<0.00002	<0.00002	0.00002	<0.000020	<0.000020	0.000011	<0.00002	0.00002	0.00005	0.00002	<0.000020	0.000031	0.000018	0.000021	<0.000010	0.000011	0.000015
Dissolved Thorium (Th)	mg/L	-	-	-		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.00010	<0.0001	<0.0001	<0.0001	0.0003	<0.00010	0.00018	<0.00010	<0.00010	0.00044	<0.00010	0.00079
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	<0.0002	<0.0002	<0.0002	<0.0002	<0.00020	<0.00020	0.00245	0.00149	0.00011	0.00016	0.00013
Dissolved Titanium (Ti)	mg/L	2	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.0030	0.00035	0.0191	0.00243	0.00888
Dissolved Tungsten (W)	mg/L		-	0.003									<0.00010							<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.00370	0.00007	0.00351	0.00338	0.00363	0.00357	0.00338	0.00346	0.00331	0.00352	0.00009	0.00046	0.00040	0.00006	0.00044	0.00247	0.00177	0.00060	0.00337	0.00072
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	<0.001	<0.001	<0.001	0.002	<0.0010	0.0013	0.00141	0.0008	0.00282	0.00068	0.00242
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5 AO	3	<0.005	0.024	<0.004	<0.004	<0.004	<0.004	<0.0040	<0.0040	0.0041	0.005	0.007	0.007	0.12	0.0819	0.0132	0.0048	0.0124	0.0051	0.0068	0.0103
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.0005	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00010	<0.00010	<0.000060	<0.0001	0.0007	0.0002	0.0012	0.0004	0.00099	0.000864	0.000481	0.00202	<0.00020	0.00153

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 5B													
		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	7-Jul-16	25-Oct-16	24-Apr-17	14-Jun-17	30-May-18	11-Jul-18	11-Sep-18	17-Apr-19	13-Aug-19	20-Nov-19
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-	<0.005													
Cyanide, total	mg/L	-	-	0.2		<0.010	<0.010											
Alkalinity (CaCO3)	mg/L	-	-	-	784	540	800	710	910	330	560	560	232	795	801	650	452	592
Dissolved Hardness (CaCO3)	mg/L	-	-	-	756	239	853											
Hardness, Total (Total as CaCO3)	mg/L		-	-				885	898	502	608	665	311	892	825	716	614	719
Chloride (Cl)	mg/L	600	250, AO	250	140	114	177	204	198	259	243.0	236.0	21.4	244.0	205.0	163.0	226.0	215.0
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5									0.119	<0.20	<0.20	<0.10	<0.10	<0.10
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	3.5	5.5	10.4	2	2.2	21.6	1.1	1.4	23.3	<3.0	5.2	37.5	7.8	2
Conductivity	uS/cm	-	-	-	1,700	128	1,880	1,740	1,990	1,360	1650	1620						1570
Field Conductivity	uS/cm	-	-	-										1409	1154			
Ammonia (N)	mg/L	0.68-28.7 (d)	-	-	0.29	<0.03	0.29	<0.03	<0.03	0.042	<0.03	<0.03	0.0302	0.0217	0.0486	0.0374	0.0285	0.078
Nitrate (N)	mg/L	32.8	10 MAC	10.0	<0.02	0.01	<0.01	0.014	<0.01	0.029	<0.01	<0.01	<0.0050	<0.050	<0.050	<0.025	<0.025	<0.025
Nitrite (N)	mg/L	0.06-0.6 (c)	1.0	1	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	<0.01	<0.01	<0.0010	<0.010	<0.010	<0.0050	<0.0050	<0.0050
Nitrate+Nitrite (N)	mg/L	-	-	10		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	-	-	-	1.060	0.580	2.630											1.610
Total Phosphorous (P)	mg/L	-	0.01	-	0.42	0.35	3.2											
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-	340	200	430											
Total Dissolved Solids	mg/L	-	-	-	928	16.4	1000											
pH	pH units	6.5 - 9.0	7.0-10.5	-	7.1	6.9	7.3	6.8	6.9	7.2	6.5	6.8			7.73		7.94	8.01
Field pH	pH units	6.5 - 9.0	7.0-10.5	-												6.6	6.64	6.67
Volatiles																		
Vinyl chloride	ug/L			2	<0.50								<0.0004					
Dichloromethane	ug/L	98.1	-	50	<2.0								<0.0050					
Benzene	ug/L	40 (a)	5 (a)	5	<0.4								<0.00050					
Toluene	ug/L	0.5 (a)	-	60	<0.4								0.00291					
1,4-dichlorobenzene	ug/L	26	-	5	<0.5								<0.0010					
Misc. Organics																		
Chemical Oxygen Demand	mg/L	-	-	-	62	59	164	58	49	48	60.00	60.00	220.00	50.00	31.00	35	47	31
Biochemical Oxygen Demand	mg/L	-	-	-														
Dissolved Organic Carbon (C)	mg/L	-	-	-	10.8	16.4	21.3											
Total Organic Carbon (C)	mg/L															13.10	10.10	9.35
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	<0.003	<0.005	<0.005	<0.005	<0.005	0.007	<0.0050	0.0154	0.0076	0.0054	0.0024	0.018	0.0098	0.0072
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	<0.005	0.0005	0.0002	0.0003	0.0003	0.0006	0.00041	0.00056	0.00015	0.00031	0.00023	0.00026	0.00021	0.00011
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00346	<0.0005	0.01020	0.00410	0.00240	0.00410	0.00230	0.00394	0.00111	0.00918	0.01130	0.00570	0.00626	0.00773
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.179	0.032	0.336	0.196	0.179	0.639	0.2810	0.1550	0.0658	0.2890	0.2880	0.246	0.252	0.281
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	<0.00010	<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	<0.000050	<0.000050	<0.000050
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00	<0.05	0.07	0.024	0.014	0.015	0.048	0.027	0.014	0.015	0.01	0.015	0.016	0.012	0.015
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	0.000041	0.000320	0.000020	0.000010	0.000100	0.000270	0.000089	0.000051	0.000019	0.000117	<0.0000050	0.0000198	0.0000295	0.0000611
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	205	70	220	228	236	126	162	180	71	229	205	183	154	188
Dissolved Cesium (Cs)	mg/L	-	-	-									<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)	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	<0.00010
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	0.0134	<0.00005	0.0121	0.0183	0.0368	0.0108	0.013	0.013	0.011	0.00645	0.00301	0.00958	0.00483	0.00409
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	<0.0050	0.0027	0.0014	0.0014	<0.0002	0.0133	0.02670	0.00024	0.00235	0.00050	0.00026	0.0004	0.00041	0.00116
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	0.109	<0.010	13.0	15.8	0.017	2.3	5.1	10.7	0.02	10.9	12.4	7.42	7.06	12.2
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	0.000089	<0.000050	<0.000050	<0.000050	0.00009	0.00005
Dissolved Lithium (Li)	mg/L	-	-	0.008	<0.005	0.0018	0.0031	0.0025	0.0033	0.0025	0.00207	0.00237	0.002	0.0028	0.0029	0.002	0.002	0.002
Dissolved Magnesium (Mg)	mg/L	-	-	-	59.0	15.6	74.1	76.5	75.2	45.3	49.5	52.5	32.4	77.6	76.0	63.1	55.8	60.6
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	4.57	0.0135	5.35	5.98	5.96	2.38	5.07	5.81	1.74	5.01	4.51	1.83	2.98	3.62
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	0.0000082	<0.0000050	<0.0000050	<0.0000050	0.0000062	<0.0000050
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.0036	0.0063	0.0073	0.0019	0.0025	0.0016	0.0016	0.0004	0.0047	0.0011	0.0011	0.00093	0.000282	0.00025
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	0.0141	0.0008	0.0173	0.0233	0.0306	0.0284	0.0183	0.0195	0.00381	0.00811	0.00513	0.01410	0.00430	0.00332
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	<0.01	0.03	<0.02	<0.02	<0.02	<0.02	<0.050	<0.050	<0.050	<0.050	0.111	<0.050	0.135	0.145
Dissolved Potassium (K)	mg/L	373-432	-	-	4.22	2.65	5.39	4.39	4.36	4.78	2.41	2.50	2.13	3.58	3.37	3.26	3.32	3.59
Dissolved Rubidium (Rb)	mg/L	-	-	-									0.00	0.00	0.00	0.00047	0.00066	0.0006
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	<0.0001	0.0012	<0.0005	<0.0005	<0.0005	<0.0005	<0.00050	<0.00050	0.00011	0.00011	0.00009	0.000401	0.00233	0.000158
Dissolved Silicon (Si)	mg/L	-	-	-	8.89	4.60	9.60	11.10	10.70	9.10	9.50	11.30	3.21	10.10	8.75	6.73	7.83	8.51
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.00002	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.000050	<0.000050	<0.000010	<0.000010	0.000028	<0.000010	<0.000010	<0.000010
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	77.0	105.0	115.0	111.0	105.0	113.0	94.8	94.5	12.4	106.0	95.7	89.900	87.900	84.900
Dissolved Strontium (Sr)	mg/L	-	-	2.50	1.61	0.89	1.67	1.68	1.69	1.06	1.040	1.230	0.713	1.680	1.700	1.55	1.27	1.55
Dissolved Sulphur (S)	mg/L	-	-	-	<3.0	75	1	<1	3	9	<3.0	<3.0	8.8	1.2	3.1	19.5	6.07	1.09
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	<0.00020	<0.00020	<0.00020
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<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	<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	<0.00010	<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	<0.00010	<0.00010	<0.00010	0.000	0.000
Dissolved Titanium (Ti)	mg/L	2	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0050	<0.0050	<0.00030	<0.00030	<0.00030	0.00033	0.00031	<0.00030
Dissolved Tungsten (W)	mg/L	-	-	0.003									<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.00063	0.00231	0.00210	0.00047	0.00051	0.00235	0.00070	0.00108	0.00065	0.00175	0.00221	0.00500	0.00245	0.00137
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	<0.00050	<0.00050	<0.00050	0.001	<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	0.032	<0.004	0.005	0.211	0.0953	0.0054	0.002	0.0079	0.0017	0.0026	0.0016	0.0065
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.0005	<0.0001	0.0011	0.0002	0.0001	0.0002	0.00019	0.00023	<0.000060	0.000536	0.000496	0.000286	0.00047	0.00039

Notes:

2018 data compared to updated criteria

A shaded value means exceeded the freshwater aquatic life criteria

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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	Wetland 4	Wetland 4	Wetland 4	Wetland 4	Wetland 4	Wetland 4 DUP	Wetland 4
Date					13-Sep-18	22-Jul-19	31-Jul-19	7-Aug-19	22-Aug-19	16-Sep-19	16-Sep-19	12-Nov-19
Total Hardness	mg/L		-	-	390	250	236	248	249	293	290	191
Dissolved Hardness (CaCO3)	mg/L		-	-								
Alkalinity (Total as CaCO3)	mg/L		-	-	518	261	259	263	262	284	283	193
Total Organic Carbon (C)	mg/L		+/- 20% of background	4.0	52	23	20	20	16	15	17	10
Alkalinity (PP as CaCO3)	mg/L		-	-								
Bicarbonate (HCO3)	mg/L		-	-								
Carbonate (CO3)	mg/L		-	-								
Hydroxide (OH)	mg/L		-	-								
Chemical Oxygen Demand	mg/L		-	-		69	82	45	43	51	56	28
BOD	mg/L		-	-		2.7	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Oxygen (DO)	mg/L					3.4	2.3	3	4.8	4.1		1.2
Dissolved Sulphate (SO4)	mg/L		128-429 (e)	500, AO	17.2	9.43	7.64	8.34	10.7	24.5	24.7	22.5
Dissolved Chloride (Cl)	mg/L	3750	600	250, AO	286	59.5	58.6	58.8	54.8	103	103	43.5
Total Kjeldahl Nitrogen	mg/L	60	-	-								
Ammonia (N)	mg/L	30	0.681-28.7 (d)	-	8.61	0.244	0.166	0.0877	0.131	2.81	2.71	0.0912
Nitrate plus Nitrite (N)	mg/L		-	-	0.186	-	-	1.29	1.36	3.75	3.92	1.51
Nitrite (N)	mg/L		0.06 -0.6 (c)	1.0	0.114	0.0015	<0.0010	<0.0010	0.0054	0.0404	0.0425	0.0129
Nitrate (N)	mg/L		32.8	10 MAC	0.072	0.0191	0.007	<0.0050	0.094	0.145	0.141	1.02
Orthophosphorous	mg/L					0.0019	<0.0010	<0.0010	<0.0010	0.0022	0.0045	0.0056
Conductivity	uS/cm		-	-		-	-	645	-			532
pH	pH Units	6.5 - 8.5	6.5 - 9.0	7.0-10.5	7.9	8.35	8.57	8.4	8.46	8.16	8.15	8.23
TSS	mg/L		25 mg/L (background 25-250 mg/l)) (i)	<500, AO								
Lethal Toxicity Testing												
LC-50	%v/v	100%								>100		
Total Metals												
Total Aluminum	mg/L		0.023-0.1 (b,c)	9.5	0.53	0.69	0.13	0.06	0.18	0.11	0.16	0.64
Total Antimony (Ab)	mg/L		0.270	0.006	0.00085	0.00028	0.00026	0.00023	0.00018	0.00023	0.00022	0.00025
Total Arsenic (As)	mg/L		0.005	0.01 MAC	0.0278	0.00764	0.0054	0.00489	0.00278	0.00201	0.00204	0.00121
Total Barium (Ba)	mg/L		1	1.0	0.953	0.122	0.111	0.104	0.104	0.118	0.112	0.0718
Total Beryllium (Be)	mg/L		0.00013	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Bismuth (Bi)	mg/L		-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Total Boron (B)	mg/L		1.2	5.0, MAC	2.42	0.592	0.533	0.575	0.48	0.556	0.547	0.251
Total Cadmium (Cd)	mg/L	0.1	0.000027 - 0.00280 (e)	0.005, MAC	0.00001	0.00002	<0.0000050	0.00001	0.00001	0.00001	0.00001	0.00002
Total Calcium (Ca)	mg/L		<4 sensitive to acid input	-	69.2	66.2	62.9	66.2	66.6	83	80.7	52.7
Total Cesium (Cs)	mg/L		-	-	0.000085	0.000055	0.000011	<0.000010	0.000015	0.000024	0.000027	0.000054
Total Chromium (Cr)	mg/L		0.001 (f)	0.05, MAC	0.0022	0.0008	0.0003	0.0002	0.0003	0.0003	0.0004	0.0006
Total Cobalt (Co)	mg/L		0.11	-	0.002	0.00088	0.00049	0.00038	0.00032	0.0007	0.0006	0.00045
Total Copper (Cu)	mg/L		0.0032-0.0396 (e)	1.0, AO	0.00197	0.0019	0.0008	0.00075	0.00122	0.00173	0.00173	0.00278
Total Iron (Fe)	mg/L	4.5	1	0.3, AO	2.17	1.93	1.02	0.68	0.53	0.35	0.34	0.57
Total Lead (Pb)	mg/L		0.011-0.402 (e)	0.01	0.00022	0.000336	0.00016	0.00009	0.00013	0.000091	0.000091	0.000173
Total Lithium (Li)	mg/L		-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Magnesium (Mg)	mg/L		-	-	49.5	20.6	19.2	20	20	20.9	21.4	14.5
Total Manganese (Mn)	mg/L		0.8-3.4 (e)	0.05, AO	2.1	1.3	0.8	0.6	0.1	0.6	0.1	0.2
Total Mercury (Hg)	mg/L.		0.0001	0.001	0.000008	0.000007	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.000007
Total Molybdenum (Mo)	mg/L		2	0.25	0.00264	0.00158	0.0013	0.00109	0.001	0.00121	0.00134	0.00081
Total Nickel (Ni)	mg/L		0.025-0.15 (e)	-	0.0173	0.00461	0.00373	0.00359	0.00356	0.00438	0.00463	0.00261
Total Phosphorus (P)	mg/L		0.005-0.015 (for lakes only)	0.01, AO	0.222	0.075	<0.050	<0.050	0.051	<0.050	<0.050	<0.050
Total Potassium (K)	mg/L		-	-	38.8	8.93	8.53	7.92	7.13	8.9	9.39	5.4
Total Rubidium (Rb)	mg/L				0.00559	0.00113	0.00077	0.00073	0.00084	0.00182	0.00203	0.00088
Total Selenium (Se)	mg/L		0.002	0.01, MAC	0.000223	0.000179	0.000133	8.10E-05	0.000118	0.000172	0.000134	0.000109
Total Silicon (Si)	mg/L		-	-	7.31	4.1	2.78	2.73	2.87	2.92	3.17	3.33
Total Silver (Ag)	mg/L		0.0001-0.003 (e)	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Total Sodium (Na)	mg/L		-	<200, AO	225	45.8	42.7	43.3	43.1	52.1	56.1	31
Total Strontium (Sr)	mg/L		-	-	0.867	0.535	0.514	0.508	0.485	0.652	0.638	0.38
Total Sulphur (S)	mg/L		-	-	8.54	4.12	3.5	3.3	4.62	9.79	9.97	7.63
Total Tellurium (Te)	mg/L			-	<0.00020	<0.00020	<0.00020	0.00021	<0.00020	<0.00020	<0.00020	<0.00020
Total Thallium (Tl)	mg/L		0.0008	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000028	<0.000010
Total Thorium (Th)	mg/L		-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Tin (Sn)	mg/L		-	-	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Tungsten (W)	mg/L				0.00807	0.0123	0.00207	0.00105	0.00257	<0.0015	<0.0024	0.011
Total Titanium (Ti)	mg/L		-	-	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Total Uranium (U)	mg/L		0.0085	0.02	0.000631	0.000349	0.000287	0.00028	0.000325	0.000487	0.000508	0.00043
Total Vanadium (V)	mg/L		-	-	0.004	0.002	0.001	0.001	0.001	<0.00050	0.001	0.002
Total Zinc (Zn)	mg/L	75	0.033-0.34 (e)	5.0, AO	0.0049	0.004	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Total Zirconium (Zr)	mg/L		-	-	0.000425	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

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

Table 4.1 Wetland #4 Water Volatile Organic Compounds

Parameters	Units	BC MOE OC Criteria	Wetland 4
Date			22-Jul-19
Total Metals			
Benzene	mg/L		<0.00050
Bromodichloromethane	mg/L		<0.0010
Bromoform	mg/L		<0.0010
Carbon Tetrachloride	mg/L		<0.00050
Chlorobenzene	mg/L		<0.0010
Dibromochloromethane	mg/L		<0.0010
Chloroethane	mg/L		<0.0010
Chloroform	mg/L		<0.0010
Chloromethane	mg/L		<0.0050
1,2-Dichlorobenzene	mg/L		<0.00050
1,3-Dichlorobenzene	mg/L		<0.0010
1,4-Dichlorobenzene	mg/L		<0.0010
1,1-Dichloroethane	mg/L		<0.0010
1,2-Dichloroethane	mg/L		<0.0010
1,1-Dichloroethylene	mg/L		<0.0010
cis-1,2-Dichloroethylene	mg/L		<0.0010
trans-1,2-Dichloroethylene	mg/L		<0.0010
Dichloromethane	mg/L		<0.0050
1,2-Dichloropropane	mg/L		<0.0010
cis-1,3-Dichloropropylene	mg/L		<0.00050
trans-1,3-Dichloropropylene	mg/L		<0.00050
1,3-Dichloropropene (cis & trans)	mg/L		<0.0010
Ethylbenzene	mg/L		<0.00050
Methyl t-butyl ether (MTBE)	mg/L		<0.00050
Styrene	mg/L		<0.00050
1,1,1,2-Tetrachloroethane	mg/L		<0.0010
1,1,2,2-Tetrachloroethane	mg/L		<0.00020
Tetrachloroethylene	mg/L		<0.0010
Toluene	mg/L		<0.00045
1,1,1-Trichloroethane	mg/L		<0.0010
1,1,2-Trichloroethane	mg/L		<0.00050
Trichloroethylene	mg/L		<0.0010
Trichlorofluoromethane	mg/L		<0.0010
Vinyl Chloride	mg/L		<0.00040
ortho-Xylene	mg/L		<0.00050
meta- & para-Xylene	mg/L		<0.00050
Xylenes	mg/L		<0.00075
4-Bromofluorobenzene (SS)	%		100.400
1,4-Difluorobenzene (SS)	%		100

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

Table 5: Hazelton Surface Water Quality Data QA/QC

Parameters	Units	BC MoE Guidelines: Freshwater Aquatic Life (1) (2)	BC MoE Guidelines: Drinking Water (2) (3)	SW-05	Duplicate	RPD (%)	SW-08 (Hwy 16 East Culvert)	Duplicate	RPD (%)
Date				21-Nov-19	21-Nov-19		21-Nov-19	21-Nov-19	
Total Hardness	mg/L	-	-	50.3	51.2	2%	36	36	1%
Dissolved Hardness (CaCO3)	mg/L	-	-						
Alkalinity (Total as CaCO3)	mg/L	-	-	7	19	89%	7	19	89%
Total Organic Carbon (C)	mg/L	+/- 20% of background	4.0	46.3	40.3	14%	46.3	40.3	14%
Alkalinity (PP as CaCO3)	mg/L	-	-						
Bicarbonate (HCO3)	mg/L	-	-						
Carbonate (CO3)	mg/L	-	-						
Hydroxide (OH)	mg/L	-	-						
Chemical Oxygen Demand (COD)	mg/L	-	-	59	103	54%	114	107	6%
Biological Oxygen Demand (BOD)	mg/L	-	-	2.1	<2.0				
Sulphate (SO4)	mg/L	128-429 (e)	500, AO	<0.30	<0.30		<0.30	0.57	
Chloride (Cl)	mg/L	600	250, AO	48.7	48.7	0%	29	25.3	13%
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	0.038	0.036	5%	<0.020	0	
Total Kjeldahl Nitrogen	mg/L	-	-	2.19	2.000	9%	2.19	2.000	9%
Ammonia (N)	mg/L	0.681-28.7 (d)	-	0.0123	0.0115	7%	0.039	0.041	5%
Nitrate plus Nitrite (N)	mg/L	-	-						
Nitrite (N)	mg/L	0.06 -0.6 (c)	1.0	<0.0010	<0.0010		<0.0010	<0.0010	
Nitrate (N)	mg/L	32.8	10 MAC	0.0059	0.0073	21%	0.0071	<0.0050	
Conductivity	uS/cm	-	-	130	130	0%	130	130	0%
Field Conductivity	uS/cm	-	-						
pH	pH Units	6.5 - 9.0	7.0-10.5	7.18	7.09	1%	6.32	7.09	11%
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						
Total Metals									
Total Aluminum	mg/L	0.023-0.1 (j,k)	9.5	0.197	0.108	58%	0.36	0.595	49%
Total Antimony (Ab)	mg/L	0.009	0.006	<0.00010	<0.00010		<0.00010	0.00011	
Total Arsenic (As)	mg/L	0.005	0.01 MAC	0.00142	0.00144	1%	0.00049	0.00075	42%
Total Barium (Ba)	mg/L	1	1.0	0.0235	0.0227	3%	0.012	0.0174	38%
Total Beryllium (Be)	mg/L	0.00013	-	<0.00010	<0.00010		<0.00010	<0.00010	
Total Bismuth (Bi)	mg/L	-	-	<0.000050	<0.000050		<0.000050	<0.000050	
Total Boron (B)	mg/L	1.2	5.0, MAC	<0.010	<0.010		<0.010	<0.010	
Total Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005, MAC	0.0000072	0.0000060	18%	0.0000187	0.0000237	24%
Total Calcium (Ca)	mg/L	<4 sensitive to acid input	-	15.1	15.4	2%	10.4	11.1	7%
Total Cesium (Cs)	mg/L	-	-	0.000016	<0.000010		0.000018	0.000035	64%
Total Chromium (Cr)	mg/L	0.001 (f)	0.05, MAC	0.00030	0.00023	26%	0.00045	0.00074	49%
Total Cobalt (Co)	mg/L	0.11	-	0.00043	0.00039	10%	0.00018	0.00026	36%
Total Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	0.00084	0.00065	26%	0.00136	0.00266	65%
Total Iron (Fe)	mg/L	1	0.3, AO	1.00	0.918	9%	0.63	0.93	40%
Total Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.000231	0.000154	40%	0.000421	0.000273	43%
Total Lithium (Li)	mg/L	-	-	<0.0010	<0.0010		<0.0010	<0.0010	
Total Magnesium (Mg)	mg/L	-	-	3.02	3.08	2%	2.78	2.54	9%
Total Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	0.105	0.102	3%	0.0314	0.0288	9%
Total Mercury (Hg)	mg/L.	0.0001	0.001	<0.0000050	<0.0000050		0.0000074	0.0000101	31%
Total Molybdenum (Mo)	mg/L	2	0.25	<0.000050	<0.000050		<0.000050	0.000088	
Total Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.00093	0.00089	4%	0.00077	0.00116	40%
Total Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	0.052	<0.050		<0.050	<0.050	
Total Potassium (K)	mg/L	-	-	0.408	0.411	1%	0.394	0.689	54%
Total Rubidium (Rb)	mg/L			0.00048	0.00038	23%	0.00045	0.00054	18%
Total Selenium (Se)	mg/L	0.002	0.01, MAC	0.000054	0.000061		<0.000050	0.000106	
Total Silicon (Si)	mg/L	-	-	1.00	0.86	15%	3.28	4.12	23%
Total Silver (Ag)	mg/L	0.0001-0.003 (e)	-	<0.000010	<0.000010		<0.000010	0.000015	
Total Sodium (Na)	mg/L	-	<200, AO	20.9	21.8	4%	13.4	13.7	2%
Total Strontium (Sr)	mg/L	-	-	0.103	0.106	3%	0.0673	0.0698	4%
Total Sulphur (S)	mg/L	-	-	<0.50	<0.50		<0.50	0.65	
Total Tellurium (Te)	mg/L		-	<0.00020	<0.00020		<0.00020	<0.00020	
Total Thallium (Tl)	mg/L	0.0008	-	<0.000010	<0.000010		<0.000010	<0.000010	
Total Thorium (Th)	mg/L	-	-	<0.00010	<0.00010		<0.00010	<0.00010	
Total Tin (Sn)	mg/L	-	-	<0.00010	<0.00010		<0.00010	<0.00010	
Total Tungsten (W)	mg/L			<0.0039	0.00209		0.00379	0.00675	56%
Total Titanium (Ti)	mg/L	-	-	<0.00010	<0.00010		<0.00010	<0.00010	
Total Uranium (U)	mg/L	0.0085	0.02	<0.000010	<0.000010		<0.000010	0.000023	
Total Vanadium (V)	mg/L	-	-	0.00072	0.00051	34%	0.00104	0.00119	13%
Total Zinc (Zn)	mg/L	0.033-0.34 (e)	5.0, AO	<0.0030	<0.0030		0.005	0.0117	80%
Total Zirconium (Zr)	mg/L	-	-	<0.00020	<0.00020		<0.00020	0.00036	

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 6: Hazelton Groundwater Quality Data QA/QC

Analyte	Units	BC MoE Guidelines		BC CSR Standards	BH 01			BH 5B		
		Freshwater Aquatic Life (1) (2)	Drinking Water (2) (3)	BC CSR-DW (4)		Duplicate			Duplicate	
					13-Aug-19	13-Aug-19	RPD(%)	20-Nov-19	20-Nov-19	RPD (%)
Strong Acid Dissoc. Cyanide (CN)	mg/L	-	-	-						
Cyanide, total	mg/L	-	-	0.2						
Alkalinity (CaCO3)	mg/L	-	-	-	326	309	5%	592	676	13%
Dissolved Hardness (CaCO3)	mg/L	-	-	-						
Hardness, Total (Total as CaCO3)	mg/L		-	-	265	318	18%	719	722	0%
Chloride (Cl)	mg/L	600	250, AO	250	<0.50	<0.50		215.0	215.0	0%
Fluoride (F)	mg/L	0.4-1.87 (e)	1.5	1.5	0.074	0.075		<0.10	<0.10	
Sulphate (SO4)	mg/L	128-429 (e)	<500, AO	500	14.4	14.7	2%	2	2	
Conductivity	uS/cm	-	-	-				1570	1740	
Field Conductivity	uS/cm	-	-	-						
Ammonia (N)	mg/L	0.68-28.7 (d)	-	-	0.276	0.271	2%	0.078	0.067	15%
Nitrate (N)	mg/L	32.8	10 MAC	10.0	<0.0050	<0.0050		<0.025	<0.025	
Nitrite (N)	mg/L	0.06-0.6 (c)	1.0	1	<0.0010	<0.0010		<0.0050	<0.0050	
Nitrate+Nitrite (N)	mg/L	-	-	10						
Total Kjeldahl Nitrogen (N)	mg/L	-	-	-				1.610	1.050	
Total Phosphorous (P)	mg/L	-	0.01	-						
Total Suspended Solids	mg/L	25 mg/L (background 25-250 mg/l)) (i)	-	-						
Total Dissolved Solids	mg/L	-	-	-						
pH	pH units	6.5 - 9.0	7.0-10.5	-	8.38	8.37		8.01	7.64	
Field pH	pH units	6.5 - 9.0	7.0-10.5	-	7.32			6.67		
Volatiles										
Vinyl chloride	ug/L			2						
Dichloromethane	ug/L	98.1	-	50						
Benzene	ug/L	40 (a)	5 (a)	5						
Toluene	ug/L	0.5 (a)	-	60						
1,4-dichlorobenzene	ug/L	26	-	5						
Misc. Organics										
Chemical Oxygen Demand	mg/L	-	-	-	148.00	134.00	10%	31	33	6%
Biochemical Oxygen Demand	mg/L	-	-	-						
Dissolved Organic Carbon (C)	mg/L	-	-	-						
Total Organic Carbon (C)	mg/L				64.40	1.22		9.35	9.59	
Phenols	mg/L	50	-	1.0						
Dissolved Metals										
Dissolved Aluminum (Al)	mg/L	0.023-0.1 (b,c)	9.5	9.5	0.0022	5.6000	200%	0.0072	0.0044	48%
Dissolved Antimony (Sb)	mg/L	0.009	0.006	0.006	<0.00010	0.00011		0.00011	0.00012	9%
Dissolved Arsenic (As)	mg/L	0.005	0.01 MAC	0.01	0.00835	0.00977	16%	0.00773	0.00804	4%
Dissolved Barium (Ba)	mg/L	1	1.0	1	0.1940	0.2890	39%	0.281	0.2470	13%
Dissolved Beryllium (Be)	mg/L	0.00013	-	0.008	<0.00010	0.00017		<0.00010	<0.00010	
Dissolved Bismuth (Bi)	mg/L	-	-	-	<0.000050	<0.000050		<0.000050	<0.000050	
Dissolved Boron (B)	mg/L	1.20	5.0, MAC	5.00	0.089	0.1	12%	0.015	0.0140	7%
Dissolved Cadmium (Cd)	mg/L	0.000027 - 0.00280 (e)	0.005	0.005	<0.0000050	0.000243		0.0000611	0.0000428	
Dissolved Calcium (Ca)	mg/L	<4 sensitive to acid input	-	-	40.7	57.7	35%	188	191	2%
Dissolved Cesium (Cs)	mg/L	-	-	-	<0.000010	0.000355		<0.000010	<0.000010	
Dissolved Chromium (Cr)	mg/L	0.001 (e, f)	0.05, MAC	0.05 (VI), 6 (III)	<0.00010	0.00647		<0.00010	<0.00010	
Dissolved Cobalt (Co)	mg/L	0.11	-	0.001	0.00011	0.00539	192%	0.00409	0.00436	6%
Dissolved Copper (Cu)	mg/L	0.0032-0.0396 (e)	1.0, AO	1.5	<0.00020	0.0227		0.00116	0.0005	75%
Dissolved Iron (Fe)	mg/L	0.35	0.3, AO	6.5	0.099	0.434	196%	12.2	12	2%
Dissolved Lead (Pb)	mg/L	0.011-0.402 (e)	0.01	0.01	<0.000050	0.00373		0.00005	<0.000050	
Dissolved Lithium (Li)	mg/L	-	-	0.008	0.0012	0.0056	129%	0.002	0.0026	8%
Dissolved Magnesium (Mg)	mg/L	-	-	-	39.6	42.2	6%	60.6	59.6	2%
Dissolved Manganese (Mn)	mg/L	0.8-3.4 (e)	0.05, AO	1.5	0.135	0.728	137%	3.62	3.92	8%
Dissolved Mercury (Hg)	mg/L	0.0001, MAC	0.001	0.001	<0.0000050	<0.0000050		<0.0000050	<0.0000050	
Dissolved Molybdenum (Mo)	mg/L	2	0.25	0.25	0.00351	0.00176	66%	0.00025	0.000298	18%
Dissolved Nickel (Ni)	mg/L	0.025-0.15 (e)	-	0.08	<0.00050	0.0117		0.00332	0.00413	22%
Dissolved Phosphorus (P)	mg/L	0.005-0.015 (for lakes only)	0.01, AO	-	<0.050	0.759		0.145	0.121	18%
Dissolved Potassium (K)	mg/L	373-432	-	-	2.1	2.34	11%	3.59	3.75	4%
Dissolved Rubidium (Rb)	mg/L	-	-	-	0.0004	0.00179	127%	0.0006	0.00065	8%
Dissolved Selenium (Se)	mg/L	0.002	0.01, MAC	0.01	<0.000050	<0.000050		0.000158	0.0001	39%
Dissolved Silicon (Si)	mg/L	-	-	-	3.77	12	104%	8.51	8.59	1%
Dissolved Silver (Ag)	mg/L	0.001-0.003 (e)	-	0.02	<0.000010	0.000021		<0.000010	<0.000010	
Dissolved Sodium (Na)	mg/L	-	<200, AO	200	30.7	30.1	2%	84.900	87.2000	3%
Dissolved Strontium (Sr)	mg/L	-	-	2.50	1.150	1.300	12%	1.55	1.56	1%
Dissolved Sulphur (S)	mg/L	-	-	-	4.8	5.0	4%	1.09	1.23	12%
Dissolved Tellurium (Te)	mg/L	-	-	-	<0.00020	<0.00020		<0.00020	<0.00020	
Dissolved Thallium (Tl)	mg/L	0.0017	-	-	<0.000010	0.000025		<0.000010	<0.000010	
Dissolved Thorium (Th)	mg/L	-	-	-	<0.00010	0.00057		<0.00010	<0.00010	
Dissolved Tin (Sn)	mg/L	-	-	2.5	<0.00010	0.00016		0.000	0.0001	
Dissolved Titanium (Ti)	mg/L	2	-	-	<0.00030	0.0642		<0.00030	<0.00030	
Dissolved Tungsten (W)	mg/L	-	-	0.003	<0.00010	<0.00010		<0.00010	<0.00010	
Dissolved Uranium (U)	mg/L	0.3	0.02	0.02	0.00066	0.00079	18%	0.00137	0.00141	3%
Dissolved Vanadium (V)	mg/L	0.006	-	0.02	<0.00050	0.0125		<0.00050	<0.00050	
Dissolved Zinc (Zn)	mg/L	0.19-0.72 (Hardness 300-1,000 mg/L) (e)	5 AO	3	<0.0010	0.0392		0.0065	0.0028	80%
Dissolved Zirconium (Zr)	mg/L	-	-	-	<0.00020	<0.0014		0.00039	0.00038	3%

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 7: Hazelton Wetland #4 Water Quality Data QA/QC

Parameters	Units	BC MOE OC Criteria	BC MoE Guidelines (a) Freshwater Aquatic Life	BC MoE Guidelines (a) Drinking Water	Wetland 4	Wetland 4 DUP	RPD
Date					16-Sep-19	16-Sep-19	
Total Hardness	mg/L		-	-	293	290	1%
Dissolved Hardness (CaCO3)	mg/L		-	-			
Alkalinity (Total as CaCO3)	mg/L		-	-	284	283	0%
Total Organic Carbon (C)	mg/L		+/- 20% of background	4.0	15	17	8%
Alkalinity (PP as CaCO3)	mg/L		-	-			
Bicarbonate (HCO3)	mg/L		-	-			
Carbonate (CO3)	mg/L		-	-			
Hydroxide (OH)	mg/L		-	-			
Chemical Oxygen Demand	mg/L		-	-	51	56	9%
BOD	mg/L		-	-	<2.0	<2.0	
Dissolved Oxygen (DO)	mg/L						
Dissolved Sulphate (SO4)	mg/L		128-429 (e)	500, AO	24.5	24.7	1%
Dissolved Chloride (Cl)	mg/L	3750	600	250, AO	103	103	0%
Total Kjeldahl Nitrogen	mg/L	60	-	-			
Ammonia (N)	mg/L	30	0.681-28.7 (d)	-	2.81	2.71	4%
Nitrate plus Nitrite (N)	mg/L		-	-	3.75	3.92	4%
Nitrite (N)	mg/L		0.06 -0.6 (c)	1.0	0.0404	0.0425	5%
Nitrate (N)	mg/L		32.8	10 MAC	0.145	0.141	3%
Orthophosphorous	mg/L						
Conductivity	uS/cm		-	-			
pH	pH Units	6.5 - 8.5	6.5 - 9.0	7.0-10.5	8.16	8.15	0%
TSS	mg/L		25 mg/L (background 25-250 mg/l)) (i)	<500, AO			
Lethal Toxicity Testing							
LC-50	%v/v	100%			>100		
Total Metals							
Total Aluminum	mg/L		-	9.5	0.11	0.16	33%
Total Antimony (Ab)	mg/L		0.270	0.006	0.00023	0.00022	4%
Total Arsenic (As)	mg/L		0.005	0.01 MAC	0.00201	0.00204	1%
Total Barium (Ba)	mg/L		1	1.0	0.118	0.112	5%
Total Beryllium (Be)	mg/L		0.00013	-	<0.00010	<0.00010	
Total Bismuth (Bi)	mg/L		-	-	<0.000050	<0.000050	
Total Boron (B)	mg/L		1.2	5.0, MAC	0.556	0.547	2%
Total Cadmium (Cd)	mg/L	0.1	0.000027 - 0.00280 (e)	0.005, MAC	0.00001	0.00001	4%
Total Calcium (Ca)	mg/L		<4 sensitive to acid input	-	83	80.7	3%
Total Cesium (Cs)	mg/L		-	-	0.000024	0.000027	12%
Total Chromium (Cr)	mg/L		0.001 (f)	0.05, MAC	0.0003	0.0004	22%
Total Cobalt (Co)	mg/L		0.11	-	0.0007	0.0006	15%
Total Copper (Cu)	mg/L		0.0032-0.0396 (e)	1.0, AO	0.00173	0.00173	0%
Total Iron (Fe)	mg/L	4.5	1	0.3, AO	0.35	0.34	3%
Total Lead (Pb)	mg/L		0.011-0.402 (e)	0.01	0.000091	0.000091	0%
Total Lithium (Li)	mg/L		-	-	<0.0010	<0.0010	
Total Magnesium (Mg)	mg/L		-	-	20.9	21.4	2%
Total Manganese (Mn)	mg/L		0.8-3.4 (e)	0.05, AO	0.6	0.1	145%
Total Mercury (Hg)	mg/L.		0.0001	0.001	<0.0000050	<0.0000050	
Total Molybdenum (Mo)	mg/L		2	0.25	0.00121	0.00134	10%
Total Nickel (Ni)	mg/L		0.025-0.15 (e)	-	0.00438	0.00463	6%
Total Phosphorus (P)	mg/L		0.005-0.015 (for lakes only)	0.01, AO	<0.050	<0.050	
Total Potassium (K)	mg/L		-	-	8.9	9.39	5%
Total Rubidium (Rb)	mg/L				0.00182	0.00203	11%
Total Selenium (Se)	mg/L		0.002	0.01, MAC	0.000172	0.000134	25%
Total Silicon (Si)	mg/L		-	-	2.92	3.17	8%
Total Silver (Ag)	mg/L		0.0001-0.003 (e)	-	<0.000010	<0.000010	
Total Sodium (Na)	mg/L		-	<200, AO	52.1	56.1	7%
Total Strontium (Sr)	mg/L		-	-	0.652	0.638	2%
Total Sulphur (S)	mg/L		-	-	9.79	9.97	2%
Total Tellurium (Te)	mg/L			-	<0.00020	<0.00020	
Total Thallium (Tl)	mg/L		0.0008	-	<0.000010	0.000028	
Total Thorium (Th)	mg/L		-	-	<0.00010	<0.00010	
Total Tin (Sn)	mg/L		-	-	<0.00010	<0.00010	
Total Tungsten (W)	mg/L				<0.0015	<0.0024	
Total Titanium (Ti)	mg/L		-	-	<0.00010	<0.00010	
Total Uranium (U)	mg/L		0.0085	0.02	0.000487	0.000508	4%
Total Vanadium (V)	mg/L		-	-	<0.00050	0.001	
Total Zinc (Zn)	mg/L	75	0.033-0.34 (e)	5.0, AO	<0.0030	<0.0030	
Total Zirconium (Zr)	mg/L		-	-	<0.00020	<0.00020	

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.

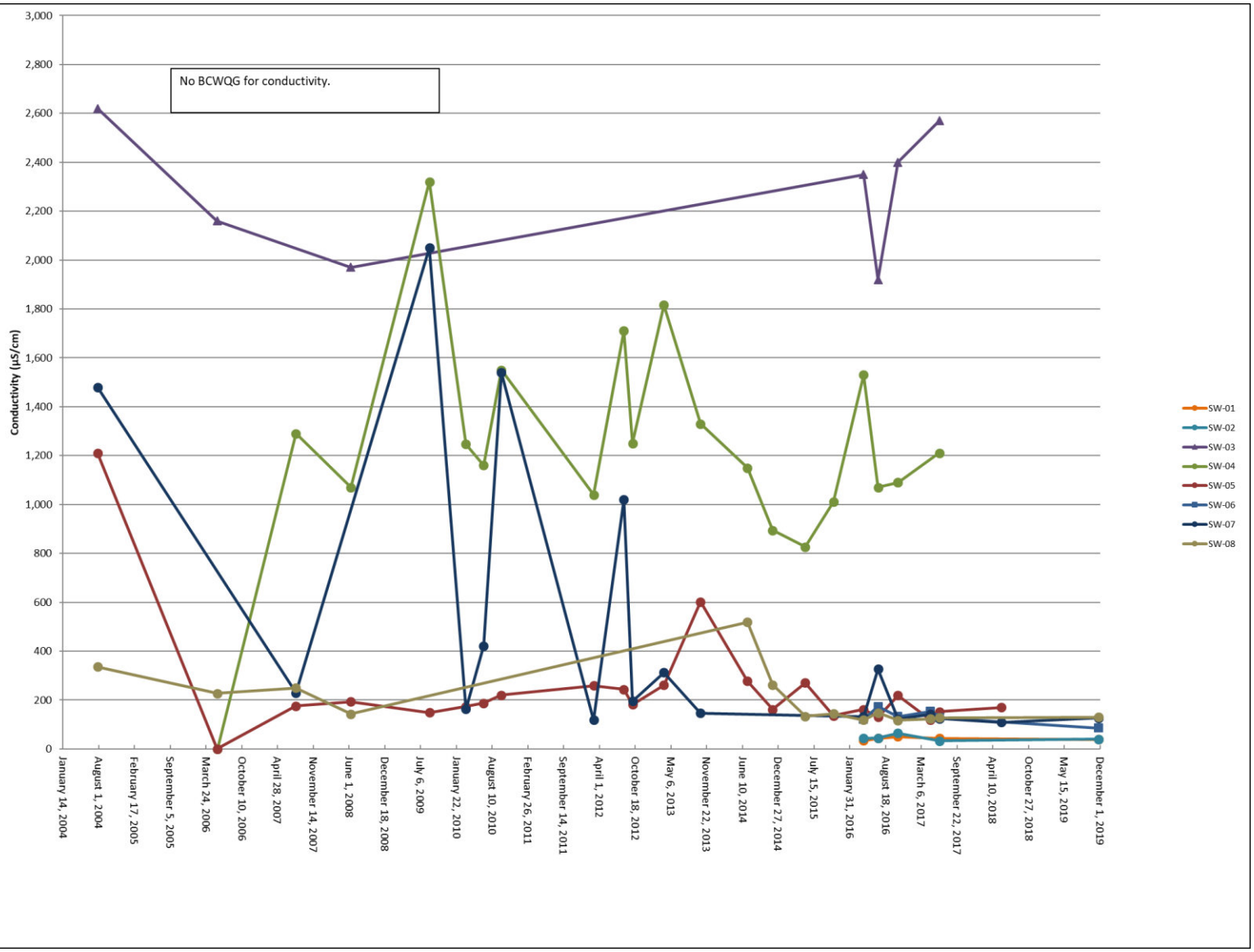
f. Limit for chromium (IV)

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

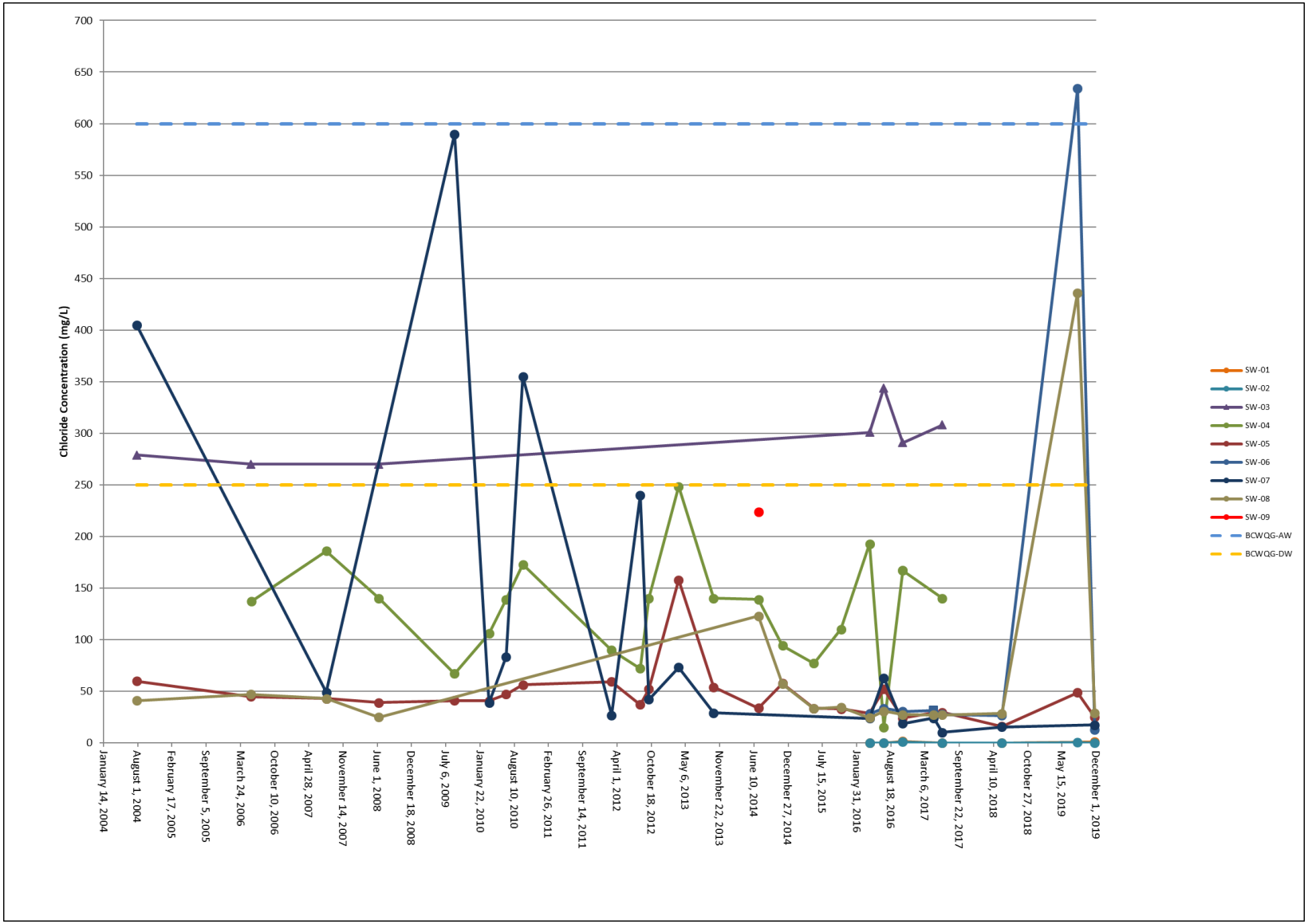
PROJECT:

Hazelton WMF Annual Monitoring Report

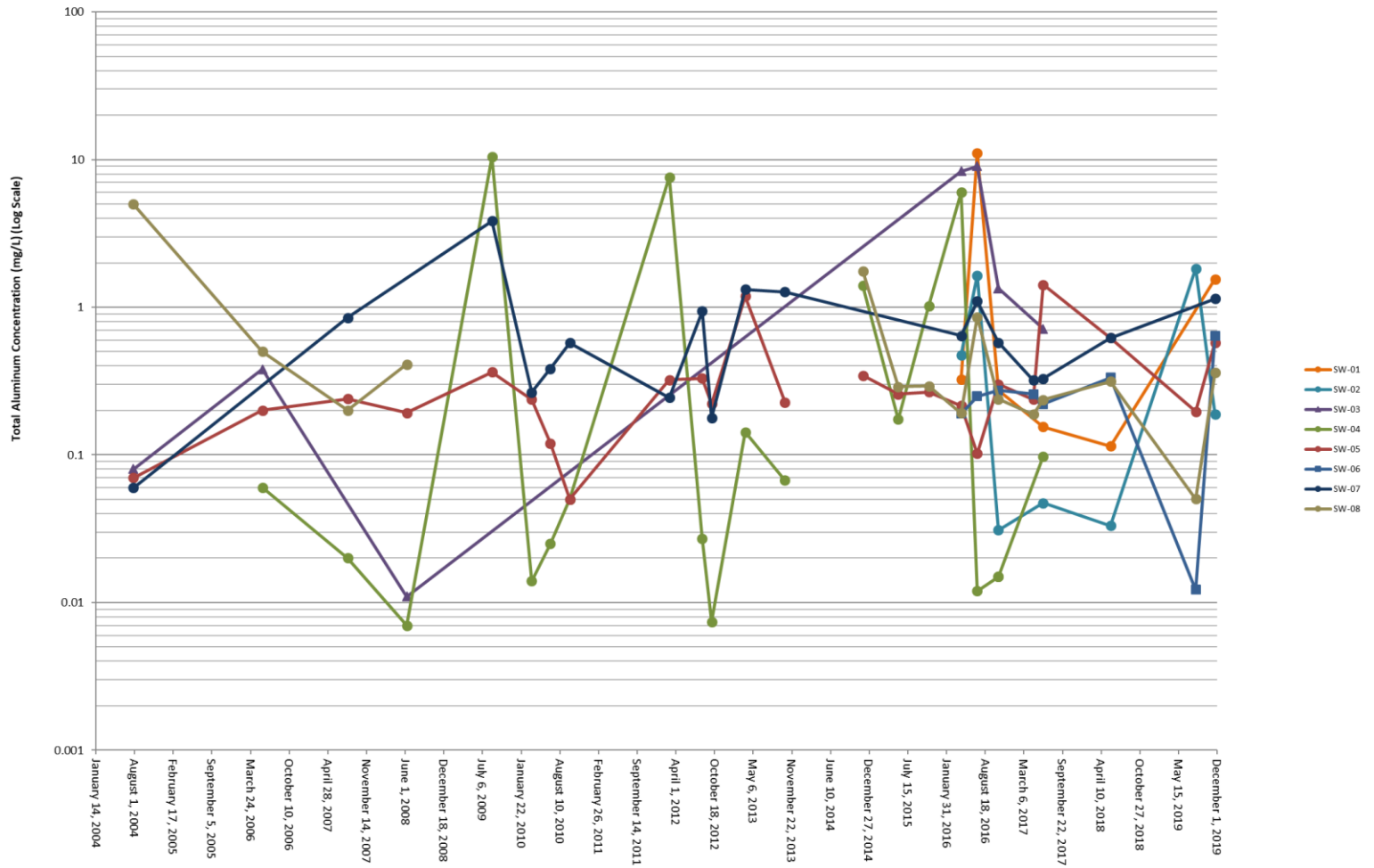
TITLE:

Surface Water Conductivity

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
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: 2020/02/07 yyyy/mm/dd; PROJECT NO: PRJ20010; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: **Chart 2**



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

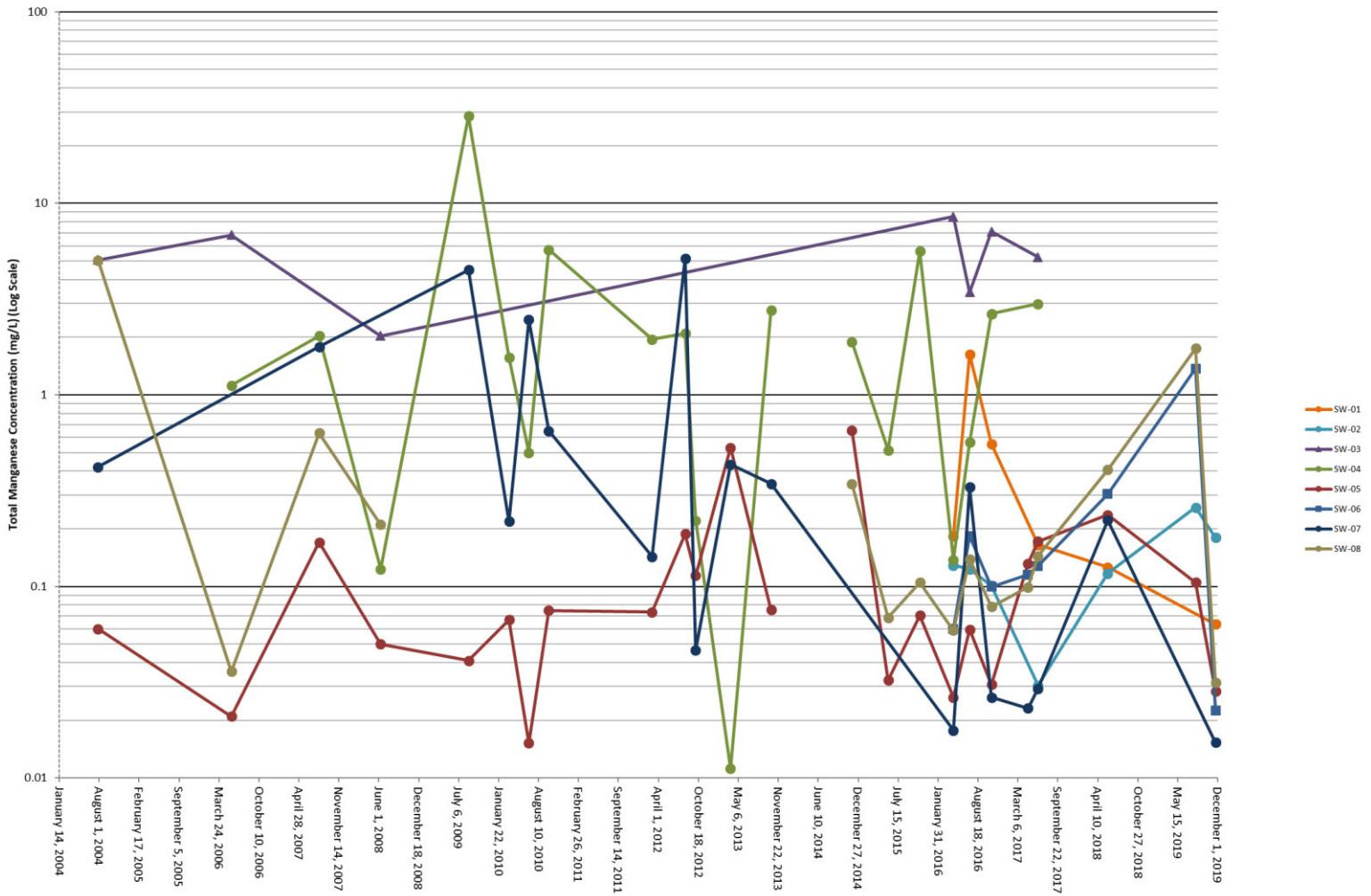
PROJECT:

Hazelton WMF Annual Monitoring Report

TITLE:

Surface Water Total Aluminum

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 yyyy/mm/dd	PRJ20010
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 3**
CHECKED	DK	



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

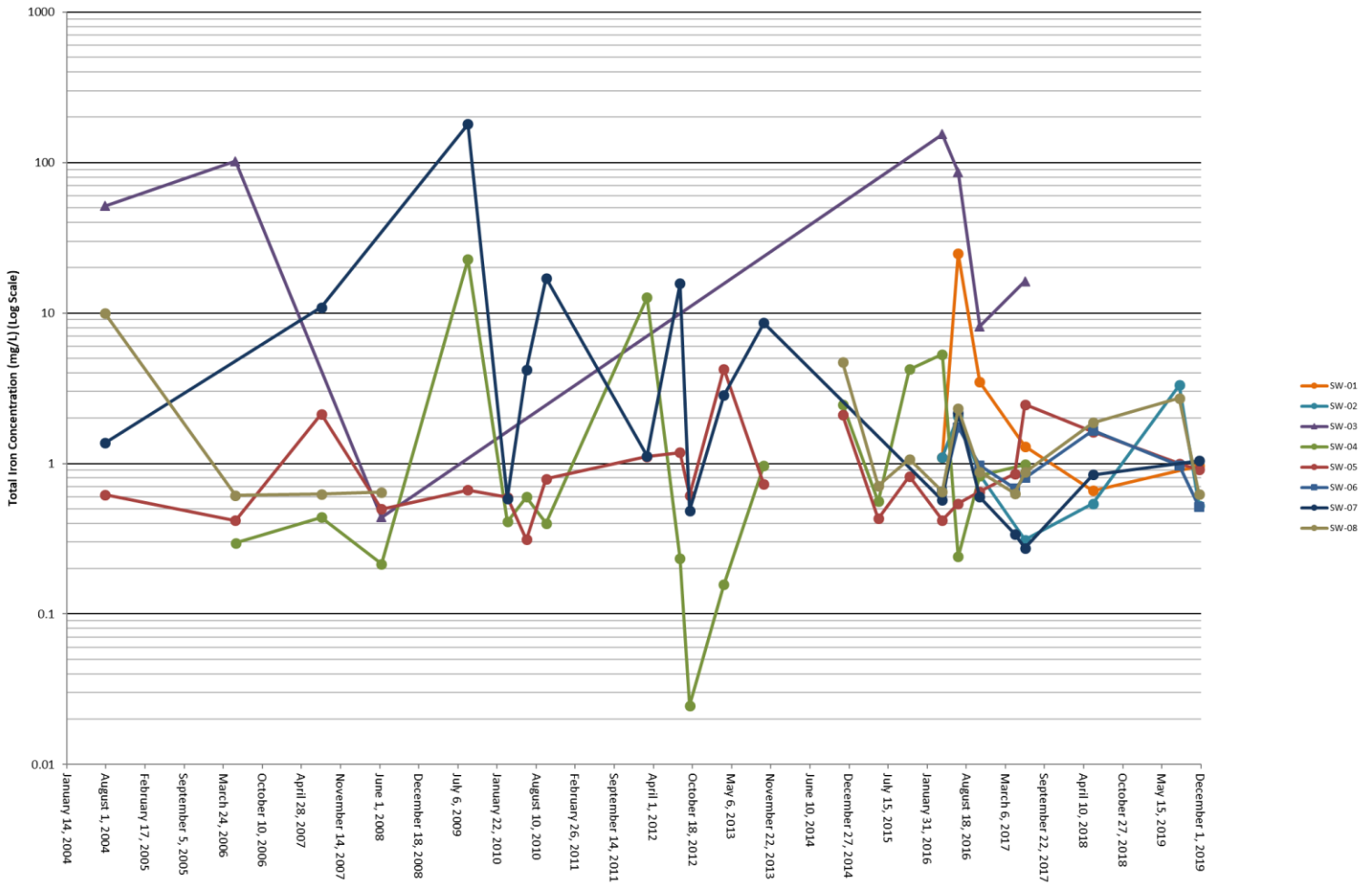
PROJECT:

Hazelton WMF Annual Monitoring Report

TITLE:

Surface Water Total Manganese

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 yyyy/mm/dd	PRJ20010
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 4**
CHECKED	DK	



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

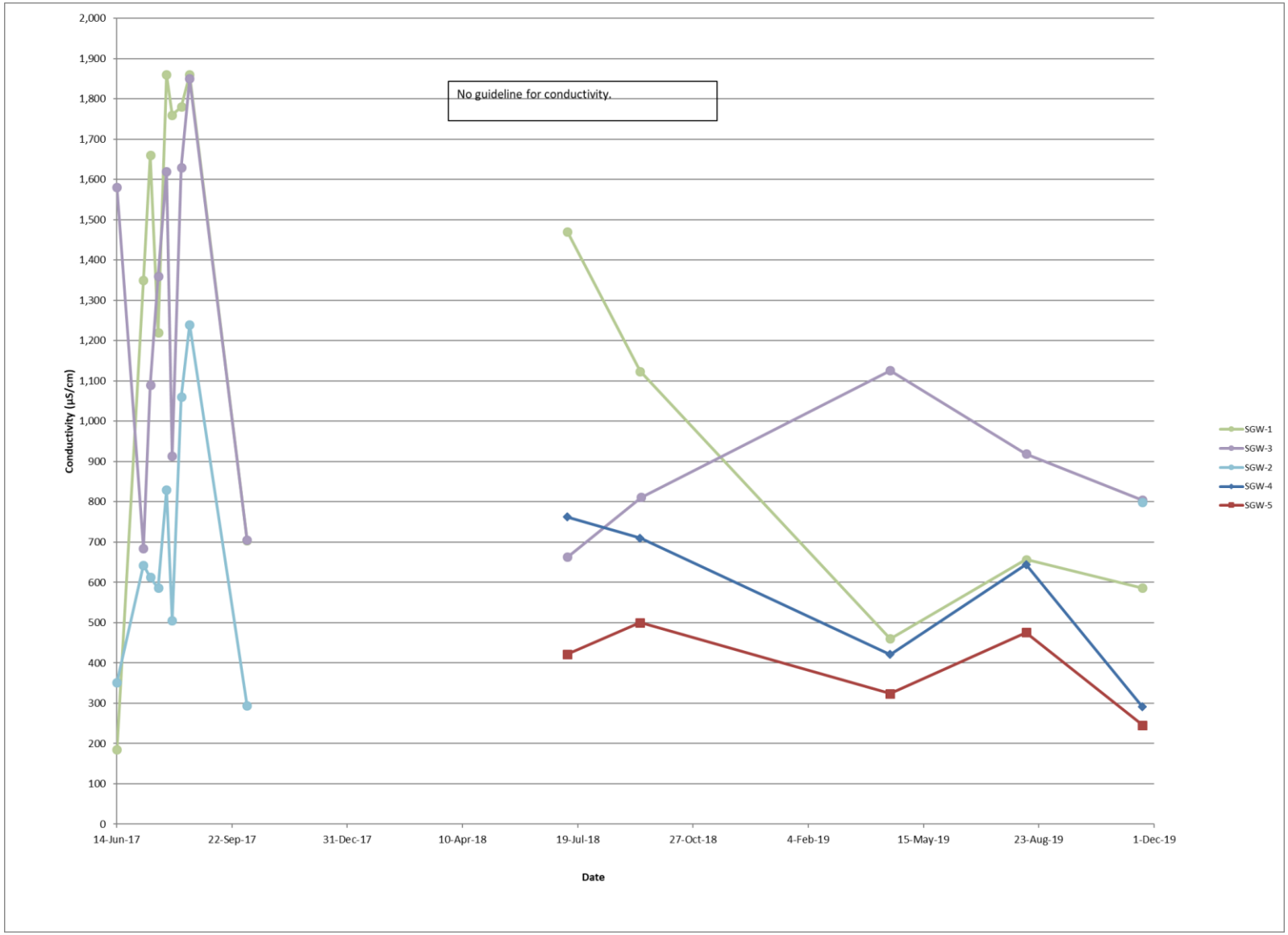
PROJECT:

Hazelton WMF Annual Monitoring Report

TITLE:

Surface Water Total Iron

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 yyyy/mm/dd	PRJ20010
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:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
DESIGNED: AM	DRAWING NO:	
DRAWN: AM	Chart 6	
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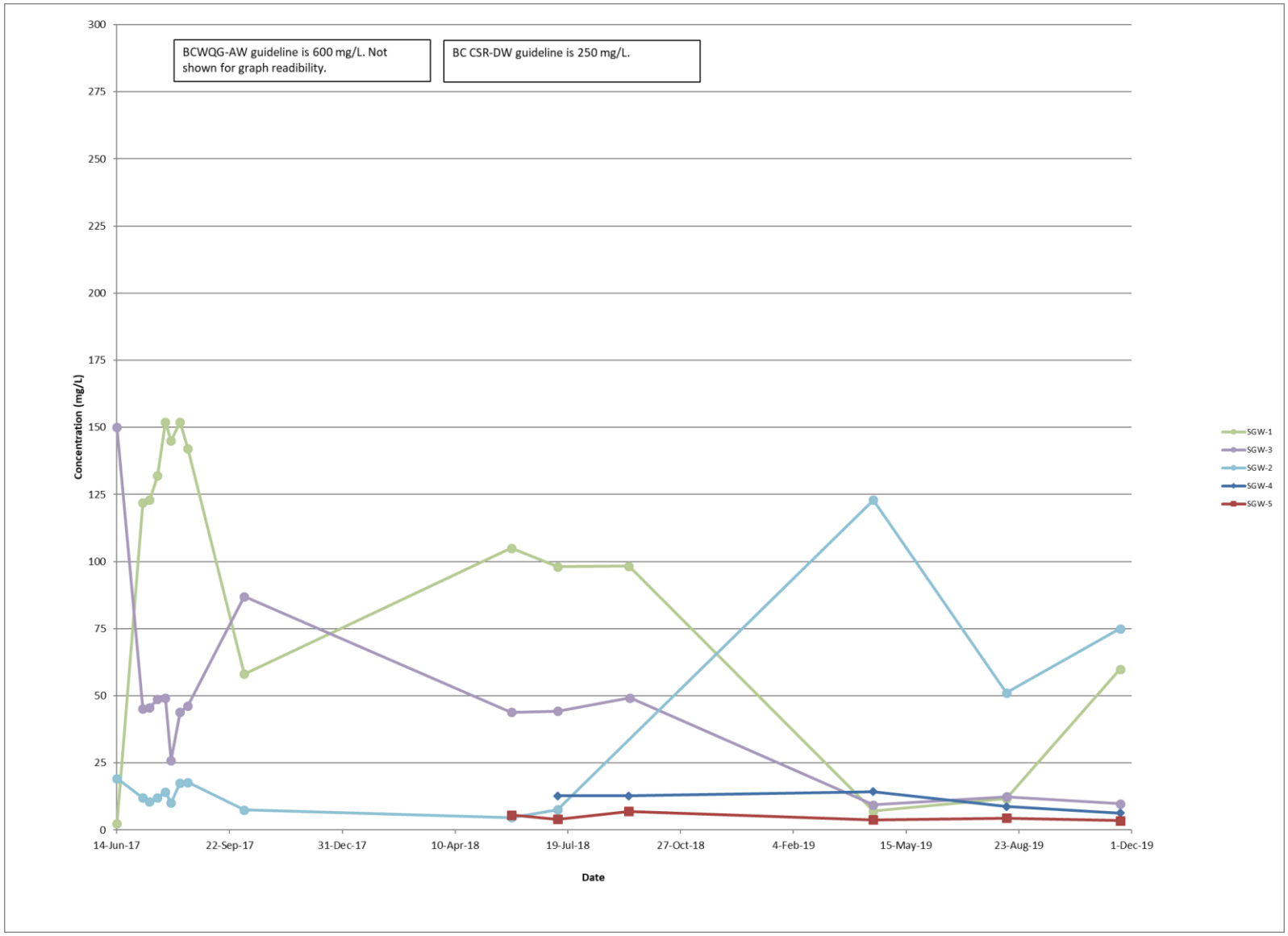

Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Chloride

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
DESIGNED: AM	DRAWING NO:	
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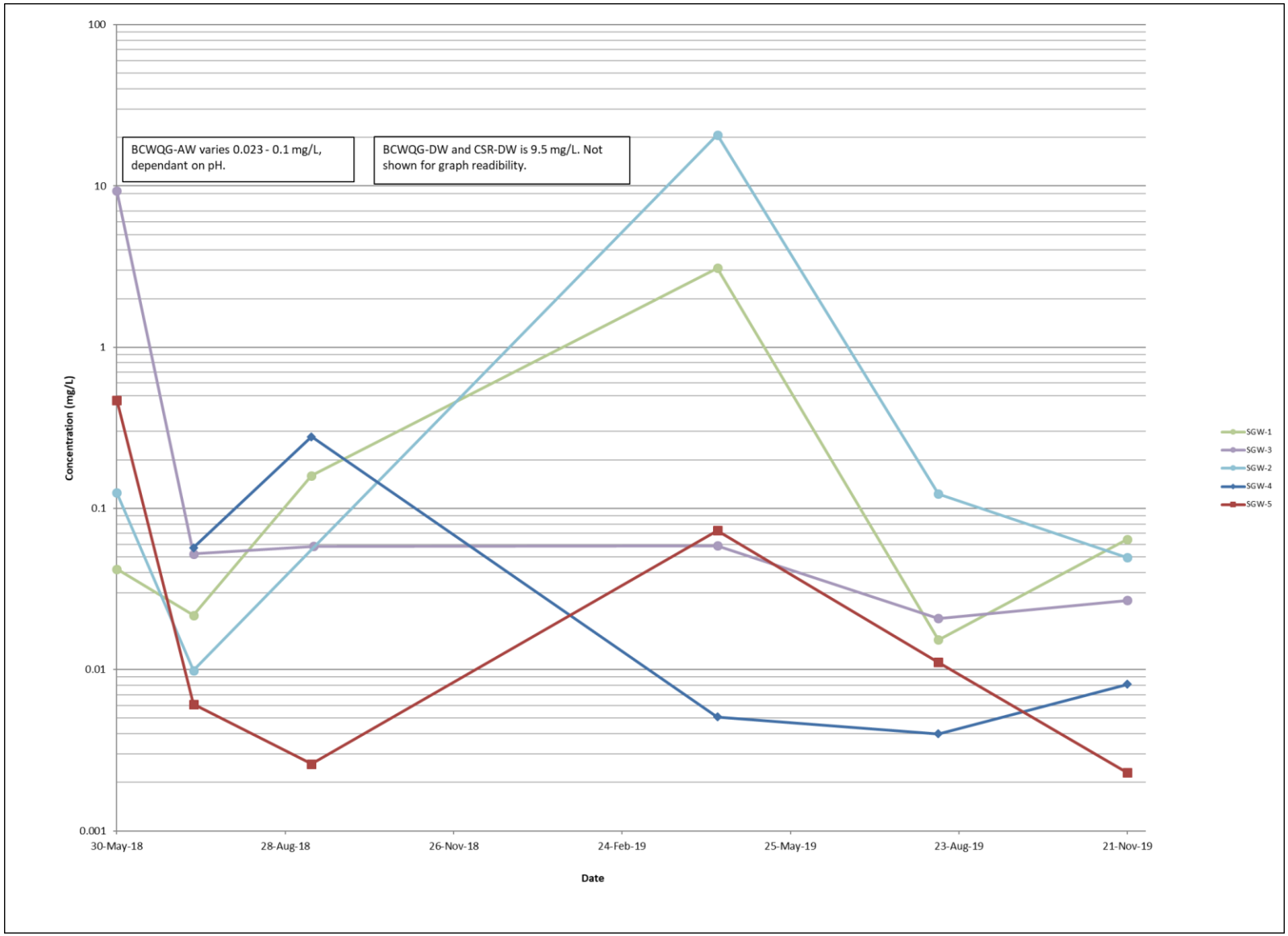
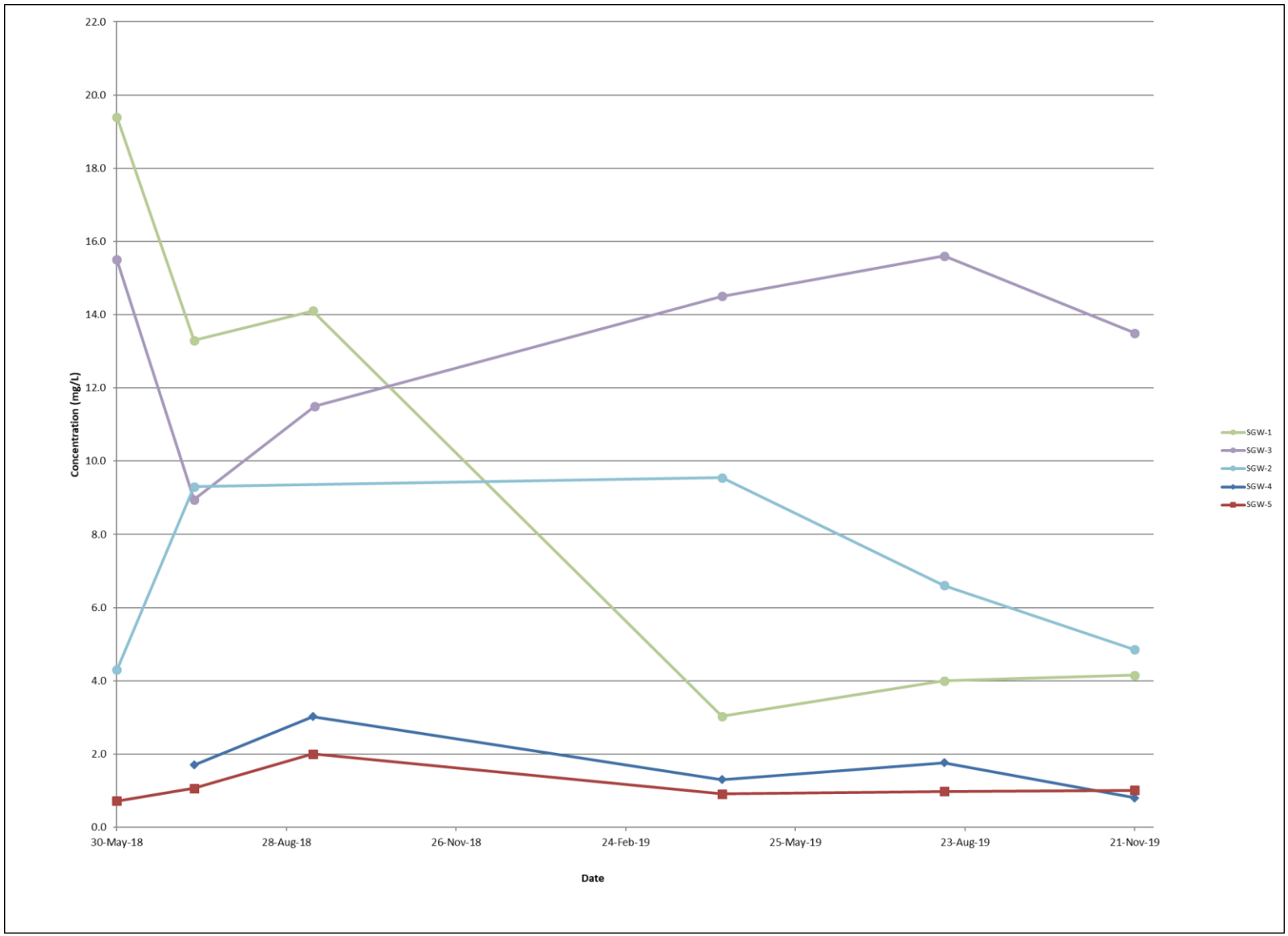
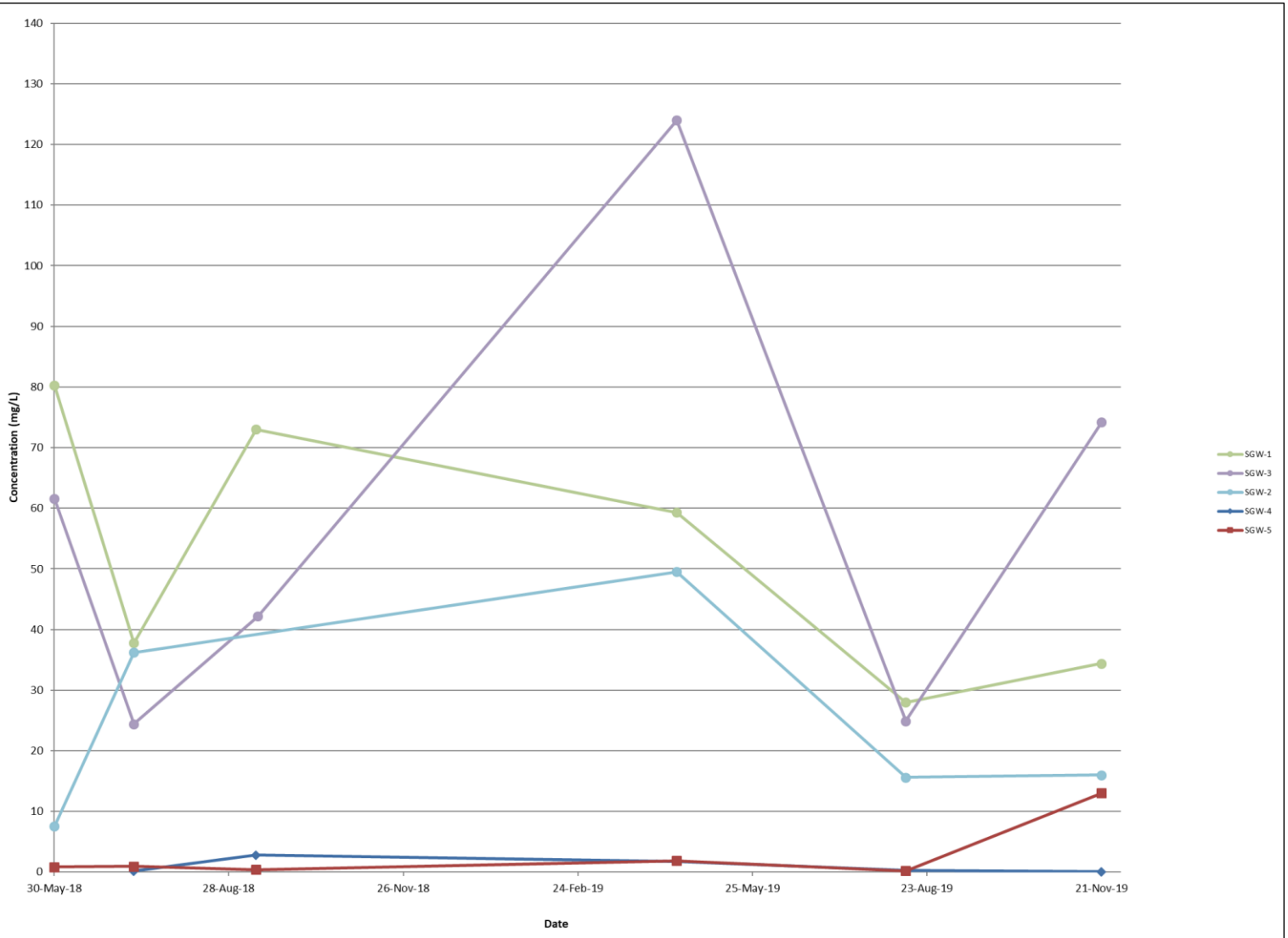


Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Dissolved Aluminum	SCALE: N/A; DATE: 2020/02/07 yyyy/mm/dd; PROJECT NO: PRJ20010; DESIGNED AM; DRAWN AM; CHECKED DK; DRAWING NO: Chart 8



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: Hazelton WMF Annual Monitoring Report	TITLE: Shallow Groundwater Dissolved Manganese	SCALE: N/A; DATE: 2020/02/07 yyyy/mm/dd; PROJECT NO: PRJ20010; 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:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
DESIGNED	AM	DRAWING NO:
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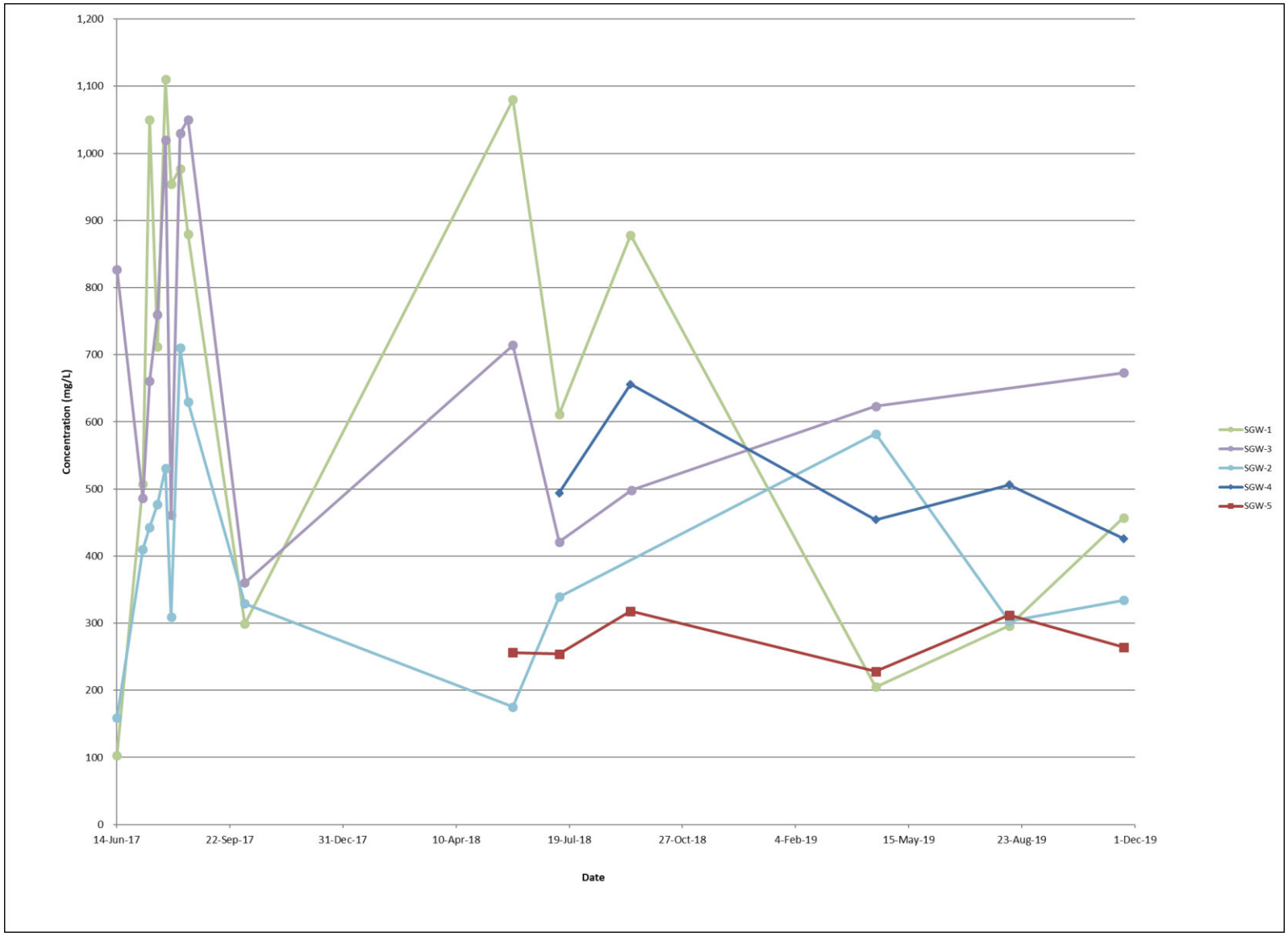
CHECKED	DK	



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

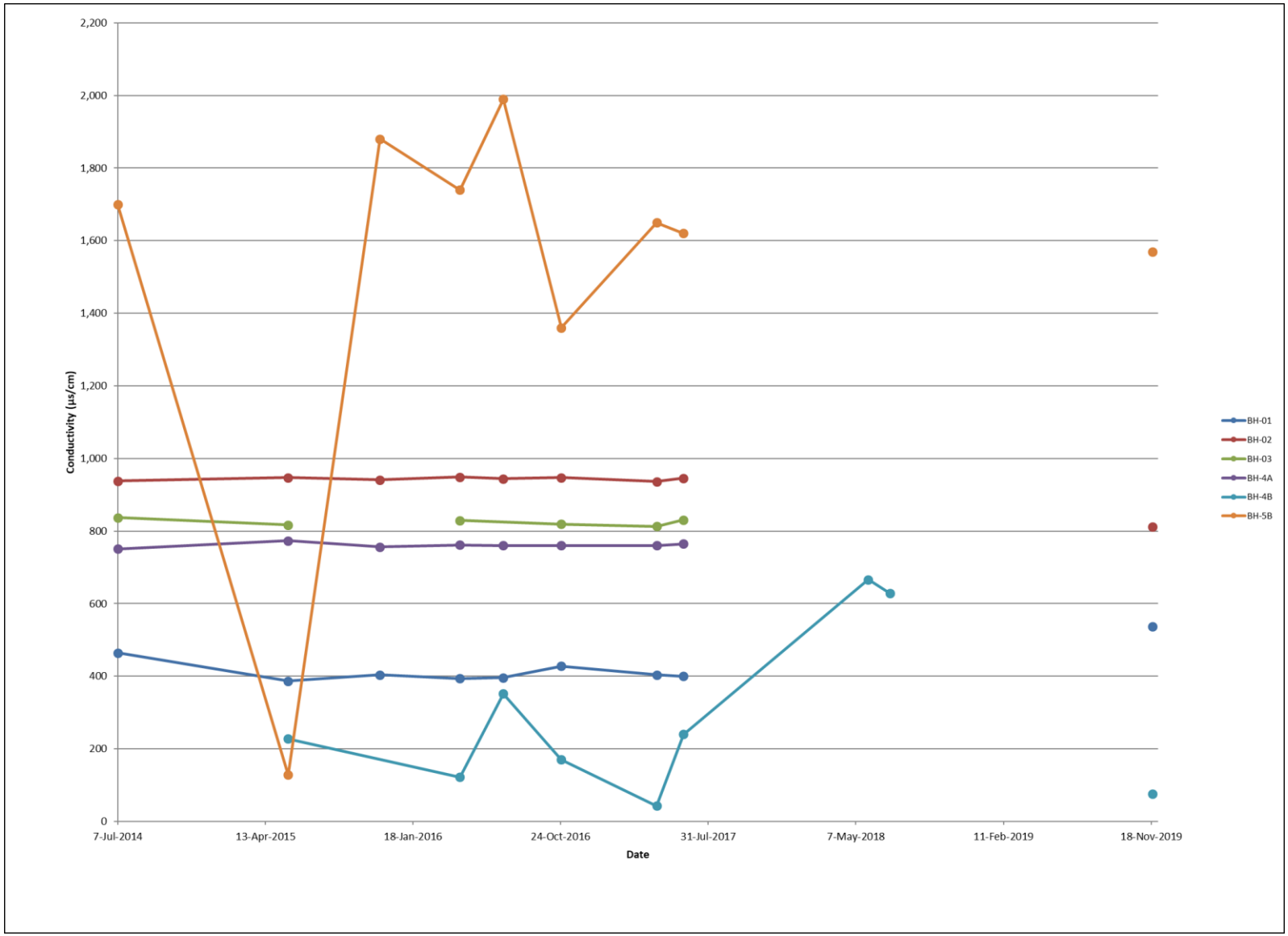
PROJECT:

Hazelton WMF Annual Monitoring Report

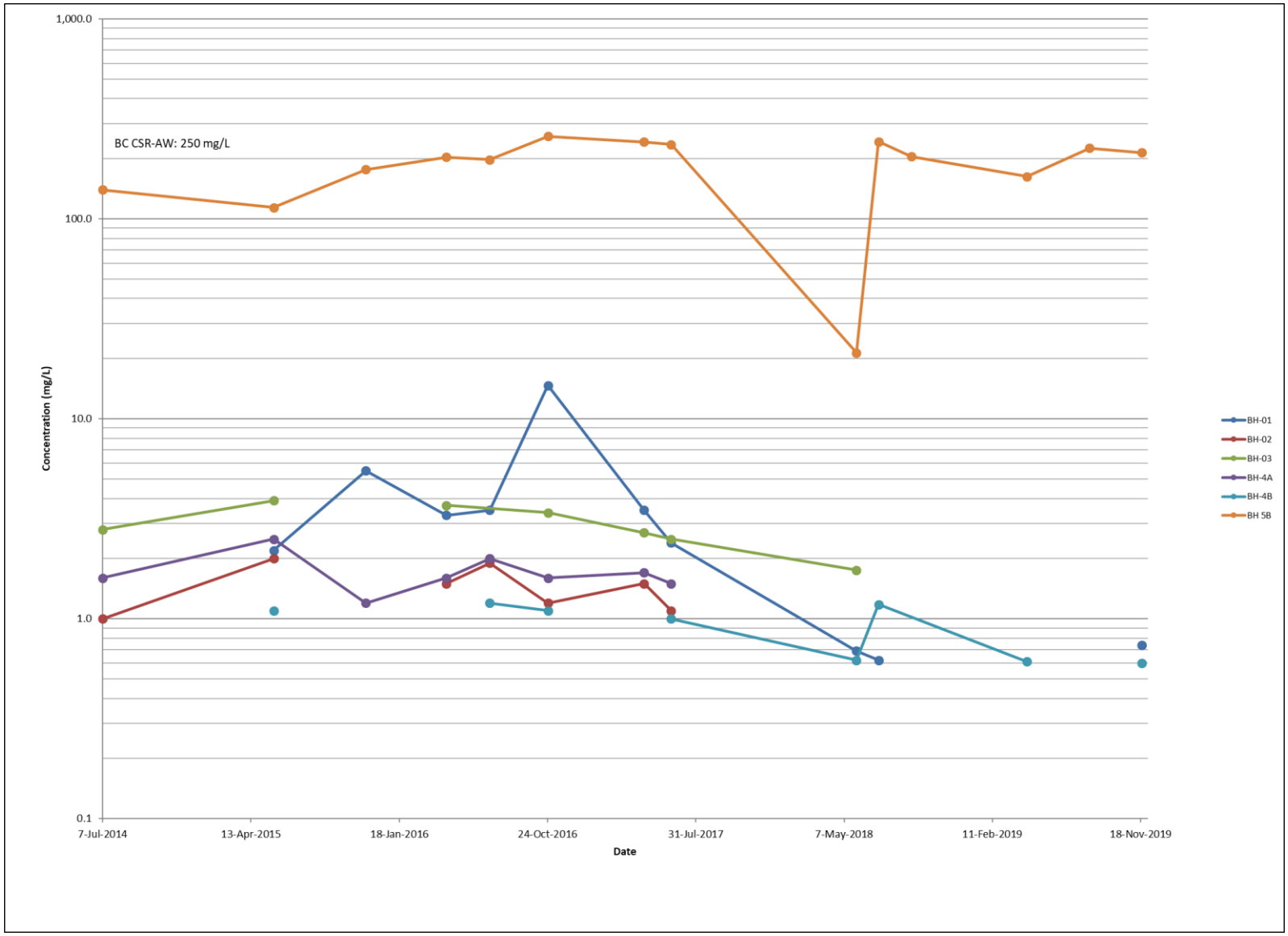
TITLE:

Shallow Groundwater Hardness

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
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: 2020/02/07 (yyyy/mm/dd)
				PROJECT NO: PRJ20010	
				DESIGNED AM	DRAWING NO: Chart 12
				DRAWN AM	
				CHECKED DK	



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

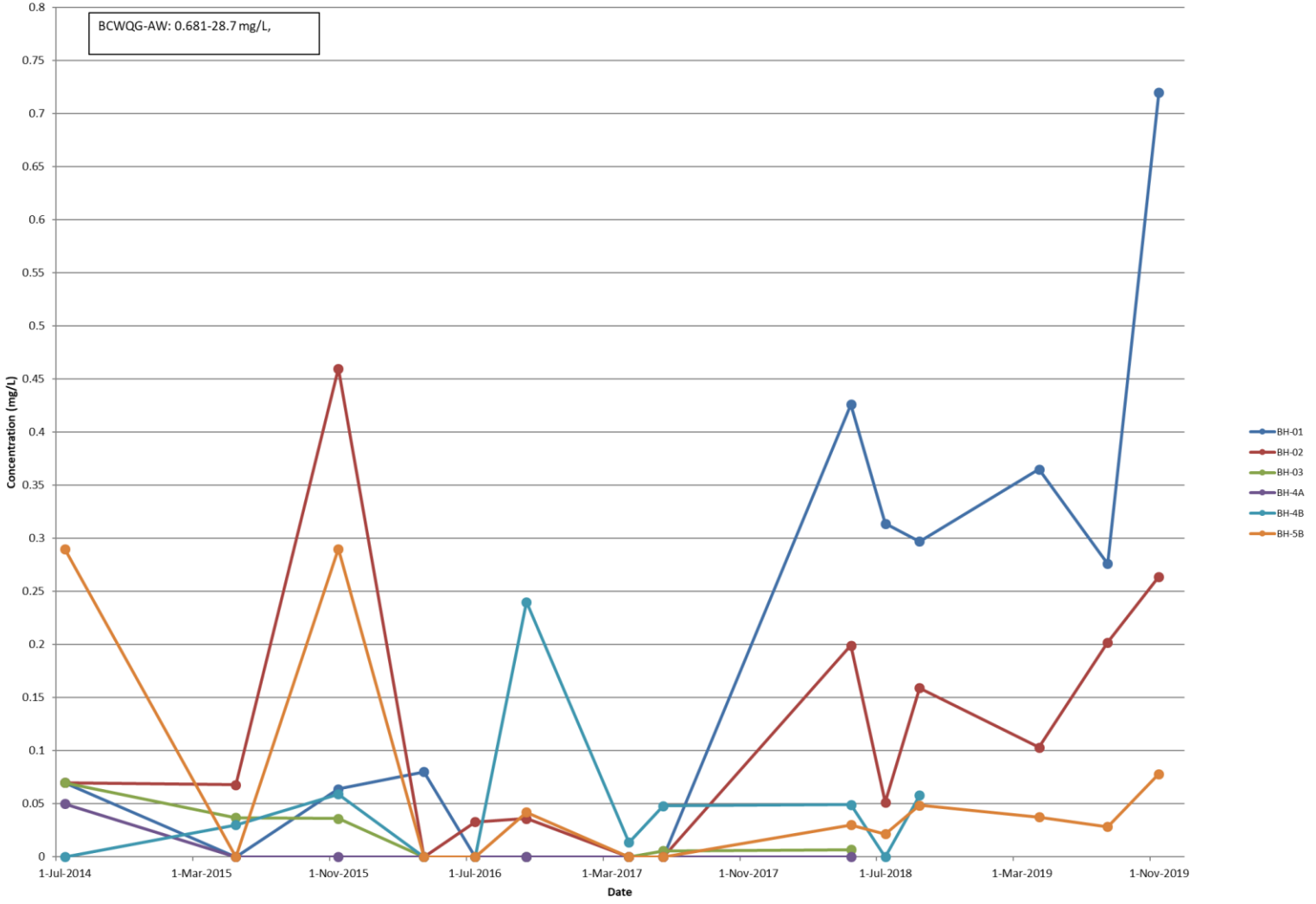
PROJECT:

Hazelton WMF Annual Monitoring Report

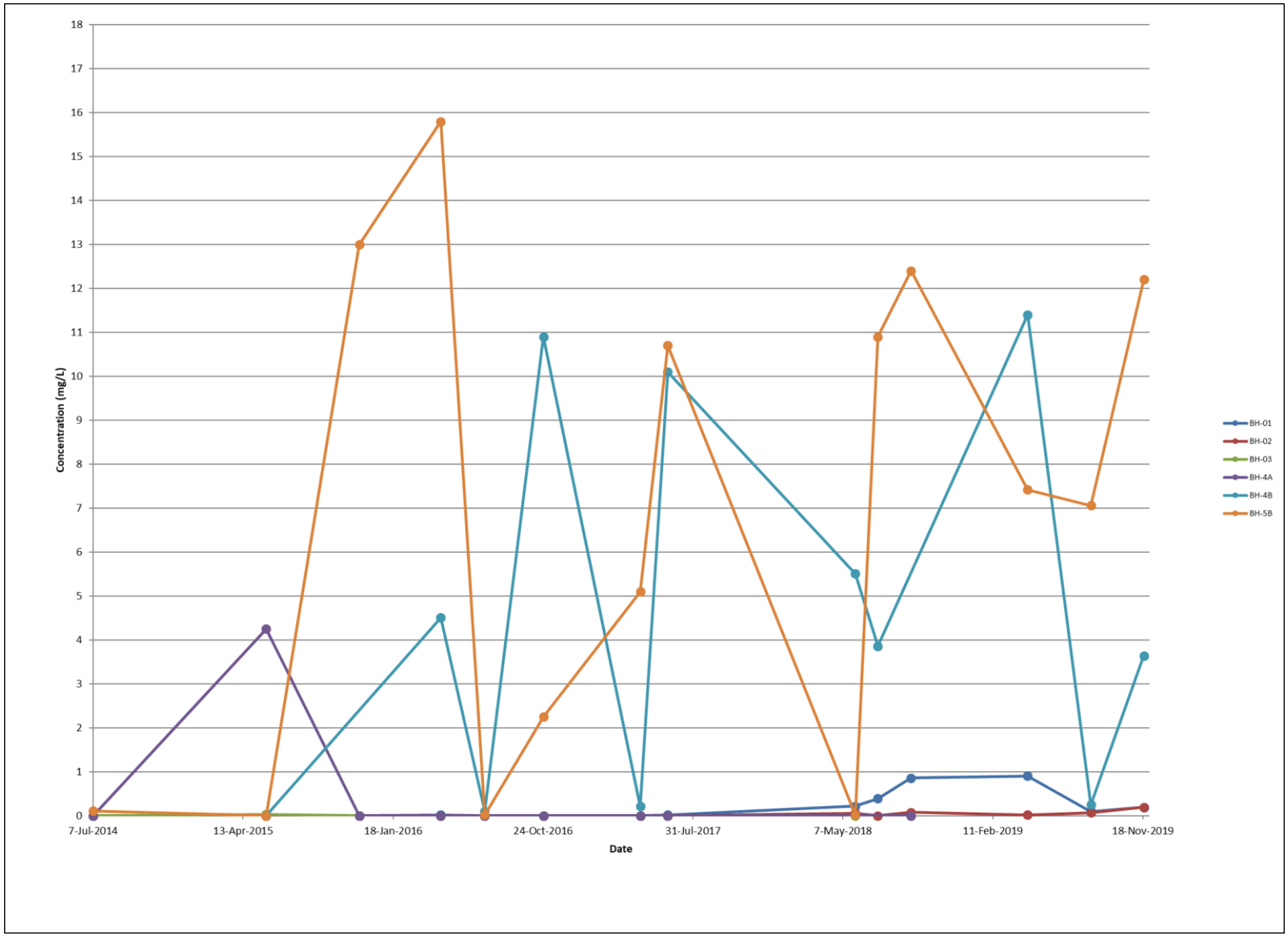
TITLE:

Groundwater Chloride

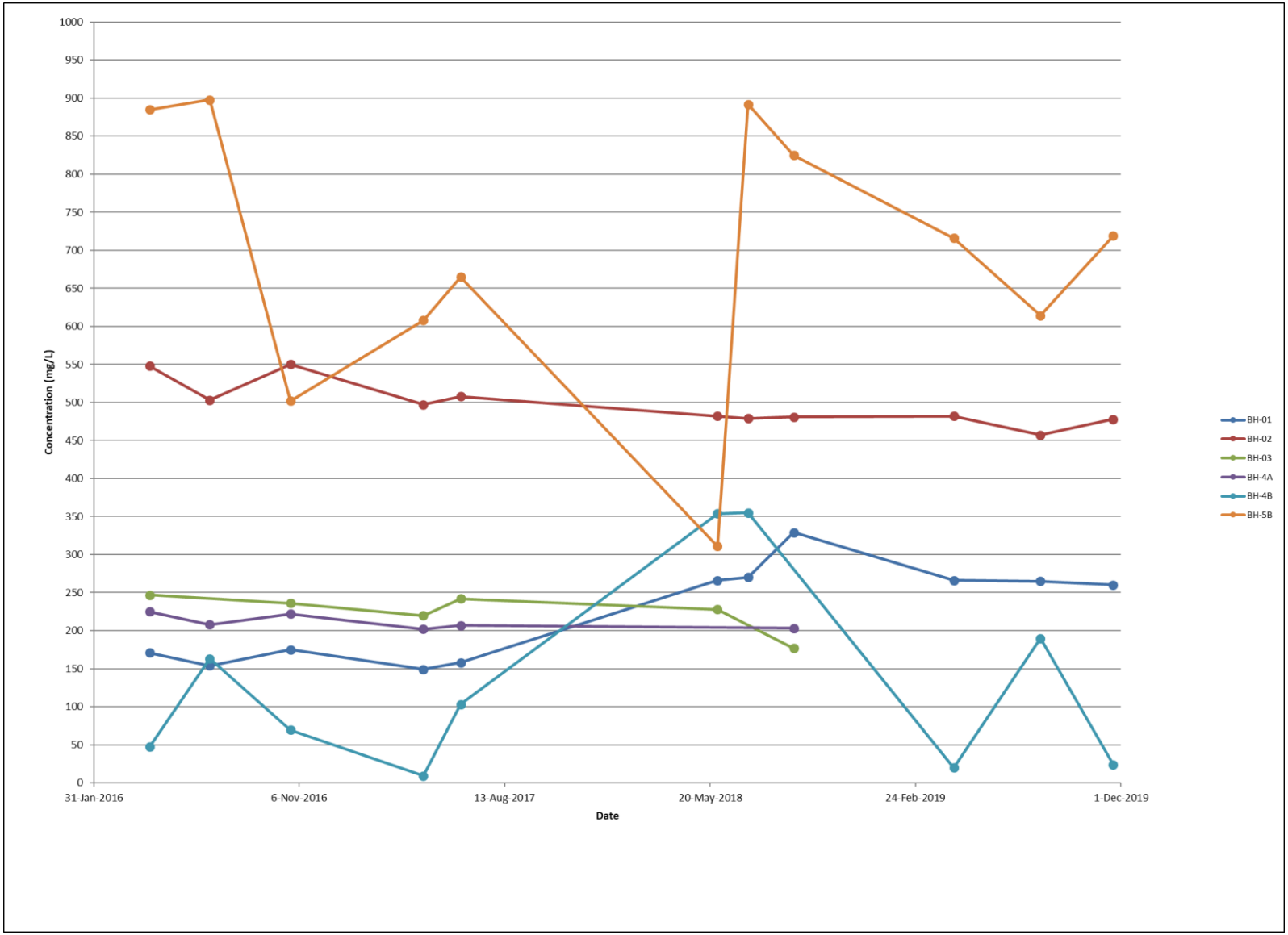
SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 13**
CHECKED	DK	



Sperling Hansen Associates	Regional District of Kitimat-Stikine	PROJECT: **Hazelton WMF Annual Monitoring Report**	TITLE: **Groundwater Ammonia**	SCALE: N/A; DATE: **2020/02/07** yyyy/mm/dd; PROJECT NO: **PRJ20010**; 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: 2020/02/07 yyyy/mm/dd; PROJECT NO: PRJ20010; DESIGNED: AM; DRAWN: AM; CHECKED: DK; DRAWING NO: **Chart 15**



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

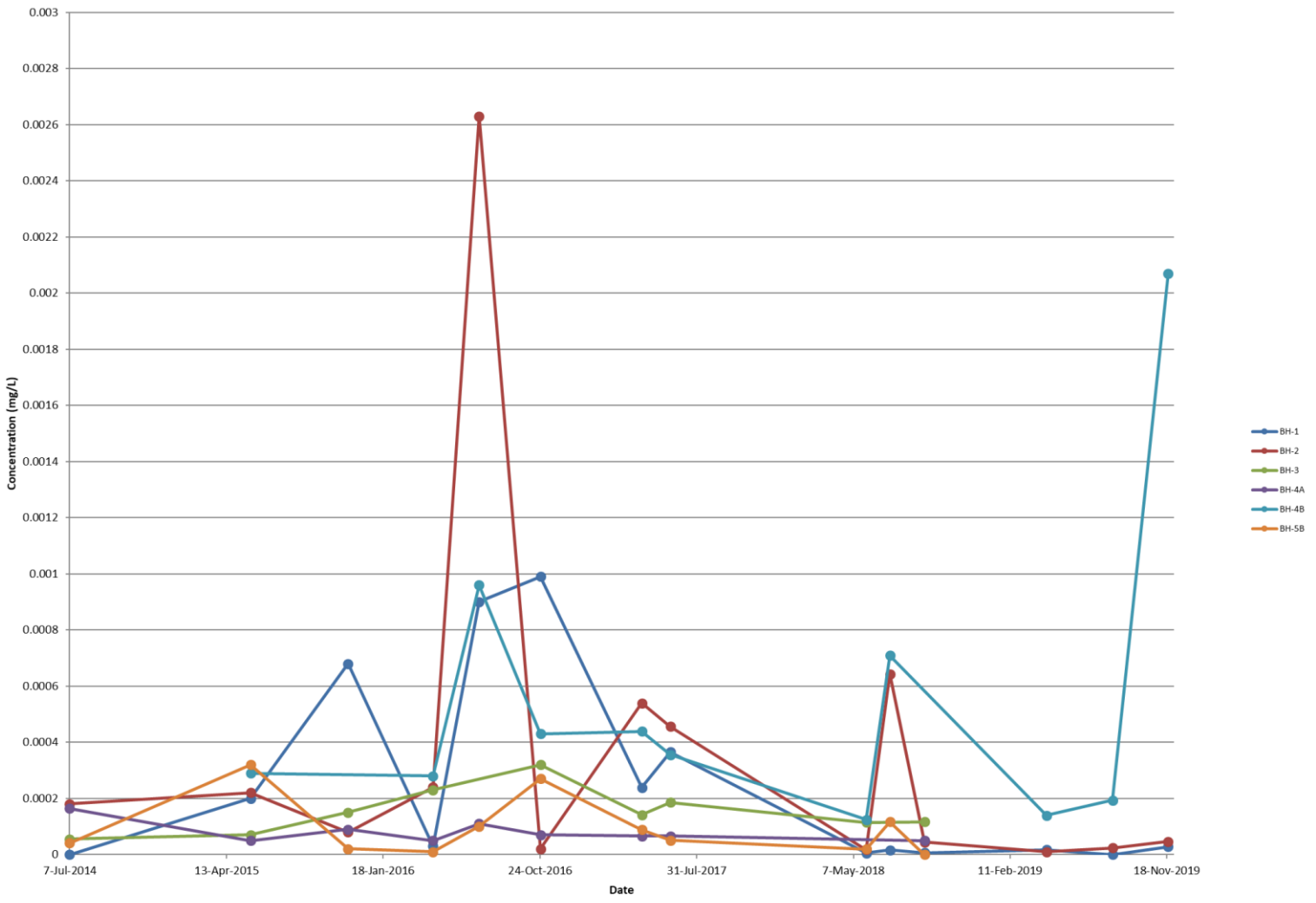
PROJECT:

Hazelton WMF Annual Monitoring Report

TITLE:

Groundwater Hardness

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 16**
CHECKED	DK	



SPERLING HANSEN ASSOCIATES

Regional District of Kitimat-Stikine

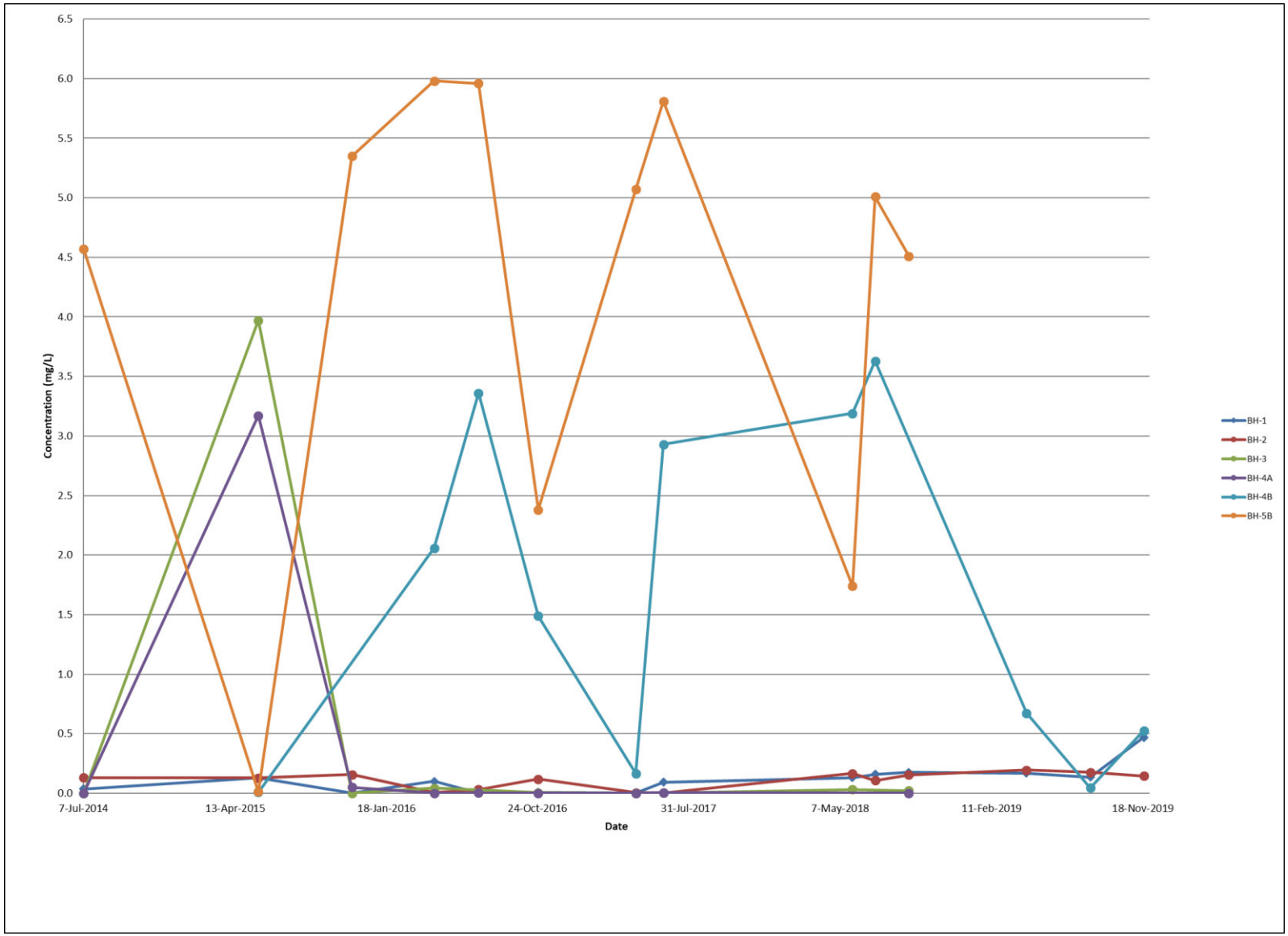
PROJECT:

Hazelton WMF Annual Monitoring Report

TITLE:

Groundwater Dissolved Cadmium

SCALE:	DATE:	PROJECT NO:
N/A	2020/02/07 (yyyy/mm/dd)	PRJ20010
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:	DATE:	PROJECT NO:
N/A	2020/02/07 yyyy/mm/dd	PRJ20010
DESIGNED	AM	DRAWING NO:
DRAWN	AM	**Chart 18**
CHECKED	DK	

Appendix D: Operational Certificate MR-17226 for the Hazelton Regional Landfill

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:

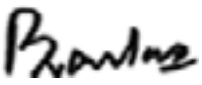
Enclosed is Operational Certificate 17226 issued under the provisions of the *Environmental Management Act*. Your attention is respectfully directed to the terms and conditions outlined in the operational certificate.

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)

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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;

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for Director, *Environmental Management Act*
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- 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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for Director, *Environmental Management Act*
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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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for Director, *Environmental Management Act*
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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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for Director, *Environmental Management Act*
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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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(most recent)

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for Director, *Environmental Management Act*
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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.

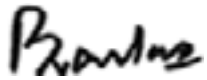
10.7 **Surface Water Quality Assessment**

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:

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



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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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Date amended: February 7, 2018
(most recent)

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for Director, *Environmental Management Act*
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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

Date issued: May 30, 2013
Date amended: February 7, 2018
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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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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.

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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.

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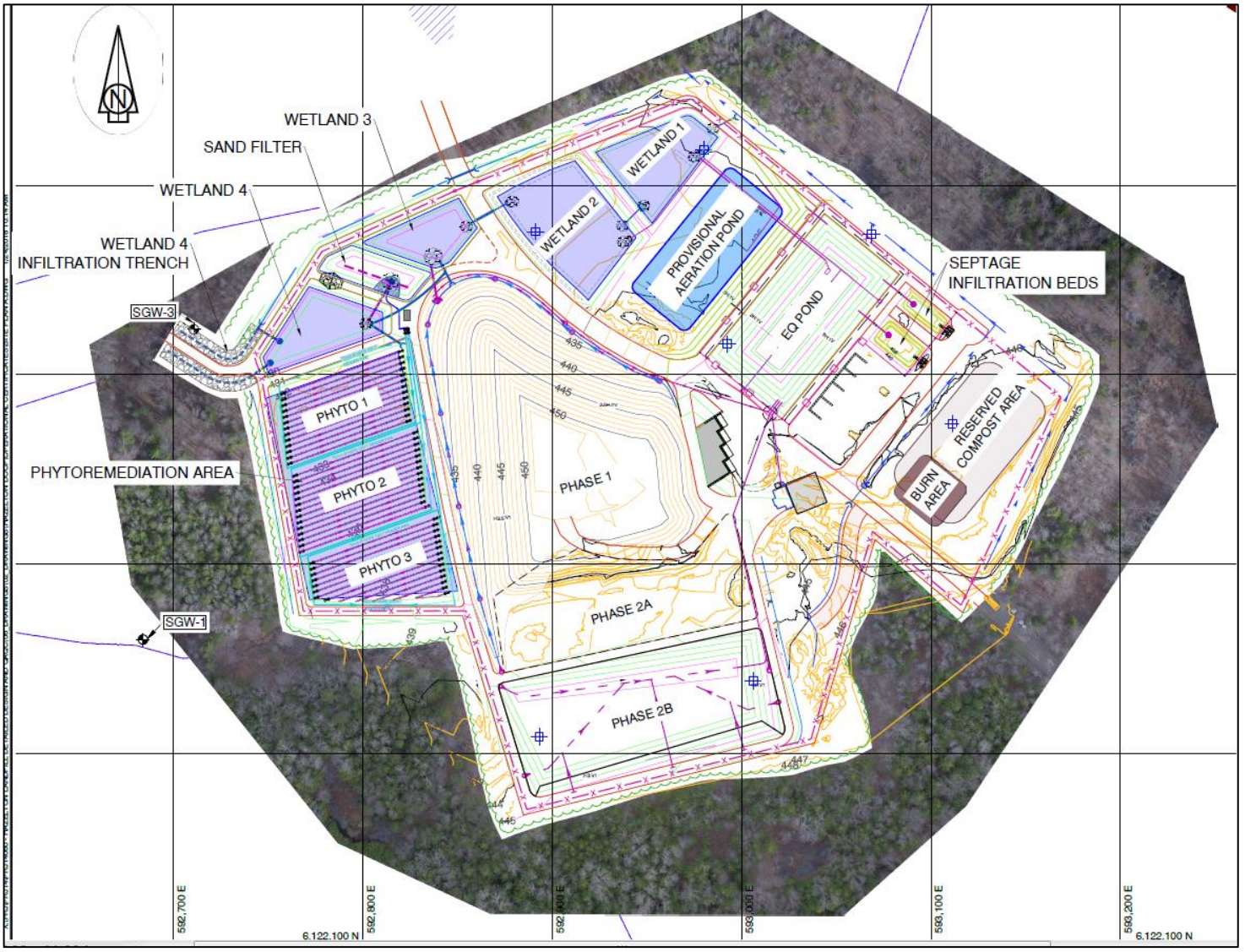
Site Plan A



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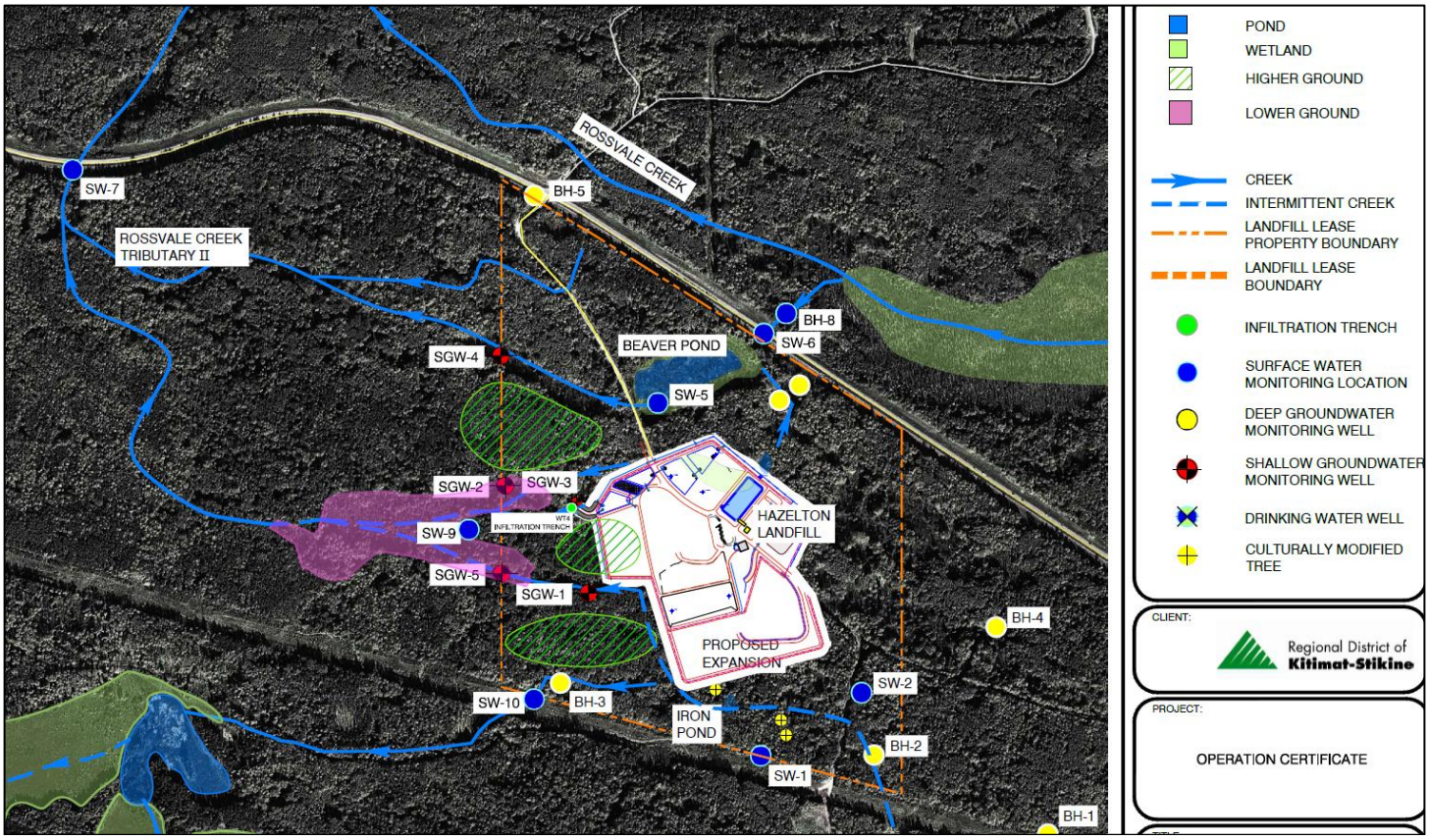
Site Plan B



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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: 24-MAY-19
Report Date: 06-JUN-19 13:45 (MT)
Version: FINAL

Client Phone: 250-615-6100

Certificate of Analysis

Lab Work Order #: L2279188

Project P.O. #: NOT SUBMITTED
Job Reference: HAZELTON SURFACE WATER
C of C Numbers: 17-721326
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:

17-721326

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 L2279188-1 WETLAND #4,
collected May 23, 2019

Final Report

June 5, 2019

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

8664 Commerce Court, Burnaby, BC V5A 4N7

SAMPLE INFORMATION

Sample ID	Dates			Receipt temperature
	Collected	Received	Rainbow trout test initiation	
L2279188-1 WETLAND #4	23-May-19 at N/A	25-May-19 at 1140h	27-May-19 at 1445h	6.3°C

N/A = Not Available

TESTS

- Rainbow trout 96-h LC50 test

RESULTS

Toxicity test results

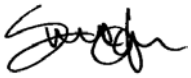
Sample ID	LC50 (% v/v)
L2279188-1 WETLAND #4	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	Rainbow trout
Reference toxicant LC50 (95% CL)	100.0 (71.7 – 139.4) µg/L Zn[1]
Reference toxicant historical mean (2 SD range)	88.8 (40.4 – 195.0) µg/L Zn
Reference toxicant CV	41%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1]Test date: May 22, 2019, 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: 96-h rainbow trout (*Oncorhynchus mykiss*) LC50 test.

Test species	*Oncorhynchus mykiss*
Organism source	Hatchery
Organism age	Juvenile
Test type	Static
Test duration	96 hours
Test vessel	20-L glass aquarium
Test volume	10 to 20 L (depending on size of fish)
Test solution depth	≥15 cm
Test concentrations	Five concentrations, plus laboratory control
Test replicates	1 per treatment
Number of organisms	10 per replicate
Control/dilution water	Dechlorinated Metro Vancouver municipal tapwater
Test solution renewal	None
Test temperature	15 ± 1°C
Feeding	None
Light intensity	100 to 500 lux
Photoperiod	16 hours light / 8 hours dark
Aeration	6.5 ± 1 mL/min/L
Test measurements	Temperature, dissolved oxygen and pH measured daily; salinity 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/13, with 2007 & 2016 amendments
Statistical software	CETIS Version 1.9.4
Test endpoints	Survival (96-hour LC50)
Test acceptability criterion for controls	Survival ≥90%
Reference toxicant	Zinc (added as $ZnSO_4$)

APPENDIX B – Toxicity test data

Rainbow Trout Summary Sheet

Client: ALS Environmental

Start Date/Time: May 27, 2019; 1445h

Work Order No.: 191050

Test Species: *Oncorhynchus mykiss*

Test Validity Criteria:
≥ 90% control survival
WQ Ranges:
T (°C) = 15 ± 1; DO (mg/L) = 7.0 to 10.3; pH = 5.5 to 8.5

Sample Information:

Sample ID: L2279188-1 Wetland #4
Sample Date: May 23, 2019
Date Received: May 25, 2019
Sample Volume: 4x20L
Other: –

Dilution Water:

Type: Dechlorinated Municipal Tap Water
Hardness (mg/L $CaCO_3$): 14
Alkalinity (mg/L $CaCO_3$): 12

Test Organism Information:

Batch No.: 042619b
Source: Aqua Farms
No. Fish/Volume (L): 10/12L
Loading Density (g/L): 0.43
Mean Length ± SD (mm): 40 ± 3 Range: 37 – 47
Mean Weight ± SD (g): 0.52 ± 0.12 Range: 0.41 – 0.80

Zinc Reference Toxicant Results:

Reference Toxicant ID: RTZn157
Stock Solution ID: 19Zn03
Date Initiated: May 22, 2019
96-h LC50 (95% CL): 100.6 (71.7 – 139.4) µg/L Zn

Reference Toxicant Mean and Historical Range: 88.8 (40.4 – 195.0) µg/L Zn
Reference Toxicant CV (%): 41%

Test Results: The 96 hour LC50 is estimated to be >100% (v/v).

Reviewed by: [signature]

Date reviewed: June 6, 2019

96-Hour Rainbow Trout Toxicity Test Data Sheet

Client/Project#: ALS Environmental
Sample I.D. L2279188-1 Wetland #4
W.O. # 191050
RBT Batch #: 042619h
Date Collected/Time: May 23/19 @ not available
Date Setup/Time: May 27/19 @ 1445h
CER #: 2
Sample Setup By: JD

Thermometer: Cer2
D.O. meter/probe: 2 / P2
Cond./Salinity meter/probe: 2 / CP2
pH meter/probe: 2 / P2

Number Fish/Volume: 10/12L
7-d % Mortality: 0%
Total Pre-aeration Time (mins): 30
Aeration rate adjusted to 6.5 ± 1 mL/min/L? (Y/N): Y

Undiluted Sample WQ			
Parameters	Initial WQ	Adjustment	30 min WQ
Temp °C	15.0		15.0
D.O. (mg/L)	8.5		9.0
pH	8.1		8.1
Cond. (µS/cm)	628		626
Salinity (ppt)	0.3		0.3

Concentration	# Survivors							Temperature (°C)					Dissolved Oxygen (mg/L)					pH					Conductivity (µS/cm)	
(% v/v)	1	2	4	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	96
Ctrl				10	10	10	10	15.0	15.0	14.5	15.0	14.5	10.0	10.1	9.3	9.2	9.3	7.0	7.1	7.0	7.1	7.0	32	38
6.25				10	10	10	10	15.0	15.0	14.5	15.0	14.5	10.0	10.2	9.3	9.2	9.2	7.4	7.0	7.1	7.2	7.2	59	64
12.5				10	10	10	10	15.0	15.0	14.5	15.0	14.5	10.0	8.9	9.5	9.1	9.3	7.4	7.0	7.3	7.3	7.3	102	105
25				10	10	10	10	15.0	15.0	14.5	15.0	14.5	10.0	9.6	9.5	9.1	9.3	7.6	7.6	7.6	7.6	7.6	172	176
50				10	10	10	10	15.0	15.0	14.5	15.0	14.5	9.7	9.6	9.6	9.2	9.4	8.0	8.0	7.9	7.9	7.9	334	339
100				10	10	10	10	15.0	15.0	14.5	15.0	14.5	9.0	9.7	9.6	9.1	9.4	8.1	8.4	8.3	8.3	8.3	626	626
Initials				JD		JD		JD	JD		JD		JD	JD		JD		JD	JD		JD		JD	

Sample Description/Comments: Turbid yellow liquid. Organic particulates. Tadpoles present. No odour.

Fish Description at 96 h: All fish appears Normal — Number of Stressed Fish at 96 h: 0

Other Observations:

Reviewed by: — Date Reviewed: June 6, 2019

APPENDIX C – Chain-of-custody form

L2279188

VANCOUVER

ALS Environmental

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# *L2279188*
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 4 Container(s)

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2279188-1 WETLAND #4	Trout Bioassay LC50 (96 Hour) - Nautilus (TROUT-LC50-96HR-NL 1)	**5/23/2019** 6/5/2019	

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

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

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

Shipped By: [illegible] Date Shipped: May 25 2019
Received By: _____ Date Received: May 25/19 @ 1120h
Verified By: _____ Date Verified: 6.3°C
Temperature: 4pm
Sample Integrity Issues: 4 x 20L

WO# 191050

END OF REPORT

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2279188-COFC

COC Number: 17 - 721326

Page of

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Turnaround Time (TAT) Requested - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Reg Dist of Kitimat-Stikine	Select Report Format: ☑ PDF ☑ EXCEL | EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Chris Kerr	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐ — EMERGENCY: 1 Business day [E-100%] ☐ / Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐
Phone:	250-641-4141	☑ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL | MAIL ☐ FAX	
Street:	4545 Lazelle Ave.	Email 1 or Fax rtoems@rdks.bc.ca	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
City/Province:	Terrace B.C.	Email 2 CKERR@rdks.bc.ca	For tests that can not be performed according to the service level selected, you will be contacted.
Postal Code:	V8G-4E1	Email 3 JCOOSEMANS@rdks.bc.ca	
Invoice To	Same as Report To ☐ YES ☑ NO	**Invoice Distribution**	**Analysis Request**
	Copy of Invoice with Report ☐ YES ☑ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	Reg Dist of Kitimat-Stikine.	Email 1 or Fax anne-marie@rdks.bc.ca	
Contact:	Roger Toems	Email 2 CKERR@rdks.bc.ca	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Account # / Quote #:		AFE/Cost Center: / PO#	
Job #:	Hazelton Surface Water	Major/Minor Code: / Routing Code:	
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: / Sampler:	

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	HCSO	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	Wetland #4	23/05/19	1:40 pm	water	✓			4

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				FINAL COOLER TEMPERATURES °C			
9.3							5

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date: May 24/19	Time: 7:30	Received by:	Date: May 24. 19	Time: 7:30	Received by: HA	Date: 5/24	Time: 8:15P

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**.

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

Date Received: 13-AUG-19
Report Date: 06-SEP-19 12:09 (MT)
Version: FINAL

Client Phone: 250-615-6100

Certificate of Analysis

Lab Work Order #: L2328091

Project P.O. #: NOT SUBMITTED
Job Reference: HAZELTON EQ LC50
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 L2328091-1 EQ POND,
collected August 12, 2019

Final Report

September 5, 2019

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	
L2328091-1 EQ POND	12-Aug-19 at N/A	14-Aug-19 at 1315h	15-Aug-19 at 1300h	6.6 - 8.2°C

N/A = Not Available

TEST

- *Daphnia magna* 48-h LC50 test

RESULTS

Toxicity test results

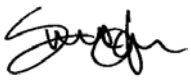
Sample ID	LC50 (% v/v)
L2328091-1 EQ POND	>100

LC = Lethal Concentration

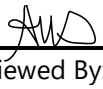
QA/QC

QA/QC summary	*Daphnia magna*
Reference toxicant LC50 (95% CL)	7.3 (6.4 – 8.3) g/L NaCl[1]
Reference toxicant historical mean (2 SD range)	5.4 (3.7 – 7.8) g/L NaCl
Reference toxicant CV	19%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1] Test date: August 7 2019, LC = Lethal Concentration, SD = Standard Deviation, CL = Confidence Limits, CV = Coefficient of Variation



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



Reviewed By:
Andy Diewald, B.Sc.
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 endpoint	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 Environmental
Work Order No.: 1915621

Start Date/Time: AUG 15, 2019 @1300h
Test Species: *Daphnia magna*
Set up by: ST

Sample Information:

Sample ID: L2328091-1 EQ Pond
Sample Date: AUG 12, 2019
Date Received: AUG 14, 2019
Sample Volume: 2x 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.: 073119B
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 29
Mortality (%) in previous 7 d: 0
Days to first brood: 9

NaCl Reference Toxicant Results:

Reference Toxicant ID: DM0C36
Stock Solution ID: 18NA006
Date Initiated: AUG 7, 2019
48-h LC50 (95% CL): 7.3 (6.4 - 8.3) g/LNaCL

Reference Toxicant Mean and Historical Range: 5.4 (3.7-7.8) g/L NaCL
Reference Toxicant CV (%): 19

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

Reviewed by: [signature]
Date reviewed: Aug 23/19

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: ALS ENVIRONMENTAL
Sample ID: L2328091-1 EQ POND
Work Order No.: 1915621

Start Date/Time: AUG 15, 2019 @ 1300h
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: ST

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
CTRL	A	10	10	0	19.0	19.0	19.0	9.2	8.1	8.4	7.2	7.2	7.5 7.6	340	343
	B														
	C														
	D														
6.25	A	10	10	0	19.0	19.0	19.0	9.2	8.2	8.4	7.3	7.5	7.7	390	390
	B														
	C														
	D														
12.5	A	10	10	0	19.0	19.0	19.0	9.2	8.4	8.5	7.4	7.5	7.9	449	449
	B														
	C														
	D														
25	A	10	10	0	19.0	19.0	19.0	9.2	8.4	8.5	7.5	7.6	8.0	547	545
	B														
	C														
	D														
50	A	10	10	0	19.0	19.0	19.0	9.1	8.4	8.5	7.5	7.7	8.2	741	730
	B														
	C														
	D														
100	A	10	10	0	19.0	19.0	19.0	8.6	8.3	8.5	7.5	7.7	8.0	1134	1055
	B														
	C														
	D														
Technician Initials		ST	"	"	ST	ST	"	ST	ST	"	ST	ST	"	ST	"

Concentration	Hardness* (mg/L as CaCO3)	Alkalinity* (mg/L as CaCO3)
Control (MHW)	160	76
Highest conc.	380	310
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	19.0		
DO (mg/L)	8.6		
pH	7.5		
Cond (µS/cm)	1134		
Salinity (ppt)	0.6		

Comments: _____ Mortality: Heartbeat checked under microscope not req'd

Sample Description: clear colorless liquid, no particulates, no odor

Batch#: 073119B 7-d previous # young/brood: 29 Previous 7-d Mortality (%): 0 Day of 1st Brood: 9

Reviewed by: " Date reviewed: Aug 23/19

APPENDIX C – Chain-of-custody form

L2328091

VANCOUVER

ALS Environmental

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# *L2328091*
ALS requires QC data to be provided with your final results.

Please see enclosed 1 sample(s) in 2 Container(s) × 1 POL JW

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2328091-1 EQ POND		**8/12/2019**	
	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	8/23/2019	

Subcontract Info Contact: Brittany Puckey (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

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

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

Shipped By: Mel Date Shipped: Aug 14 2019

Received By: Jeslin Wijaya Date Received: Aug 14/19 @ 1445 1315h

Verified By: _____ Date Verified: _____

Temperature: 6.6 - 8.2 °C

Sample Integrity Issues: n/a

WO# 191561

END OF REPORT

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2328091-COFC

COC Number: 17 -

Page of

Report To	Contact and company name below will appear on the final report
Company:	Regional District of Kitimat-Stikine
Contact:	Chris Kerr
Phone:	250-641-4141
	Company address below will appear on the final report
Street:	4545 Lazelle Avenue
City/Province:	Terrace/BC
Postal Code:	V8G4E1
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	Regional District of Kitimat-Stikine
Contact:	Roger Tooms

Report Format / Distribution	
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	ckerr@rdks.bc.ca
Email 3	eblaney@rdks.bc.ca
Invoice Distribution	
Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	anne-maries@rdks.bc.ca
Email 2	ckerr@rdks.bc.ca; eblaney@rdks.bc.ca

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Hazelton EQ LC50	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact: Amber Springer	Sampler: Chris Kerr

Select Service Level Below - 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):
- 4 day [P4-20%] ☐
- 3 day [P3-25%] ☐
- 2 day [P2-50%] ☐

EMERGENCY:
- 1 Business day [E1 - 100%] ☐
- Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs:

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

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 LC50 Daphnia magna	SAMPLES ON HOLD	Sample is hazardous (please provide further detail)	NUMBER OF CONTAINERS
	EQ Pond	12/8/19	9:30	Effluent	R			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)

British Columbia Approved and Working Water Quality Guidelines (MAY, 2015)

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				FINAL COOLER TEMPERATURES °C			
10	8						

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: C Kerr	Date: Aug-12/19	Time: 5:[illegible]	Received by:	Date:	Time:	Received by: CW	Date: Aug 13	Time: 20:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

SEPT 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.**

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

Date Received: 17-SEP-19
Report Date: 04-OCT-19 11:50 (MT)
Version: FINAL

Client Phone: 250-615-6100

Certificate of Analysis

Lab Work Order #: L2349150

Project P.O. #: NOT SUBMITTED
Job Reference: HAZELTON WMF LC-50
C of C Numbers: 17-828814
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:

17-828814

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 L2349150-1 WETLAND #4,
collected September 16, 2019

Final Report

October 3, 2019

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	
L2349150-1 WETLAND #4	16-Sep-19 at N/A	18-Sep-19 at 0956h	19-Sep-19 at 1345h	2.1°C

N/A = Not Available

TEST

- *Daphnia magna* 48-h LC50 test

RESULTS

Toxicity test results

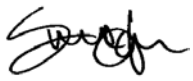
Sample ID	LC50 (% v/v)
L2349150-1 WETLAND #4	>100

LC = Lethal Concentration

QA/QC

QA/QC summary	*Daphnia magna*
Reference toxicant LC50 (95% CL)	5.9 (4.8 – 7.3) g/L NaCl[1]
Reference toxicant historical mean (2 SD range)	5.5 (3.7 – 8.4) g/L NaCl
Reference toxicant CV	21%
Organism health history	Acceptable
Protocol deviations	None
Water quality range deviations	None
Control performance	Acceptable
Test performance	Valid

[1] Test date: September 18 2019, LC = Lethal Concentration, SD = Standard Deviation, CL = Confidence Limits, 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 endpoint	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 ENVIRONMENTAL
Work Order No.: 19I813

Start Date/Time: sept 19, 2019 @ 1345 h
Test Species: *Daphnia magna*
Set up by: MLF

Sample Information:

Sample ID: L2349150-1 WETLANDS #4
Sample Date: sept 16, 2019
Date Received: sept 18, 2019
Sample Volume: 2 x 10L

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.: 090419A TB
Age of young (Day 0): <24 h
Avg No. young per brood in previous 7 d: 17
Mortality (%) in previous 7 d: 0
Days to first brood: 9

NaCl Reference Toxicant Results:

Reference Toxicant ID: DMNC3B
Stock Solution ID: 18 NA 06
Date Initiated: sept 18, 2019
48-h LC50 (95% CL): 5.9 (4.8 - 7.3) g/LNaCL

Reference Toxicant Mean and Historical Range: 5.5 (3.7 - 8.4) g/L NaCL
Reference Toxicant CV (%): 21

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

Reviewed by: [signature]

Date reviewed: Oct. 3, 2019

Freshwater Acute
48 Hour Toxicity Test Data Sheet

Client: ALS Environmental (Kelowna)
Sample ID: L2349150-1 Wetlands #4
Work Order No.: 191813

Start Date/Time: Sept 19/19 @ 1345h
CER #: 5
No. Organisms/volume: 10/200mL
Test Organism: *D.magna*
Set up by: MLF

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		No. Immobilized	Temperature (°C)			Dissolved oxygen (mg/L)			pH			Conductivity (µS/cm)	
		24	48	48	0	24	48	0	24	48	0	24	48	0	48
CTRL	A	10	10	0	20.0	19.0	19.0	8.9	8.4	8.5	7.6	7.5	7.7	337	351
	B														
	C														
	D														
6.25	A	10	10	0	19.0	19.0	19.0	8.9	8.4	8.5	7.5	7.5	7.9	371	379
	B														
	C														
	D														
12.5	A	10	10	0	19.0	19.0	19.0	8.9	8.4	8.5	7.5	7.5	7.9	404	408
	B														
	C														
	D														
25	A	10	10	0	19.0	19.0	19.0	8.8	8.4	8.5	7.5	7.5	7.9	471	472
	B														
	C														
	D														
50	A	10	10	0	19.0	19.0	19.0	8.5	8.3	8.6	7.5	7.6	8.1	607	603
	B														
	C														
	D														
100	A	10	10	0	20.0	19.0	19.0	7.6	8.3	8.5	7.6	7.9	8.2	880	864
	B														
	C														
	D														
Technician Initials		MLF	JD	JD	MLF	MLF	JD	MLF	MLF	JD	MLF	MLF	JD	MLF	JD

Concentration	Hardness*	Alkalinity*
	*(mg/L as CaCo3)	
Control (MHW)	100	76
Highest conc.	376	300
Hardness adjusted	—	—

	Initial WQ	Adjustment	Adjusted WQ
Temp (°C)	20.0		
DO (mg/L)	7.6		
pH	7.6		
Cond (µS/cm)	880		
Salinity (ppt)	0.4		

Comments: _____ Mortality: Heartbeat checked under microscope 9/A Not rcvd

Sample Description: clear colorless liquid, some brown particulates, no odour

Batch#: 090419A+B 7-d previous # young/brood: 17 Previous 7-d Mortality (%): 0 Day of 1st Brood: 9

Reviewed by: _____ Date reviewed: Oct 3, 2019

APPENDIX C – Chain-of-custody form

L2349150

VANCOUVER

ALS Environmental

Subcontract Request Form

Subcontract To:

NAUTILUS ENVIRONMENTAL
8664 COMMERCE COURT
BURNABY,BC V5A 4N7

NOTES: Please reference on final report and invoice: PO# *L2349150*
ALS requires QC data to be provided with your final results.

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

SAMPLE NUMBER	ANALYTICAL REQUIRED	DATE SAMPLED / DUE DATE	Priority Flag
L2349150-1 WETLAND #4		**9/16/2019**	
	Daphnia Magna LC50 (48 Hour) - Nautilus (DAPHNIA-LC50-48HR-NL 1)	9/27/2019	

Subcontract Info Contact: Brittany Puckey (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: Paul-C. Date Shipped: Sept 18/2019.

Received By: Tyrone Hamilton Date Received: Sept. 18/19 @ 9:56

Verified By: _____ Date Verified: _____

Temperature: 2.1°C

Sample Integrity Issues: 2x10L

191813

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

Kitimat

END OF REPORT

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2349150-COFC

COC Number: 17 - 828814

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Report To	Contact and company name below will appear on the final report	Report Format / Distribution	Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Company:	Reg Dist of Kitimat-Stikine	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply
Contact:	Chris Kerr	Quality Control (QC) Report with Report ☑ YES ☐ NO	PRIORITY (Business Days): 4 day [P4-20%] ☐ / 3 day [P3-25%] ☐ / 2 day [P2-50%] ☐
Phone:	250-615-6100	☑ Compare Results to Criteria on Report - provide details below if box checked	EMERGENCY: 1 Business day [E - 100%] ☐ / Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm
Street:	4545 Lazelle Ave	Email 1 or Fax sprouse@rdks.bc.ca	For tests that can not be performed according to the service level selected, you will be contacted.
City/Province:	Terrace, B.C.	Email 2 ckerr@rdks.bc.ca	
Postal Code:	V8G-4E1	Email 3 ehanney@rdks.bc.ca	
Invoice To	Same as Report To ☑ YES ☐ NO	**Invoice Distribution**	**Analysis Request**
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Company:	Reg Dist of Kitimat-Stikine	Email 1 or Fax Anne-Marie@rdks.bc.ca	
Contact:	Steve Rouse	Email 2 ckerr@rdks.bc.ca/ehanney@rdks.bc.ca	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	Hazelton WMF LC-50	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only):		ALS Contact:	Sampler:

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	NUMBER OF CONTAINERS	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below: Acute Toxicity LC50 Daphnia Magna	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	Wetland #4	16/09/19	1:50	Water	2	F/P		

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				FINAL COOLER TEMPERATURES °C			
9.7				1			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	Sept 16/19	3:30	Chris Rosins	Sept 16	3:50	CW	Sep 17	2120

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

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