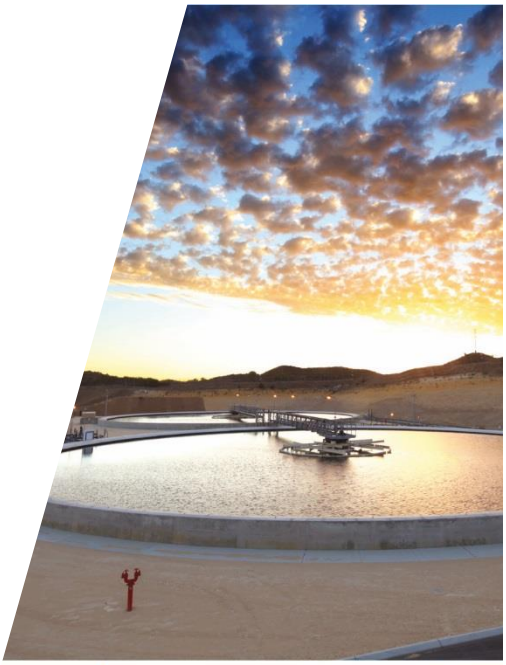

2020 Operations and Monitoring Report

Campbell River Waste Management Centre
Campbell River, British Columbia

Comox Strathcona Waste Management

Executive Summary

GHD Limited (GHD) was retained by Comox-Strathcona Waste Management (CSWM), a function of the Comox Valley Regional District (CVRD), to complete the 2020 water quality monitoring and prepare this Annual Operations and Monitoring Report (Annual Report) for the Campbell River Waste Management Centre (Site or CRWMC). The objective of this Annual Report is to summarize the developmental progress and environmental monitoring for the Site during the 2020 calendar year (Reporting Period). The Annual Report contains the information required by Section 10.6 of the Landfill Criteria for Municipal Solid Waste (Landfill Criteria), Section 25.3 of the 2012 Comox-Strathcona Solid Waste Management Plan (SWMP), and Section 3.2 of the Operational Certificate (OC) MR-02401.

The Site is located on Crown Lands within the city limits of Campbell River, British Columbia (BC) at 6700 Argonaut Road approximately 7.5 kilometres (km) west of the city centre. The Site is owned by the CVRD and operated by Berry & Vale Contracting Ltd. under contract with the CVRD. The authorized works include the municipal solid waste landfill and related appurtenances.

Site Operations and Development

During the 2020 calendar year, approximately 26,272 tonnes of waste was landfilled at the Site, resulting in an updated per capita disposal rate estimate of 0.63 tonnes/year. Approximately 3,592 tonnes of waste was diverted from the landfill to the end of the Reporting Period. Approximately 56,203 m^3 of airspace remains under the current design contours. At this time, the Landfill is forecasted to reach final capacity in early 2022.

The BC Ministry of Environment and Climate Change Strategy (ENV) issued an amendment to the Site's OC on May 19, 2020. A copy of the OC with the OC amendment letter are provided in Appendix A.

A closure design for the landfill was submitted to the ENV in 2020 and an RFP for construction of closure works is anticipated to be put out in 2021 for construction to be initiated in 2022.

Material for final cover of the landfill is being excavated from Block J and stockpiled in anticipation of construction of the organics facility.

During 2020, 167 loads of waste were excavated from the southern toe of the landfill east of the transfer station to make additional space for waste diversion and operations in the future. To cover the waste 85 loads of soil were moved to the top of the landfill and six loads of gravel were hauled to the parking lot area.

Monitoring wells MW01-16, MW04-19, AM02-19, HBT94-1, HBT94-2, HBT94-3 and AG99-06 were resurveyed for ground surface elevation in June 2020.

Construction for final closure for landfill at the Site is scheduled to be complete by late 2023. The detailed design of final cover system including the LFG collection system is scheduled to occur in 2021. Construction of the final cover system, LFG collection system, and flare compound for the Site is currently scheduled to commence in concurrence with the closure of the Landfill in 2022.

Environmental Monitoring

Groundwater was observed to flow towards the east across the Site based on water levels measured during the reporting period, which is consistent with previous years. There is approximately a 38 m drop in groundwater elevations between background location MW01-16 and Site monitoring location HBT94-1. In general, groundwater elevations in 2020 were higher than in 2019, but below the average of the past five years (2014-2019).

Downward vertical gradients were observed at nested wells EBA04-6/EBA04-7 and MW03-18/AG99-05 in 2020. Vertical gradients at EBA04-6 and EBA04-7 have historically been downward. At nested wells MW03-18/AG99-05, a slight downward gradient was observed during the May, August, and November monitoring events and a slight upward gradient was observed in the February monitoring event. MW03-18 was installed in summer 2018; therefore, limited historical groundwater elevation data is available for comparison.

Analytical results for groundwater and surface water samples are compared to the BC Contaminated Sites Regulation (CSR) (BC Reg. 375/96 including amendments up to BC Reg. 253/2016, November 1, 2017) Schedule 3.2 Column 3 (Aquatic Life - Freshwater) (FAW) and Schedule 3.2 Column 6 (Drinking Water) (DW).

Surface water analytical results are compared to the British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (BC ENV, 2018), BC Source Drinking Water Quality Guidelines (ENV, 2017), and BC Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (BC Ministry of Environment [MOE], 2017) (WQG) for drinking water (DW) and the protection of freshwater aquatic life (FWAL).

No landfill derived impacts were observed in groundwater quality at background monitoring well MW01-16. Groundwater quality at monitoring well MW01-16 is considered to be representative of background groundwater quality at the Site.

Leachate impacts continue to be observed in groundwater at monitoring wells located in the Landfill Area monitoring wells EBA04-6, HBT94-1, HBT94-2 and HBT94-3. Manganese concentrations were greater than the CSR DW standards during one or more monitoring events in 2020 at HBT94-1.

Discernible changes to the shallow downgradient groundwater quality were observed at EBA11-1, with concentrations of several leachate indicator parameters increasing sharply in 2019. In 2020, concentrations of most parameters decreased to within historical ranges except for manganese and chloride which remained well above historical concentrations throughout 2020. Groundwater quality at EBA11-1 is likely being impacted by infiltration of leachate impacted surface water in the SWM Pond.

Shallow downgradient groundwater quality southeast of the Site at MW02-18 continues to show some level of leachate derived impacts. Leachate parameters are significantly elevated in water collected from MW02-18 compared to background groundwater. Manganese concentrations at MW02-18 were greater than the applicable CSR standards throughout 2020. It is noted that monitoring well MW02-18 is located adjacent to a historic dumping ground, therefore, it is difficult to determine if groundwater quality is adversely affected by the dumping ground, the Site, or both.

Deep downgradient groundwater quality southeast of the Site at AG99-01, AG99-02, AG99-04, and AG99-05 remains generally stable over time with minimal leachate impacts observed. Concentrations of all parameters were below the applicable CSR standards 2020 with the exception of vanadium concentrations detected at AG99-02 during all monitoring events. The source of vanadium in groundwater quality at AG99-02 is not known at this time but is unlikely related to landfill activities.

Surface water quality monitoring results obtained in 2020 from SW-1 (tributary of Cold Creek) and SW03-17 (unnamed pond upstream of SW-1) were assessed. Based on the results from the surface water samples, the presence of leachate impacts are not suspected, based on low level of leachate indicator parameters including alkalinity, ammonia, chloride, and conductivity levels.

The surface water management pond (SWM Pond) was sampled for the first time in November 2020, water quality in the SWM Pond appears to be significantly affected by landfill activities, with concentrations of several leachate indicator parameters similar to typical MSW leachate. Water quality in the SWM Pond is affected by discharge from the side slope seeps which has been re-routed from Argonaut road.

Following the closure of the landfill and application of final cover in 2022-2023, it is anticipated that leachate generation in the landfill will decrease significantly as precipitation will runoff into the SWM Pond rather than infiltrate and generate leachate.

Recommendations

Based on the conclusions of this Annual Report, GHD provides the following recommendations:

Operations

- Complete the detailed design of the landfill gas collection system in 2021 in preparation for construction in 2022 to comply with the requirements of the LFG Regulation.

Monitoring Program

- Continue the groundwater and surface water monitoring programs on a quarterly basis with the following modification:
  - Remove HBT94-5 and GLL93-4 from the groundwater monitoring program, as they have been consistently dry.
  - Add the three new monitoring wells that are scheduled to be installed in spring 2021 to the groundwater monitoring program.

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1. Introduction

GHD Limited (GHD) was retained by Comox-Strathcona Waste Management (CSWM), a function of the Comox Valley Regional District (CVRD), to complete the 2020 water quality monitoring and prepare this Annual Operations and Monitoring Report (Annual Report) for the Campbell River Waste Management Centre (CRWMC or Site).

1.1 Objectives and Scope

The purpose of this Annual Report is to summarize the Site operations and development activities carried out during the reporting period and to provide and assess the Site environmental monitoring data for the 2020 calendar year (Reporting Period). The Annual Report contains the following information in accordance with Section 10.6 of the Landfill Criteria for Municipal Solid Waste (Landfill Criteria) (BC MOE, 2016), Section 25.3 of the 2012 Comox Strathcona Solid Waste Management Plan (SWMP) (AECOM, 2013), and Section 3.2 of the Site's Operational Certificate (OC) MR-02401 (attached as Appendix A):

- A review of the preceding year of operation, plans for the next year and any new information or proposed changes relating to the facility (Sections 3.2, 3.3, 3.11).
- A summary of the landfill operation equipment (Section 3.1).
- Closure works completed (Section 3.3.2).
- Summary of complaints received and the actions taken as a result of the complaint (Section 3.4).
- Identification of non-compliance items and proposed action plan and schedule to reach compliance (if applicable). (Section 3.5).
- Progress report on efforts to resolve previously identified non-compliance items (if applicable). (Section 3.5).
- Landfill gas quantities collected, flared, and utilized (Section 3.6).
- The tonnage of each type of waste discharged into the landfill or diverted (Section 3.7).
- An updated estimate of the municipal solid waste (MSW) per capita disposal rate (Section 3.7.1).
- A waste area population table including adjusted projected population for the estimated facility life (Section 3.7).
- A survey including volume changes, on required frequency (Section 3.8).
- The remaining site life and capacity update (Section 3.9).
- Update to the closure and post-closure liability fund estimate (Section 3.10).
- Comparison of the water quality monitoring data with the performance criteria in Section 4 of the Landfill Criteria for Municipal Solid Waste and the Guidelines for Environmental Monitoring at Municipal Solid Waste Landfills, interpretation of the monitoring data, identification and

interpretation or irregularities and trends, recommendations, and any proposed changes to the monitoring program (Section 5.0).

1.2 Regulatory Settings

The landfill currently operates under OC MR-02401, issued on December 2, 2003, by the British Columbia Ministry of Environment (MOE), and last amended on May 19, 2020. OC MR-02401 replaced the original permit, which was issued in November 1973 and last amended in July 1992 (CH2MHILL, 2009). A copy of the OC with the OC amendment letter are provided in Appendix A. Refuse authorized for disposal at the Site is characterized as “municipal solid waste as defined under the Waste Management Act”.

Groundwater quality for the Site has been historically compared to the BC Contaminated Sites Regulation (CSR) (BC Reg. 375/96 including amendments) Schedule 10 (Schedule 10) Column V (Drinking Water) (DW) and Schedule 6 (Schedule 6) Column II (Aquatic Life, Freshwater) (FAW) and Column V (Drinking Water) (DW). On November 1, 2017, the Stage 10 (Omnibus) and Stage 11 (Housekeeping) amendments came into effect, thus replacing the CSR Standards listed above. The CSR standards applied in this Annual Report are:

- Schedule 3.2 Generic Numerical Water Standards Column 3 (Aquatic Life, Freshwater [FAW])
- Schedule 3.2 Generic Numerical Water Standards Column 6 (Drinking Water [DW])

The appropriate groundwater standards that apply to the Site depend on the current and future potential groundwater and surface water uses in the vicinity of the Site and the potential for groundwater or surface water at the Site to flow to surface water bodies that support aquatic life in the vicinity of the Site. The BC Ministry of Environment and Climate Change Strategy (ENV) (formerly the BC MOE) *Protocol 21 Water Use Determination* (Protocol 21) provides the criteria for selecting the appropriate CSR standards for water quality.

Protocol 21 specifies that Aquatic Life (AW) standards apply to groundwater quality at sites located within a 500 metre (m) radius of a surface water body. According to iMapBC, accessed February 12, 2019, the Site is located less than 500 m from two fresh surface water bodies: McIvor Lake and an ephemeral tributary of Cold Creek. McIvor Lake is upgradient of the Site and is not a receptor of any groundwater discharge from the Site. The tributary of Cold Creek is downgradient of the Site and may potentially be a receptor of groundwater discharge from the Site. Therefore, freshwater AW standards apply to groundwater at the Site.

Based on the information obtained from iMapBC, accessed April 7, 2021, five water supply wells are located within a 500 m radius from the Site listed for Private Domestic use. Additionally, based on GHD’s correspondence with the owner of the adjacent property, located at 5900 Argonaut Road, there is an unregistered shallow dug well located on the 5900 Argonaut Road property, which is located less than 500 m from the Site. GHD understands the well is used for domestic purposes at this time. The DW CSR standards have been applied to the Site in accordance with Protocol 21.

Surface water analytical results are also compared to the British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (ENV, 2018), BC Source Drinking Water Quality Guidelines (ENV, 2017), and BC Working Water Quality Guidelines: Aquatic Life, Wildlife &

Agriculture (BC MOE, 2017) (WQG) for drinking water (DW) the protection of freshwater aquatic life (FWAL).

1.3 Annual Report Organization

The Annual Report is organized into the following sections:

- Section 1. Introduction
- Section 2. Site Background
- Section 3. Site Operations and Development
- Section 4. Environmental Monitoring Program
- Section 5. Environmental Monitoring Results
- Section 6. Summary
- Section 7. Recommendations
- Section 8. References

2. Site Background

2.1 Site Location

A Site location map is presented on Figure 2.1 and a Site Plan is presented on Figure 2.2. Figure 2.3 presents the land zoning uses in the area surrounding the Site.

The Site is located on Crown Lands within the city limits of Campbell River, BC at 6700 Argonaut Road, approximately 7.5 kilometres (km) west of the city centre. The legal description for the southern half of the Site is Block M, all part of District Lot 85, Sayward District. The legal description of the northern portion of the Site is Block J, all part of District Lot 85, Sayward District. The previous legal land description for Block M was “Block C, together with that part of Block A, and that part of Block K, all part of District Lot 85, Sayward District”. The aforementioned lands were all combined into Block M as per Land Lease V934579 dated January 8, 2019 from the Ministry of Forests, Lands and Natural Resource Operations.

A portion of Block M and a majority of Block J are located within the ALR as set out by the ALC. The CVRD has received a variance from the ALC with regards to the current location of the sanitary landfill and surface water management pond where they overlap with ALR lands. The ALR boundary also includes land parcels located north and east of the Site as illustrated in Figure 2.4.

The total Site area is 29.7 hectares. The Site is currently zoned as Industrial Four (I-4) under the City of Campbell River Bylaw No. 3250, 2006, consolidated to bylaw 3743, 2019 (last amended November 4, 2019).

Island Ready Mix is located immediately to the west of the Site and houses operations and equipment for concrete manufacturing and a gravel pit. West Shore Aggregates Ltd. operates a gravel pit immediately to the south of the Site. The West Shore Aggregates property also has a

landfill permitted to discharge refuse from “dryland log sorting, land clearing, construction and demolition operations” under permit PR-07730.

Mature forests situated on Crown Land are located to the north and east of the Site. There are three residential dwellings located approximately 500 m to the northeast of the landfill footprint. The property immediately to the east of Block J is occupied by a single dwelling residential lot.

There are also several active and historical industrial operations in the vicinity of the Site. Active industrial operations include an auto scrap yard, three construction waste landfills (permits PR-07730, PR-10807, and PR-9081), aggregate extraction pits, an asphalt paving plant, and an Emcon facility, which includes a salt storage shed. Historical operations in the area include a crane operation, which housed facilities for cleaning copper coated fish farm nets, and a metal scrap yard.

2.2 Landfill Development

Prior to waste disposal operations at the Site, the Site operated as an aggregate extraction facility in the 1950s. According to CH2MHILL’s 2009 closure plan, the Site was then used as an unregulated dump site prior to the 1970s. Waste burning took place at the Site as well as disposal of liquid wastes (EBA, 2014). The City of Campbell River took over Site operations in the mid 1970s until ownership was transferred to the CVRD in 1999 (EBA, 2014). A private contractor, Berry & Vale Contracting Ltd. (Berry & Vale), has operated the Site under contract with the CVRD since 1996.

According to the SWMP, the Site was projected to reach its capacity in early 2012. A transfer station was constructed in 2011 to divert certain incoming waste streams to the Comox Valley Waste Management Centre (CVWMC). In 2014, a mechanically stabilized earth wall (MSE wall) was constructed along the southeastern Site boundary with the aim of addressing slope re-grading concerns and adding approximately five years of Site life.

Landfilling currently occurs on Block M. Block J is primarily used for extraction of sand and gravel for use as cover material within the landfill. An updated 2017 Design, Operations, and Closure Plan (2017 DOCP) (GHD, 2017) was prepared in 2017 and was submitted to ENV in March 2018. The 2017 DOCP provides final contours and a closure plan for the Site. The 2017 DOCP includes updated plans for the management of landfill gas and surface water. In 2018 construction began on a surface water management pond (SWM Pond) in Block J and was completed in 2019. Material for final cover of the landfill is being excavated from Block J and stockpiled in anticipation of construction of the organics facility. Construction for the final closure works for the Landfill is scheduled for 2022.

Figure 2.2 presents a site plan for the Site.

2.3 Topography and Drainage

Topography in the vicinity of the Site generally slopes downward to the east from McIvor Lake, (approximately 400 m to the west of the landfill footprint), flattening out approximately 500 m to the east of the Site. The Site is located on the north side of a local valley. The narrow valley floor slopes to the east/northeast following the course of Argonaut Road. The valley appears to have been expanded laterally by historical soil extraction operations at the Site and to the southwest of the Site across Argonaut Road.

There are no natural watercourses on the Site. A constructed surface water infiltration swale is located along the southeast boundary of the landfill footprint, which collects surface runoff from the southeast side of the landfill footprint. During periods of heavy rainfall, surface water has been observed to flow northeast along the swale infiltrating into the ground within approximately 500 m of the landfill footprint.

The closest natural surface water channel is located 400 m northeast of the Site and is one of several ephemeral tributaries of Cold Creek. Cold Creek discharges into the Quinsam River approximately 3 km northeast of the Site. Quinsam Hatchery, a salmon hatchery, is located at the confluence of Cold Creek and the Quinsam River. Quinsam River ultimately drains into the Campbell River approximately 2.3 km downstream of the confluence of Cold Creek and Quinsam River.

McIvor Lake, which is contiguous with Campbell Lake, is located approximately 400 m to the west of the Site with a lake elevation of approximately 180 metres above mean sea level (m AMSL) well above the inferred original ground surface elevation of the Site (140 m AMSL). A drainage map illustrating surface water drainage in the area of the Site is presented in Figure 2.5.

2.4 Geologic Setting

2.4.1 Regional Geology

Vancouver Island is part of the Wrangellia Terrane, which includes most of Vancouver Island, Haida Gwaii, and parts of central Alaska. The Wrangellia Terrane is composed mostly of widespread, late Triassic aged flood basalts (Greene, Scoates and Weis, 2005). Regional bedrock geology in the vicinity of the Site is composed of the Vancouver Group of mid to late Triassic age (Guthrie, 2003). The Vancouver Group is composed of undivided sedimentary rocks, marine sedimentary volcanic rocks, and small amounts of siltstones.

At several time periods during the Pleistocene Epoch, Vancouver Island was believed to be glaciated with ice thicknesses up to 2,000 m. During the recession of the last glaciation approximately 14,000-years ago, glacial and glaciofluvial sediments were deposited, and in some cases reworked and redeposited, to make up many of the present surficial deposits of Vancouver Island. These deposits consist of till, which is deposited directly by glacial activity and consist of larger clasts supported in a matrix of fine grained sediment, and of glacial outwash, which consists primarily of poorly sorted, coarse grained (sand and gravel) sediments deposited by glacial melt water (Greene, Scoates and Weis, 2005). The overburden at the Site consists of glaciofluvial and outwash deposits of sand and gravel.

2.4.2 Site Geology

The understanding of the Site geology presented in the following sections is based on existing Site borehole logs for the monitoring wells, provided in Appendix B, regional mapping, previous reports, and well completion logs from nearby private wells.

2.4.2.1 Overburden Geology

Overburden geology at the Site is relatively homogeneous and is primarily composed of deposits of fine to medium grained sand interbedded with deposits of fine to medium grained sand and medium

subrounded gravel. Lenses of silt and fine grained sand up to 4 metres in thickness are present in an irregular distribution across the Site. Decommissioned monitoring well EBA04-5 was the deepest boring within the Site boundaries with a depth of 67 metres below ground surface (m BGS). Bedrock was not encountered at monitoring well EBA04-5. The boring locations (monitoring wells) are illustrated on Figure 2.2.

2.4.2.2 Bedrock Geology

Based on Site borehole logs and private water supply well stratigraphy logs, bedrock has not been encountered in any boreholes advanced within the Site or immediately to the north and west of the Site, which are up to 67 m deep. Bedrock is also not encountered at private water supply wells, which are approximately 60 m deep and located approximately 3 km to the northeast to the Site. Bedrock is encountered at a depth of approximately 1.8 m BGS) approximately 1.5 km to the southwest of the Site based on well stratigraphy log for private water supply well (well tag 98020) adjacent to McIvor Lake. The bedrock lithology was not indicated on the well log.

From review of bedrock geology maps of the area, it appears the Karmutsen formation is the bedrock unit in the vicinity of the Site. The Karmutsen formation is comprised of volcanic basalts and breccias.

2.5 Hydrogeologic Setting

The BC aquifer classification system lists Aquifer 975 to be evident over the extent of the Site. Aquifer 975 is classified as a sand and gravel aquifer of moderate productivity, high vulnerability, and low demand.

The Site is located on an unconfined aquifer primarily composed of sands and gravels. Groundwater within this aquifer flows to the east northeast across the Site. From the mid-1990s to the early 2000s an overall decrease in groundwater elevations within the sand and gravel aquifer by 2 to 4 m is apparent based on historical Site groundwater elevation measurements. The cause of this decrease in groundwater elevations is unknown, however, this phenomenon is not suspected to be related to the Site.

The Site monitoring wells are generally screened at depths ranging from approximately 1 to 25 m below the top of the water table within the overburden aquifer. Wells screened less than 15 m below the top of the water table are intended to monitor the shallow portion of the overburden aquifer. Wells screened greater than 15 m below the top of the water table are intended to monitor the deep portion of the overburden aquifer. Further details regarding well depth classification is provided in Section 4.1.

Figure 5.2 presents groundwater contours for the November 2020 monitoring event. Based on GHD field measurements, the water table in the vicinity of the landfill is encountered at depths ranging from 19 to 32 m BGS. Seasonal water table fluctuations ranging from 0.34 m to 2.90 m were observed in 2020. The lowest groundwater elevations at most of the monitoring wells were measured in February during the 2020 monitoring year. In previous annual reports, groundwater contours were generated for spring and fall conditions. In those reports, it was noted there was not a significant change in the groundwater flow direction between the spring and fall monitoring events.

Further details of the results of the 2020 hydraulic monitoring program at the Site are presented in Section 5.2.

2.6 Potential Receptors

Surface water bodies located within a 500 m radius of the Site are McIvor Lake and Cold Creek. Based on the local topography and interpreted groundwater flow direction, McIvor Lake is located upgradient from the Site; therefore, it is an unlikely receptor of groundwater or surface water from the Site. The ephemeral tributary of Cold Creek is located northeast of the Site boundary (750 m northeast of the waste footprint). Based on local topography, groundwater and surface water elevations and hydrogeologic conditions (i.e., unconfined sand and gravel aquifer) of the area, the nearest tributary of Cold Creek is downgradient of the Site. There are no surface water drainages from the Site to the tributary. Groundwater discharge to this tributary is not confirmed as groundwater elevations in the vicinity of the ephemeral tributary is not known. Surface water sampling is carried out on the Cold Creek tributaries east and northeast of the Site. (SW-1 located on a tributary of Cold Creek located approximately 1,100 m east of the Site and SW03-17 located approximately 1000 m east of the Site on a pond).

Based on a search of the iMapBC (accessed April 7, 2021), there are eleven water wells within a 500 m radius of the Site. Five of the water wells are listed as water supply wells for Private Domestic use, four are listed as water supply wells for Commercial/Industrial use, one is listed as a water supply well for unknown use and one is listed as a decommissioned monitoring well (Well tag 110853 assigned as monitoring well GLL93-1) in 2013. The well licenses and a map indicating the locations of the water wells are included in Appendix C.

Well tag 84136 was included in the 2020 environmental monitoring program (EMP) under the label EBA04-1. It should be noted the BC Water Resource Atlas indicates that well tag 84136 (labeled EBA04-1) is located at the southeast side of the landfill footprint, however, it is actually located at the southwest corner of the Site.

Well tag 109728 was installed in January 2015 and appears to be located southeast of the landfill footprint on the south side of Argonaut Road.

Well tags 122464, 122450, 39950, 73577, 74191, 74207, 93413, and 103257 appear to be located hydraulically upgradient from the Site; therefore, it is unlikely that MSW leachate from the Site will migrate to these well locations.

GHD understands an unregistered well is located on the 5900 Argonaut Road property approximately 70 m east of the Block J property line. GHD understands the well is a dug well currently used for domestic purposes. The well is approximately 7.9 m (26 feet) deep.

3. Site Operations and Development

3.1 Site Operations

The Site operates 7-days a week from 8:30 a.m. to 5:30 p.m., with the exception of Christmas Day and New Year's Day. The authorized works includes entrance facilities, sanitary landfill, recycling and waste drop off/storage areas, and related appurtenances.

When the COVID-19 pandemic began in March 2020, staff were adaptable, and the facility was able to remain open with no changes to operating hours or closures necessary. Some health and safety and operational changes were made to keep the facility safe for staff and customers including limiting the number of vehicles and customers at the bin wall and in the recycling area, physical barriers between staff and customers at the scalehouse, and maintaining a 2 m distance between people even when outside. These measures continued into the end of 2020 and will likely remain in place for most of 2021.

Entrance Facilities

The Site entrance is equipped with a lockable and electrified gate system, posted signs, power, and phone connection. The Site receives waste primarily from the Campbell River wasteshed, which includes the City of Campbell River and the surrounding communities. Waste collected from transfer stations in Gold River and Cortes Island is also transferred to the Site. A weigh scale and scalehouse with a full-time attendant are located near the entrance.

Sanitary Landfill

The sanitary landfill (Landfill) is located to the northeast of the entrance facilities. It is a single-cell unlined natural attenuation landfill.

Transfer Station

The transfer station at the Site currently accepts the following types of waste:

- Household waste (non-recyclable)
- Construction and demolition materials
- Clean wood waste
- Yard waste
- Recyclable drywall

Non-recyclable household waste and construction and demolition waste received at the transfer station is discharged to the Landfill. Clean wood waste and yard waste received at the transfer station is diverted from landfill at off-site facilities.

Management of Recyclable Materials

The selected recyclables that are accepted at the Site are:

- Glass containers
- Foam containers
- Paper containers containing liquids
- Plastic film
- Other flexible plastic packaging
- Metal containers
- Hard plastic containers

- Paper and cardboard
- Household batteries (excluding vehicle batteries)
- Residential small appliance and power tools
- Larger residential product packaging (e.g., hard plastic pots and trays)
- Scrap metal
- Drywall
- Refrigerant containing items
- Commercial recyclable hard plastics
- Tires off of rims (commercial and residential)
- Light bulbs (commercial and residential)
- Yard waste and grass clippings
- Clean wood waste
- Cooking oil
- Thermostats
- Polychlorinated biphenyls (PCB) ballasts
- Smoke alarms and carbon monoxide detectors
- Commercial and residential motor oil and antifreeze
- Propane cylinders

Fencing

The entrance facilities and landfill area are surrounded by an electric fence operated year-round.

3.2 Changes from Approved Reports, Plans, and Specifications

3.2.1 OC Amendment

In response to the CVRD's application, the ENV issued an amended OC on May 19, 2020. The application was made to update the list of authorized works, to incorporate Block J within the limits of the landfill site (not the area for disposal), and to recognize the 2017 DOCP.

A copy of the OC with the OC amendment letter are provided in Appendix A.

3.2.2 Existing Waste

During 2020, 167 loads of waste were excavated from the southern toe of the landfill east of the transfer station to make additional space for waste diversion and operations in the future. To cover the waste 85 loads of soil were moved to the top of the landfill and six loads of gravel were hauled to the parking lot area.

3.3 Site Development

3.3.1 Closure Works Completed

No closure works were completed at the Site in 2020.

3.3.2 Maintenance and Repairs

Ongoing maintenance and repairs of Site equipment was completed as scheduled and required.

3.3.3 Monitoring Well Repairs and Decommissioning

Monitoring wells AM02-19, MW01-16, HBT94-1, HBT94-2, and HBT94-3 were resurveyed in June 2020 for ground surface elevation.

3.3.4 Composting Facility

In 2019, the CVRD received Board approval for a food and yard waste composting facility on Block J of the Site. The preliminary design of the compost facility was completed in 2020 and will be finalized in 2021 and construction will commence in summer 2021.

3.3.5 Inspections

Inspections undertaken on Site for cover integrity, health of vegetation, burrowing animals, erosion and settlement were reported as good by the CVRD throughout 2020.

3.4 Complaints

Several complaints were received in 2020, many of which were related to longer than usual wait times resulting from the operational changes in response to the COVID-19 pandemic. To address these complaints, communication with the public were increased substantially in response to constantly changing conditions at the landfill and other waste management facilities in the region. Radio ads and website updates as well as additional onsite signage were implemented to address concerns.

3.5 Emergencies or Non-Compliance Items

The CVRD advised that no emergencies, incidents, or non-compliance issues occurred at the Site in 2020.

3.6 Landfill Gas Collection

As part of the 2017 Design, Operations, and Closure Plan (GHD, 2018) [2017 DOCP], GHD updated the most recent Landfill Gas Generation Assessment (Conestoga-Rovers and Associates, 2010) to assist the development of the conceptual design of the landfill gas (LFG) collection system for the Site. The updated LFG generation assessment (GHD 2017) predicted that the Site will produce approximately 1,536 tonnes of methane in 2020 (GHD, 2017). The detailed design of the LFG collection system is scheduled to occur in 2021. Construction of the LFG collection system and flare

compound for the Site is currently scheduled to commence in concurrence with the closure of the Landfill in 2022.

3.7 Waste Tonnage

Table 3.1 presents tonnages of each type of waste received and discharged to the Landfill in 2020. Approximately 31,489 tonnes was received at the Site. Approximately 3,592 tonnes of waste was diverted from the Landfill resulting in a total of 26,272 tonnes of waste landfilled at the Site in 2020.

3.7.1 Estimate of MSW Disposal Per Capita

Table 3.2 presents the current and projected population of the Campbell River wasteshed until the estimated date of Site closure. Based on a landfilled waste total of 26,272 tonnes and a population of 43,946 in the Campbell River wasteshed in 2020, the updated 2020 municipal solid waste per capita estimate is 0.63 tonnes.

3.8 Volume Survey

The annual airspace consumption estimate for 2020 was completed in two calculations. The first calculation used topographic survey data from November 5, 2019 and October 6, 2020. From these two surveys approximately 51,322 m^3 of airspace was consumed between the two surveys. Based on this survey data, the annual airspace consumption rate is 55,202 m^3 per year.

The second calculation used topographic survey data from October 20, 2016 and October 6, 2020. From these two surveys, approximately 176,801 m^3 of airspace was consumed between the two survey events. Based on this survey data, the average annual airspace consumption rate is 44,597 m^3 per year.

Additionally, approximately 1,837 m^3 of waste was removed from the south toe of the landfill to the top for a reshaping effort to create additional space for diversion and equipment. Due to this, as well as settlement not being included in the calculation, the apparent waste density is likely slightly higher than the value calculated.

3.9 Remaining Capacity and Estimated Site Life

Based on the October 6, 2020, topographic survey, the remaining airspace between the survey and final design waste contours is approximately 82,859 m^3. The corresponding final cover over the Landfill area will consume approximately 17,370 m^3, leaving approximately 65,489 m^3 of airspace for the discharge of waste at the time of the survey. The total remaining airspace is prorated to a remaining airspace volume of 56,203 m^3 as of December 31, 2020.

The CVRD recorded a total of 26,272 tonnes of waste discharged to the landfill in 2020. Using this data, the apparent waste density (mass of waste landfilled/volume of airspace consumed) from January 1 to December 31, 2020 is approximately 0.48 tonnes/m^3.

To prolong the site life of Cell 1 at the CVWMC, the CVRD has opted to defer transporting walking floor trailers from the Site until the last 6-months of the Landfill's site life. This results in a 30 percent waste diversion from the Site to CVWMC in the last 6-months of operating the Landfill.

As indicated in Section 3.8, the average annual airspace consumption rate is approximately 44,597 m^3/year. Based on the remaining airspace, airspace consumption rate, and planned partial waste diversion to the CVWMC starting in mid-2021, approximately 1.5-years of site life remains (November 2020 to March 2022). Using these inputs, the Landfill is forecasted to reach its capacity by the spring of 2022. As required by the Landfill Criteria, a Closure Plan must be submitted to ENV two years prior to closure of the landfill.

3.10 Closure and Post-Closure Fund Estimate

Forecasted closure and post-closure costs for the Site were prepared for the CVRD under separate cover. The memorandum prepared for the CVRD detailing the forecasted closure and post-closure costs also includes the Comox Valley Waste Management Centre, Gold River Landfill, Tahsis Landfill, and Zeballos Landfill. A copy of the memorandum including the information pertinent to the Site is included in Appendix D.

3.11 Operational Plan for the Next 12 Months

Operational plans for 2021 includes the following activities:

- Continue landfilling as outlined in the 2017 DOCP.
- As the landfill active area gets smaller the transfer trailers used to move waste consolidated from small loads at the transfer station tipping floor will be diverted to the CVWMC. The volume of loads will increase through the year.
- Construction of the Regional Organics Compost Facility on Block J, to the north of the landfill, will begin in 2021.
- An area for asbestos waste will be maintained through 2021.
- Stockpiling and extraction of sands and gravels to be used as final cover materials began in 2020 and will continue in 2021. The sands and gravels will be sourced from the land grading in Block J as part of the construction works for the organics composting facility.
- The three remaining monitoring wells proposed in the 2017 DOCP will be installed in spring 2021.

4. Environmental Monitoring Program

The water quality monitoring program for the Site was developed based on previous water quality monitoring reports and the requirements for monitoring municipal landfills as provided in Guidelines for Environmental Monitoring and Municipal Solid Waste Landfills (BC MOE, 1996). The objective of the program is to identify potential impacts (if any) the Landfill has on the receiving groundwater and surface water.

Four water quality monitoring events were conducted during the reporting period: February, May, August, and November.

During the reporting period, water quality monitoring was conducted by GHD personnel with analytical services provided by Canadian Association for Laboratory Accreditation (CALA)

accredited laboratory ALS Canada Ltd, located in Burnaby, BC. Water quality monitoring locations are presented on Figure 2.2. Monitoring specifications including analytical parameters and monitoring frequency for 2020 are included in Appendix E.

4.1 Groundwater Monitoring Program

The objective of the groundwater monitoring program is to monitor groundwater quality within the Site area and to identify, if any, the extent, magnitude and temporal trends of landfill derived impacts to groundwater quality.

The field component of the groundwater monitoring program consists of both hydraulic monitoring and groundwater sampling at 21 locations in the Site area. Groundwater monitoring wells (MWs) are located as shown in Figure 2.2. The 2020 groundwater monitoring program included sampling individual monitoring wells as follows:

- Background wells: AM02-01, MW01-16
- Landfill Wells located within the landfill footprint or on or near the Site boundary adjacent to the landfill footprint. For discussion purposes in this Annual Report, the Landfill Wells are further divided between their screened locations in the shallow (<15 metres below the water table) or deep portions (>15 metres below the water table) of the overburden aquifer:
  - Shallow: EBA04-7, HBT94-1, HBT94-3
  - Deep: EBA04-1, EBA04-4, EBA04-6, HBT94-2
- Downgradient Wells located east of the Landfill. The Downgradient Wells are further divided between the areas northeast of the landfill footprint or southeast of the landfill footprint as well as their screen locations in the shallow or deep portions of the overburden aquifer:
  - Northeast downgradient shallow: AG99-06, EBA11-1, EBA11-2, EBA11-3, EBA11-4, and GLL93-4
  - Northeast downgradient deep: MW04-19
  - Southeast downgradient shallow: HBT94-5, MW02-18, MW03-18
  - Southeast downgradient deep: AG99-01, AG99-02, AG99-04, AG99-05

EBA04-1 is sampled from a tap near the Site scale house upgradient of the estimated limit of waste but has been included with landfill wells for assessment due to its close proximity to the estimated limit of waste.

- Groundwater samples are collected quarterly as outlined in Table 4.1 and analyzed for various general chemistry parameters, nutrients, dissolved metals, and volatile organic compounds (VOCs) at select locations, with the following exceptions:
- GLL93-4, HBT94-3, and HBT94-5 were dry for all 2020 monitoring events. These monitoring wells have been historically dry.
- HBT94-1 was dry during the February and May monitoring events.
- AM02-01 was dry during the February, August, and November monitoring events. AM02-01 has historically been periodically dry. There was enough water at AM02-01 in the May 2020

monitoring event to take a water level measurement, however there was an insufficient volume of water to collect a sample.

Well completion details including screened intervals for each groundwater monitoring well are included in Table 4.2.

4.2 Surface Water Monitoring Program

The objective of the surface water monitoring program is to identify the extent, magnitude (if any) and temporal trends of potential landfill derived impacts to surface water quality.

- Surface water monitoring locations are located downstream from the Site as shown on Figure 2.2. The 2020 surface water monitoring program included sampling of two surface water monitoring locations as follows:
- SW-1 is located on an ephemeral tributary of Cold Creek, which drains into the Quinsam River. SW-1 was sampled during the February, May, and November monitoring events.
  - SW-1 was not sampled in August 2020 as it was dry.
- SW03-17 is located approximately 1 km east of the Site on a pond, which at times drains into to the same ephemeral tributary of Cold Creek that SW-1 is located on. SW03-17 was sampled during the February, May, August, and November sampling events.
- SWM Pond is located on Site in Block J, northeast if the landfill. The SWM Pond was sampled during the November sampling event.

4.3 Leachate Monitoring Program

As there is no leachate collection system at the Site, no leachate monitoring program is currently in place. The Site was originally developed as a natural attenuation landfill.

4.4 Sampling Methodology

Groundwater sampling was conducted in general accordance with BC Field Sampling Manual (MOE, 2013) and consisted of the following methodology:

- Well identification and inspection.
- Water level monitoring followed by well volume calculation.
- Well purging and stabilization monitoring. Purging was completed using a dedicated bailer or dedicated Waterra™ tubing. A minimum three well volumes were purged at wells with good recovery. Wells with insufficient yield were purged dry and allowed to recover followed by sample collection. Field measurements included pH, conductivity, temperature, turbidity, and oxidation-reduction potential.
- Sample collection using dedicated sampling equipment (bailer or Waterra™).
- Equipment decontamination.

Surface water samples were collected by directly dipping a pre-cleaned unpreserved sample container below the water surface and then transferring to the appropriate preserved container when

necessary. Field measurements included pH, conductivity, temperature, turbidity, oxidation-reduction potential, and dissolved oxygen.

Sampling of the domestic well on Site was completed by purging for a period of 20-minutes from an outside tap followed by direct sample collection. Field measurements collected included pH, conductivity, temperature, turbidity, and oxidation-reduction potential.

All samples were collected in the appropriate laboratory-supplied sample containers, preserved as required, packaged in an ice-chilled cooler, and delivered to the laboratory under chain-of-custody protocol. Groundwater samples designated for dissolved metals analysis were field filtered when possible.

4.5 Quality Assurance/Quality Control

In order to ensure adequate quality control for water quality samples, the following quality assurance/quality control (QA/QC) practices were employed during the reporting period:

- Activities performed by qualified and trained personnel.
- Daily field equipment calibration.
- Field QA/QC practices included field duplicate, field blank, and trip blank analysis.
- Data validation was completed by a qualified GHD chemist to assess laboratory and field QA/QC practices and to determine if the data exhibited acceptable levels of accuracy and precision.

5. Environmental Monitoring Results

This section presents hydraulic monitoring results, water quality monitoring results, and a review of the QA/QC practices conducted to ensure available field and analytical data are suitable for their intended use. Field data collected during the reporting period is included in Appendix F. Field sample keys and laboratory reports are also provided in Appendix F.

5.1 Data Quality Assessment and Validation

Analytical data generated during the reporting period was reviewed by a qualified GHD chemist to assess laboratory and field QA/QC.

Laboratory QA/QC practices were evaluated by analyzing laboratory holding time periods, method blank samples, control samples, replicate sample and calibration check samples in general accordance with USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA-540/R-99/008, October 1999) and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA-540/R-04-004, October 2004).

Field QA/QC practices were monitored by analyzing field blank, trip blank, and duplicate samples. The maximum criterion used to assess overall precision for field duplicates is a relative percent difference (RPD) of 30 percent.

Qualifications made to the analytical data based on the quality assessment and validation results are included in Appendix G. Overall the data were found to exhibit acceptable levels of accuracy and precision and are suitable for their intended use with noted qualifiers presented in Appendix G.

It is noted that a qualification is applied to the lab pH results for all samples for all monitoring events. This is due to the short (15-minute) holding time for pH measurements which makes reliable lab measurements impossible. pH of all samples is also measured in the field at the time of sampling, and these results are considered representative of sampling conditions.

5.2 Hydraulic Monitoring Results

Hydraulic monitoring data was collected on a quarterly basis in 2020. Results are tabulated and presented in Table 4.2. Groundwater elevation data for each well collected between 2009 and 2020 is presented as a hydrograph on Figures 5.1a, 5.1b, 5.1c, and 5.1d.

Groundwater was encountered at elevations ranging from approximately 156 m AMSL at the upgradient wells to 109 m AMSL in the downgradient wells in the Site area. The mean groundwater elevation for the Site is approximately 115 m AMSL. The highest groundwater elevations are found in background wells MW01-16 and AM02-1, which are located approximately 400 m to the west of the Site property boundary. There is approximately a 38 m difference in groundwater elevations between background location MW01-16 and Site monitoring location HBT94-1. There is also approximately a 23 m difference between water elevations at McIvor Lake (177 m AMSL) and MW01-16 (154 m AMSL). In general, groundwater elevations in 2020 were higher than in 2019, but below the average of the past five years (2014-2019).

Groundwater contours were generated for the Site using groundwater elevation data collected in November and are presented on Figure 5.2. From examination of Figure 5.2, groundwater is inferred to flow towards the east. The inferred groundwater flow direction is consistent with groundwater elevations from the other 2020 monitoring events and with historical data.

To determine flow in the vertical direction, groundwater levels measured in nested monitoring wells (wells located together with varying screen depths) were compared to each other. Upward gradients indicate that groundwater should flow from deeper to shallower elevations while downward gradients indicate that groundwater should flow from shallower to deeper elevations.

From a review of the groundwater elevations at MW01-16 in 2020, it appears groundwater elevations were greater than the historical range in this area and were approximately 2.5 to 6.6 m higher than 2019 levels. Monitoring wells AM02-01 and MW01-16 are approximately 200 m east of the shore of McIvor Lake, which is contiguous with Campbell Lake. Campbell Lake is dammed by the Ladore Dam, which controls the water level in Campbell Lake and McIvor Lake. As a result, groundwater elevations at AM02-01 and MW01-16 may be affected by water level adjustments at the Ladore Dam. BC Hydro records water level elevations at the Ladore Dam; continued review of water level elevations at the Ladore Dam is necessary to determine whether there is a correlation.

Groundwater elevation data from nested wells EBA04-6/EBA04-7 show a slight downward gradient during each 2020 monitoring event ranging from approximately 0.017 to 0.019 (over a mid-screen to mid-screen separation of 7.66 m). A slight downward gradient has historically been observed at these monitoring locations.

Groundwater elevation data from nested wells MW03-18/AG99-05 show a very slight downward gradient during the May, August, and November monitoring events ranging from 0.0021 to 0.0027 and a slight upward gradient in the February event of 0.046 (over a mid-screen to mid-screen separation of 20.6 m).

5.3 Groundwater Quality Monitoring Results

Groundwater analytical data collected in 2020 was compared to the BC CSR water quality standards Schedule 3.2 and is presented in Tables 5.9 and 5.10. Analytical results notes for Tables 5.9 and 5.10 are provided in Table 5.12.

The following sections present an assessment of groundwater quality during the reporting period and provide a summary of where groundwater quality parameter concentrations were detected above the applicable BC CSR standards. MSW leachate derived impacts to groundwater are identified based on the concentrations of typical MSW leachate parameters compared with Site background groundwater quality data.

To assist in the assessment of potential MSW leachate derived impacts, groundwater chemistry results have been separated into groundwater zones. The shallow wells – i.e., wells that are screened in the shallow portion (top 15 m) of the overburden aquifer, and the deep wells – i.e., wells that are screened in the deep portion (greater than 15 m below the top of the water table) of the overburden aquifer.

5.3.2 Background Overburden Aquifer Quality: AM02-01, MW01-16

5.3.3 Landfill Overburden Aquifer Quality:

- Shallow wells: HBT94-1, HBT94-3, EBA04-7
- Deep wells: EBA04-1, HBT94-2, EBA04-6

5.3.4 Downgradient Overburden Aquifer Quality:

- Northeast shallow wells: EBA11-1, EBA11-2, AG99-06, EBA11-4, EBA11-3, GLL93-4, and MW04-19
- Southeast shallow wells: HBT94-5, MW02-18, MW03-18
- Southeast deep wells: AG99-02, AG99-01, AG99-04, and AG99-05

5.3.1 MSW Leachate Indicators

Selected parameters (typical MSW leachate parameters) were examined in groundwater quality to assess the presence of leachate in groundwater at or near the Site. Due to the lack of site-specific leachate chemistry data, typical leachate indicator parameters and their respective range of concentrations as determined by monitoring data with similar landfills (CRA, 2014), and literature values (Dydo et. al., 2005 and US EPA, 1986), were used to represent MSW leachate. Typical leachate parameters and their associated concentration ranges are presented in Table 5.1.

Table 5.1 Typical MSW Leachate Parameter Concentration Ranges

Parameter	Concentration
Alkalinity (mg/L)(1)	71 – 3,340
Ammonia (mg/L)(1)	84.3 – 449
Boron (ug/L)(1)	3,200 – 4,680
Chloride (mg/L)(1)	150 – 506
Conductivity (uS/cm)(1)	161 – 8,126
Iron (ug/L)(1)	940 – 40,440
Hardness (mg/L)(2)	0.1 – 36,000
Manganese (ug/L)(1)	1,250 – 7,250
pH(2)	3.5 – 8.5
Sulphate (mg/L)(2)	25 – 500

Notes:
(1) CRA, 2014
(2) Dydo et. al., 2005 and US EPA, 1986

In order to supplement the evaluation of potential landfill-remated impacts to groundwater quality, GHD analyzed hydrogeochemical “fingerprints” of groundwater at the Site using a Piper Plot which is presented in Figure 5.3.

A piper plot is a diagram used to represent the chemical characteristics of a water sample or group of samples. Piper plots consist of two ternary plots (triangular graphs) on which the concentrations of major anions and cations in groundwater are plotted as relative percentages for a water sample, and a diamond plot onto which the ternary plots are projected. On the left ternary plot, relative percentages of magnesium, calcium, and the sum of sodium and potassium are plotted, while relative percentages of sulphate, chloride, and the sum of carbonate and bicarbonate are plotted on the right ternary plot. Piper plots are used to distinguish water types and can be used to infer aquifer lithology and identify the mixing of multiple waters.

5.3.2 Background Groundwater Quality

Groundwater monitoring locations AM02-01 and MW01-16 are used to characterize background groundwater quality conditions at the Site. AM02-01 and MW01-16 are selected as background locations based on their upgradient position relative to the Landfill and historical groundwater chemistry results. It is noted that monitoring well AM02-01 was dry or had insufficient volume for sampling during all monitoring events in 2020. The following table presents ranges of leachate indicator parameter concentrations observed in 2020 at MW01-16. Indicator parameters’ concentration ranges in typical MSW leachate are also included in Table 5.2 to illustrate the relative difference between Site background groundwater and leachate chemistry.

Table 5.2 Leachate Indicator Parameter Concentration Ranges at Background Locations

Parameter	Alk. (mg/L)	NH_4 (mg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH	SO_4 (mg/L)
Typical MSW Leachate	71 – 3,340	84.3 – 449	3,200 – 4,680	150 – 506	161 – 8,126	0.1 – 36,000	940 – 40,440	1,250 – 7,250	3.5 – 8.5	25 – 500
Background MW01-16	28.4 - 49.7	ND (0.0050)	ND (10) - 10	0.73 - 1	64.6 – 107	29.4 - 51.4	ND (10)	ND (0.1)	7.51 - 7.69	2.37 - 2.78

ND – Parameter concentration below laboratory detection limit.
mg/L - milligrams per litre; µg/L - micrograms per litre; µS/cm - microSiemens per centimeter.
Alk: alkalinity, NH_4: Ammonia, B: boron, Cl^-: chloride, Fe: iron, Mn: manganese, SO_4: sulphate, Cond.: Conductivity.
Conductivity – measured in the lab; pH – measured in the field.

Detailed Background Area groundwater analytical results are presented in Tables 5.9 and 5.10. Historical Background Area groundwater chemistry trend plots of selected leachate indicator parameters are presented in Appendix H (Figures H-1 and H-2). Historical data from private residential water well EBA06-1 has also been included in Figures H-1 and H-2; however, it has not been included in the Site's monitoring program since September 2014.

From a review of the historical data presented in Figures H-1 and H-2, and the 2020 data presented in Table 5.2, GHD observes the following:

- Groundwater quality at MW01-16 is generally characterized by stable concentrations of MSW leachate indicator parameters which are significantly lower than typical MSW leachate indicator parameter concentrations.
- AM02-01 continued to be dry in 2020 preventing collection of groundwater samples for field monitoring and laboratory analysis. There was enough water at AM02-01 in the May 2020 monitoring event to take a water level measurement, however there was not enough water in the well to collect a sample.
- VOC analytical results from MW01-16 were less than the laboratory detection limits in 2020.

Analytical results for groundwater samples collected from MW01-16 were less than the applicable CSR standards for all parameters tested in 2002.

At this time, groundwater quality at MW01-16 is considered to be representative of background groundwater quality for the Site.

5.3.3 Landfill Groundwater Quality

5.3.3.1 Landfill Shallow Groundwater Quality

Groundwater quality in the shallow portion of the overburden aquifer in the immediate vicinity of the landfill footprint (Landfill Area) is monitored by the following wells:

- Nested wells HBT94-1 and HBT94-3 are located at the toe of the landfill directly to the southeast of the landfill footprint. These wells monitor groundwater in the shallow portion of the overburden aquifer. HBT94-2 is nested with HBT94-1 and HBT94-3 and is screened in the deep portion of the overburden aquifer. HBT94-1 was dry during the February and May monitoring events and

HBT94-3 was dry or had an insufficient volume for sample collection during all 2020 monitoring events.

- EBA04-7 located immediately to northeast of the landfill footprint. EBA04-7 is nested with deep well EBA04-6.

Table 5.3 presents ranges of MSW leachate indicator parameter concentrations observed in 2020 at the Landfill Area shallow wells. Typical MSW leachate concentration ranges and background groundwater concentrations are included for comparison.

Table 5.3 Leachate Indicator Parameter Concentration Ranges at Shallow Landfill Area Wells

Parameter	Alk. (mg/L)	NH_4 (mg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH (S.U)	SO_4 (mg/L)
Typical MSW Leachate	71 – 3,340	84.3 – 449	3,200 – 4,680	150 – 506	161 – 8,126	0.1 – 36,000	940 – 40,440	1,250 – 7,250	3.5 – 8.5	25 - 500
HBT94-1[2]	219 - 239	7.87 - 8.65	131 - 284	31 - 34.2	535 - 565	184 - 198	32 - 1810	1520 - 1710	7.54 - 7.93	5.37 - 6.16
EBA04-7	419 - 515	ND (0.0050)	198 - 418	28.5 - 36.3	849 - 1040	423 - 549	ND (10)	134 - 211	7.24 - 7.56	13.2 - 15.4
Background (MW01-16)	28.4 - 49.7	ND (0.0050)	ND (10) - 10	0.73 - 1	64.6 - 107	29.4 - 51.4	ND (10)	ND (0.1)	7.51 - 7.69	2.37 - 2.78

ND – Parameter concentration below laboratory detection limit.
mg/L - milligrams per litre; µg/L - micrograms per litre; µS/cm - microSiemens per centimeter.
Alk: alkalinity, NH_4: Ammonia, B: boron, Cl^-: chloride, Fe: iron, Mn: manganese, SO_4: sulphate, Cond.: Conductivity.
Conductivity – measured in the lab; pH – measured in the field.
(1) – HBT94-3 was dry during the 2020 monitoring events.
(2) – HBT94-1 was dry during the February and May monitoring events
Red – Concentration greater than applicable CSR standard

Landfill Area shallow groundwater analytical results are presented in Table 5.9 and 5.10. Historical Landfill Area groundwater chemistry trend plots of select leachate indicator parameters are presented in Appendix H (Figures H-3, H-4, H5, and H-6).

Based on the historical data presented in Figures H-3, H-4, H-5, and H-6 and the 2020 water quality data presented in Table 5.3, GHD observed the following:

- Groundwater quality at nested well HBT94-1 continues to show the influence of leachate, with elevated concentrations of all leachate indicator parameters compared to background groundwater. The concentration of manganese at HBT94-1 exceeded the BC CSR standard for drinking water in the August and November monitoring events.
  - During the 2020 monitoring events, concentrations of iron and ammonia at HBT94-1 were within the historical range and other leachate indicators remained similar to historical values.
- Chloride concentrations in groundwater collected from EBA04-7 began to increase in September 2017 and continued through 2018, reaching a maximum of 110 mg/L in September 2018. In 2019, chloride concentrations at EBA04-7 began to decrease and returned to the

historical range. Chloride concentrations at EBA04-7 in 2020 were within the pre-2017 historical range.

- Manganese concentrations in groundwater at EBA04-7 began increasing in 2018 and have continued increasing through 2020. Manganese concentrations at EBA04-7 were above the historical range and reached a maximum of 0.211 mg/L in November 2020. Other leachate indicator parameter (e.g., hardness, alkalinity) concentrations in groundwater at EBA04-7 are similar to historical results. Leachate generation and potential impacts to groundwater will decrease following the closure of the landfill and application of final cover in 2022-2023. Post-closure groundwater monitoring will be completed to monitor the decreasing impact of the landfill on the environment.
- VOC concentrations were less than the laboratory detection limits in groundwater quality at the shallow Landfill Area wells in 2020.

Concentrations of leachate parameters were less than applicable CSR standards in groundwater at the Landfill Area shallow wells for all parameters tested in 2020 except the following:

Manganese

Manganese concentrations were greater than the CSR DW standard (1,500 µg/L) in groundwater samples collected from HBT94-1 for the August (1,520 µg/L) and November (1,710 µg/L) monitoring events in 2020.

Manganese concentrations in groundwater at HBT94-1 have historically been greater than background concentrations and the applicable CSR standards. Manganese concentrations observed at HBT94-1 in 2020 were within the historical range.

5.3.3.2 Landfill Area Deep Groundwater Quality

Groundwater quality in the deep portion of the overburden aquifer within the immediate vicinity of the landfill footprint (Landfill Area) is monitored by the following wells:

- EBA04-1, located at the southwest corner of the landfill footprint. EBA04-1 is a water supply well used by Site staff for non-potable uses.
- HBT94-2, located at the toe of the landfill footprint directly to the southeast of the landfill footprint. HBT94-2 is nested with shallow wells HBT94-1 and HBT94-3.
- EBA04-6, located approximately 60 m northeast of the landfill footprint. EBA04-6 is nested with shallow well EBA04-7.

Table 5.4 presents concentration ranges of MSW leachate indicator parameters observed in 2020 at Landfill Area deep wells. Typical MSW leachate concentration ranges and background groundwater concentrations are included for comparison.

Table 5.4 Leachate Indicator Parameter Concentration Ranges at Deep Landfill Area Wells

Parameter	Alk. (mg/L)	NH_4 (mg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH (S.U)	SO_4 (mg/L)
Typical MSW Leachate	71 – 3,340	84.3 – 449	3,200 – 4,680	150 – 506	161 – 8,126	0.1 – 36,000	940 – 40,440	1,250 – 7,250	3.5 – 8.5	25 – 500
HBT94-2	163 - 253	1.73 - 2.01	90 – 146	19.9 - 37	354 - 579	144 - 243	163 - 239	598 - 1060	7.91 - 8.1	2.69 - 3.04
EBA04-6	292 - 311	ND (0.0050)	28 – 43	2.49 - 3.8	523 - 577	261 - 316	ND (10)	ND (0.1)	7.62 - 7.97	2.17 - 4.43
EBA04-1	34.8 - 44	ND (0.0050)	ND (10)	0.67 - 0.82	79.1 - 88.1	38.4 - 44.3	ND (10) - 39	ND (0.1) - 0.38	7.89 - 8.11	2.39 - 2.5
Background (MW01-16)	28.4 - 49.7	ND (0.0050)	ND (10) – 10	0.73 - 1	64.6 - 107	29.4 - 51.4	ND (10)	ND (0.1)	7.51 - 7.69	2.37 - 2.78

ND – Parameter concentration below laboratory detection limit.
mg/L - milligrams per litre; µg/L - micrograms per litre; µS/cm - microSiemens per centimeter.
Alk: alkalinity, NH_4: Ammonia, B: boron, Cl^-: chloride, Fe: iron, Mn: manganese, SO_4: sulphate, Cond.: Conductivity.
Conductivity – measured in the lab; pH – measured in the field.

Deep Landfill Area groundwater well analytical results are presented in Tables 5.9 and 5.10. Historical Landfill Area groundwater chemistry trend plots of select leachate indicator parameters are presented in Appendix H (Figures H-3, H-4, H-5, and H-6).

Based on historical data presented in Figures H-3, H-4, H-5, and H-6 and the 2020 data presented in Table 5.4 GHD observed the following:

- Groundwater quality at HBT94-2 continues to show the presence of leachate in groundwater, with elevated concentrations of all leachate indicator parameters compared to background groundwater.
  - Concentrations of leachate parameters at HBT94-2 were below the applicable CSR standards and within the historical range throughout 2020.
  - The leachate indicator parameter concentrations observed at HBT94-2 are generally one to two orders of magnitude less than typical MSW leachate concentrations indicating significant attenuation is occurring within both the unsaturated and saturated zones directly beneath the landfill footprint.
- Groundwater quality at EBA04-6 continues to show low level leachate impacts based on slightly elevated levels of chloride, hardness, alkalinity, and conductivity when compared to background groundwater conditions. MSW leachate impacts at EBA04-6 continue to be lower than leachate impacts observed at HBT94-2. Analytical results at EBA04-6 in 2020 were generally consistent with historical results.
  - Groundwater chemistry at EBA04-6 indicates lower leachate parameter concentrations compared to shallow nested well EBA04-7. This indicates that additional leachate attenuation is occurring between the shallow and deeper portions of the overburden aquifer. This observation is consistent with historical results. Unlike groundwater quality at shallow

well EBA04-7, chloride, and manganese concentrations in groundwater at EBA04-6 were similar to historical results.

- EBA04-1 continues to show little to no landfill derived impacts based on leachate indicator concentrations similar to background groundwater conditions. Analytical results for groundwater quality at EBA04-1 in 2020 were similar to historical results. EBA04-1 is a water supply well used by the landfill workers for non-potable purposes.
- VOC concentrations were below laboratory detection limits at all landfill in groundwater at the sampled deep overburden Landfill Area wells in 2020.

Concentrations of leachate parameters were less than applicable CSR standards in groundwater in the deep portion of the overburden aquifer Landfill Area wells for all parameters tested in 2020.

5.3.4 Downgradient Groundwater Quality

Groundwater quality in the area downgradient of the landfill footprint is monitored at 13 monitoring wells. To facilitate the discussion of groundwater quality downgradient of the Site in this Annual Report, the discussion is divided between monitoring wells located to the northeast and the southeast of the landfill footprint as listed in Section 5.3.

5.3.4.1 Northeast Downgradient Shallow Groundwater Quality

Groundwater quality in the shallow portion of the overburden aquifer northeast of the landfill footprint is monitored by six monitoring wells as follows (from closest to furthest from the landfill footprint): EBA11-1, EBA11-2, MW04-19, AG99-06, EBA11-4, and EBA11-3.

Table 5.5 presents ranges of MSW leachate indicator parameter concentrations observed in 2020 at northeast shallow wells along with background groundwater quality for comparison. If leachate indicator concentrations at the northeast wells are greater than background groundwater conditions, it may be indicative of MSW leachate impact to groundwater quality downgradient of the landfill footprint.

Table 5.5 Leachate Indicator Parameter Concentration Ranges at NE Downgradient Shallow Wells

Parameter	Alk. (mg/L)	NH_4 (mg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH (S.U)	SO_4 (mg/L)
EBA11-1	192 - 323	0.0104 - 0.035	91 - 122	59 - 100	661 - 889	315 - 418	ND (10) - 144	826 - 1390	7.9 - 8.14	16.3 - 28.3
EBA11-2	134 - 162	ND (0.0050)	11 - 21	5.33 - 20.8	277 - 377	134 - 193	ND (10) - 38	ND (0.1) - 1.19	7.88 - 8.13	3.36 - 4.17
MW04-19(D)	51.8 - 66.7	ND (0.0050) - 0.010	ND (10)	2.79 - 3.31	117 - 142	51 - 64	ND (10) - 16	ND (0.1) - 0.7	8.1 - 8.22	3.39 - 4.76
AG99-06	46.8 - 58.5	ND (0.0050) - 0.012	ND (10)	3.7 - 6.81	96.5 - 140	42.8 - 57.3	ND (10) - 15	0.48 - 2.72	7.75 - 7.86	1.06 - 1.73
EBA11-4	47 - 54.8	ND (0.0050)	ND (10)	4.58 - 7.95	118 - 134	50.9 - 56.1	ND (10) - 21	ND (0.1) - 0.27	7.82 - 7.98	2 - 3.26

Table 5.5 Leachate Indicator Parameter Concentration Ranges at NE Downgradient Shallow Wells

Parameter	Alk. (mg/L)	NH_4 (mg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH (S.U)	SO_4 (mg/L)
EBA11-3	42.3 - 62.1	ND (0.0050)	ND (10)	3.69 - 26.7	120 - 198	56 - 91.4	ND (10)	ND (0.1)	7.77 - 7.88	2.53 - 3.35
Background (MW01-16)	28.4 - 49.7	ND (0.0050)	ND (10) - 10	0.73 - 1	64.6 - 107	29.4 - 51.4	ND (10)	ND (0.1)	7.51 - 7.69	2.37 - 2.78

ND – Parameter concentration below laboratory detection limit.
mg/L - milligrams per litre; µg/L - micrograms per litre; µS/cm - microSiemens per centimeter.
Alk: alkalinity, NH_4: Ammonia, B: boron, Cl^-: chloride, Fe: iron, Mn: manganese, SO_4: sulphate, Cond.: Conductivity.
Conductivity – measured in the lab; pH – measured in the field.
Red – Concentration greater than applicable CSR standard
(D) – Deep monitoring well.

Detailed Northeast Downgradient Area groundwater analytical results are presented in Tables 5.9 and 5.10. Historical Downgradient Area groundwater chemistry trend plots of selected leachate indicator parameters are presented in Appendix H (Figures H-7 and H-8).

Based on historical data presented in Figures H-7 and H-8, and the 2020 data presented in Table 5.5, GHD has made the following interpretations regarding groundwater quality at the northeast Downgradient Area shallow wells.

- Groundwater quality at EBA11-1 changed significantly in 2019 with sharp increases in concentrations of manganese, iron, chloride, hardness, and alkalinity. Concentrations of these parameters reached maximum concentrations in November 2019. In 2020, the concentrations of manganese and chloride at EBA11-1 remained well above their historical levels, although lower than the November 2019 concentrations, while concentrations of alkalinity and hardness were slightly above their historical ranges and the concentration of iron was below the limit of detection for all monitoring events except for February.
  - From a review of the Piper plot in Figure 5.3, EBA11-1 appears to be an outlier compared to the other monitoring wells, with a much higher proportion of chloride than any other location. EBA11-1 would plot at the end of a trendline connecting background location MW01-16 and EBA11-3. Due to the unusual characteristics of groundwater quality at EBA11-1 and EBA11-3 compared to the other monitoring locations at the Site, leachate impact is not suspected. Groundwater quality at these monitoring locations appears to be influenced by an alternate source. A salt storage shed located west of Block J may be a potential source of elevated chloride concentrations at EBA11-3. It also is noted that a private landfill is located approximately 400 m west of Block J.
- Groundwater quality at EBA11-2 continues to show generally stable, mild leachate impacts based on slightly elevated levels of alkalinity, boron, chloride, conductivity, hardness, iron, manganese, and sulphate compared to background groundwater.
- MW04-19 was installed in October 2019 and shows mild leachate impacts based on slightly elevated concentrations of alkalinity, chloride, conductivity, hardness, iron, manganese, and sulphate compared to background groundwater. Further monitoring is required to further characterize the water quality at MW04-19 and discern any trends.

- Groundwater quality at AG99-06 was comparable to background groundwater and concentrations of all leachate indicator parameters were within their historical ranges.
- Groundwater quality at EBA11-4 has generally been similar to background groundwater conditions. Concentrations of iron and manganese were notably elevated during the May 2019 monitoring event but were less than the laboratory detection limits during the June, September, and November 2019 monitoring events. In 2020, concentrations of iron and manganese at EBA11-4 were below the laboratory detection limits in all monitoring events except for November. In general, groundwater quality at EBA11-4 is comparable to background groundwater.
  - It is noted that vanadium concentrations at EBA11-4 are elevated relative to background groundwater levels and most of the rest of the Site and are only slightly below the applicable CSR standard. Vanadium concentrations at EBA11-4 ranged from 14.5 to 15.3 µg/L in 2020 compared to the CSR DW standard of 20 µg/L and concentrations of 1.12 to 1.57 µg/L in background groundwater. Vanadium concentrations in the immediate vicinity of the landfill footprint (HBT94-1 and HBT94-2) were below the laboratory limit of detection of 0.5 µg/L in 2020 and have been consistently low in the past. Vanadium was observed at all other monitoring locations in 2020 at concentrations above the limit of detection but well below the applicable CSR standard except for AG99-02 where concentrations varied from 18.6 to 22.8 µg/L in 2020.
  - Considering the spatial variability of vanadium concentrations in groundwater at the Site, with the highest concentrations observed at cross-gradient monitoring locations and the lowest concentrations observed in the landfill area, it appears that the vanadium is originating at an unknown off-Site source and is unrelated to landfill activities.
- In November 2017, chloride concentrations in groundwater at EBA11-3 were significantly higher than historical chloride ranges at this monitoring location and elevated concentrations continued to be observed in 2018. Chloride concentrations at EBA11-3 returned to pre-2017 ranges in 2019 and remained stable throughout 2020.
- VOC analytical results continued to be less than the laboratory detection limits at northeast shallow overburden wells in 2020.

Concentrations of leachate parameters were less than applicable CSR standards in groundwater at the Northeast Downgradient Area wells for all parameters tested in 2020.

5.3.4.2 Southeast Downgradient Shallow Groundwater Quality

Groundwater quality in the shallow portion of the overburden aquifer southeast of the Site is monitored by HBT94-5, MW02-18, and MW03-18. Groundwater monitoring at HBT94-5 has not been possible since 2000 as the well has been dry during all monitoring events. As stated in Section 2.5, groundwater elevations in the vicinity of the Site decreased by approximately 2 to 4 m between 1995 and 2003. This apparent drop in regional groundwater elevation is likely the cause for HBT94-5 becoming dry. Historical analytical results for HBT94-5 are provided in Appendix I. MW02-18 and MW03-18 were installed in July 2018 and were included in all four of the 2020 monitoring events.

Concentrations versus time graphs for selected MSW leachate indicator parameters are presented in Figures H-11 and H-12 in Appendix H.

Table 5.6 presents concentration ranges of leachate indicator parameters in groundwater quality at MW02-18 and MW03-18. The purpose of the table is to illustrate the potential landfill derived impact on the shallow portion of the overburden aquifer groundwater quality southeast of the Site.

Table 5.6 Leachate Indicator Parameter Concentration Ranges at SE Downgradient Shallow Wells

Parameter	Alk. (mg/L)	NH_4 (mg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH (S.U)	SO_4 (mg/L)
MW02-18	282 - 430	12 - 15.7	299 - 427	23.8 - 72.8	608 – 1010	193 - 346	26 - 62	2170 - 3950	7.1 - 7.54	2.3 - 2.8
MW03-18	66.3 - 128	ND (0.0050)	16 - 30	1.5 - 5.48	142 - 261	68.4 - 128	ND (10)	ND (0.1)	8.1 - 8.25	2.57 - 3.01
Background (MW01-16)	28.4 - 49.7	ND (0.0050)	ND (10) - 10	0.73 - 1	64.6 5-107	29.4 - 51.4	ND (10)	ND (0.1)	7.51 - 7.69	2.37 - 2.78

Notes:
ND – Parameter concentration below laboratory detection limit.
mg/L - milligrams per litre; µg/L - micrograms per litre; µS/cm - microSiemens per centimeter.
Alk: alkalinity, NH_4: Ammonia, B: boron, Cl^-: chloride, Fe: iron, Mn: manganese, SO_4: sulphate, Cond.: Conductivity.
Conductivity – measured in the lab; pH – measured in the field.
Red – Concentration greater than applicable CSR standard

Detailed analytical results for the Northeast Downgradient Area shallow wells are presented in Tables 5.9 and 5.10. Historical Downgradient Area groundwater chemistry trend plots of selected leachate indicator parameters are presented in Appendix H (Figures H-11 and H-12).

From a review of Table 5.6, Figures H-11 and H-12, and Appendix I, GHD observed the following:

Detailed Northeast Downgradient Area groundwater analytical results are presented in Tables 5.9 and 5.10. Historical Downgradient Area groundwater chemistry trend plots of selected leachate indicator parameters are presented in Appendix H (Figures H-7 and H-8).

- Groundwater quality at MW02-18 shows elevated concentrations of all leachate indicator parameters relative to background groundwater conditions, indicating some landfill related impact. Concentrations of several parameters including chloride, hardness, iron, and manganese increased sharply in the May 2020 monitoring event before returning to concentrations within the historical range in August and November. Manganese concentrations at MW02-18 were by far the highest of any monitoring location at the Site in 2020, ranging from 2,170 to 3,950 µg/L. Manganese concentrations at MW02-18 have consistently been in excess of the CSR DW standard since monitoring began in 2018.
  - From a review of the Piper plot in Figure 5.3, MW02-18 is an outlier compared to the other monitoring locations with significantly higher proportions of sodium and potassium, and a lower proportion of calcium compared to the other monitoring locations. Monitoring well MW02-18 is located adjacent to a historic dumping ground, therefore it is difficult to determine if groundwater quality is being adversely affected by the dumping ground, the Site, the neighboring landfill, or a combination of all three.

- Groundwater quality at MW03-18 is similar to background groundwater conditions. MW03-18 is nested with AG99-05, which exhibits similar groundwater quality. Based on the 2020 groundwater sample results, negligible leachate influence is observed at MW03-18.

Concentrations of all leachate parameters observed in 2020 were less than the applicable CSR standards at the southeast shallow overburden groundwater wells with the exception of the following:

Manganese

Manganese concentrations in groundwater samples collected at MW02-18 were greater than the CSR DW standard (1,500 µg/L) during all four monitoring events in 2020, with concentrations of 2,680 µg/L in February, 3,950 µg/L in May, 2,610 µg/L in August, and 2,170 µg/L in November. As indicated above, MW02-18 is located adjacent to a former apparent historic dumping ground, therefore groundwater quality at MW02-18 is likely affected by the presence of this dumping ground.

5.3.4.3 Southeast Downgradient Deep Groundwater Quality

Groundwater quality in the deep portion of the overburden aquifer southeast of the Site is monitored by monitoring wells AG99-02, AG99-01, AG99-04, and AG99-05.

Table 5.7 presents ranges of leachate indicator parameter concentrations observed in 2020 at southeast downgradient deep wells compared to background groundwater quality to illustrate the potential impacts of landfilling operations on southeast deep groundwater quality. The table is arranged by increasing distance from the landfill footprint.

Table 5.7 Leachate Indicator Parameter Concentration Ranges at SE Downgradient Deep Wells

Parameter	Alk. (mg/L)	NH_4 (mg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH (S.U)	SO_4 (mg/L)
AG99-01	86 - 98.8	ND (0.0050)	ND (10)	1.6 - 1.76	176 - 197	86.8 - 101	ND (10)	ND (0.1)	7.98 - 8.1	2.74 - 2.95
AG99-02	69.7 - 152	ND (0.0050)	ND (10)	1.37 - 1.72	146 - 261	70.8 - 144	ND (10)	ND (0.1)	8.11 - 8.22	2.56 - 3.12
AG99-04	45.6 - 54.8	ND (0.0050)	ND (10) - 11	0.99 - 1.24	100 - 114	46.1 - 54.1	ND (10)	ND (0.1) - 0.29	7.94 - 8.05	2.45 - 2.74
AG99-05	45.4 - 79.3	ND (0.0050)	ND (10) - 15	0.87 - 3.63	96.1 - 173	46.8 - 87.6	ND (10)	ND (0.1) - 0.45	7.94 - 8.17	2.53 - 2.58
Background (MW01-16)	28.4 - 49.7	ND (0.0050)	ND (10) - 10	0.73 - 1	64.6 - 107	29.4 - 51.4	ND (10)	ND (0.1)	7.51 - 7.69	2.37 - 2.78

ND – Parameter concentration below laboratory detection limit.
mg/L - milligrams per litre; µg/L - micrograms per litre; µS/cm - microSiemens per centimeter.
Alk: alkalinity, NH_4: Ammonia, B: boron, Cl^-: chloride, Fe: iron, Mn: manganese, SO_4: sulphate, Cond.: Conductivity.
Conductivity – measured in the lab; pH – measured in the field.

Detailed analytical results are presented in Tables 5.9 and 5.10 Historical groundwater quality data and graphs of selected leachate indicator parameters are presented in Appendix H (Figures H-9 and H-10).

Based on the historical data presented in Figures H-9 and H-10, and the 2020 data presented Table 5.7, GHD has made the following interpretations regarding groundwater quality at AG99-01, AG99-02, AG99-04, and AG99-05.

- Groundwater quality at AG99-01 and AG99-02 continues to show slightly elevated levels of alkalinity, conductivity, and hardness compared to background groundwater conditions indicating a potential for minor leachate impacts. This observation is consistent with previous monitoring years.
- Groundwater quality at AG99-04 and AG99-05 continues to demonstrate stable groundwater quality similar to background conditions indicating negligible leachate impacts are present in the deep portion of the overburden aquifer southeast of the landfill footprint.
- An exceptionally high field pH value of 8.91 was observed at AG99-04 in the November 2020 monitoring event. This value is above the historical range for all of the downgradient deep wells, further monitoring will be required to determine if this value is part of a trend of increasing pH or anomalous.
- In general, it appears that groundwater quality in the deep portion of the overburden aquifer southeast of the landfill footprint is minimally impacted by leachate. Shallow groundwater quality southeast of the landfill appears to be impacted at MW02-18. Based on outlying position of MW02-18 on the Piper plot, it appears that groundwater at this location is being impacted by an additional source or sources, which may be the historic dumping ground, the neighboring landfill, or both.

Southeast Downgradient Deep Groundwater Assessment

Concentrations of all leachate parameters observed in 2020 were below applicable CSR standards at the southeast deep overburden groundwater wells for all parameters tested in 2020 with the exception of the following:

- Concentrations of vanadium at AG99-02 were greater than the applicable CSR DW standard (20 µg/L) during the May (20.6 µg/L), August (22.6 and 22.8 µg/L), and November (21.5 µg/L) monitoring events and was just below the standard in the February event (19.2 µg/L).

As discussed in Section 5.3.4.1, vanadium concentrations in the immediate vicinity of the landfill footprint (HBT94-1 and HBT94-2) were less than the laboratory limit of detection of 0.5 µg/L in 2020 and have been consistently low in the past. Vanadium was observed at all monitoring locations in 2020 at concentrations above the limit of detection but well below the applicable CSR standard. Considering the spatial variability of vanadium concentrations in the vicinity of the Site, it is unclear what the source of elevated vanadium concentrations at AG99-02 and EBA11-4 may be and further monitoring will be required.

5.4 Surface Water Quality Monitoring Results

Site surface water quality is monitored at two surface water locations to the east of the landfill footprint:

- SW-1 on a tributary of Cold Creek approximately 1.1 km east of the Landfill.
- SW03-17 an unnamed pond located upstream of SW-1, approximately 1 km east of the Landfill.

As previously discussed, there is no direct surface water discharge from the Site to the ephemeral tributaries east of the Site. The depth of groundwater in the vicinity of the tributaries is unknown and as such the discharge of groundwater to the tributaries cannot be confirmed without further investigation. The monitoring wells closest to the Cold Creek tributaries included in the Site's monitoring program are nested wells MW03-18 and AG99-05, which are located approximately 900 m west of SW-1. Groundwater levels at AG99-05 ranged from 20.0 to 21.9 m below top of riser (BTOR) in 2020. Groundwater levels at MW03-18 ranged from 20.0 to 22.9 m BTOR in 2020. However, as previously stated, the depth to groundwater adjacent to the Cold Creek tributaries has not been investigated.

Table 5.8 presents the 2020 surface water analytical results for leachate indicator parameters indicated in Section 5.3.1 of this Annual Report. These parameters are selected to best indicate the potential presence of leachate in surface water downgradient of the Site.

Table 5.8 Leachate Indicator Parameter Concentration Ranges for Surface Water

Parameter	Alk. (mg/L)	NH_4 (µg/L)	B (µg/L)	Cl^- (mg/L)	Cond. (µS/cm)	Hardness (mg/L)	Fe (µg/L)	Mn (µg/L)	pH (S.U)	SO_4 (mg/L)
SW-1 (tributary of Cold Creek)	6.6 - 15	ND (0.0050) - 0.0313	ND (10)	3.33 - 3.55	27.4 - 43.8	7.59 - 15.7	60 - 341	5.65 - 32.3	6.66 - 6.94	0.54 - 1.02
SW03-17 (Pond upstream of SW-1)	7.1 - 7.9	ND (0.0050) - 0.0094	ND (10)	3.39 - 3.43	28.6 - 29.7	8.01 - 8.96	22 - 90	1.44 - 6.73	6.68 - 6.97	0.81 - 1.17
SWM Pond*	158	17.2	147	105	27	134	233	810	7.86	60.6

* The SWM Pond was sampled during the November 2020 monitoring event only
ND – Parameter concentration below laboratory detection limit.
mg/L - milligrams per litre; µg/L - micrograms per litre; µS/cm - microSiemens per centimeter.
Alk: alkalinity, NH_4: Ammonia, B: boron, Cl^-: chloride, Fe: iron, Mn: manganese, SO_4: sulphate, Cond.: Conductivity.
Conductivity – measured in the lab; pH – measured in the field.

Detailed surface water analytical results are presented in Table 5.11. Historical surface water quality data and graphs of selected parameters are presented in Appendix H (Figures H-13 and H-14).

Based on historical data presented in Figures H-13 and H-14, and the 2020 data presented in Table 5.8, GHD has observed the following:

- From a review of the 2020 monitoring results, surface water quality at SW-1 and SW03-17 does not appear to be influenced by leachate. This observation is based on the low and stable concentrations of leachate indicator parameters observed at this location.
- It is noted that concentrations of certain parameters including aluminium, copper, iron, and manganese have typically been observed at concentrations close to or in excess of the applicable BC WQG standards in water collected from SW-1 and SW3-17. This has been common occurrence at SW-1 since at least 2015, and at SW3-17 since monitoring began in 2017.
- Water quality data collected from the Quinsam River upstream of the confluence of the Quinsam River and Cold Creek periodically been observed to display similar concentrations of aluminum,

copper, iron, and manganese to SW-1 and SW07-17 (Kangasniemi, 1989). This indicates that the aluminum, copper, iron, and manganese concentrations observed at SW-1 and SW03-17 are naturally occurring or originating from an upstream source.

WQGs include both acute (short-term) and chronic (long-term) guidelines for most parameters analyzed at surface water monitoring locations on Site. For screening purposes, analytical results presented in Table 5.11 were compared to the most stringent available guideline (typically the chronic (long term) guideline).

Concentrations and measurements of all parameters observed in 2020 were below applicable BC WQG standards at SW-1 and SW3-17 with the exception of the following:

Temperature (Field)

The field temperatures measured at SW03-17 exceeded the BC WQG DW standard (15 ^{o}C) in the May monitoring event (16.86 ^{o}C) and the BC WQG FAW standard (18 ^{o}C) in the August monitoring event (18.05 ^{o}C). This is interpreted to be due to ambient spring/summer temperatures and unrelated to landfill operations.

Alkalinity

The concentration of alkalinity observed at SW-1 exceeded the BC WQG FAW standard (10 mg/L) in the May monitoring event (15.0 mg/L).

Aluminium (Dissolved)

The concentration of aluminum observed at SW-1 exceeded the BC WQG FAW standard (50 mg/L) in all monitoring events in 2020 (51.5 mg/L - February), (88.1 mg/L – May), (50.8 mg/L – November). The concentration of aluminium observed at SW03-17 exceeded the CSR FAW standard in the February monitoring event (57.7 mg/L).

Iron (Total)

The concentration of iron observed at SW-1 exceeded the BC WQG standard (300 µg/L) in the May monitoring event (465 µg/L).

5.5 Surface Water Management Pond

The SWM Pond is a surface water retention and infiltration pond completed in 2019. The SWM pond is located in Block J.

Analytical results for selected leachate indicator parameters are included in table 5.8 and detailed analytical results are presented in Table 5.11.

- The SWM pond was added to the EMP in 2020 and was sampled for the first time in the November 2020 monitoring event. Water quality at the SWM Pond appears to be influenced by leachate.
  - After the closure of the landfill and application of the final cover in 2022-2023, the SWM Pond will receive the runoff from the final cover system and will no longer be impacted by leachate seeps from the landfill side slopes.

6. Summary

The following summarizes the findings of the Annual Report:

Operations

- The remaining airspace volume for the Site as of December 31, 2020, is 56,203 m^3. At this time, the Site is forecasted to reach capacity in the first quarter of 2022.
- An amendment to the Site's OC was issued by the ENV on May 19, 2020.

Monitoring Program

- Groundwater was sampled as per the 2020 monitoring specification, with the following exceptions:
  - GLL93-4, HBT94-3, and HBT94-5 were dry for all monitoring events in 2020. These monitoring wells have been historically dry.
  - AM02-01 was dry or had insufficient volume for sampling during all monitoring events in 2020. AM02-01 had sufficient water for a water level measurement in the May 2020 monitoring event but insufficient volume for sampling. AM02-01 has generally been dry in recent years.
  - HBT94-1 was dry during the February and May monitoring events in 2020.
- Groundwater contours were generated for the Site using the water level data collected in November 2020. The groundwater flow direction is consistent seasonally and with previous years.
- The observed groundwater flow direction is to the east across the Site.
- Vertical groundwater gradients were calculated using the nested wells on Site. The results indicated a slight downward gradient at nested wells EBA04-6/EBA04-7 and MW03-18/AG99-05, with a slight upward gradient observed at MW03-18/AG99-05 in February 2020.
- Groundwater quality results obtained in 2020 were assessed across the Site with the following observations:
  - *Background* - Water quality results for the background monitoring well MW01-16 was found to be characterized by low and stable concentrations of MSW leachate indicator parameters.
  - *Shallow Landfill Vicinity* - Groundwater quality at monitoring wells located in the shallow portion of the overburden aquifer in the immediate vicinity of the landfill footprint indicate the presence of leachate indicator parameters above background concentrations. Concentrations of all parameters were less than the applicable CSR standards in groundwater in the shallow portion of the overburden aquifer in 2020 with the exception of manganese at HBT94-1.
  - *Deep Landfill Vicinity* - Monitoring wells located in the deep portion of the overburden aquifer within the immediate vicinity of the landfill footprint also indicate low level presence of leachate in groundwater at HBT94-2 and EBA04-6. Concentrations are generally lower than in the shallow overburden aquifer wells, indicating attenuation is occurring. Concentrations

of all parameters were less than applicable CSR standards in deep Landfill Area wells in 2020.

  - *Northeast Downgradient Shallow* - Groundwater quality northeast of the Site in the shallow portion of the overburden aquifer shows generally stable low level leachate impacts. Concentrations of chloride and manganese increased sharply at monitoring location EBA11-1 in 2019 and remained well above historical levels throughout 2020. The increase in chloride and manganese concentrations at this location is potentially the result of infiltration of leachate impacted surface water in the SWM Pond. Leachate generation will significantly decrease with the application of final cover in 2022-2023 and the SWM Pond will receive only surface water runoff from the final cover system. Concentrations of all parameters were below the applicable CSR standards at the northeast shallow overburden groundwater wells in 2020.
  - *Northeast Downgradient Deep* - Groundwater quality in the deep portion of the overburden aquifer northeast of the landfill footprint was previously monitored by EBA04-3, which was decommissioned in 2019. The deep portion of the overburden aquifer northeast of the landfill footprint was monitored by EBA04-6 and MW04-19 during 2020. EBA04-6 and MW04-19 show minor leachate impacts consistent with historical results.
  - *Southeast Downgradient Shallow* - Groundwater quality in the shallow portion of the overburden aquifer southeast of the Site exhibits low level leachate impact to groundwater based on elevated concentrations of key leachate indicator parameters compared to background concentrations. Concentrations of all parameters are significantly elevated above background levels in groundwater at monitoring well MW02-18. Due to its proximity to the historic dumping ground, it is difficult to determine if groundwater quality at MW02-18 is being adversely affected by the Site, the dumping ground, or both. Water quality at MW03-19 is similar to background concentrations and was stable throughout 2020. Concentrations of all parameters were less than applicable CSR standards at the southeast shallow overburden groundwater in 2020 with the exception of manganese at MW02-18.
  - *Southeast Downgradient Deep* - Groundwater quality in the deep portion of the overburden aquifer southeast of the Site indicate a slight presence of leachate at monitoring wells AG99-01 and AG99-02. Monitoring wells AG99-04 and AG99-05 continue to demonstrate stable groundwater quality similar to background conditions, indicating minimal to no leachate impacts at these locations. Concentrations of all parameters were less than applicable CSR standards at the southeast deep overburden groundwater wells in 2010 with the exception of vanadium at AG99-02 during all sampling events. The source of vanadium at in groundwater quality at AG99-02 is unknown at this time.

- Surface water quality monitoring results obtained in 2020 from SW-1 (tributary of Cold Creek) and SW03-17 (unnamed pond upstream of SW-1) were assessed. Based on the results from the surface water samples, the presence of leachate impacts are not suspected, based on low level of leachate indicator parameters including alkalinity, ammonia, chloride, and conductivity levels.
- The SWM Pond was sampled for the first time in November 2020, water quality in the SWM Pond appears to be affected by landfill activities. After the closure of the landfill and application of the final cover in 2022-2023, the SWM Pond will receive the runoff from the final cover system and will no longer be impacted by leachate seeps from the landfill side slopes.

7. Recommendations

Based on the findings of the 2020 Annual Operations and Monitoring Report, GHD provides the following recommendations:

Operations

- Complete the detailed design of the landfill gas collection system in 2021 in preparation for construction in 2022 to comply with the requirements of the LFG Regulation.
- Complete the detailed design of the final cover system in 2021 in preparation for construction in 2022 to reduce leachate generation at the Site.

Monitoring Program

- Continue the groundwater and surface water monitoring programs on a quarterly basis with the following modification:
  - Remove HBT94-5 and GLL93-4 from the groundwater monitoring program, as they have been consistently dry.
  - Add the three new monitoring wells that are scheduled to be installed in spring 2021 to the groundwater monitoring program.

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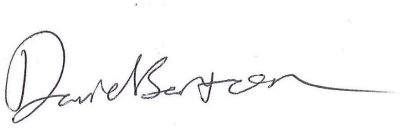
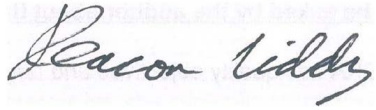
All of which is Respectfully Submitted,

GHD



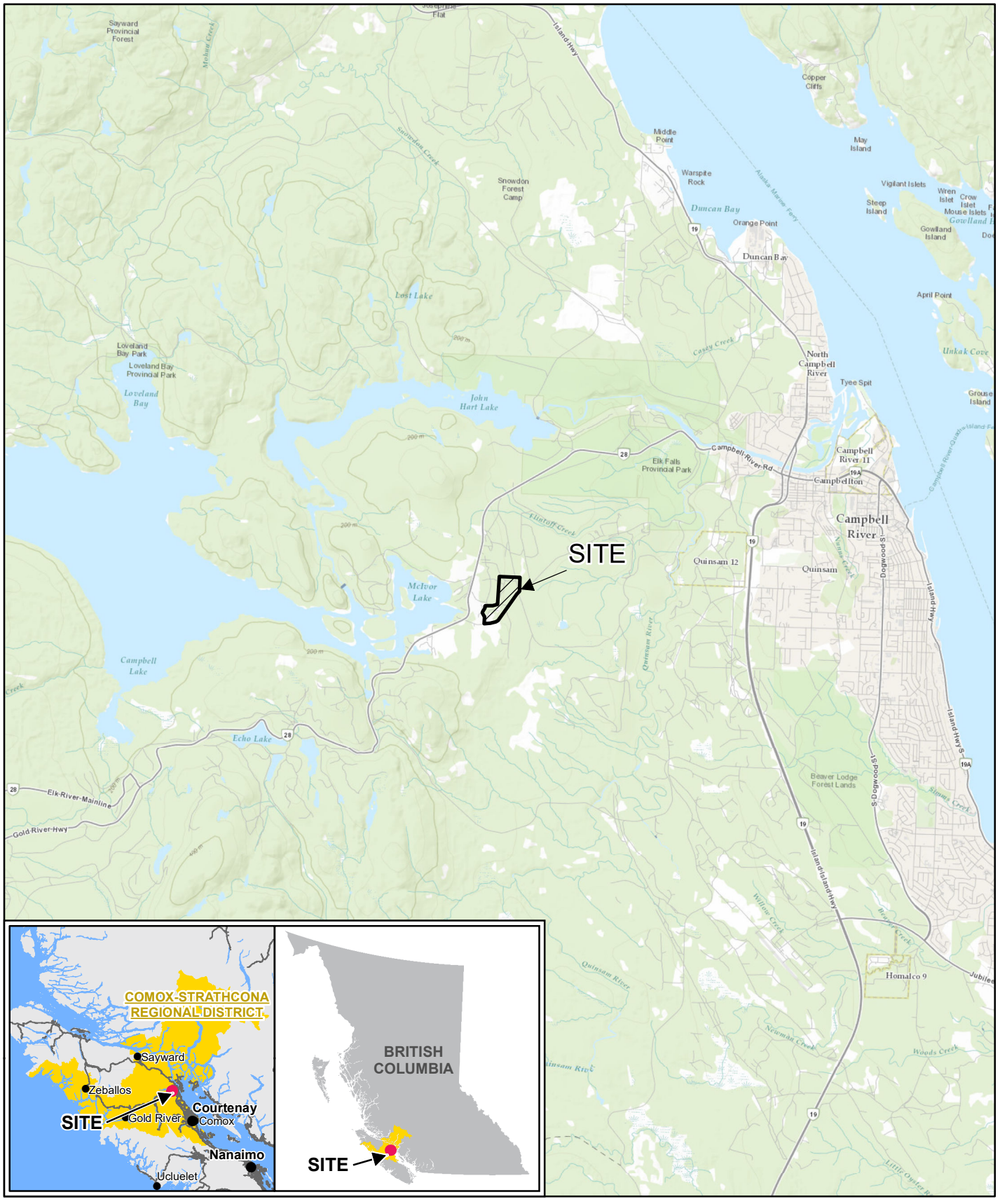
David R. Barton, M.Sc., G.I.T.

Natasha Turl, B.Sc., EPt



Deacon Liddy, P.Eng.

Figures



Source: ESRI Topographic Basemap, Accessed 2021

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Meters

Coordinate System:
NAD 1983 UTM Zone 10N

N

GHD

COMOX-STRATHCONA WASTE MANAGEMENT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
2020 OPERATIONS AND MONITORING REPORT

11208296

Apr 9, 2021

SITE LOCATION

FIGURE 2.1

GIS File: Q:\GIS\PROJECTS\11209000s\11209296\Layouts\202104_RPT004\11209296_202104_RPT004_GIS001.mxd

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SCALE=1:6000

APPROXIMATE LOCATION OF SURFACE WATER MANAGEMENT POND

ELECTRIC FENCE

WEIGH SCALES AND GATEHOUSE

PUBLIC ACCESS WASTE DROP-OFF AREA

APPROXIMATE LOCATION OF HISTORICAL DUMPING AREA

CAMPBELL RIVER WASTE MANAGEMENT CENTRE

BLOCK J

BLOCK N D.L. 85

BLOCK L

BLOCK M

5900 ARGONAUT

EBA11-3

EBA11-4

AG99-06

MW04-19

EBA11-2

EBA11-1

EBA04-3

GLL93-4

EBA04-7

EBA04-6

EBA04-2

EBA04-5

EBA04-4

GLL93-1

HBT94-4

AG99-05

MW03-18

AG99-04

AG99-03

HBT94-5

MW02-18

HBT94-1

HBT94-2

HBT94-3

AG99-01

AG99-02

109728

EBA04-1

GLL93-2

GLL93-3

AM00-01

EBA06-1

AM02-01

MW01-16

McIVOR LAKE

ARGONAUT ROAD

SW-2

SW-1

COLD CREEK TRIBUTARY

SW03-17

UNNAMED POND

LEGEND

- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- TOPOGRAPHIC CONTOUR
- APPROXIMATE LIMIT OF WASTE
- BEAR FENCE
- EXISTING STRUCTURE
- MW3-18 APPROXIMATE GROUNDWATER MONITORING WELL LOCATION
- EBA04-5 DECOMMISSIONED/DESTROYED MONITORING LOCATION
- EBA06-1 APPROXIMATE WATER SUPPLY WELL LOCATION
- SW-3 APPROXIMATE SURFACE WATER SAMPLE LOCATION
- SW-2 FORMER SURFACE WATER SAMPLE LOCATION

NOTE: McIVOR LAKE AND COLD CREEK TRIBUTARY LOCATIONS ARE APPROXIMATE.

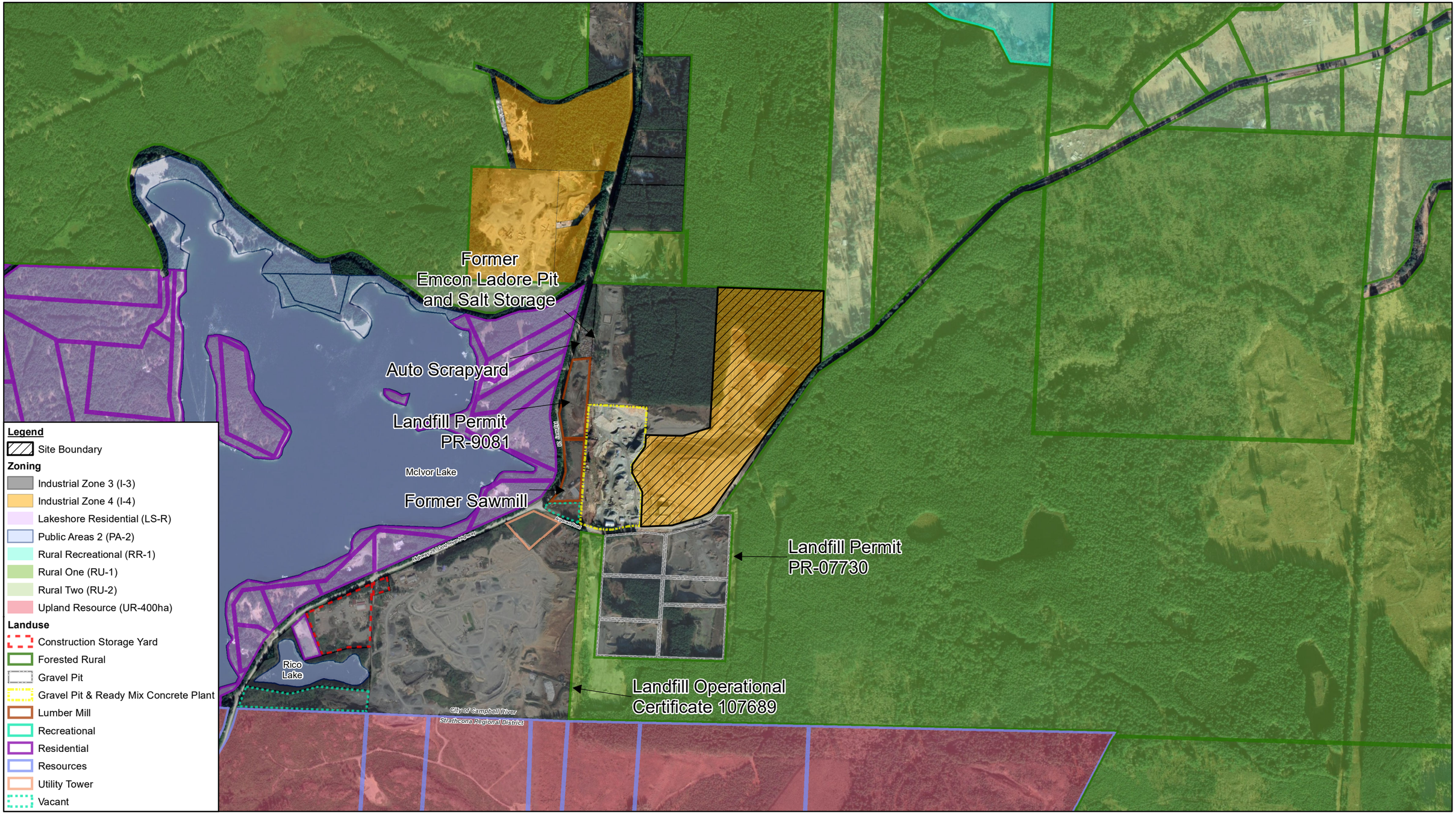
SOURCE: TOPOGRAPHICAL INFORMATION BASED SURVEY BY McELHANNEY ASSOCIATES DATED OCTOBER 6, 2020.
WELL LOCATIONS BASED ON SURVEY DATA PROVIDED BY TETRA TECH EBA.
LIMIT OF WASTE FROM SCS ENGINEERS, PHASE I CLOSURE PLAN, JUNE 6, 2013.

figure 2.2

SITE PLAN AND MONITORING LOCATIONS
2020 OPERATIONS AND MONITORING REPORT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE

Comox Strathcona Waste Management

N:\CA\Vancouver\Projects\663\11209296\Digital_Design\ACAD\Figures\RPT004\11209296-GHD-0000-RPT-EN-0101_WA-004.dwg Plot Date: APR 27, 2021



Sources: CanVec Edition 1.1 © Department of Natural Resources Canada, all rights reserved; National Road Network 2.0 GeoBase; Property Parcels - City of Campbel River; Google Imagery, Date 11/24/2019

0 125 250 375
Meters

Coordinate System:
NAD 1983 UTM Zone 10N

N

GHD

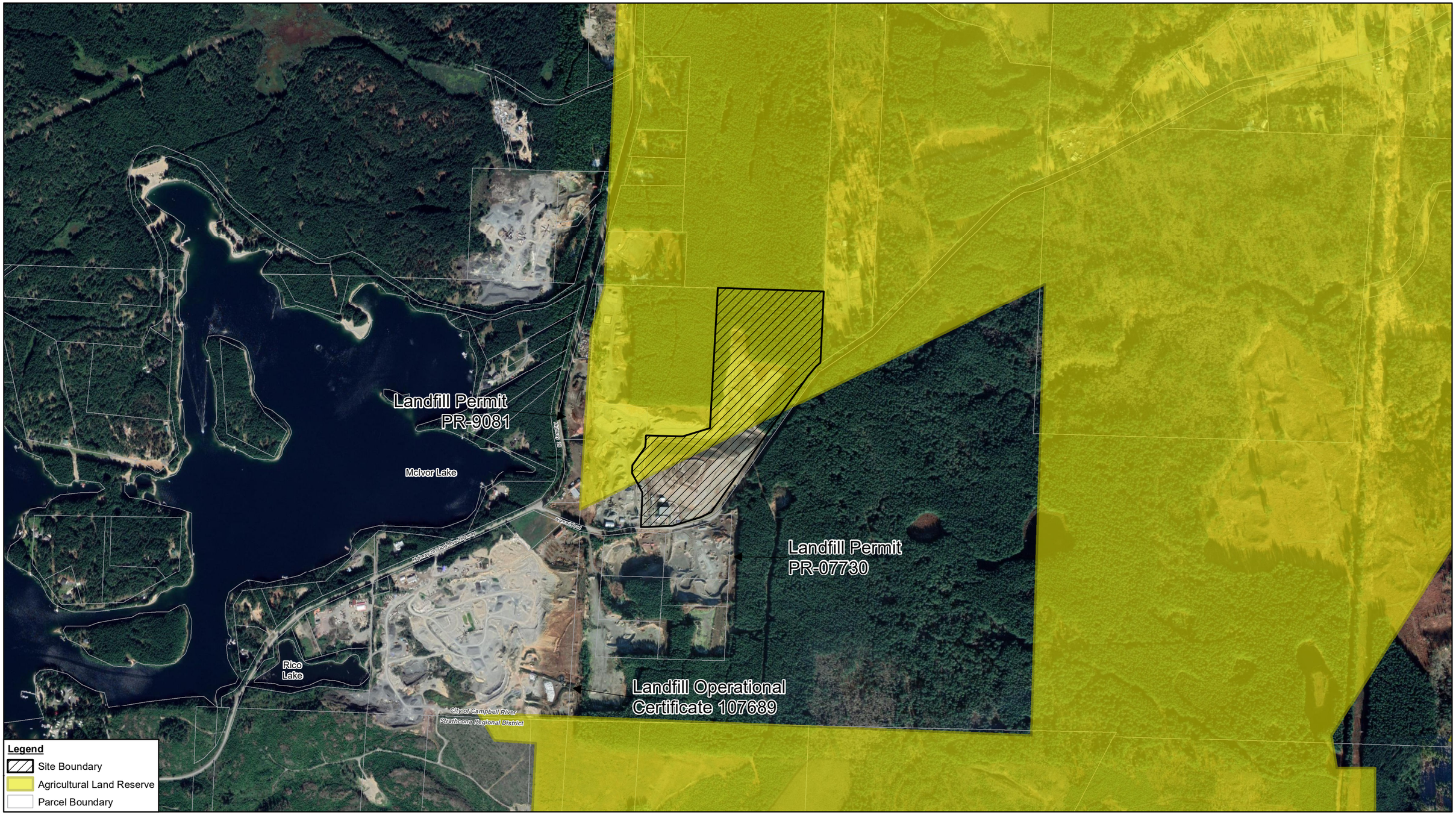
COMOX-STRATHCONA WASTE MANAGEMENT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
2020 OPERATIONS AND MONITORING REPORT

11209296
Apr 29, 2021

SITE AREA ZONING AND LAND USE

FIGURE 2.3

GIS File: Q:\GIS\PROJECTS\11209000s\11209296\Layouts\202104_RPT004\11209296_202104_RPT004_GIS002.mxd



Sources: CanVec Edition 1.1 © Department of Natural Resources Canada, all rights reserved; National Road Network 2.0 GeoBase; Property Parcels - City of Campbel River; Google Imagery, Date 11/24/2019, Agricultural Land Reserve from Provincial Agricultural Land Commission, accessed 2020

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Meters

Coordinate System:
NAD 1983 UTM Zone 10N

N

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COMOX-STRATHCONA WASTE MANAGEMENT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
2020 OPERATIONS AND MONITORING REPORT

11209296
Apr 29, 2021

AGRICULTURAL LAND RESERVE BOUNDARIES

FIGURE 2.4

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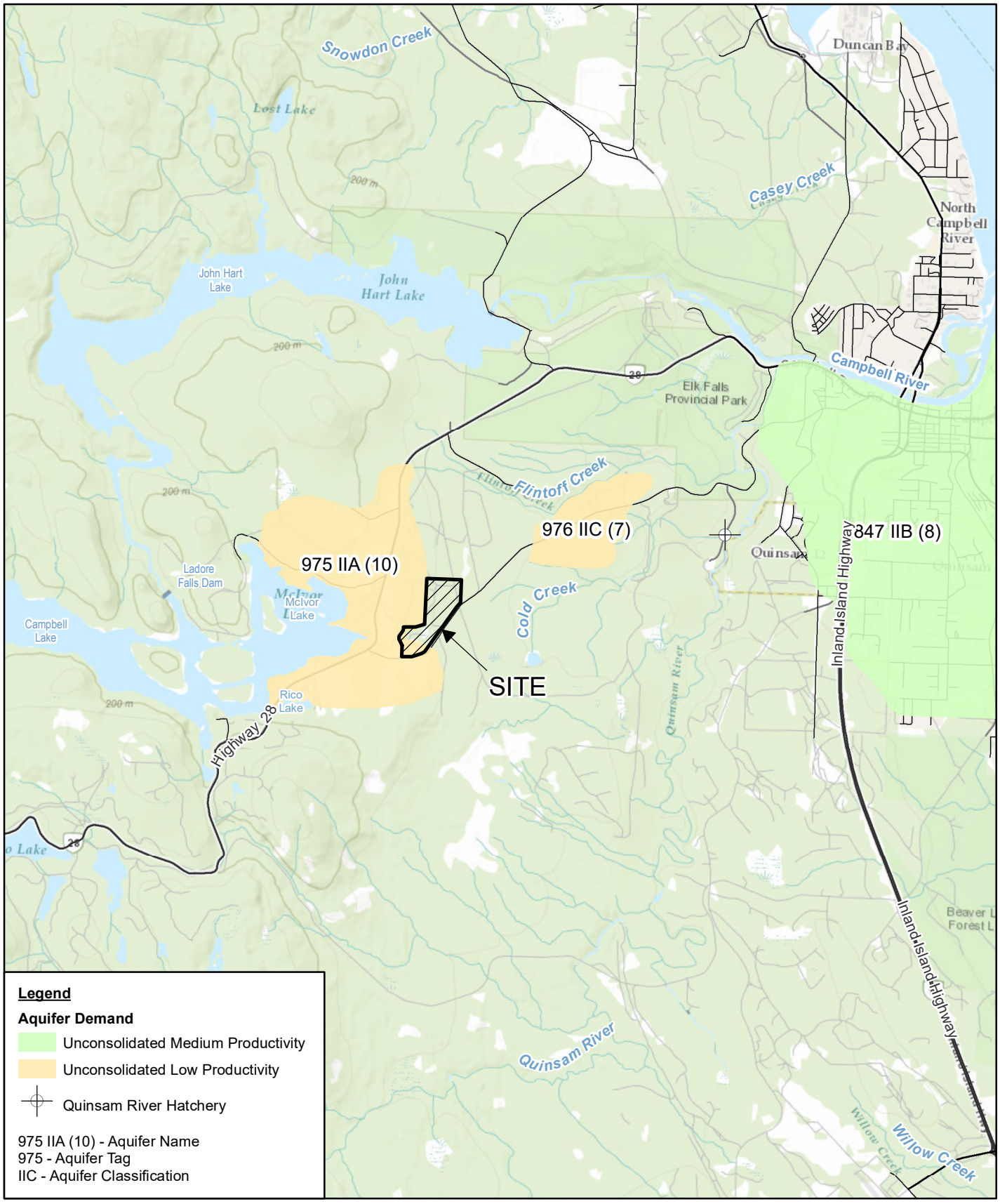

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Coordinate System:
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COMOX-STRATHCONA WASTE MANAGEMENT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
2020 OPERATIONS AND MONITORING REPORT

11209296
Apr 9, 2021

DRAINAGE MAP

FIGURE 2.5

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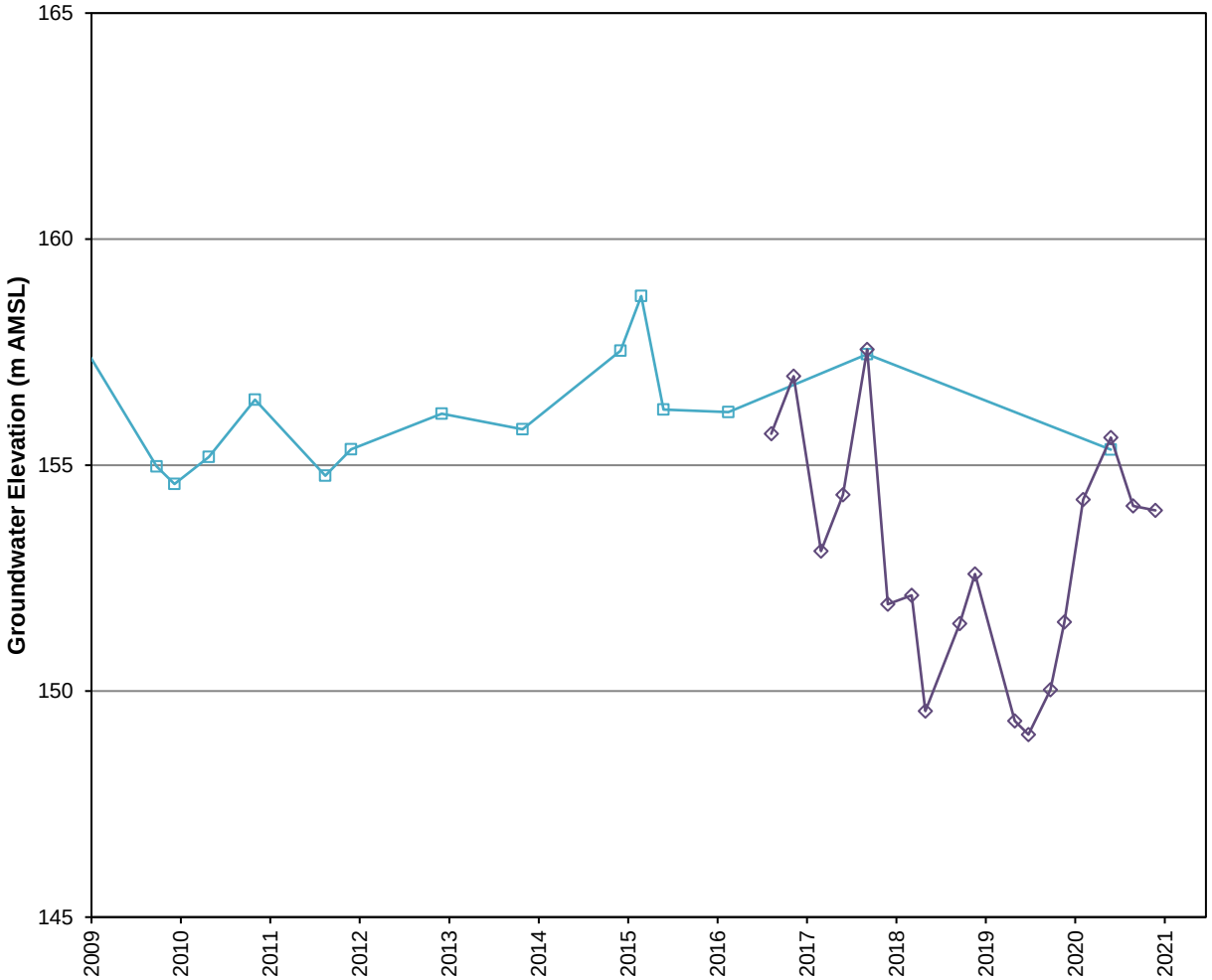


Note: AM02-01 was dry during all monitoring events in 2018, 2019, and 2020 except for Q2 2020

figure 5.1a

HYDROGRAPH 2009 - 2020 - BACKGROUND WELLS
2020 OPERATIONS AND MONITORING REPORT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
Comox Strathcona Waste Management

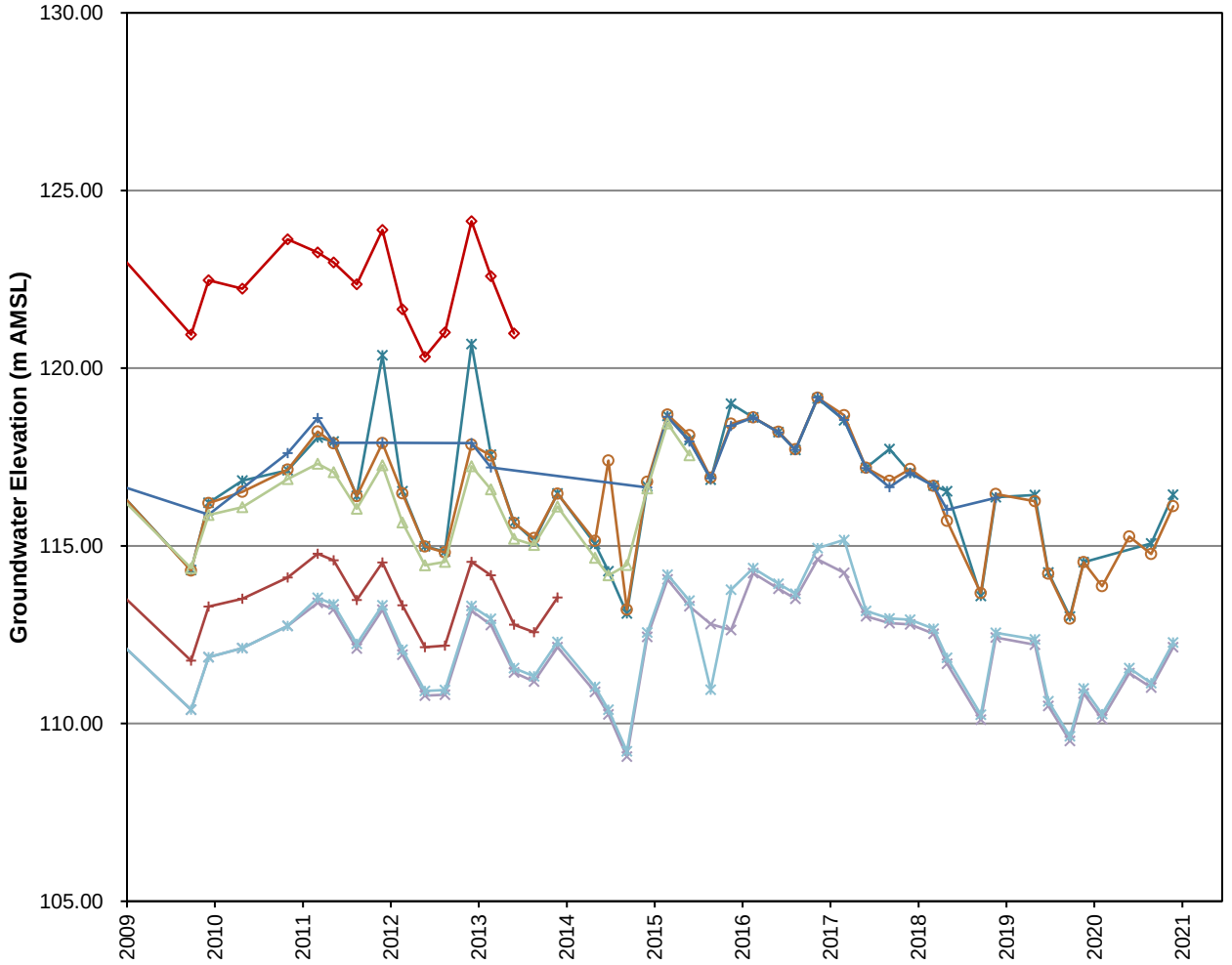


figure 5.1b

HYDROGRAPH 2009 - 2020 - LANDFILL WELLS
2020 OPERATIONS AND MONITORING REPORT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
Comox Strathcona Waste Management

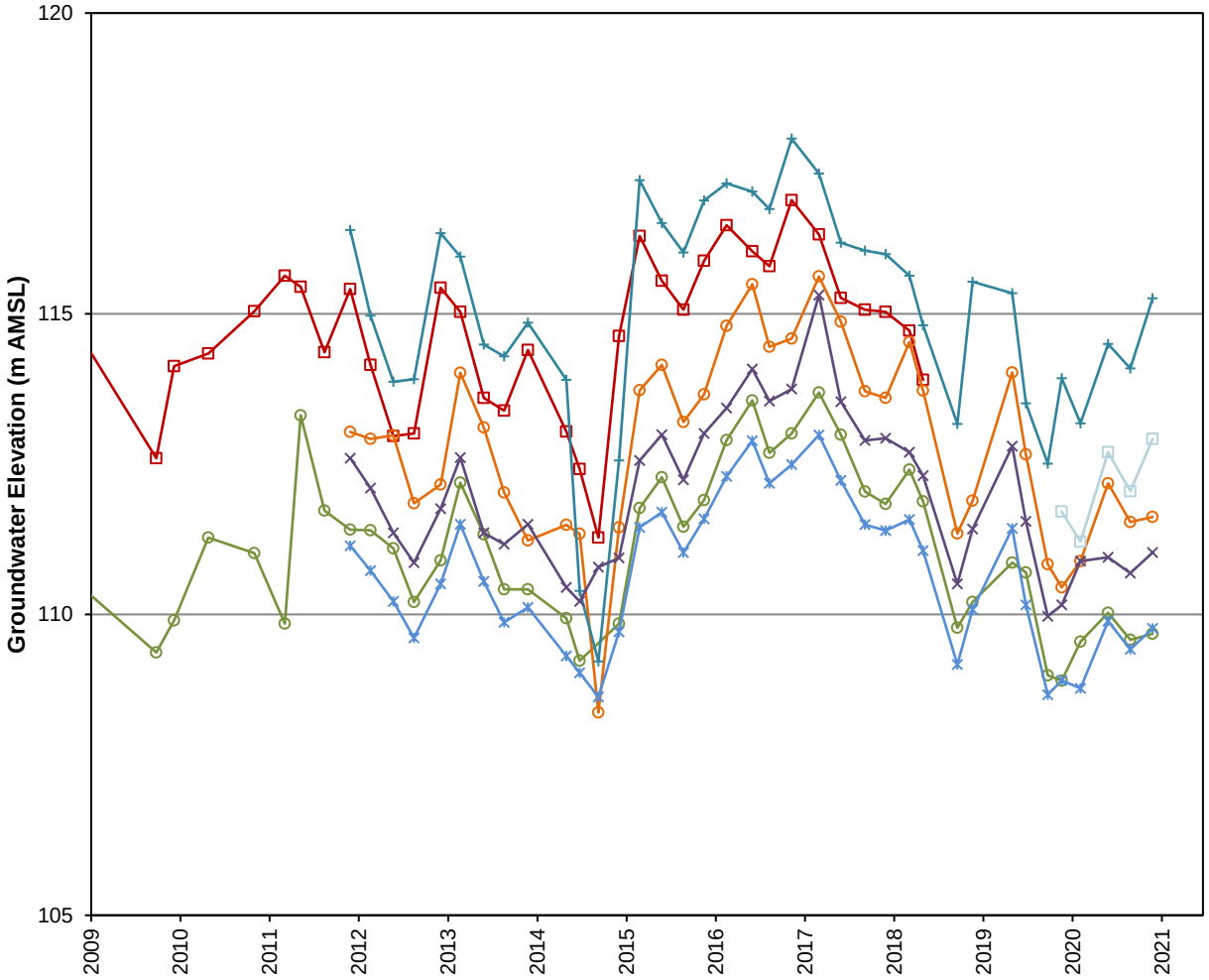


figure 5.1c

HYDROGRAPH 2009 - 2020 - NORTHEAST WELLS
2020 OPERATIONS AND MONITORING REPORT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
Comox Strathcona Waste Management

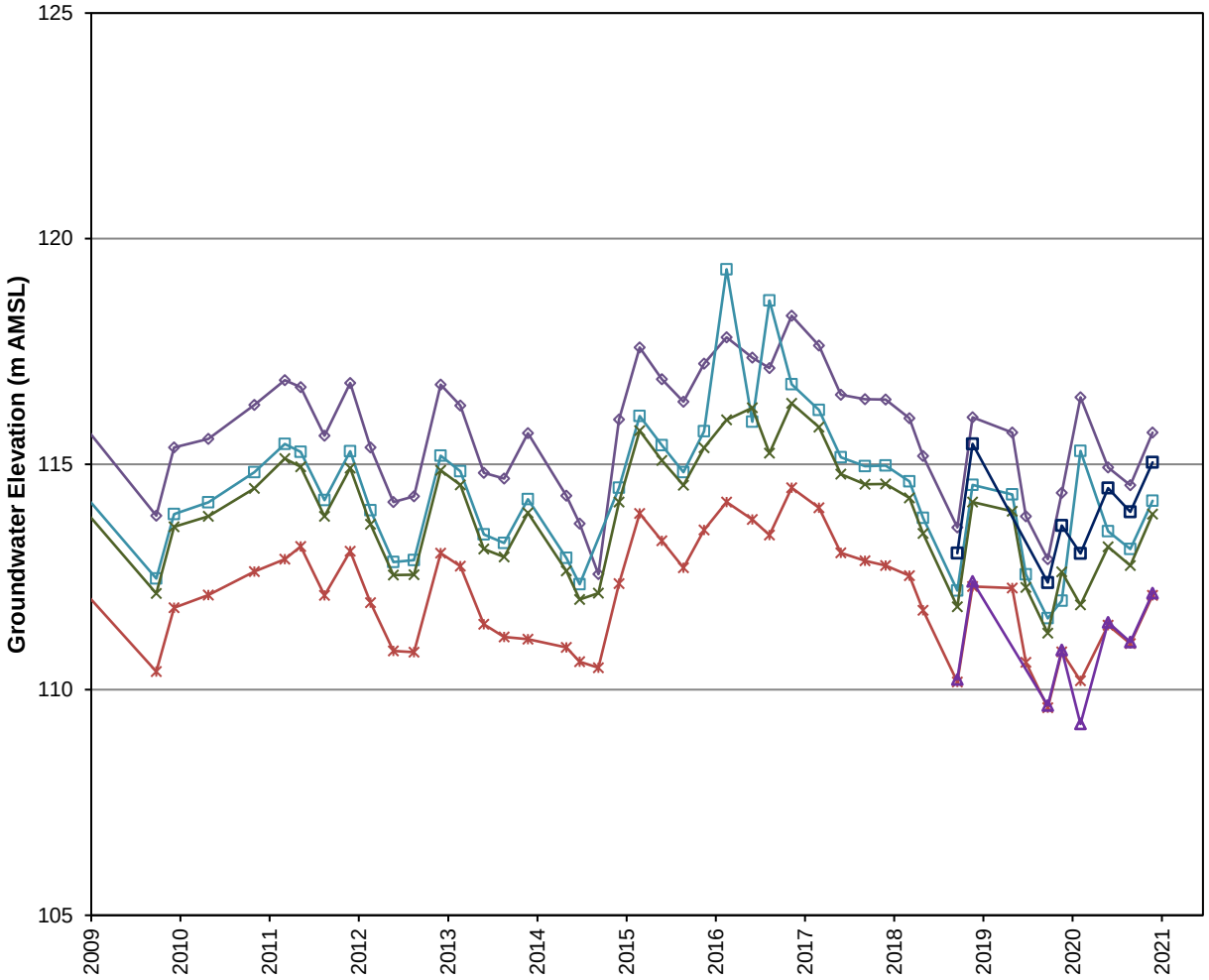
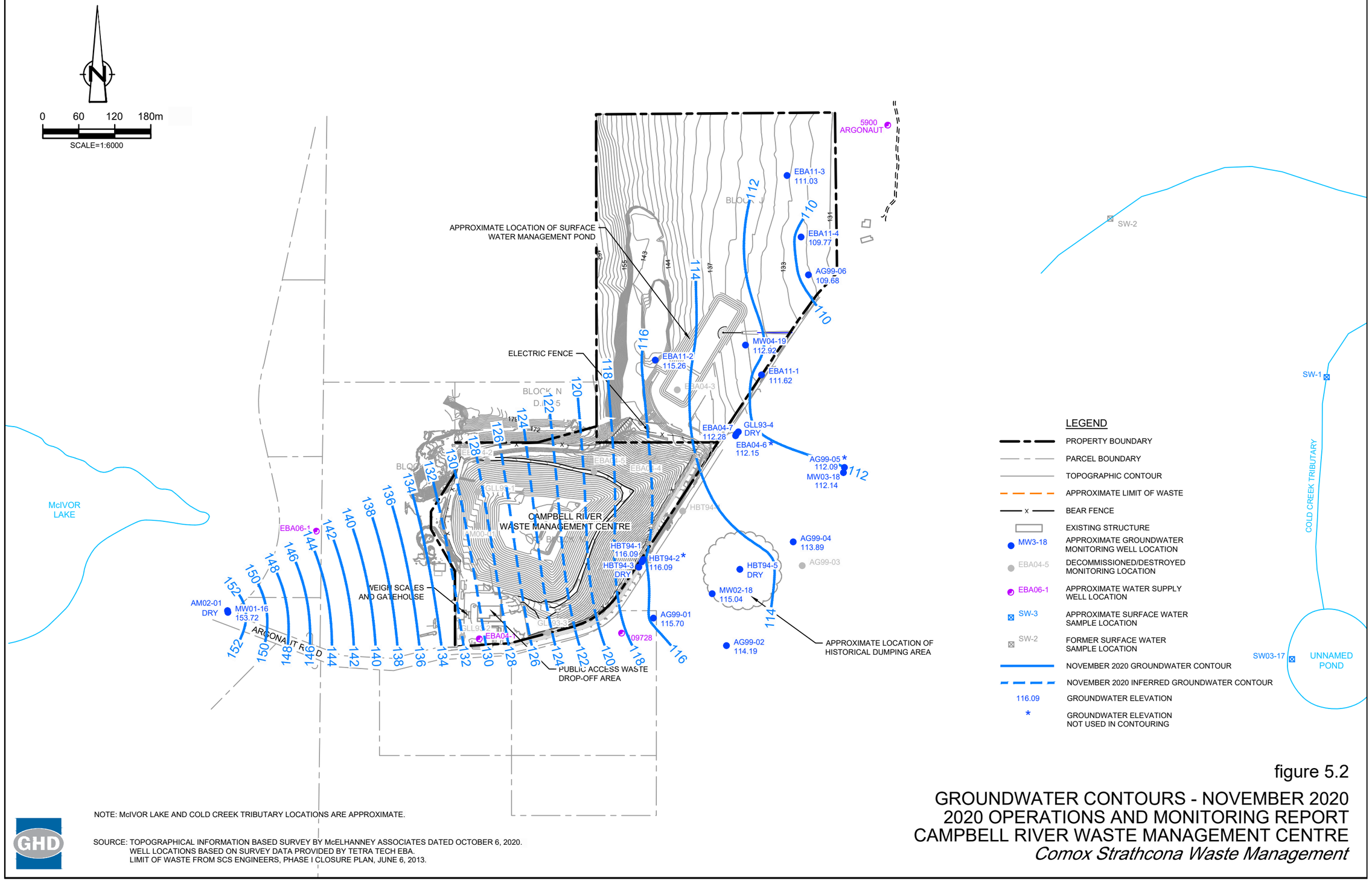


figure 5.1d

HYDROGRAPH 2009 - 2020 - SOUTHEAST WELLS
2020 OPERATIONS AND MONITORING REPORT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
Comox Strathcona Waste Management

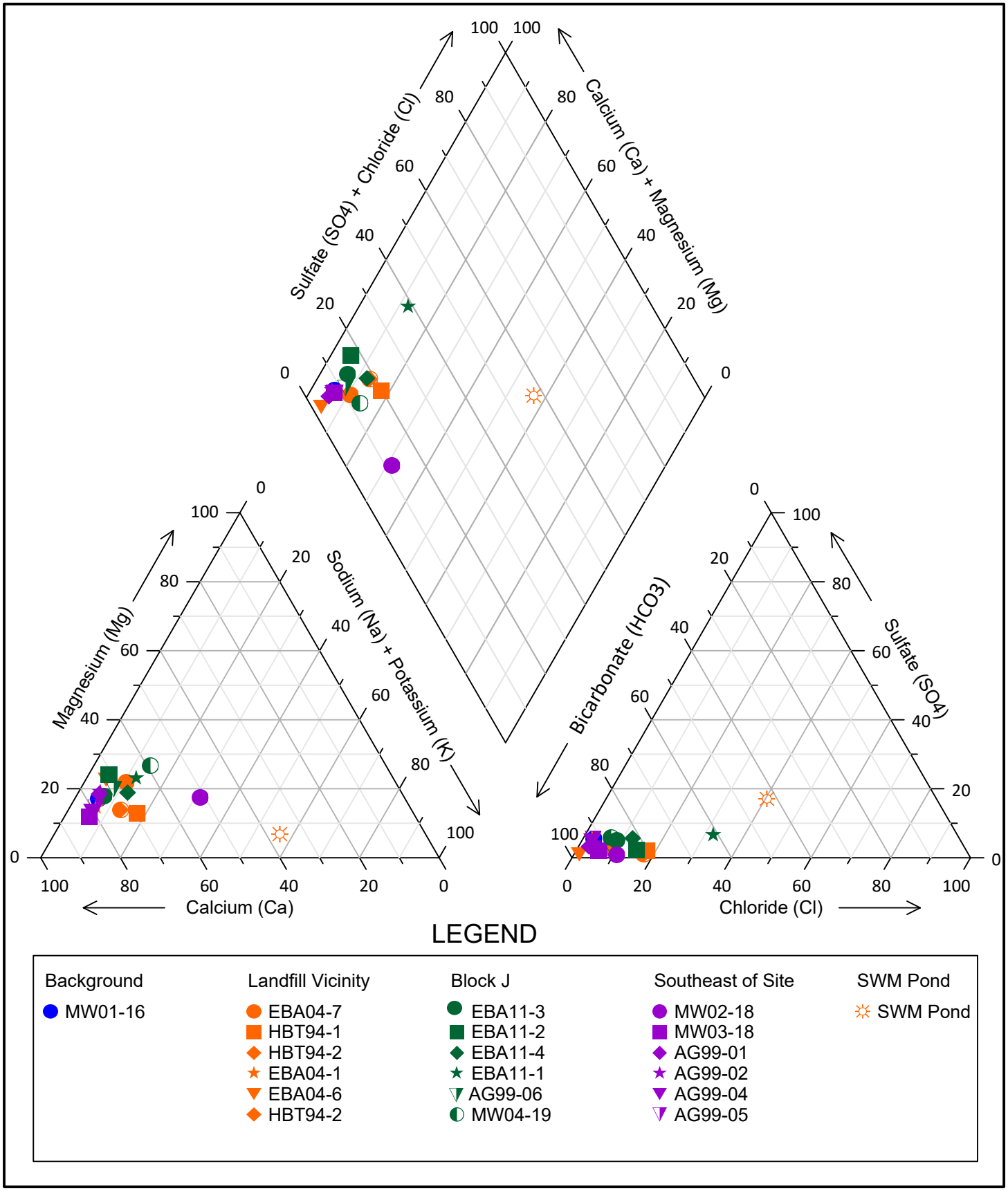


NOTE: McIVOR LAKE AND COLD CREEK TRIBUTARY LOCATIONS ARE APPROXIMATE.

SOURCE: TOPOGRAPHICAL INFORMATION BASED SURVEY BY McELHANNEY ASSOCIATES DATED OCTOBER 6, 2020.
WELL LOCATIONS BASED ON SURVEY DATA PROVIDED BY TETRA TECH EBA.
LIMIT OF WASTE FROM SCS ENGINEERS, PHASE I CLOSURE PLAN, JUNE 6, 2013.

figure 5.2

GROUNDWATER CONTOURS - NOVEMBER 2020
2020 OPERATIONS AND MONITORING REPORT
CAMPBELL RIVER WASTE MANAGEMENT CENTRE
Comox Strathcona Waste Management



CAMPBELL RIVER WASTE MANAGEMENT CENTRE
COMOX STRATHCONA WASTE MANAGEMENT
2020 OPERATIONS AND MONITORING REPORT

11209296-52

April 26, 2021

NOVEMBER 2020 GROUNDWATER DATA - PIPER PLOT

FIGURE 5.3

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Tables

Table 3.1
Waste Tonnage and Diversion
2020 Operations and Monitoring Report
Campbell River Waste Management Centre
Comox Strathcona Waste Management

	Units	2020
WASTE DISCHARGED TO LANDFILL [(1)]		
Waste from CRWMC wasteshed		
Construction Waste	tonnes	2311
ICI & Household	tonnes	18867
Municipal Waste by Contract	tonnes	4202
Volunteer Clean Up	tonnes	102
Asbestos	tonnes	789
Streetside cleanup/illegal dumping	tonnes	1
Total Waste Discharge		26272
RECYLED/DIVERTED MATERIAL[(1)]		
Battery Sales	tonnes	30
Clean Wood Waste	tonnes	185
Cut Grass	tonnes	460
Drywall	tonnes	642
Scrap Metal Sales	tonnes	928
Tires	tonnes	66
Yard Waste	tonnes	1076
Commercial Cardboard	tonnes	9
Recycle BC	tonnes	172
Oil	tonnes	24
Total Recycled/Diverted Material		3592
Clean fill used as cover		1625
Total Material Delivered		31489

Notes:

(1) Campbell River Waste Management Centre Yearly Tonnage Summary
CRWMC - Campbell River Waste Management Centre

Table 3.2

Waste Area Population and Projected Population
2020 Annual Operations and Monitoring Report
Campbell River Waste Management Centre
Campbell River, British Columbia

Year	Estimated Population[(1)(2)]
2020	43,946
2021	44,254
2022	44,564
2023	44,876
2024	45,190

Notes:
(1) 2016 population sourced from Stats Canada for City of Campbell River, Village of Sayward, Village of Gold River, and Strathcona electoral areas A, B, C, and D
(2) Annual population growth rate of 0.7% (Stats Canada, 2016)

Table 4.1

Monitoring Locations and Sampling Frequency
2020 Operations and Monitoring Report
Campbell River Waste Management Centre
Comox Strathcona Waste Management

Monitoring Location	February	May	August	November
Groundwater				
MW01-16	√	√	√	√
MW02-18	√	√	√	√
MW03-18	√	√	√	√
MW04-19	√	√	√	√
AG99-01	√	√	√	√
AG99-02	√	√	√	√
AG99-04	√	√	√	√
AG99-05	√	√	√	√
AG99-06	√	√	√	√
AM02-01	**Dry**	**- ***	**Dry**	**Dry**
EBA04-1	√	√	√	√
EBA04-6	√	√	√	√
EBA04-7	√	√	√	√
EBA11-1	√	√	√	√
EBA11-2	√	√	√	√
EBA11-3	√	√	√	√
EBA11-4	√	√	√	√
GLL93-4	**Dry**	**Dry**	**Dry**	**Dry**
HBT94-1	√	√	**Dry**	**Dry**
HBT94-2	√	√	√	√
HBT94-3	**Dry**	**Dry**	**Dry**	**Dry**
HBT94-5	**Dry**	**Dry**	**Dry**	**Dry**
Surface Water				
SW-1	√	**Dry**	√	√
SW03-17	√	√	√	√
SWM Pond	**Dry**	**Dry**	**Dry**	√

Notes:
√ - Sample collected and submitted for laboratory analysis.
- Not included in sampling event.
* Insufficient volume to sample.

Table 4.2

Well Completion Details and Hydraulic Monitoring
2020 Annual Operations and Monitoring Report
Campbell River Waste Management Centre
Campbell River, British Columbia

Location	Coordinates		Top of Riser Reference Elevation [1]	Total Depth of Well	Screened Interval				Screen Length	February 3, 2020		May 26, 2020		August 25, 2020		November 24, 2020		Screened Unit	Screened Lithology
					(m BTOR)		(m AMSL)			Depth to Water	Water Elevation	Depth to Water	Water Elevation	Depth to Water	Water Elevation	Depth to Water	Water Elevation		
	Northing (y)	Easting (x)	(m AMSL)	(m btor)	from	to	from	to	(m)	(m btor)	(m btor)	(m btor)	(m AMSL)	(m btor)	(m AMSL)	(m btor)	(m AMSL)		
MW01-16	5542073.127	331106.575	186.90	43.17	38.60	41.64	148.15	145.10	3.1	32.95	153.96	31.57	155.33	33.08	153.82	33.176	153.72	Shallow overburden	Sand and gravel
MW02-18	5542104.290	331913.490	138.79	32.66	31.14	32.66	107.65	106.13	1.5	25.77	113.02	24.32	114.47	24.85	113.94	23.75	115.04	Shallow overburden	Sand
MW03-18	5542306.040	332132.200	132.10	27.21	25.68	27.21	106.42	104.89	1.5	22.86	109.24	20.62	111.49	21.04	111.06	19.961	112.14	Shallow overburden	Sand and gravel
MW04-19	5542518.573	331969.010	136.32	36.12	32.31	35.36	104.01	100.96	3.1	25.12	111.21	23.62	112.70	24.27	112.05	23.405	112.92	Shallow overburden	Silty sand
AG99-01	5542063.675	331815.529	144.19	48.50	46.50	48.50	97.69	95.69	2.0	30.69	116.48	29.27	114.93	29.67	114.53	28.489	115.70	Deep overburden	Gravel
AG99-02	5542017.821	331937.280	139.85	51.51	49.00	51.00	90.85	88.85	2.0	27.71	115.29	26.34	113.51	26.73	113.12	25.66	114.19	Deep overburden	Gravel, some sand and cobbles
AG99-04	5542190.662	332048.523	136.44	45.42	38.00	45.00	98.44	91.44	7.0	24.56	111.88	23.27	113.17	23.69	112.75	22.554	113.89	Deep overburden	Gravel, some sand and cobbles
AG99-05	5542314.710	332133.846	132.09	50.90	44.00	50.00	88.09	82.09	6.0	21.90	110.20	20.66	111.43	21.08	111.02	20	112.09	Deep overburden	Sand, trace silt
AG99-06	5542635.565	332073.874	132.69	45.11	22.00	25.00	110.69	107.69	3.0	23.14	109.55	22.66	110.03	23.11	109.58	23.012	109.68	Shallow overburden	Sand, trace silt
AM02-01	5542076.112	331105.831	186.86	33.20	19.00	34.00	167.86	152.86	15.0	Dry	Dry	31.52	155.35	Dry	Dry	Dry	Dry	Shallow overburden	Sand
EBA04-1	-	-	164.74	68.30	62.90	65.50	101.84	99.24	2.6	-	Tap	-	Tap	-	Tap	-	Tap	Deep overburden	Sand and gravel
EBA04-6	5542397.539	331952.509	136.34	39.60	38.10	39.60	98.24	96.74	1.5	26.21	110.13	24.92	111.42	25.34	111.01	24.19	112.15	Deep overburden	Sand and gravel
EBA04-7	5542370.669	331954.022	136.40	32.00	30.50	32.00	105.90	104.40	1.5	26.13	110.27	24.84	111.56	25.26	111.14	24.12	112.28	Shallow overburden	Sand and gravel
EBA11-1	5542468.941	331995.662	134.77	28.96	25.60	28.70	109.17	106.07	3.1	23.88	110.89	22.59	112.18	23.23	111.54	23.146	111.62	Shallow overburden	Sand, trace/some silt
EBA11-2	5542493.615	331818.679	141.55	35.00	32.00	35.00	109.55	106.55	3.0	28.38	113.18	27.05	114.50	27.46	114.09	26.291	115.26	Shallow overburden	Sand, gravelly, trace silt
EBA11-3	5542801.160	332038.159	134.19	30.18	27.10	30.18	107.09	104.01	3.1	23.30	110.89	23.25	110.95	23.50	110.69	23.162	111.03	Shallow overburden	Sand, trace gravel
EBA11-4	5542698.635	332061.625	133.13	29.57	25.90	29.00	107.23	104.13	3.1	24.36	108.77	23.25	109.89	23.71	109.42	23.357	109.77	Shallow overburden	Sand, trace gravel, trace/some silt
GLL93-4	5542039.410	331639.796	137.39	19.40	16.50	19.40	120.89	117.99	2.9	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Shallow overburden	Sand
HBT94-1	5542161.126	331798.592	141.98	34.00	31.00	34.00	110.98	107.98	3.0	Dry	Dry	Dry	Dry	27.26	114.72	25.887	116.09	Shallow overburden	Sand, trace silt and gravel
HBT94-2	5542157.473	331796.264	142.05	44.00	41.00	43.00	101.05	99.05	2.0	28.23	113.83	26.83	115.23	27.31	114.74	25.96	116.09	Deep overburden	Sand, some silt
HBT94-3	5542148.604	331791.155	142.26	27.00	25.00	27.00	117.26	115.26	2.0	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Shallow overburden	Gravel
HBT94-5	5542144.933	331959.531	138.29	32.00	20.00	22.00	118.29	116.29	2.0	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Shallow overburden	Sand, silty

Notes:

[1] Monitoring wells installed prior to 2016 - Hydrogeologic Assessment and Closure Plan, Piteau Associates Engineering Ltd., April 1998
AM02-19, MW01-16, HBT94-1, HBT94-2, and HBT94-3 were resurveyed in June 2020

m metre

m BTOR metres below top of riser

m AMSL metres above mean sea level

\- not measured/data unavailable

Table 5.9

Groundwater Analytical Results - General Chemistry, Nutrients and Metals
2020 Annual Operations and Monitoring Report
Campbell River Waste Management Centre
Campbell River, British Columbia

Sample Location:				AG99-01	AG99-01	AG99-01	AG99-01	AG99-02	AG99-02	AG99-02	AG99-02	AG99-02	AG99-02	AG99-04	AG99-04
Sample ID:				WG-11209296-030220-NT-10	WG-11209296-260520-NT-15	WG-11209296-250820-NT-09	WG-11209296-241120-CT-16	WG-11209296-020220-NT-02	WG-11209296-020220-NT-03	WG-11209296-260520-NT-07	WG-11209296-240820-NT-02	WG-11209296-240820-NT-03	WG-11209296-231120-CT-06	WG-11209296-020220-NT-05	WG-11209296-260520-NT-17
Sample Date:			BC CSR	02/03/2020	05/26/2020	08/25/2020	11/24/2020	02/02/2020	02/02/2020 Duplicate	05/26/2020	08/24/2020	08/24/2020 Duplicate	11/23/2020	02/02/2020	05/26/2020
Parameters	**Units**	**DW a**	**FAW b**												
Field Parameters															
Conductivity, field	uS/cm	--	--	141	169	170	165	195	195	177	126	126	130	82	91
Oxidation reduction potential (ORP), field	millivolts	--	--	333	194	243	162	235	235	222	190	190	259	191	184
pH, field	s.u.	--	--	6.85	7.91	7.71	7.89	7.81	7.81	8.25	8.06	8.06	8.24	7.99	8.30
Temperature, field	Deg C	--	--	9.90	10.72	11.42	10.79	9.74	9.74	9.06	14.66	14.66	11.13	10.27	10.32
Total dissolved solids, field (TDS)	mg/L	--	--	92	110	111	107	127	127	115	82	82	84	53	59
Turbidity, field	NTU	--	--	2.3	14.7	8.3	5.9	2.9	2.9	1.1	2.4	2.4	1.0	0.4	0.0
General Chemistry															
Alkalinity, bicarbonate	mg/L	--	--	92.8	86.0	98.8 J	86.6	152	151	95.6	71.7 J	72.5 J	69.7	54.8	45.6
Alkalinity, carbonate	mg/L	--	--	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, hydroxide	mg/L	--	--	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	--	--	92.8	86.0	98.8 J	86.6	152	151	95.6	71.7 J	72.5 J	69.7	54.8	45.6
Chloride	mg/L	250	1500	1.70	1.66	1.76 J	1.60	1.47	1.47	1.43	1.40 J	1.37 J	1.72	1.24	1.16
Conductivity	uS/cm	--	--	177	181	197 J	176	260	261	190	153 J	151 J	146	110	100
Fluoride	mg/L	1.5	[h]	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020) J	ND (0.020)	ND (0.020)	ND (0.020)
Hardness < 50 mg/L	mg/L		2												ND (0.020)
Hardness >= 50 mg/L	mg/L		3	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020) J	ND (0.020)	ND (0.020)	
Hardness	mg/L	--	--	-	-	-	87.9	-	-	-	-	-	70.8	-	-
Hardness (dissolved)	mg/L	--	--	89.6	86.8	101	-	135	144	97.5	78.4	77.0	-	54.1	46.7
pH, lab	s.u.	--	--	7.98 J	8.10 J	7.98 J	8.08	8.21 J	8.21 J	8.22 J	8.19 J	8.19 J	8.11	7.94 J	7.95 J
Sulfate	mg/L	500	[b]	2.80	2.74	2.79 J	2.95	2.57	2.56	2.94	3.08 J	3.03 J	3.12	2.60	2.48
Hardness <= 30 mg/L	mg/L		1280												
Hardness 31 - 75 mg/L	mg/L		2180										3.12	2.60	2.48
Hardness 76 - 180 mg/L	mg/L		3090	2.80	2.74	2.79 J	2.95	2.57	2.56	2.94	3.08 J	3.03 J			
Hardness > 180 mg/L	mg/L		4290												
Total dissolved solids (TDS)	mg/L	--	--	103	117	149 J	115	155	158	123	92 J	100 J	95	65	68
Total organic carbon (TOC)	mg/L	--	--	-	-	-	-	-	-	-	-	-	-	-	-
Nutrients															
Ammonia-N	mg/L	--	[a]	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050) J	ND (0.0050)	ND (0.0050)	ND (0.0050)
pH < 7.0	mg/L		18.4	ND (0.0050)											
pH 7.0 - < 7.5	mg/L		18.5												
pH 7.5 - < 8.0	mg/L		11.3		ND (0.0050)	ND (0.0050) J	ND (0.0050)	ND (0.0050)	ND (0.0050)					ND (0.0050)	
pH 8.0 - < 8.5	mg/L		3.7							ND (0.0050)	ND (0.0050) J	ND (0.0050) J	ND (0.0050)		ND (0.0050)
pH >= 8.5	mg/L		1.31												
Nitrate (as N)	mg/L	10	400	0.106	0.121	0.158 J	0.155	0.176 J	0.177 J	0.159	0.128 J	0.124 J	0.145	0.109 J	0.0797
Nitrite (as N)	mg/L	1	[c]	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010)
Chloride < 2 mg/L	mg/L		0.2	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010)
Chloride 2 - < 4 mg/L	mg/L		0.4												
Chloride 4 - < 6 mg/L	mg/L		0.6												
Chloride 6 - < 8 mg/L	mg/L		0.8												
Chloride >= 10 mg/L	mg/L		2												
Nitrite/Nitrate	mg/L	10	400	0.106	0.121	0.158 J	0.155	0.176 J	0.177 J	0.159	0.128 J	0.124 J	0.145	0.109 J	0.0797
Dissolved Metals															
Aluminum (dissolved)	ug/L	9500	--	4.7	2.9	5.2	3.2	4	4.4	4.5	6.8	7	4.8	5	5
Antimony (dissolved)	ug/L	6	90	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)
Arsenic (dissolved)	ug/L	10	50	0.84	0.88	0.83 J	0.87	1.88	1.92	2.06	2.36	2.43	2.36	0.42	0.45
Barium (dissolved)	ug/L	1000	10000	1.64	1.7	2.05	1.61	6.28	6.36	4.51	3.73	4.05	3.67	0.82	0.7
Beryllium (dissolved)	ug/L	8	1.5	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth (dissolved)	ug/L	--	--	ND (0.05)	ND (0.05)	ND (0.05) J	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05) J	ND (0.05)	ND (0.05)	ND (0.05)
Boron (dissolved)	ug/L	5000	12000	ND (10)	ND (10)	ND (10) J	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10) J	ND (10)	11	ND (10)
Cadmium (dissolved)	ug/L	5	[b]	0.0252	ND (0.005)	ND (0.005) J	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005) J	ND (0.005)	ND (0.005)	ND (0.005)
Hardness < 30 mg/L	ug/L		0.5												
Hardness 30 - < 90 mg/L	ug/L		1.5	0.0252	ND (0.005)		ND (0.005)				ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Hardness 90 - < 150 mg/L	ug/L		2.5			ND (0.005)		ND (0.005)	ND (0.005)	ND (0.005)					
Hardness 150 - < 210 mg/L	ug/L		3.5												
Hardness >= 210 mg/L	ug/L		4												
Caesium (dissolved)	ug/L	--	--	ND (0.01)	ND (0.01)	ND (0.01) J	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01) J	ND (0.01)	ND (0.01)	ND (0.01)
Calcium (dissolved)	ug/L	--	--	29400	28100	32700	28300	43300	46600	31300	25100	24400	22600	18700	16000
Chromium (dissolved)	ug/L	50	10	0.48	0.49	0.55	0.52	0.62	0.67	0.47	0.5	0.54	0.5	0.28	0.23
Cobalt (dissolved)	ug/L	20 (i)	40	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)
Copper (dissolved)	ug/L	1500	[b]	0.48	ND (0.2)	ND (0.2) J	0.32	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)	ND (0.2)
Hardness < 50 mg/L	ug/L		20												ND (0.2)
Hardness 50 - < 75 mg/L	ug/L		30										ND (0.2)	ND (0.2)	
Hardness 75 - < 100 mg/L	ug/L		40	0.48	ND (0.2)		0.32			ND (0.2)	ND (0.2)	ND (0.2)			
Hardness 100 - < 125 mg/L	ug/L		50			ND (0.2)									
Hardness 125 - < 150 mg/L	ug/L		60					ND (0.2)	ND (0.2)						
Hardness 150 - < 175 mg/L	ug/L		70												
Hardness 175 - < 200 mg/L	ug/L		80												
Hardness >= 200 mg/L	ug/L		90												
Iron (dissolved)	ug/L	6500	--	ND (10)	ND (10)	ND (10) J	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10) J	ND (10)	ND (10)	ND (10)
Lead (dissolved)	ug/L	10	[b]	ND (0.05)	ND (0.05)	ND (0.05) J	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05) J	ND (0.05)	ND (0.05)	ND (0.05)
Hardness < 50 mg/L	ug/L		40												ND (0.05)
Hardness 50 - < 100 mg/L	ug/L		50	ND (0.05)	ND (0.05)		ND (0.05)			ND (0.05)	ND (0.05)	ND (0.05) J	ND (0.05)	ND (0.05)	
Hardness 100 - < 200 mg/L	ug/L		60			ND (0.05)		ND (0.05)	ND (0.05)						
Hardness 200 - < 300 mg/L	ug/L		110												
Hardness >= 300 mg/L	ug/L		160												
Lithium (dissolved)	ug/L	8	--	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1)	ND (1)
Magnesium (dissolved)	ug/L	--	--	3910	4060	4610 J	4160	6550	6800	4680	3850	3890	3480	1820	1660
Manganese (dissolved)	ug/L	1500	--	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	0.13	ND (0.1)
Mercury (dissolved)	ug/L	1	0.25	ND (0.005)	ND (0.005)	ND (0.005) J	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005) J	ND (0.005)	ND (0.005)	ND (0.005)
Molybdenum (dissolved)	ug/L	250	10000	0.131	0.126	0.14	0.143	0.064	0.07	0.103	0.141	0.139	0.128	0.096	0.131
Nickel (dissolved)	ug/L	80	[b]	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)	ND (0.5)
Hardness < 60 mg/L	ug/L		250												ND (0.5)
Hardness 60 - < 120 mg/L	ug/L		650	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)			ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)		
Hardness 120 - < 180 mg/L	ug/L		1100					ND (0.5)	ND (0.5)						
Hardness >= 180 mg/L	ug/L		1500												
Phosphorus (dissolved)	ug/L	--	--	ND (50)	ND (50)	ND (50) J	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50) J	ND (50)	ND (50)	ND (50)
Potassium (dissolved)	ug/L	--	--	709	737	789	705	1390	1450	1230	1130	1140	1030	340	289
Rubidium (dissolved)	ug/L	--	--	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)	ND (0.2)
Selenium (dissolved)	ug/L	10	20	0.146	0.101	0.106 J	0.133	0.151	0.137	0.145	0.175	0.185 J	0.155	0.121	0.093
Silicon (dissolved)	ug/L	--	--	5420	5760	5930 J	5820	5210	5310	5510	5540	5630 J	5460	3740	3740
Silver (dissolved)	ug/L	20	[b]	ND (0.01)	ND (0.01)	ND (0.01) J	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01) J	ND (0.01)	ND (0.01)	ND (0.01)
Hardness <= 100 mg/L	ug/L		0.5	ND (0.01)	ND (0.01)		ND (0.01)			ND (0.01)	ND (0.01)	ND (0.01) J	ND (0.01)	ND (0.01)	ND (0.01)
Hardness > 100 mg/L	ug/L		15			ND (0.01) J		ND (0.01)	ND (0.01)						
Sodium (dissolved)	ug/L	200000	--	1840	1970	2120	1830	1640	1690	1410	1380	1380 J	1170	1410	1300
Strontium (dissolved)	ug/L	2500	--	40.7	43.5	54.2	45.2	48.4	52.1	37.1	30.9	33.2	27.6	25.4	24.2
Sulfur (dissolved)	ug/L	--	--	980	540	790	1160	750	780	600	830	700 J	940	650	ND (500)
Tellurium (dissolved)	ug/L	--	--	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)	ND (0.2)
Thallium (dissolved)	ug/L	--	3	ND (0.01)	ND (0.01)	ND (0.01) J	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01) J	ND (0.01)	ND (0.01)	ND (0.01)
Thorium (dissolved)	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)
Tin (dissolved)	ug/L	2500	--	0.28	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)
Titanium (dissolved)	ug/L	--	1000	ND (0.3)	ND (0.3)	ND (0.3) J	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3) J	ND (0.3)	ND (0.3)	ND (0.3)
Tungsten (dissolved)	ug/L	3	--	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1) J	ND (0.1)	ND (0.1)	ND (0.1)
Uranium (dissolved)	ug/L	20	85	0.077	0.079	0.089 J	0.073	0.337	0.337	0.188	0.119	0.122 J	0.095	0.028	0.026
Vanadium (dissolved)	ug/L	20	--	5.82	5.98	5.81 J	5.85	18.6	19.2	20.6*	22.6*	22.8*	21.5*	2.83	3.28
Zinc (dissolved)	ug/L	3000	[b]	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1)	ND (1)
Hardness < 90 mg/L	ug/L		75	ND (1)	ND (1)		ND (1)				ND (1)	ND (1) J	ND (1)	ND (1)	ND (1)
Hardness 90 - < 100 mg/L	ug/L		150							ND (1)					
Hardness 100 - < 200 mg/L	ug/L		900			ND (1) J		ND (1)	ND (1)						
Hardness 200 - < 300 mg/L	ug/L		1650												
Hardness 300 - < 400 mg/L	ug/L		2400												
Zirconium (dissolved)	ug/L	--	--	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)	ND (0.2)

Table 5.9

Groundwater Analytical Results - General Chemistry, Nutrients and Metals
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Campbell River Waste Management Centre
Campbell River, British Columbia

Sample Location:		AG99-04	AG99-04	AG99-05	AG99-05	AG99-05	AG99-05	AG99-06	AG99-06	AG99-06	AG99-06	EBA04-1	EBA04-1	EBA04-1	EBA04-1
Sample ID:		WG-11209296-240820-NT-05	WG-11209296-241120-CT-18	WG-11209296-030220-NT-16	WG-11209296-260520-NT-13	WG-11209296-250820-NT-13	WG-11209296-241120-CT-12	WG-11209296-020220-NT-07	WG-11209296-250520-NT-03	WG-11209296-250820-NT-17	WG-11209296-231120-CT-03	WG-11209296-030220-NT-09	WG-11209296-260520-NT-14	WG-11209296-250820-NT-10	WG-11209296-241120-CT-17
Sample Date:		08/24/2020	11/24/2020	02/03/2020	05/26/2020	08/25/2020	11/24/2020	02/02/2020	05/25/2020	08/25/2020	11/23/2020	02/03/2020	05/26/2020	08/25/2020	11/24/2020
Parameters	**Units**														
Field Parameters															
Conductivity, field	uS/cm	86	107	85	158	109	92	105	126	120	102	245	72	84	82
Oxidation reduction potential (ORP), field	millivolts	149	189	293	189	339	242	323	232	328	270	274	176	308	198
pH, field	s.u.	8.15	8.91	8.09	8.24	7.29	8.52	7.29	7.15	7.52	7.47	7.20	8.54	7.17	9.01
Temperature, field	Deg C	12.07	9.87	9.65	10.38	10.54	10.34	6.12	8.17	7.89	9.62	4.24	11.94	13.10	9.29
Total dissolved solids, field (TDS)	mg/L	56	70	56	102	71	60	68	82	78	66	159	47	54	54
Turbidity, field	NTU	2.1	0	12.6	0.8	1.6	2.2	542	159	507	218	0.0	0.3	0.4	0.1
General Chemistry															
Alkalinity, bicarbonate	mg/L	45.8 J	53.5	54.6	79.3	58.6 J	45.4	46.8	58.5	57.5	53.9	44.0	34.8	40.6 J	41.5
Alkalinity, carbonate	mg/L	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)
Alkalinity, hydroxide	mg/L	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	45.8 J	53.5	54.6	79.3	58.6 J	45.4	46.8	58.5	57.5	53.9	44.0	34.8	40.6 J	41.5
Chloride	mg/L	1.07 J	0.99	1.19	3.63	1.27 J	0.87	3.70	6.81	6.33	3.72	0.81	0.82	0.72 J	0.67
Conductivity	uS/cm	100 J	114	107	173	124 J	96.1	96.5	140	134	118	88.1	79.1	87.8 J	87.3
Fluoride	mg/L	ND (0.020) J	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	0.030	0.021	0.022	0.024	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)
Hardness < 50 mg/L	mg/L	ND (0.020) J	ND (0.020)	ND (0.020)			ND (0.020)	0.030				ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)
Hardness >= 50 mg/L	mg/L		ND (0.020)		ND (0.020)	ND (0.020) J			0.021	0.022	0.024				
Hardness	mg/L	-	53.2	-	-	-	46.8	-	-	-	52.0	-	-	-	40.3
Hardness (dissolved)	mg/L	46.1	-	49.0	87.6	61.0	-	42.8	57.3	56.7	-	41.0	38.4	44.3	-
pH, lab	s.u.	8.05 J	7.97	7.97 J	8.17 J	8.12 J	7.94	7.75 J	7.81 J	7.76	7.86	7.95 J	7.96 J	8.11 J	7.89
Sulfate	mg/L	2.45 J	2.74	2.58	2.55	2.53 J	2.57	1.06	1.73	1.42	1.47	2.50	2.39	2.44 J	2.44
Hardness <= 30 mg/L	mg/L														
Hardness 31 - 75 mg/L	mg/L	2.45 J	2.74	2.58		2.53 J	2.57	1.06	1.73	1.42	1.47	2.50	2.39	2.44 J	2.44
Hardness 76 - 180 mg/L	mg/L				2.55										
Hardness > 180 mg/L	mg/L														
Total dissolved solids (TDS)	mg/L	62 J	75	67	109	69 J	66	71	99	89	95	57	66	65 J	59
Total organic carbon (TOC)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nutrients															
Ammonia-N	mg/L	ND (0.0050) J	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)	ND (0.0050)	0.0118	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)
pH < 7.0	mg/L														
pH 7.0 - < 7.5	mg/L					ND (0.0050) J		ND (0.0050)	0.0118		ND (0.0050)	ND (0.0050)		ND (0.0050) J	
pH 7.5 - < 8.0	mg/L									ND (0.0050)					
pH 8.0 - < 8.5	mg/L	ND (0.0050) J		ND (0.0050)	ND (0.0050)										
pH >= 8.5	mg/L		ND (0.0050)				ND (0.0050)						ND (0.0050)		ND (0.0050)
Nitrate (as N)	mg/L	0.0994 J	0.120	0.0817	0.0614	0.0596 J	0.0687	0.0869 J	0.0648	0.0541	0.0727	0.0460	0.0373	0.0565 J	0.0400
Nitrite (as N)	mg/L	ND (0.0010) J	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)
Chloride < 2 mg/L	mg/L	ND (0.0010) J	ND (0.0010)	ND (0.0010)		ND (0.0010) J	ND (0.0010)					ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)
Chloride 2 - < 4 mg/L	mg/L				ND (0.0010)			ND (0.0010) J			ND (0.0010)				
Chloride 4 - < 6 mg/L	mg/L														
Chloride 6 - < 8 mg/L	mg/L								ND (0.0010)	ND (0.0010)					
Chloride >= 10 mg/L	mg/L														
Nitrite/Nitrate	mg/L	0.0994 J	0.120	0.0817	0.0614	0.0596 J	0.0688	0.0869 J	0.0648	0.0541	0.0729	0.0460	0.0373	0.0565 J	0.0400
Dissolved Metals															
Aluminum (dissolved)	ug/L	12.4	4.8	4.6	6.1	4.9	4.4	18.5	6.1	3.6	3	2.4	5.4	5	4.7
Antimony (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Arsenic (dissolved)	ug/L	0.44	0.38	0.46	0.4	0.4	0.51	0.17	0.14	0.16	0.14	0.49	0.33	0.28	0.34
Barium (dissolved)	ug/L	0.83	0.77	0.72	1.35	0.91	0.67	0.41	2.4	0.36	0.65	0.38	0.43	0.5	0.36
Beryllium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Boron (dissolved)	ug/L	ND (10)	ND (10)	ND (10)	ND (10)	15	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)
Cadmium (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0094	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0082
Hardness < 30 mg/L	ug/L														
Hardness 30 - < 90 mg/L	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0094	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0082
Hardness 90 - < 150 mg/L	ug/L														
Hardness 150 - < 210 mg/L	ug/L														
Hardness >= 210 mg/L	ug/L														
Caesium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Calcium (dissolved)	ug/L	15700	18200	16700	30100	20700	15800	13300	18200	17600	16300	13600	12900	14900	13600
Chromium (dissolved)	ug/L	0.25	0.24	0.26	0.2	0.24	0.23	0.28	0.61	0.61	0.5	0.93	0.27	0.44	0.4
Cobalt (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Copper (dissolved)	ug/L	0.2	ND (0.2)	ND (0.2)	0.57	0.3	ND (0.2)	0.41	1.35	0.23	0.91	2.46	1.62	2.05	1.55
Hardness < 50 mg/L	ug/L	0.2		ND (0.2)			ND (0.2)	0.41				2.46	1.62	2.05	1.55
Hardness 50 - < 75 mg/L	ug/L		ND (0.2)			0.3			1.35	0.23	0.91				
Hardness 75 - < 100 mg/L	ug/L				0.57										
Hardness 100 - < 125 mg/L	ug/L														
Hardness 125 - < 150 mg/L	ug/L														
Hardness 150 - < 175 mg/L	ug/L														
Hardness 175 - < 200 mg/L	ug/L														
Hardness >= 200 mg/L	ug/L														
Iron (dissolved)	ug/L	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	15	ND (10)	ND (10)	ND (10)	35	ND (10)	ND (10)	39
Lead (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.1	0.067	0.124	0.267
Hardness < 50 mg/L	ug/L	ND (0.05)		ND (0.05)			ND (0.05)	ND (0.05)				0.1	0.067	0.124	0.267
Hardness 50 - < 100 mg/L	ug/L		ND (0.05)		ND (0.05)	ND (0.05)			ND (0.05)	ND (0.05)	ND (0.05)				
Hardness 100 - < 200 mg/L	ug/L														
Hardness 200 - < 300 mg/L	ug/L														
Hardness >= 300 mg/L	ug/L														
Lithium (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Magnesium (dissolved)	ug/L	1650	1860	1790	3030	2280	1750	2290	2870	3080	2730	1730	1500	1710	1530
Manganese (dissolved)	ug/L	0.29	ND (0.1)	ND (0.1)	0.45	ND (0.1)	ND (0.1)	0.78	2.72	0.89	0.48	0.38	ND (0.1)	0.29	0.16
Mercury (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Molybdenum (dissolved)	ug/L	0.118	0.112	0.107	0.114	0.131	0.133	0.074	0.095	0.109	0.124	0.202	0.15	0.117	0.133
Nickel (dissolved)	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Hardness < 60 mg/L	ug/L	ND (0.5)	ND (0.5)	ND (0.5)			ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Hardness 60 - < 120 mg/L	ug/L				ND (0.5)	ND (0.5)									
Hardness 120 - < 180 mg/L	ug/L														
Hardness >= 180 mg/L	ug/L														
Phosphorus (dissolved)	ug/L	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Potassium (dissolved)	ug/L	264	302	386	501	427	349	230	315	288	262	284	190	203	231
Rubidium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Selenium (dissolved)	ug/L	0.1	0.09	0.102	0.086	0.097	0.107	ND (0.05)	0.124	0.139	0.109	0.098	0.073	0.076	0.075
Silicon (dissolved)	ug/L	3690	3700	3690	4230	4190	4210	4590	4740	4650	4610	4320	3360	3330	3620
Silver (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Hardness <= 100 mg/L	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Hardness > 100 mg/L	ug/L														
Sodium (dissolved)	ug/L	1320	1320	1470	1910	1580	1260	2270	2410	2160	2000	1270	1000	1120	1120
Strontium (dissolved)	ug/L	26.1	27.1	24.6	42.9	33.8	24.3	30.9	45.1	47.4	40.4	19.6	18.1	23.8	20.8
Sulfur (dissolved)	ug/L	580	1020	730	650	660	640	ND (500)	ND (500)	ND (500)	ND (500)	870	520	580	920
Tellurium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Thallium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Thorium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tin (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.22	ND (0.1)	0.11	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Titanium (dissolved)	ug/L	0.35	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	0.52	0.31	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)
Tungsten (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Uranium (dissolved)	ug/L	0.026	0.027	0.027	0.051	0.043	0.022	0.04	0.061	0.079	0.059	0.012	ND (0.01)	0.012	0.014
Vanadium (dissolved)	ug/L	2.98	2.8	3.23	2.96	3.19	3.27	3.19	3.12	3.31	3.28	3.02	2.39	2.13	2.4
Zinc (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	1.1	10.8	2.1	1.2	14.3	8.9	12.8	19.9
Hardness < 90 mg/L	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	1.1	10.8	2.1	1.2	14.3	8.9	12.8	19.9
Hardness 90 - < 100 mg/L	ug/L														
Hardness 100 - < 200 mg/L	ug/L														
Hardness 200 - < 300 mg/L	ug/L														
Hardness 300 - < 400 mg/L	ug/L														
Zirconium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Table 5.9

Groundwater Analytical Results - General Chemistry, Nutrients and Metals
2020 Annual Operations and Monitoring Report
Campbell River Waste Management Centre
Campbell River, British Columbia

Sample Location:		EBA04-6	EBA04-6	EBA04-6	EBA04-6	EBA04-7	EBA04-7	EBA04-7	EBA04-7	EBA11-1	EBA11-1	EBA11-1	EBA11-1	EBA11-1	EBA11-2
Sample ID:		WG-11209296-030220-NT-20	WG-11209296-260520-NT-19	WG-11209296-240820-NT-07	WG-11209296-241120-CT-09	WG-11209296-030220-NT-19	WG-11209296-260520-NT-18	WG-11209296-240820-NT-08	WG-11209296-241120-CT-08	WG-11209296-030220-NT-18	WG-11209296-250520-NT-06	WG-11209296-240820-NT-06	WG-11209296-241120-CT-14	WG-11209296-241120-CT-15	WG-11209296-030220-NT-13
Sample Date:		02/03/2020	05/26/2020	08/24/2020	11/24/2020	02/03/2020	05/26/2020	08/24/2020	11/24/2020	02/03/2020	05/25/2020	08/24/2020	11/24/2020	11/24/2020 Duplicate	02/03/2020
Parameters	**Units**														
Field Parameters															
Conductivity, field	uS/cm	422	540	487	540	2510	802	734	422	2290	655	564	819	819	232
Oxidation reduction potential (ORP), field	millivolts	294	211	313	289	252	200	201	247	111	124	42	207	207	291
pH, field	s.u.	7.45	7.27	6.24	7.56	6.41	6.98	6.50	6.87	6.99	7.69	7.18	8.04	8.04	7.66
Temperature, field	Deg C	10.35	10.21	9.36	10.55	9.70	8.97	12.51	10.26	8.67	8.63	10.53	9.44	9.44	9.93
Total dissolved solids, field (TDS)	mg/L	275	345	316	345	1610	514	470	590	1460	419	361	524	524	151
Turbidity, field	NTU	0.6	0.5	0.4	0.1	0.4	6.8	2.1	1.2	2.1	10.5	2.6	0.0	0.0	56.4
General Chemistry															
Alkalinity, bicarbonate	mg/L	292	311	303 J	310	463	419	428 J	515	323	222	192 J	271	266	159
Alkalinity, carbonate	mg/L	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, hydroxide	mg/L	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	292	311	303 J	310	463	419	428 J	515	323	222	192 J	271	266	159
Chloride	mg/L	3.80	2.79	3.35 J	2.49	36.3	28.9	28.5 J	35.2	77.4	59.0	68.3 J	100	99.8	5.33
Conductivity	uS/cm	523	573	573 J	577	901	849	872 J	1040	819	687	661 J	889	881	287
Fluoride	mg/L	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	ND (0.10)	ND (0.10)	ND (0.10) J	ND (0.100)	ND (0.10)	ND (0.10)	ND (0.020) J	ND (0.100)	ND (0.100)	ND (0.020)
Hardness < 50 mg/L	mg/L														
Hardness >= 50 mg/L	mg/L	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	ND (0.10)	ND (0.10)	ND (0.10) J	ND (0.100)	ND (0.10)	ND (0.10)	ND (0.020) J	ND (0.100)	ND (0.100)	ND (0.020)
Hardness	mg/L	-	-	-	313	-	-	-	549	-	-	-	393	413	-
Hardness (dissolved)	mg/L	261	316	310	-	432	423	439	-	418	316	315	-	-	150
pH, lab	s.u.	7.93 J	7.87 J	7.62 J	7.97	7.56 J	7.53 J	7.24 J	7.26	7.92 J	8.09 J	7.90 J	8.14	8.12	7.88 J
Sulfate	mg/L	2.17	3.00	4.43 J	3.35	13.2	14.2	13.9 J	15.4	19.4	17.5	16.3 J	28.3	27.7	3.36
Hardness <= 30 mg/L	mg/L														
Hardness 31 - 75 mg/L	mg/L														
Hardness 76 - 180 mg/L	mg/L														3.36
Hardness > 180 mg/L	mg/L	2.17	3.00	4.43 J	3.35	13.2	14.2	13.9 J	15.4	19.4	17.5	16.3 J	28.3	27.7	
Total dissolved solids (TDS)	mg/L	318	352	358 J	356	531	501	494 J	637	516	468	436 J	589	602	174
Total organic carbon (TOC)	mg/L	ND (0.50)	-	-	-	3.56	-	-	-	-	-	-	-	-	-
Nutrients															
Ammonia-N	mg/L	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)	0.0104	0.0351	0.0249 J	0.0255	0.0242	ND (0.0050)
pH < 7.0	mg/L			ND (0.0050) J		ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)	0.0104					
pH 7.0 - < 7.5	mg/L	ND (0.0050)	ND (0.0050)									0.0249 J			
pH 7.5 - < 8.0	mg/L				ND (0.0050)						0.0351				ND (0.0050)
pH 8.0 - < 8.5	mg/L												0.0255	0.0242	
pH >= 8.5	mg/L														
Nitrate (as N)	mg/L	1.60 J	2.49	1.80 J	2.69 J	0.241 J	0.417	0.283 J	0.174	0.033	8.48	6.21 J	5.48	5.48	1.03
Nitrite (as N)	mg/L	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010) J	ND (0.0050) J	ND (0.0050)	ND (0.0050) J	ND (0.0050)	ND (0.0050)	0.631	0.779 J	0.686	0.682	ND (0.0010)
Chloride < 2 mg/L	mg/L														
Chloride 2 - < 4 mg/L	mg/L	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010) J										
Chloride 4 - < 6 mg/L	mg/L														ND (0.0010)
Chloride 6 - < 8 mg/L	mg/L														
Chloride >= 10 mg/L	mg/L					ND (0.0050) J	ND (0.0050)	ND (0.0050) J	ND (0.0050)	ND (0.0050)	0.631	0.779 J	0.686	0.682	
Nitrite/Nitrate	mg/L	1.60 J	2.49	1.80 J	2.69 J	0.241 J	0.417	0.283 J	0.175	0.033	9.11	6.99 J	6.17	6.16	1.03
Dissolved Metals															
Aluminum (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	1.7	ND (1)	ND (1)	16.9	1	3.4	2	2.2	1.7	1.3	1.9
Antimony (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.14	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Arsenic (dissolved)	ug/L	ND (0.1)	ND (0.1)	0.11	0.12	0.16	0.13	0.17	0.2	0.6	0.29	0.26	0.33	0.34	ND (0.1)
Barium (dissolved)	ug/L	6.62	7.18	7.72	7.26	17.9	16.3	18	21.5	13.3	10.1	9.94	15.3	15	7.2
Beryllium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Boron (dissolved)	ug/L	43	28	29	30	198	202	217	418	122	92	96	91	100	21
Cadmium (dissolved)	ug/L	0.0063	0.0107	0.0118	0.0083	0.0492	0.0444	0.0466	0.0593	0.0291	0.0259	0.0277	0.0465	0.0445	ND (0.005)
Hardness < 30 mg/L	ug/L														
Hardness 30 - < 90 mg/L	ug/L														
Hardness 90 - < 150 mg/L	ug/L														
Hardness 150 - < 210 mg/L	ug/L														ND (0.005)
Hardness >= 210 mg/L	ug/L	0.0063	0.0107	0.0118	0.0083	0.0492	0.0444	0.0466	0.0593	0.0291	0.0259	0.0277	0.0465	0.0445	
Caesium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Calcium (dissolved)	ug/L	78800	96300	94500	95500	130000	126000	126000	166000	124000	94000	92800	116000	123000	40700
Chromium (dissolved)	ug/L	1.22	1.27	1.28	1.09	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.16	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	2.39
Cobalt (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.44	0.42	0.42	0.72	1.56	1.03	0.84	1.06	1.04	ND (0.1)
Copper (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	3.82	2.72	3.02	6.77	2.25	2.1	1.87	2.24	2.04	ND (0.2)
Hardness < 50 mg/L	ug/L														
Hardness 50 - < 75 mg/L	ug/L														
Hardness 75 - < 100 mg/L	ug/L														
Hardness 100 - < 125 mg/L	ug/L														
Hardness 125 - < 150 mg/L	ug/L														
Hardness 150 - < 175 mg/L	ug/L														ND (0.2)
Hardness 175 - < 200 mg/L	ug/L														
Hardness >= 200 mg/L	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	3.82	2.72	3.02	6.77	2.25	2.1	1.87	2.24	2.04	
Iron (dissolved)	ug/L	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	144	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)
Lead (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Hardness < 50 mg/L	ug/L														
Hardness 50 - < 100 mg/L	ug/L														
Hardness 100 - < 200 mg/L	ug/L														ND (0.05)
Hardness 200 - < 300 mg/L	ug/L	ND (0.05)													
Hardness >= 300 mg/L	ug/L		ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	
Lithium (dissolved)	ug/L	ND (1)	1.1	ND (1)	ND (1)	1.1	1.3	1.1	1.3	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Magnesium (dissolved)	ug/L	15600	18400	18000	18200	26100	26400	29900	32500	26300	19800	20200	25300	25700	11900
Manganese (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	157	134	163	211	896	826	862	1390	1350	ND (0.1)
Mercury (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0238	0.0085	0.009	0.0067	ND (0.005)	ND (0.005)
Molybdenum (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.108	0.112	0.117	0.111	0.298	0.381	0.357	0.213	0.225	ND (0.05)
Nickel (dissolved)	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	1.78	1.49	1.59	2.86	1.35	0.91	0.7	0.85	0.84	ND (0.5)
Hardness < 60 mg/L	ug/L														
Hardness 60 - < 120 mg/L	ug/L														
Hardness 120 - < 180 mg/L	ug/L														ND (0.5)
Hardness >= 180 mg/L	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	1.78	1.49	1.59	2.86	1.35	0.91	0.7	0.85	0.84	
Phosphorus (dissolved)	ug/L	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Potassium (dissolved)	ug/L	1290	1450	1450	1440	2180	2190	2390	2470	1250	1300	1270	1740	1720	501
Rubidium (dissolved)	ug/L	0.48	0.49	0.49	0.54	1.09	0.99	1.05	1.32	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	0.32
Selenium (dissolved)	ug/L	0.073	ND (0.05)	ND (0.05)	0.062	ND (0.05)	ND (0.05)	0.051	ND (0.05)	0.165	0.137	0.108	0.1	0.11	0.127
Silicon (dissolved)	ug/L	11900	11600	11900	12200	13100	12400	13100	13700	6450	6860	7130	7950	7660	8140
Silver (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.033	0.015	0.014	ND (0.01)	ND (0.01)	ND (0.01)
Hardness <= 100 mg/L	ug/L														
Hardness > 100 mg/L	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.033	0.015	0.014	ND (0.01)	ND (0.01)	ND (0.01)
Sodium (dissolved)	ug/L	6420	6980	7120	6500	22400	24600	27700	27800	10300	15200	13100	24100	24400	4570
Strontium (dissolved)	ug/L	173	194	215	196	327	304	348	390	237	202	204	284	284	70.5
Sulfur (dissolved)	ug/L	920	710	1390	1130	5690	5120	4970	5400	6340	5980	5110	10800	10100	1120
Tellurium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Thallium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Thorium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tin (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Titanium (dissolved)	ug/L	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	0.46	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)
Tungsten (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Uranium (dissolved)	ug/L	0.225	0.243	0.271	0.264	0.797	0.779	0.852	0.938	0.985	0.679	0.668	0.776	0.831	0.224
Vanadium (dissolved)	ug/L	1.54	1.65	1.69	1.66	1.73	1.67	1.86	1.78	1.43	3.66	3.78	4.19	4.1	2.94
Zinc (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	1.1	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Hardness < 90 mg/L	ug/L														
Hardness 90 - < 100 mg/L	ug/L														
Hardness 100 - < 200 mg/L	ug/L														ND (1)
Hardness 200 - < 300 mg/L	ug/L	ND (1)													
Hardness 300 - < 400 mg/L	ug/L		ND (1)	ND (1)	ND (1)						ND (1)	ND (1)	ND (1)		
Zirconium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Table 5.9

Groundwater Analytical Results - General Chemistry, Nutrients and Metals
2020 Annual Operations and Monitoring Report
Campbell River Waste Management Centre
Campbell River, British Columbia

Sample Location:		EBA11-2	EBA11-2	EBA11-2	EBA11-2	EBA11-3	EBA11-3	EBA11-3	EBA11-3	EBA11-4	EBA11-4	EBA11-4	EBA11-4	EBA11-4	HBT94-1
Sample ID:		WG-11209296-260520-NT-10	WG-11209296-250820-NT-18	WG-11209296-250820-NT-19	WG-11209296-241120-CT-11	WG-11209296-020220-NT-06	WG-11209296-250520-NT-02	WG-11209296-250820-NT-15	WG-11209296-231120-CT-04	WG-11209296-020220-NT-08	WG-11209296-250520-NT-04	WG-11209296-250520-NT-05	WG-11209296-250820-NT-16	WG-11209296-231120-CT-05	WG-11209296-250820-NT-21
Sample Date:		05/26/2020	08/25/2020	08/25/2020 Duplicate	11/24/2020	02/02/2020	05/25/2020	08/25/2020	11/23/2020	02/02/2020	05/25/2020	05/25/2020 Duplicate	08/25/2020	11/23/2020	08/25/2020
Parameters	**Units**														
Field Parameters															
Conductivity, field	uS/cm	253	275	275	349	148	143	161	110	86	118	118	115	110	461
Oxidation reduction potential (ORP), field	millivolts	202	308	308	167	208	203	173	185	220	197	197	166	184	0
pH, field	s.u.	7.70	7.65	7.65	7.70	7.84	7.49	7.70	7.33	8.08	7.89	7.89	8.00	7.66	6.97
Temperature, field	Deg C	9.75	11.98	11.98	10.24	10.29	10.00	12.13	10.68	9.77	9.45	9.45	12.34	10.40	11.91
Total dissolved solids, field (TDS)	mg/L	164	179	179	227	1139	93	105	71	56	77	77	75	71	300
Turbidity, field	NTU	74.4	27.3	27.3	21.9	15	11.8	1.9	9.1	78	33	33	24.6	43.5	3.5
General Chemistry															
Alkalinity, bicarbonate	mg/L	134	148	147	162	62.1	51.3	42.3	52.4	47.0	52.3	52.5	54.8	48.2	239
Alkalinity, carbonate	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, hydroxide	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	134	148	147	162	62.1	51.3	42.3	52.4	47.0	52.3	52.5	54.8	48.2	239
Chloride	mg/L	7.76	13.1	13.1	20.8	24.5	12.5	26.7	3.69	7.95	4.88	4.88	4.58	5.08	31.0
Conductivity	uS/cm	277	323	318	377	198	153	188	120	118	125	126	134	121	565
Fluoride	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	0.021
Hardness < 50 mg/L	mg/L														
Hardness >= 50 mg/L	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	0.021
Hardness	mg/L	-	-	-	193	-	-	-	56.0	-	-	-	-	53.5	-
Hardness (dissolved)	mg/L	134	153	151	-	91.4	68.0	76.4	-	50.9	56.1	53.7	55.9	-	184
pH, lab	s.u.	7.91 J	8.10	8.09	8.13	7.77 J	7.88 J	7.81	7.88	7.82 J	7.94 J	7.95 J	7.98	7.92	7.54
Sulfate	mg/L	3.44	3.75	3.74	4.17	2.53	2.89	3.35	2.96	2.14	2.00	2.00	3.21	3.26	6.16
Hardness <= 30 mg/L	mg/L														
Hardness 31 - 75 mg/L	mg/L						2.89		2.96	2.14	2.00	2.00	3.21	3.26	
Hardness 76 - 180 mg/L	mg/L	3.44	3.75	3.74		2.53		3.35							
Hardness > 180 mg/L	mg/L				4.17										6.16
Total dissolved solids (TDS)	mg/L	179	194	203	226	130	112	154	79	71	85	86	95	86	298
Total organic carbon (TOC)	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nutrients															
Ammonia-N	mg/L	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	7.87
pH < 7.0	mg/L														7.87
pH 7.0 - < 7.5	mg/L						ND (0.0050)		ND (0.0050)						
pH 7.5 - < 8.0	mg/L	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)		ND (0.0050)			ND (0.0050)	ND (0.0050)		ND (0.0050)	
pH 8.0 - < 8.5	mg/L									ND (0.0050)			ND (0.0050)		
pH >= 8.5	mg/L														
Nitrate (as N)	mg/L	0.638	0.496	0.496	0.581	0.119 J	0.131	0.351	0.128	0.219 J	0.201	0.200	0.525	0.429	0.509
Nitrite (as N)	mg/L	ND (0.0010)	0.0012	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	0.0824
Chloride < 2 mg/L	mg/L														
Chloride 2 - < 4 mg/L	mg/L								ND (0.0010)						
Chloride 4 - < 6 mg/L	mg/L										ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	
Chloride 6 - < 8 mg/L	mg/L	ND (0.0010)								ND (0.0010) J					
Chloride >= 10 mg/L	mg/L		0.0012	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)							0.0824
Nitrite/Nitrate	mg/L	0.638	0.497	0.496	0.581	0.119 J	0.131	0.351	0.128	0.219 J	0.201	0.200	0.525	0.430	0.592
Dissolved Metals															
Aluminum (dissolved)	ug/L	2.8	2.8	2.2	37.1	1.9	3.1	1.4	1.8	3.3	2.8	3.1	2.9	8.1	2.8
Antimony (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.13
Arsenic (dissolved)	ug/L	0.13	0.16	0.17	0.16	0.14	0.18	0.18	0.22	1.64	1.48	1.53	1.54	1.82	0.65
Barium (dissolved)	ug/L	7.67	8.3	8.55	8.83	0.75	0.77	0.64	0.51	1.44	1.53	1.57	1.74	1.91	17.8
Beryllium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Boron (dissolved)	ug/L	15	11	11	11	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	284
Cadmium (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0177
Hardness < 30 mg/L	ug/L														
Hardness 30 - < 90 mg/L	ug/L						ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	
Hardness 90 - < 150 mg/L	ug/L	ND (0.005)				ND (0.005)									
Hardness 150 - < 210 mg/L	ug/L		ND (0.005)	ND (0.005)	ND (0.005)										0.0177
Hardness >= 210 mg/L	ug/L														
Caesium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.161
Calcium (dissolved)	ug/L	36700	45200	43200	57700	29800	21600	24600	18100	15700	17500	16500	17100	16800	63100
Chromium (dissolved)	ug/L	1.82	1.5	1.46	1.47	0.33	0.42	0.4	0.36	2	0.86	0.86	0.76	0.66	ND (0.1)
Cobalt (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.37
Copper (dissolved)	ug/L	0.26	ND (0.2)	ND (0.2)	0.98	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	0.89	2.69	1.48
Hardness < 50 mg/L	ug/L														
Hardness 50 - < 75 mg/L	ug/L						ND (0.2)		ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	0.89	2.69	
Hardness 75 - < 100 mg/L	ug/L					ND (0.2)		ND (0.2)							
Hardness 100 - < 125 mg/L	ug/L														
Hardness 125 - < 150 mg/L	ug/L	0.26													
Hardness 150 - < 175 mg/L	ug/L		ND (0.2)	ND (0.2)											
Hardness 175 - < 200 mg/L	ug/L				0.98										1.48
Hardness >= 200 mg/L	ug/L														
Iron (dissolved)	ug/L	ND (10)	ND (10)	ND (10)	38	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	21	1810
Lead (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Hardness < 50 mg/L	ug/L														
Hardness 50 - < 100 mg/L	ug/L					ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	
Hardness 100 - < 200 mg/L	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)										ND (0.05)
Hardness 200 - < 300 mg/L	ug/L														
Hardness >= 300 mg/L	ug/L														
Lithium (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	1.1
Magnesium (dissolved)	ug/L	10200	9670	10300	11900	4140	3390	3640	2620	2860	3020	3030	3210	2810	6450
Manganese (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	1.19	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.27	1520*
Mercury (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Molybdenum (dissolved)	ug/L	0.059	0.056	0.058	ND (0.05)	0.133	0.179	0.131	0.176	0.082	0.072	0.074	0.084	0.08	0.59
Nickel (dissolved)	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	1.4
Hardness < 60 mg/L	ug/L								ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	
Hardness 60 - < 120 mg/L	ug/L					ND (0.5)	ND (0.5)	ND (0.5)							
Hardness 120 - < 180 mg/L	ug/L	ND (0.5)	ND (0.5)	ND (0.5)											
Hardness >= 180 mg/L	ug/L				ND (0.5)										1.4
Phosphorus (dissolved)	ug/L	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Potassium (dissolved)	ug/L	593	978	1010	1160	387	330	354	295	1040	1210	1210	1260	1140	5480
Rubidium (dissolved)	ug/L	0.4	0.45	0.49	0.46	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	2.84
Selenium (dissolved)	ug/L	0.141	0.161	0.194	0.172	0.095	0.172	0.216	0.121	0.305	0.212	0.171	0.192	0.178	ND (0.05)
Silicon (dissolved)	ug/L	8550	8740	8730	8780	4100	4550	4560	4530	5230	5320	5390	5290	5100	7350
Silver (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Hardness <= 100 mg/L	ug/L					ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	
Hardness > 100 mg/L	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)										ND (0.01)
Sodium (dissolved)	ug/L	4140	3510	3630	3980	2040	1970	2000	1670	2790	3100	3020	3160	2760	21200
Strontium (dissolved)	ug/L	74.2	92.7	94	112	45.3	38.2	44.4	30.9	26.9	30.4	30.1	33.2	26.7	269
Sulfur (dissolved)	ug/L	840	1150	1220	1140	780	570	1070	950	570	ND (500)	ND (500)	850	990	2080
Tellurium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Thallium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Thorium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tin (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.14
Titanium (dissolved)	ug/L	ND (0.3)	ND (0.3)	ND (0.3)	3.33	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	0.4	ND (0.3)
Tungsten (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.1
Uranium (dissolved)	ug/L	0.192	0.217	0.216	0.231	0.057	0.034	0.031	0.033	0.251	0.259	0.262	0.299	0.22	0.111
Vanadium (dissolved)	ug/L	3.01	2.79	2.82	2.45	3.19	3.78	3.18	3.82	15.2	15.1	15.2	14.5	15.3	ND (0.5)
Zinc (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	11.9
Hardness < 90 mg/L	ug/L						ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	
Hardness 90 - < 100 mg/L	ug/L					ND (1)									
Hardness 100 - < 200 mg/L	ug/L	ND (1)	ND (1)	ND (1)	ND (1)										11.9
Hardness 200 - < 300 mg/L	ug/L														
Hardness 300 - < 400 mg/L	ug/L														
Zirconium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Table 5.9

Groundwater Analytical Results - General Chemistry, Nutrients and Metals
2020 Annual Operations and Monitoring Report
Campbell River Waste Management Centre
Campbell River, British Columbia

Sample Location:		HBT94-1	HBT94-2	HBT94-2	HBT94-2	HBT94-2	MW01-16	MW01-16	MW01-16	MW01-16	MW01-16	MW02-18	MW02-18	MW02-18	MW02-18
Sample ID:		WG-11209296-241120-CT-20	WG-11209296-030220-NT-21	WG-11209296-260520-NT-20	WG-11209296-250820-NT-20	WG-11209296-241120-CT-19	WG-11209296-020220-NT-01	WG-11209296-250520-NT-01	WG-11209296-240820-NT-01	WG-11209296-231120-CT-01	WG-11209296-231120-CT-02	WG-11209296-020220-NT-04	WG-11209296-260520-NT-08	WG-11209296-240820-NT-04	WG-11209296-231120-CT-07
Sample Date:		11/24/2020	02/03/2020	05/26/2020	08/25/2020	11/24/2020	02/02/2020	05/25/2020	08/24/2020	11/23/2020	11/23/2020 Duplicate	02/02/2020	05/26/2020	08/24/2020	11/23/2020
Parameters	**Units**														
Field Parameters															
Conductivity, field	uS/cm	487	289	381	501	484	58	59	63	97	97	553	948	584	537
Oxidation reduction potential (ORP), field	millivolts	39	19	-23	18	-8	225	226	224	209	209	119	90	114	109
pH, field	s.u.	7.56	7.60	7.62	7.37	7.83	7.39	7.07	6.99	6.82	6.82	7.02	6.85	6.86	7.03
Temperature, field	Deg C	11.55	11.20	11.66	11.67	11.26	12.05	9.91	9.79	11.16	11.16	10.88	10.05	13.92	11.30
Total dissolved solids, field (TDS)	mg/L	317	188	247	321	315	38	39	41	63	63	354	607	373	343
Turbidity, field	NTU	9.3	8.5	5.7	1.7	17.3	37.2	6	9.7	8.4	8.4	1.0	0.0	1.6	0.3
General Chemistry															
Alkalinity, bicarbonate	mg/L	219	163	185	253	221	39.2	28.4	33.2 J	49.2	49.7	363	430	309 J	282
Alkalinity, carbonate	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)
Alkalinity, hydroxide	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	219	163	185	253	221	39.2	28.4	33.2 J	49.2	49.7	363	430	309 J	282
Chloride	mg/L	34.2	19.9	23.5	37.0	33.3	0.75	0.85	0.73 J	1.00	1.00	34.6	0.99	32.8 J	23.8
Conductivity	uS/cm	535	354	415	579	518	79.0	64.6	73.9 J	107	107	739	1010	696 J	608
Fluoride	mg/L	ND (0.020)	0.029	0.032	ND (0.020)	0.024	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	ND (0.020)	ND (0.10)	ND (0.10)	ND (0.10) J	ND (0.020)
Hardness < 50 mg/L	mg/L						ND (0.020)	ND (0.020)	ND (0.020) J						
Hardness >= 50 mg/L	mg/L	ND (0.020)	0.029	0.032	ND (0.020)	0.024				ND (0.020)	ND (0.020)	ND (0.10)	ND (0.10)	ND (0.10) J	ND (0.020)
Hardness	mg/L	198	-	-	-	225	-	-	-	51.4	51.4	-	-	-	193
Hardness (dissolved)	mg/L	-	144	178	243	-	36.0	29.4	35.7	-	-	226	346	220	-
pH, lab	s.u.	7.93	7.99 J	8.06 J	7.91	8.10	7.55 J	7.57 J	7.51 J	7.68	7.69	7.44 J	7.10 J	7.25 J	7.54
Sulfate	mg/L	5.37	2.69	2.88	3.04	2.91	2.51	2.37	2.58 J	2.78	2.78	2.3	2.4	2.8 J	2.80
Hardness <= 30 mg/L	mg/L							2.37							
Hardness 31 - 75 mg/L	mg/L						2.51		2.58 J	2.78	2.78				
Hardness 76 - 180 mg/L	mg/L		2.69	2.88											
Hardness > 180 mg/L	mg/L	5.37			3.04	2.91						2.3	2.4	2.8 J	2.80
Total dissolved solids (TDS)	mg/L	274	206	238	341	300	51	54	50 J	69	73	375	533	348 J	319
Total organic carbon (TOC)	mg/L	-	1.78	-	-	-	-	-	-	-	-	-	-	-	-
Nutrients															
Ammonia-N	mg/L	8.65	1.73	1.81	1.73	2.01	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)	ND (0.0050)	13.3	15.7	12.3 J	12.0
pH < 7.0	mg/L								ND (0.0050) J	ND (0.0050)	ND (0.0050)		15.7	12.3 J	
pH 7.0 - < 7.5	mg/L				1.73		ND (0.0050)	ND (0.0050)				13.3			12.0
pH 7.5 - < 8.0	mg/L	8.65	1.73	1.81		2.01									
pH 8.0 - < 8.5	mg/L														
pH >= 8.5	mg/L														
Nitrate (as N)	mg/L	0.355	ND (0.0050) J	0.0073	ND (0.0050)	ND (0.0050)	0.0438 J	0.0399	0.0512 J	0.264	0.265	ND (0.025) J	ND (0.025)	ND (0.025) J	ND (0.0050)
Nitrite (as N)	mg/L	0.0824	ND (0.0010) J	ND (0.0010)	0.0028	0.0015	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)	ND (0.0050) J	ND (0.0050)	ND (0.0050) J	ND (0.0010)
Chloride < 2 mg/L	mg/L						ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)				
Chloride 2 - < 4 mg/L	mg/L														
Chloride 4 - < 6 mg/L	mg/L														
Chloride 6 - < 8 mg/L	mg/L														
Chloride >= 10 mg/L	mg/L	0.0824	ND (0.0010) J	ND (0.0010)	0.0028	0.0015						ND (0.0050) J	ND (0.0050)	ND (0.0050) J	ND (0.0010)
Nitrite/Nitrate	mg/L	0.437	ND (0.0051) J	0.0073	ND (0.0051)	ND (0.0051)	0.0438 J	0.0399	0.0512 J	0.264	0.265	ND (0.025) J	ND (0.025)	ND (0.025) J	ND (0.0051)
Dissolved Metals															
Aluminum (dissolved)	ug/L	2.2	5.6	5.4	4.4	4.2	3	2.3	5	1.8	1.3	1.3	1.4	1.2	ND (1)
Antimony (dissolved)	ug/L	0.15	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Arsenic (dissolved)	ug/L	0.41	1.3	1.33	1.69	1.66	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.23	0.27	0.23	0.22
Barium (dissolved)	ug/L	14.5	7.33	8.04	11.5	10.5	1.63	1.23	1.32	2.22	2.21	36.9	49.6	34.9	28.4
Beryllium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Boron (dissolved)	ug/L	131	146	90	90	123	ND (10)	ND (10)	ND (10)	10	10	375	299	381	427
Cadmium (dissolved)	ug/L	0.0267	0.0171	0.018	0.0285	0.0407	ND (0.005)	ND (0.005)	ND (0.005)	0.0052	ND (0.005)	0.0903	0.144	0.139	0.1
Hardness < 30 mg/L	ug/L							ND (0.005)							
Hardness 30 - < 90 mg/L	ug/L						ND (0.005)		ND (0.005)	0.0052	ND (0.005)				
Hardness 90 - < 150 mg/L	ug/L		0.0171												
Hardness 150 - < 210 mg/L	ug/L	0.0267		0.018											0.1
Hardness >= 210 mg/L	ug/L				0.0285	0.0407						0.0903	0.144	0.139	
Caesium (dissolved)	ug/L	0.128	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Calcium (dissolved)	ug/L	67000	49600	61200	82200	75800	11400	9480	11400	16800	16900	67100	104000	65900	57600
Chromium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.24	0.12	0.17	0.17	0.18	0.14	0.13	0.12	ND (0.1)
Cobalt (dissolved)	ug/L	0.28	ND (0.1)	ND (0.1)	0.12	0.13	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	1.49	2.09	1.71	1.35
Copper (dissolved)	ug/L	3.26	ND (0.2)	ND (0.2)	0.24	0.42	ND (0.2)	1.58	ND (0.2)	ND (0.2)	ND (0.2)	11.8	13.1	19.2	13.3
Hardness < 50 mg/L	ug/L						ND (0.2)	1.58	ND (0.2)						
Hardness 50 - < 75 mg/L	ug/L									ND (0.2)	ND (0.2)				
Hardness 75 - < 100 mg/L	ug/L														
Hardness 100 - < 125 mg/L	ug/L														
Hardness 125 - < 150 mg/L	ug/L		ND (0.2)												
Hardness 150 - < 175 mg/L	ug/L														
Hardness 175 - < 200 mg/L	ug/L	3.26		ND (0.2)											13.3
Hardness >= 200 mg/L	ug/L				0.24	0.42						11.8	13.1	19.2	
Iron (dissolved)	ug/L	32	217	163	239	224	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	30	62	33	26
Lead (dissolved)	ug/L	0.073	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.056	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Hardness < 50 mg/L	ug/L						ND (0.05)	ND (0.05)	ND (0.05)						
Hardness 50 - < 100 mg/L	ug/L									0.056	ND (0.05)				
Hardness 100 - < 200 mg/L	ug/L	0.073	ND (0.05)	ND (0.05)											ND (0.05)
Hardness 200 - < 300 mg/L	ug/L				ND (0.05)	ND (0.05)						ND (0.05)		ND (0.05)	
Hardness >= 300 mg/L	ug/L												ND (0.05)		
Lithium (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Magnesium (dissolved)	ug/L	7560	4900	6140	9040	8740	1820	1380	1760	2270	2240	14200	20800	13300	11900
Manganese (dissolved)	ug/L	1710*	598	686	1060	1040	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	2680*	3950*	2610*	2170*
Mercury (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0054	0.0077	ND (0.005)
Molybdenum (dissolved)	ug/L	0.567	0.22	0.193	0.173	0.168	0.143	0.137	0.125	0.111	0.099	0.664	0.583	0.706	0.702
Nickel (dissolved)	ug/L	1.47	ND (0.5)	0.6	1.06	1.28	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	1.68	2.37	4.52	2.54
Hardness < 60 mg/L	ug/L						ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)				
Hardness 60 - < 120 mg/L	ug/L														
Hardness 120 - < 180 mg/L	ug/L		ND (0.5)	0.6											
Hardness >= 180 mg/L	ug/L	1.47			1.06	1.28						1.68	2.37	4.52	2.54
Phosphorus (dissolved)	ug/L	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Potassium (dissolved)	ug/L	6250	2270	2600	3110	2980	209	127	129	194	189	11800	13200	11000	9430
Rubidium (dissolved)	ug/L	2.29	0.53	0.47	0.61	0.52	0.23	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	0.55	0.59	0.55	0.44
Selenium (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.151	ND (0.05)	0.079	0.129	0.111	ND (0.05)	0.055	ND (0.05)	ND (0.05)
Silicon (dissolved)	ug/L	7030	6670	6680	7640	7220	3740	3580	3370	3950	3900	13000	14200	13400	13700
Silver (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Hardness <= 100 mg/L	ug/L						ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)				
Hardness > 100 mg/L	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)						ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Sodium (dissolved)	ug/L	15900	11200	16300	16600	13700	1230	1030	1110	1310	1270	49900	50700	41500	34500
Strontium (dissolved)	ug/L	258	116	135	198	187	16.9	13.8	17.9	24.8	23.9	315	481	326	266
Sulfur (dissolved)	ug/L	2110	1120	590	1140	1200	840	ND (500)	580	940	850	890	900	1020	930
Tellurium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Thallium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Thorium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tin (dissolved)	ug/L	0.1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Titanium (dissolved)	ug/L	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)
Tungsten (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Uranium (dissolved)	ug/L	0.117	0.082	0.098	0.131	0.121	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.439	0.538	0.403	0.357
Vanadium (dissolved)	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	1.57	1.43	1.12	1.19	1.19	1.72	1.79	1.81	1.7
Zinc (dissolved)	ug/L	3.2	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	1.4	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Hardness < 90 mg/L	ug/L						ND (1)	1.4	ND (1)	ND (1)	ND (1)				
Hardness 90 - < 100 mg/L	ug/L														
Hardness 100 - < 200 mg/L	ug/L	3.2	ND (1)	ND (1)											ND (1)
Hardness 200 - < 300 mg/L	ug/L				ND (1)	ND (1)						ND (1)		ND (1)	
Hardness 300 - < 400 mg/L	ug/L												ND (1)		
Zirconium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Table 5.9

Groundwater Analytical Results - General Chemistry, Nutrients and Metals
2020 Annual Operations and Monitoring Report
Campbell River Waste Management Centre
Campbell River, British Columbia

Sample Location:		MW03-18	MW03-18	MW03-18	MW03-18	MW03-18	MW03-18	MW04-19	MW04-19	MW04-19	MW04-19
Sample ID:		WG-11209296-030220-NT-15	WG-11209296-030220-NT-17	WG-11209296-260520-NT-11	WG-11209296-260520-NT-12	WG-11209296-250820-NT-12	WG-11209296-241120-CT-13	WG-11209296-030220-NT-14	WG-11209296-260520-NT-09	WG-11209296-250820-NT-14	WG-11209296-241120-CT-10
Sample Date:		02/03/2020	02/03/2020 Duplicate	05/26/2020	05/26/2020 Duplicate	08/25/2020	11/24/2020	02/03/2020	05/26/2020	08/25/2020	11/24/2020
Parameters	**Units**										
Field Parameters											
Conductivity, field	uS/cm	483	483	131	131	134	247	108	121	117	111
Oxidation reduction potential (ORP), field	millivolts	310	310	194	194	313	180	278	130	152	144
pH, field	s.u.	7.04	7.04	7.77	7.77	7.51	7.96	8.40	8.35	8.18	8.30
Temperature, field	Deg C	9.03	9.03	11.80	11.80	11.72	10.99	8.07	8.80	12.19	9.44
Total dissolved solids, field (TDS)	mg/L	314	314	85	85	87	160	70	79	76	72
Turbidity, field	NTU	0.4	0.4	0.3	0.3	0	0.6	>800	98.7	564	297
General Chemistry											
Alkalinity, bicarbonate	mg/L	89.5	89.1	66.3	66.9	72.1 J	128	66.7	59.3	61.8	51.8
Alkalinity, carbonate	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, hydroxide	mg/L	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	89.5	89.1	66.3	66.9	72.1 J	128	66.7	59.3	61.8	51.8
Chloride	mg/L	1.64	1.65	1.50	1.50	2.35 J	5.48	3.30	3.31	3.30	2.79
Conductivity	uS/cm	172	172	142	142	153 J	261	136	139	142	117
Fluoride	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	0.023	0.021	0.022	0.020
Hardness < 50 mg/L	mg/L										
Hardness >= 50 mg/L	mg/L	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	0.023	0.021	0.022	0.020
Hardness	mg/L	-	-	-	-	-	128	-	-	-	51.0
Hardness (dissolved)	mg/L	84.5	84.7	68.4	68.5	74.0	-	58.6	64.0	60.9	-
pH, lab	s.u.	8.10 J	8.10 J	8.11 J	8.10 J	8.15 J	8.25	8.10 J	8.19 J	8.22	8.11
Sulfate	mg/L	2.70	2.71	3.01	3.01	2.57 J	2.78	4.76	3.74	3.81	3.39
Hardness <= 30 mg/L	mg/L										
Hardness 31 - 75 mg/L	mg/L			3.01	3.01	2.57 J		4.76	3.74	3.81	3.39
Hardness 76 - 180 mg/L	mg/L	2.70	2.71				2.78				
Hardness > 180 mg/L	mg/L										
Total dissolved solids (TDS)	mg/L	104	115	89	91	82 J	163	102	96	98	95
Total organic carbon (TOC)	mg/L	-	-	-	-	-	-	-	-	-	-
Nutrients											
Ammonia-N	mg/L	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)	0.0104	ND (0.0050)	ND (0.0050)	ND (0.0050)
pH < 7.0	mg/L										
pH 7.0 - < 7.5	mg/L	ND (0.0050)	ND (0.0050)								
pH 7.5 - < 8.0	mg/L			ND (0.0050)	ND (0.0050)	ND (0.0050) J	ND (0.0050)				
pH 8.0 - < 8.5	mg/L							0.0104	ND (0.0050)	ND (0.0050)	ND (0.0050)
pH >= 8.5	mg/L										
Nitrate (as N)	mg/L	0.158	0.158	0.160	0.162	0.122 J	0.171	0.189	0.192	0.191	0.200
Nitrite (as N)	mg/L	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)
Chloride < 2 mg/L	mg/L	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)						
Chloride 2 - < 4 mg/L	mg/L					ND (0.0010) J		ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)
Chloride 4 - < 6 mg/L	mg/L						ND (0.0010)				
Chloride 6 - < 8 mg/L	mg/L										
Chloride >= 10 mg/L	mg/L										
Nitrite/Nitrate	mg/L	0.158	0.158	0.160	0.162	0.122 J	0.171	0.189	0.192	0.191	0.200
Dissolved Metals											
Aluminum (dissolved)	ug/L	4.6	5.2	5.6	5.7	5.1	3.6	28.6	5.7	11.4	6.6
Antimony (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Arsenic (dissolved)	ug/L	0.53	0.59	0.61	0.64	0.63	0.47	0.49	0.37	0.42	0.5
Barium (dissolved)	ug/L	2.15	2.21	1.84	1.89	2.04	3.7	5.51	5.35	5.23	5.1
Beryllium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Boron (dissolved)	ug/L	29	30	20	19	16	24	ND (10)	ND (10)	ND (10)	ND (10)
Cadmium (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0095	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Hardness < 30 mg/L	ug/L										
Hardness 30 - < 90 mg/L	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)		ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Hardness 90 - < 150 mg/L	ug/L						0.0095				
Hardness 150 - < 210 mg/L	ug/L										
Hardness >= 210 mg/L	ug/L										
Caesium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Calcium (dissolved)	ug/L	29900	29900	24200	24100	26100	44800	16300	17800	16700	14100
Chromium (dissolved)	ug/L	0.26	0.29	0.27	0.29	0.26	0.26	6.23	6.69	6.35	2.62
Cobalt (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Copper (dissolved)	ug/L	0.32	0.35	ND (0.2)	0.21	0.25	3.51	ND (0.2)	ND (0.2)	0.63	0.27
Hardness < 50 mg/L	ug/L										
Hardness 50 - < 75 mg/L	ug/L			ND (0.2)	0.21	0.25		ND (0.2)	ND (0.2)	0.63	0.27
Hardness 75 - < 100 mg/L	ug/L	0.32	0.35								
Hardness 100 - < 125 mg/L	ug/L										
Hardness 125 - < 150 mg/L	ug/L						3.51				
Hardness 150 - < 175 mg/L	ug/L										
Hardness 175 - < 200 mg/L	ug/L										
Hardness >= 200 mg/L	ug/L										
Iron (dissolved)	ug/L	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	16	ND (10)	ND (10)	ND (10)
Lead (dissolved)	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Hardness < 50 mg/L	ug/L										
Hardness 50 - < 100 mg/L	ug/L	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)		ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Hardness 100 - < 200 mg/L	ug/L						ND (0.05)				
Hardness 200 - < 300 mg/L	ug/L										
Hardness >= 300 mg/L	ug/L										
Lithium (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Magnesium (dissolved)	ug/L	2370	2470	1950	2010	2160	3990	4350	4740	4690	3860
Manganese (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.7	0.41	0.1	ND (0.1)
Mercury (dissolved)	ug/L	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Molybdenum (dissolved)	ug/L	0.117	0.142	0.164	0.185	0.149	0.116	0.546	0.219	0.213	0.17
Nickel (dissolved)	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)
Hardness < 60 mg/L	ug/L							ND (0.5)			ND (0.5)
Hardness 60 - < 120 mg/L	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)			ND (0.5)	ND (0.5)	
Hardness 120 - < 180 mg/L	ug/L						ND (0.5)				
Hardness >= 180 mg/L	ug/L										
Phosphorus (dissolved)	ug/L	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)
Potassium (dissolved)	ug/L	562	571	532	554	587	747	1000	852	852	962
Rubidium (dissolved)	ug/L	ND (0.2)	0.22	ND (0.2)	ND (0.2)	0.21	0.24	0.35	0.4	0.44	0.58
Selenium (dissolved)	ug/L	0.083	0.197	0.16	0.128	0.162	0.127	0.273	0.305	0.322	0.218
Silicon (dissolved)	ug/L	3730	3860	4060	4090	4310	4500	6610	7300	7690	7280
Silver (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Hardness <= 100 mg/L	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)		ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Hardness > 100 mg/L	ug/L						ND (0.01)				
Sodium (dissolved)	ug/L	2310	2390	2450	2540	3070	3390	4070	4020	3640	3280
Strontium (dissolved)	ug/L	45.2	44.7	39.1	37.2	43	77.8	37.9	38.7	40.9	32.7
Sulfur (dissolved)	ug/L	750	780	ND (500)	580	560	740	1370	880	1290	840
Tellurium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Thallium (dissolved)	ug/L	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Thorium (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tin (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Titanium (dissolved)	ug/L	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	ND (0.3)	0.88	ND (0.3)	ND (0.3)	ND (0.3)
Tungsten (dissolved)	ug/L	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Uranium (dissolved)	ug/L	0.074	0.078	0.039	0.04	0.047	0.09	0.169	0.147	0.151	0.107
Vanadium (dissolved)	ug/L	2.45	2.45	2.99	2.98	3	2.3	3.93	5.13	4.75	4.68
Zinc (dissolved)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Hardness < 90 mg/L	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)		ND (1)	ND (1)	ND (1)	ND (1)
Hardness 90 - < 100 mg/L	ug/L										
Hardness 100 - < 200 mg/L	ug/L						ND (1)				
Hardness 200 - < 300 mg/L	ug/L										
Hardness 300 - < 400 mg/L	ug/L										
Zirconium (dissolved)	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)

Table 5.10

Groundwater Analytical Results - Volatile Organic Compounds and Petroleum Products
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Sample Location:				AG99-06	AG99-06	EBA04-7	EBA04-7	EBA11-1	EBA11-1	EBA11-3	EBA11-3
Sample ID:				WG-11209296-020220-NT-07	WG-11209296-250820-NT-17	WG-11209296-030220-NT-19	WG-11209296-240820-NT-08	WG-11209296-030220-NT-18	WG-11209296-240820-NT-06	WG-11209296-020220-NT-06	WG-11209296-250820-NT-15
Sample Date:		BC CSR		02/02/2020	08/25/2020	02/03/2020	08/24/2020	02/03/2020	08/24/2020	02/02/2020	08/25/2020
Parameters	Units	DW a	FAW b								
Volatile Organic Compounds											
1,1,1,2-Tetrachloroethane	ug/L	6	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
1,1,1-Trichloroethane	ug/L	8000	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
1,1,2,2-Tetrachloroethane	ug/L	0.8	--	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2)
1,1,2-Trichloroethane	ug/L	3	--	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
1,1-Dichloroethane	ug/L	30	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
1,1-Dichloroethene	ug/L	14	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
1,2-Dichlorobenzene	ug/L	200	7	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
1,2-Dichloroethane	ug/L	5	1000	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
1,2-Dichloropropane	ug/L	4.5	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
1,3-Dichlorobenzene	ug/L	--	1500	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
1,4-Dichlorobenzene	ug/L	5	260	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Benzene	ug/L	5	400	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
Bromodichloromethane	ug/L	100	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Bromoform	ug/L	100	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Carbon tetrachloride	ug/L	2	130	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
Chlorobenzene	ug/L	80	13	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Chloroethane	ug/L	--	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Chloroform (Trichloromethane)	ug/L	100	20	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Chloromethane (Methyl chloride)	ug/L	--	--	ND (5)	ND (5)	ND (5)	ND (5) J	ND (5)	ND (5) J	ND (5)	ND (5)
cis-1,2-Dichloroethene	ug/L	8	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
cis-1,3-Dichloropropene	ug/L	--	--	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
cis-1,3-Dichloropropene/trans-1,3-Dichloropropene	mg/L	--	--	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010)
Dibromochloromethane	ug/L	100	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Ethylbenzene	ug/L	140	2000	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
m&p-Xylenes	ug/L	--	--	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
Methyl tert butyl ether (MTBE)	ug/L	95	34000	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
Methylene chloride	ug/L	50	980	ND (5)	ND (5)	ND (5)	ND (5) J	ND (5)	ND (5) J	ND (5)	ND (5)
o-Xylene	ug/L	--	--	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
Styrene	ug/L	800	720	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
Tetrachloroethene	ug/L	30	1100	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Toluene	ug/L	60	5	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45) J	ND (0.45)	ND (0.45) J	ND (0.45)	ND (0.45)
trans-1,2-Dichloroethene	ug/L	80	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
trans-1,3-Dichloropropene	ug/L	--	--	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5) J	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)
Trichloroethene	ug/L	5	200	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Trichlorofluoromethane (CFC-11)	ug/L	1000	--	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J	ND (1)	ND (1)
Vinyl chloride	ug/L	2	--	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.4) J	ND (0.4)	ND (0.4) J	ND (0.4)	ND (0.4)
Xylenes (total)	ug/L	90	300	ND (0.75)	ND (0.75)	ND (0.75)	ND (0.75) J	ND (0.75)	ND (0.75) J	ND (0.75)	ND (0.75)
Petroleum Products											
VHw6-10	ug/L	15000	15000	ND (100)	ND (100)	ND (100)	ND (100) J	ND (100)	ND (100) J	ND (100)	ND (100)
VPHw	ug/L	--	1500	ND (100)	ND (100)	ND (100)	ND (100) J	ND (100)	ND (100) J	ND (100)	ND (100)

Table 5.10

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Sample Location:		EBA11-4	EBA11-4	HBT94-2	HBT94-2	MW01-16	MW01-16	MW02-18	MW02-18
Sample ID:		WG-11209296-020220-NT-08	WG-11209296-250820-NT-16	WG-11209296-030220-NT-21	WG-11209296-250820-NT-20	WG-11209296-020220-NT-01	WG-11209296-240820-NT-01	WG-11209296-020220-NT-04	WG-11209296-240820-NT-04
Sample Date:		02/02/2020	08/25/2020	02/03/2020	08/25/2020	02/02/2020	08/24/2020	02/02/2020	08/24/2020
Parameters	**Units**								
Volatile Organic Compounds									
1,1,1,2-Tetrachloroethane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
1,1,1-Trichloroethane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
1,1,2,2-Tetrachloroethane	ug/L	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2) J	ND (0.2)	ND (0.2) J
1,1,2-Trichloroethane	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
1,1-Dichloroethane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
1,1-Dichloroethene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
1,2-Dichlorobenzene	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
1,2-Dichloroethane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
1,2-Dichloropropane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
1,3-Dichlorobenzene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
1,4-Dichlorobenzene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Benzene	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
Bromodichloromethane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Bromoform	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Carbon tetrachloride	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
Chlorobenzene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Chloroethane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Chloroform (Trichloromethane)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Chloromethane (Methyl chloride)	ug/L	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5) J	ND (5)	ND (5) J
cis-1,2-Dichloroethene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
cis-1,3-Dichloropropene	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
cis-1,3-Dichloropropene/trans-1,3-Dichloropropene	mg/L	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010) J	ND (0.0010)	ND (0.0010) J
Dibromochloromethane	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Ethylbenzene	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
m&p-Xylenes	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
Methyl tert butyl ether (MTBE)	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	0.78	ND (0.5) J
Methylene chloride	ug/L	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5) J	ND (5)	ND (5) J
o-Xylene	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
Styrene	ug/L	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
Tetrachloroethene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Toluene	ug/L	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45)	ND (0.45) J	ND (0.45)	ND (0.45) J
trans-1,2-Dichloroethene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
trans-1,3-Dichloropropene	ug/L	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5)	ND (0.5) J	ND (0.5)	ND (0.5) J
Trichloroethene	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Trichlorofluoromethane (CFC-11)	ug/L	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1) J	ND (1)	ND (1) J
Vinyl chloride	ug/L	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.4)	ND (0.4) J	ND (0.4)	ND (0.4) J
Xylenes (total)	ug/L	ND (0.75)	ND (0.75)	ND (0.75)	ND (0.75)	ND (0.75)	ND (0.75) J	ND (0.75)	ND (0.75) J
Petroleum Products									
VHw6-10	ug/L	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100) J	ND (100)	ND (100)
VPHw	ug/L	ND (100)	ND (100)	ND (100)	ND (100)	ND (100)	ND (100) J	ND (100)	ND (100)

Table 5.11

Surface Water Analytical Results
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Sample Location:				SW-1	SW-1	SW-1	SW-1	SW03-17	SW03-17	SW03-17	SW03-17	CAM_SWM Pond**
Sample ID:				**WS-11209296-030220-NT-01**	**WS-11209296-030220-NT-02**	**WS-11209296-260520-NT-01**	**WS-11209296-241120-CT-01**	**WS-11209296-030220-NT-03**	**WS-11209296-260520-NT-02**	**WS-11209296-250820-NT-01**	**WS-11209296-241120-CT-02**	**WS-11209296-241120-CT-03**
Sample Date:			**BC WQG**	**02/03/2020**	**02/03/2020**	**05/26/2020**	**11/24/2020**	**02/03/2020**	**05/26/2020**	**08/25/2020**	**11/24/2020**	**11/24/2020**
		DW	**FAW**		**Duplicate**							
Parameters	**Units**	**a**	**b**									
Field Parameters												
Dissolved Oxygen, Field	mg/L	--	5-999	11.64	11.64	12.21	10.91	12.52	9.51	6.55	9.26	-
ORP, Field	millivolts	--	--	320	320	205	147	336	195	320	155	-
pH, Field	s.u.	--	6.5-9.0	6.71	6.71	7.38	7.18	6.64	7.26	7.08	7.20	-
Specific Conductance, Field	uS/cm	--	--	83	83	44	28	88	28	28	27	-
Temperature, Field	Deg C	15 AO	18 (12 spring/fall) (c) (STM)	2.65	2.65	10.43	6.00	1.17	16.86[a]	18.05[ab]	6.22	-
Total dissolved solids, field (TDS)	mg/L	--	--	53	53	28	18	57	18	18	18	-
Turbidity, Field	NTU	(c)	(c)	0.8	0.8	1.5	0.6	0.7	7.7	0.1	8.1	-
General Chemistry												
Alkalinity, bicarbonate	mg/L	--	--	6.8	6.6	15.0	7.1	7.9	7.3 J+	7.5 J	7.1	158
Alkalinity, carbonate	mg/L	--	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)
Alkalinity, hydroxide	mg/L	--	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0) J	ND (1.0)	ND (1.0)
Alkalinity, total (as CaCO3)	mg/L	--	[e] w	6.8	6.6	15.0	7.1	7.9	7.3 J+	7.5 J	7.1	158
Dissolved Calcium < 4 mg/L	mg/L		0.00001-10 w	6.8	6.6	15.0[a]	7.1	7.9	7.3 J+	7.5 J	7.1	
Dissolved Calcium > 8 mg/L	mg/L		>20 w									158
Chloride	mg/L	250 AO	150	3.34	3.33	3.55	3.41	3.43	3.39	3.42 J	3.40	105
Conductivity	uS/cm	--	--	27.8	27.4	43.8	28.9	29.1	28.8	29.7 J	28.6	791
Fluoride	mg/L	1.5	[b] (STM)	ND (0.020)	ND (0.020)	0.023	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	ND (0.100)
Hardness <= 10 mg/L	mg/L		0.4	ND (0.020)	ND (0.020)		ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020) J	ND (0.020)	
Hardness > 10 - 385 mg/L	mg/L		[b] calcgg (STM)			0.023						ND (0.100)
Hardness	mg/L	--	--	-	-	-	9.09	-	-	-	8.42	134
Hardness (dissolved)	mg/L	--	--	7.67	7.59	15.7	-	8.01	8.33	8.96	-	-
Hardness, calculation	mg/L	--	--	7.70	7.67	16.4	9.05	8.28	8.50	8.65	8.48	151
pH, lab	s.u.	--	6.5-9.0	6.71 J	6.66 J	6.90 J	6.94	6.68 J	6.89 J	6.97 J	6.95	7.86
Sulphate	mg/L	500 AO	[b]	1.02	1.02	0.54	0.83	1.17	0.94	0.81 J	0.82	60.6
Hardness <= 30 mg/L	mg/L		128	1.02	1.02	0.54	0.83	1.17	0.94	0.81 J	0.82	
Hardness 76 - 180 mg/L	mg/L		309									60.6
Total dissolved solids (TDS)	mg/L	--	--	30	31	47	32	32	32	33 J	30	388
Nutrients												
Ammonia-N	mg/L	--	[d]	ND (0.0050)	ND (0.0050)	0.0313	0.0244	0.0061	ND (0.0050)	ND (0.0050) J	0.0094	17.2
Varies with pH and Temperature	mg/L		[d]	ND (0.0050)	ND (0.0050)	0.0313	0.0244	0.0061	ND (0.0050)	ND (0.0050) J	0.0094	17.2
Nitrate (as N)	mg/L	10	3.0	0.0559	0.0544	0.0391	0.0152 J	0.0392	ND (0.0050)	ND (0.0050) J	0.0144 J	0.0740
Nitrite (as N)	mg/L	1	[c]	ND (0.0010)	ND (0.0010)	0.0016	R	ND (0.0010)	ND (0.0010)	ND (0.0010) J	R	0.0388
Chloride 2 - < 4 mg/L	mg/L		0.04	ND (0.0010)	ND (0.0010)	0.0016	R	ND (0.0010)	ND (0.0010)	ND (0.0010) J	R	
Chloride >= 10 mg/L	mg/L		0.20									0.0388
Nitrite/Nitrate	mg/L	--	--	0.0559	0.0544	0.0407	0.0153 J	0.0392	ND (0.0051)	ND (0.0051) J	0.0146 J	0.113
Dissolved Metals												
Aluminum (dissolved)	ug/L	--	[a]	51.5	51.4	88.1	50.8	57.7	31.6	18.8	36.3	34.6
pH >= 6.5	ug/L	50		51.5[a]	51.4[a]	88.1[a]	50.8[a]	57.7[a]	31.6	18.8	36.3	34.6
Antimony (dissolved)	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.46
Arsenic (dissolved)	ug/L	--	--	0.1	ND (0.1)	0.16	0.12	ND (0.1)	ND (0.1)	0.1	0.13	0.77
Barium (dissolved)	ug/L	--	--	1.18	1.17	1.98	1.47	1.18	1.17	1.18	1.45	28.6
Beryllium (dissolved)	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth (dissolved)	ug/L	--	--	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)
Boron (dissolved)	ug/L	--	--	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	147
Cadmium (dissolved)	ug/L	--	[b]	ND (0.005)	ND (0.005)	0.0068	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0216 J
Hardness 3.4 - 285 mg/L	ug/L		[b] calcb	ND (0.005)	ND (0.005)	0.0068	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0216 J
Caesium (dissolved)	ug/L	--	--	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.065
Calcium (dissolved)	ug/L	--	--	1820	1770	3750	2160	1890	1970	2070	1980	45200
Chromium (dissolved)	ug/L	--	--	0.11	0.11	0.26	0.12	0.12	ND (0.1)	ND (0.1)	ND (0.1)	1.12
Cobalt (dissolved)	ug/L	--	--	ND (0.1)	ND (0.1)	0.11	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	2.38
Copper (dissolved)	ug/L	--	--	ND (0.2)	ND (0.2)	0.46	0.25	0.21	0.22	0.2	0.21	3.93
Iron (dissolved)	ug/L	--	350 (STM)	62	60	341	78	90	22	48	58	233
Lead (dissolved)	ug/L	--	--	ND (0.05)	ND (0.05)	0.132	0.051	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.102
Lithium (dissolved)	ug/L	--	--	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Magnesium (dissolved)	ug/L	--	--	760	771	1550	894	798	826	919	844	5180
Manganese (dissolved)	ug/L	--	--	5.69	5.65	32.3	6.29	3.24	3.08	1.44	6.73	810
Mercury (dissolved)	ug/L	--	--	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Molybdenum (dissolved)	ug/L	--	--	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.85
Nickel (dissolved)	ug/L	--	--	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	3.16
Phosphorus (dissolved)	ug/L	--	--	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	ND (50)	55
Potassium (dissolved)	ug/L	--	--	141	131	182	146	126	139	139	139	13800
Rubidium (dissolved)	ug/L	--	--	ND (0.2)	0.23	0.28	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	9.84
Selenium (dissolved)	ug/L	--	--	0.055	ND (0.05)	0.084	0.052	ND (0.05)	0.051	0.054	ND (0.05)	0.129
Silicon (dissolved)	ug/L	--	--	2380	2320	3340	2070	2960	2040	1500	1900	2520
Silver (dissolved)	ug/L	--	--	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Sodium (dissolved)	ug/L	--	--	2300	2340	3030	2460	2360	2460	2810	2470	71900
Strontium (dissolved)	ug/L	--	--	7.6	7.53	14.3	9.47	7.75	8.52	10.1	8.89	204
Sulphur (Dissolved)	ug/L	--	--	ND (500)	ND (500)	ND (500)	-	ND (500)	ND (500)	ND (500)	-	-
Tellurium (dissolved)	ug/L	--	--	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Thallium (dissolved)	ug/L	--	--	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)
Thorium (dissolved)	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tin (dissolved)	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Titanium (dissolved)	ug/L	--	--	1	0.91	3.7	1.4	1.1	ND (0.3)	ND (0.3)	0.52	1.07
Tungsten (dissolved)	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Uranium (dissolved)	ug/L	--	--	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.104
Vanadium (dissolved)	ug/L	--	--	ND (0.5)	ND (0.5)	1.24	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	1.03
Zinc (dissolved)	ug/L	--	--	ND (1)	ND (1)	1.5	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	7.2
Zirconium (dissolved)	ug/L	--	--	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Total Metals												
Aluminum	ug/L	9500	--	58	60.6	123	75.9	71	37.2	21.1	39.4	3600
Antimony	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.53
Arsenic	ug/L	10	5	ND (0.1)	0.11	0.21	0.15	ND (0.1)	0.13	0.12	0.14	1.38
Barium	ug/L	--	1000 w	1.27	1.35	2.04	1.63	1.31	1.29	1.05	1.42	63.4
Beryllium	ug/L	--	0.13 w	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Bismuth	ug/L	--	--	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.057
Boron	ug/L	5000	1200	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	ND (10)	172
Cadmium	ug/L	5	--	ND (0.005)	0.0065	0.0098	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.136
Caesium	ug/L	--	--	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.09
Calcium	ug/L	--	--	1870	1820	3800	2130	1970	1990	2040	2010	50800
Chromium	ug/L	--	--	0.15	0.14	0.35	0.17	0.14	0.2	ND (0.1)	0.1	2.72
Cobalt	ug/L	--	4	ND (0.1)	ND (0.1)	0.12	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	4.62
Copper	ug/L	1000 AO	[b]	ND (0.5)	ND (0.5)	0.54	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	18.2
Hardness < 50 mg/L	ug/L		2	ND (0.5)	ND (0.5)	0.54	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	
Hardness 50 - 250 mg/L	ug/L		[b] calcc									18.2
Iron	ug/L	300 AO	1000 (STM)	90	90	495[a]	116	116	65	30	80	2810
Lead	ug/L	10	[b]	ND (0.05)	ND (0.05)	0.177	0.104	0.058	ND (0.05)	ND (0.05)	ND (0.05)	1.98
Hardness <= 8 mg/L	ug/L		3	ND (0.05)	ND (0.05)							
Hardness > 8 - 360 mg/L	ug/L		[b] calcd			0.177	0.104	0.058	ND (0.05)	ND (0.05)	ND (0.05)	1.98
Lithium	ug/L	--	--	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)
Magnesium	ug/L	--	--	733	761	1670	908	818	858	865	839	5900
Manganese	ug/L	50 AO	[b]	7.93	8.04	39.1	11.4	3.58	6.81	2.58	9.61	1040
Hardness 37 - 450 mg/L	ug/L		[b] calce									1040
Mercury	ug/L	1	[f]	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.0104
Molybdenum	ug/L	250	1000	ND (0.05)	ND (0.05)	0.062	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.928

Table 5.11

Surface Water Analytical Results
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Campbell River Waste Management Centre
Campbell River, British Columbia

Sample Location:				**SW-1**	**SW-1**	**SW-1**	**SW-1**	**SW03-17**	**SW03-17**	**SW03-17**	**SW03-17**	**CAM_SWM Pond****
Sample ID:				**WS-11209296-030220-NT-01**	**WS-11209296-030220-NT-02**	**WS-11209296-260520-NT-01**	**WS-11209296-241120-CT-01**	**WS-11209296-030220-NT-03**	**WS-11209296-260520-NT-02**	**WS-11209296-250820-NT-01**	**WS-11209296-241120-CT-02**	**WS-11209296-241120-CT-03**
Sample Date:		**BC WQG**		**02/03/2020**	**02/03/2020 Duplicate**	**05/26/2020**	**11/24/2020**	**02/03/2020**	**05/26/2020**	**08/25/2020**	**11/24/2020**	**11/24/2020**
Parameters	**Units**	**DW a**	**FAW b**									
Nickel	ug/L	--	[b] w	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	4.53
Hardness <= 60 mg/L	ug/L		25 w	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	
Hardness > 60 - < 180 mg/L	ug/L		[b] calch									4.53
Phosphorus	ug/L	10 AO for lakes	5	ND (50)[ab]	ND (50)[ab]	ND (50)[ab]	ND (50)[ab]	ND (50)[ab]	ND (50)[ab]	ND (50)[ab]	ND (50)[ab]	1070
Potassium	ug/L	--	--	115	128	216	147	119	140	122	130	15300
Rubidium	ug/L	--	--	ND (0.2)	ND (0.2)	0.26	0.26	0.23	0.2	0.2	0.2	10.7
Selenium	ug/L	10	2	0.053	ND (0.05)	0.07	0.051	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	0.458
Silicon	ug/L	--	--	2400	2420	3620	2190	3180	2260	1670	2050	5680
Silver	ug/L	--	[b]	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.017
Hardness < 100 mg/L	ug/L		0.05	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	
Hardness >= 100 mg/L	ug/L		1.5									0.017
Sodium	ug/L	--	--	2320	2490	2940	2640	2490	2520	2520	2610	76000
Strontium	ug/L	--	--	7.72	8.1	15.6	9.38	8.43	9.22	9.1	8.91	241
Sulphur	ug/L	--	--	ND (500)	ND (500)	ND (500)	ND (500)	ND (500)	ND (500)	ND (500)	ND (500)	22200 / 20800
Tellurium	ug/L	--	--	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)
Thallium	ug/L	--	0.8 w SS	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.013
Thorium	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)
Tin	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.2
Titanium	ug/L	--	--	1.74	1.76	6.92	3.53	1.75	0.43	0.35	0.61	116
Tungsten	ug/L	--	--	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.13
Uranium	ug/L	--	8.5 w	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.229
Vanadium	ug/L	--	--	ND (0.5)	ND (0.5)	1.7	0.57	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	9.53
Zinc	ug/L	5000 AO	[b]	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	48.8
Hardness < 90 mg/L	ug/L		7.5	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	ND (3)	
Hardness 90 - 330 mg/L	ug/L		[b] calcf									48.8
Zirconium	ug/L	--	--	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.2)	1.21

Notes:
**The SWM Pond is not compared to the WQGs.

Analytical Results Tables Notes
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Campbell River, British Columbia

Notes:

BC ENV	British Columbia Ministry of Environment and Climate Change Strategy
CSR	ENV British Columbia Contaminated Sites Regulation (CSR) Schedule 3.2 Generic Numerical Water Standards (June, 2018)
WQG	ENV British Columbia Approved (March 2018), Working (June 2017) and Source Drinking (December 2017) Water Quality Guidelines (WQG). Most stringent guideline is presented unless otherwise indicated.
FAW	Guideline/standard for the protection of freshwater aquatic life
DW	Guideline/standard for the protection of drinking water
IW	Guideline/standard for the protection of irrigation water. Applies to all soil types.
LW	Guideline/standard for the protection of livestock water
STM	Short term maximum WQG FAW (generally less stringent than LTA guidelines)
LTA	Long term average WQG FAW (generally most stringent guideline). WQGs presented are LTA unless otherwise specified.
a	WQG DW
b	WQG FAW
c	CSR DW
d	CSR FAW
w	Working WQG. Provides benchmarks for those substances that have not yet been fully assessed and endorsed by the ENV.
Interim	Interim WQG developed when insufficient data available to meet the minimum requirement of a full guideline.
AO	Aesthetic objective. Parameters may impair the taste, smell or colour of water or interfere with the supply of good quality water. Parameters do not cause adverse health effects.
ND	Not detected at the associated reporting limit.
J	Estimated concentration.
R	Rejected result
[a]	Limit varies with pH.
[b]	Limit varies with Hardness.
[c]	Limit varies with Chloride (mg/L).
[d]	Limit varies with pH and Temperature.
[e]	Limit varies with Dissolved Calcium.
[f]	Limit varies with Methyl Mercury.
[h]	Standard varies with pH, temperature and substance isomer.
calca	EXP(1.6-3.327*pH+0.402*pH^2) mg/L
calcb	EXP(0.736*LN(Hardness)-4.943) ug/L
calcc	0.04*Hardness ug/L
calcd	3.31+(Exp(1.273*LOG(Hardness)-4.704)) ug/L
calce	0.0044*Hardness+0.605 mg/L
calch	Exp(0.76*LN(Hardness)+1.06) ug/L
calcf	7.5+(0.75*(Hardness-90)) ug/L
[i]	Cobalt concentrations in groundwater do not exceed the referenced cobalt interim background groundwater concentration estimate. Standard confirmed in email received from ENV, November 7, 2017.
[j]	Limit varies with dissolved calcium
[l]	Limit varies with crop.
{ii}	Standard varies with pH, temperature and substance isomer. Consult a director for further advice.
	Exceeds indicated standard or guideline
Blue text	Laboratory detection limit is greater than indicated standard or guideline
(c)	Background dependent. Comparison to background not complete or background location has not been established.
SS	Site-specific objective for the lower Columbia River, BC
Dissolved Oxygen, field	WQG specific to buried embryo/alevin life stages of aquatic life (most conservative).
Temperature, field (stream)	WQG specific to streams with unknown fish distributions.
Temperature, field (lake/impou	WQG specific to lakes/impoundments.
Turbidity, field	WQG applies to water during clear flows or clear water
Cadmium, dissolved	WQG LTA applies to water hardnesses between 3.4 and 285 mg/L CaCO3.
Copper, total	WQG LTA applies to water hardnesses between 50 and 250 mg/L CaCO3.
Lead, total	WQG LTA and STM apply to water hardnesses between 8 and 360 mg/L CaCO3.
Manganese, total	WQG LTA applies to water hardnesses between 37 and 450 mg/L CaCO3.
Phosphorous, total (lakes)	WQG applies to total phosphorous in lakes where salmonoids are predominant fish species and during the spring overturn (if residence time of the epilimnetic water exceeds 6 months) or the mean phosphorous epilimnetic growing season concentration (if time of the epilimnetic water is less than 6 months) residence
Selenium, total	Alert concentration = 1 ug/L.
Zinc, total	WQG LTA applies to water hardnesses between 90 and 330 mg/L CaCO3.

about GHD

GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. We provide engineering, environmental, and construction services to private and public sector clients.

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