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Hartland Landfill Groundwater, Surface Water and Leachate Monitoring Program Annual Report

(April 2019 to March 2020)

Capital Regional District

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Quality information

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Executive Summary

Based on our review of historical data and interpretation of groundwater, surface water and leachate quality data collected between April 2019 and March 2020, the annual monitoring program provides an effective assessment of landfill performance and compliance related to groundwater, surface water and leachate flow and quality. The following conclusions are drawn based on our interpretation of the 2019/20 data.

Groundwater Flow

The groundwater level information collected in 2019/20 revealed the following:

- Groundwater flow in 2019/20 generally followed previously established patterns. Regional groundwater flows from Mount Work northeast to the north-south trending valley that underlies the northern portions of the Phase 1 and Phase 2 landfill. The majority of groundwater flow is northward.
- Most of the northward groundwater flow in the bedrock below the landfill is captured by the Toutle Valley Underdrain, Phase 2 basin leachate collection system, springs discharging to the lower lagoon and the north purge well systems (wells P7, P8, and P9). Northward groundwater flow conditions are similar to previous years.
- In 2019/20, a total of 24,494 m^3 of leachate was removed by the north purge wells, which was slightly lower than that reported in 2018/19 (25,578 m^3) and higher than that reported in 2017/18 (21,092 m^3). Leachate discharge rates increased significantly in January and February 2020, in response to intense precipitation. A total of 7,438 m^3 of leachate was collected by north purge wells during that period, with the average daily leachate flows ranged from 96 to 232 m^3/day.
- The average water levels in 52-4-0-P7 was 112.1 m ASL in 2019/20 and were approximately 1.0-1.5 m lower than those reported in 2018/19. However, the lower water levels in 80-1-0-P7 was primarily due to the pressure transducer re-calibration. Water levels in 52-4-0-P7 remained relatively stable since the re-calibration of pressure transducer in October 2018. The average water levels in the north purge wells 80-1-0-P8 and 81-1-0-P9 were 113.09 and 118.9 m ASL, which were generally consistent with those reported in 2018/19. Water levels in P9 were still relatively high compared to P7 and P8, consideration should be given to either increasing the pumping rates or adjusting set points to achieve the groundwater elevations required to maintain pumping levels below the lower leachate lagoon and collect more of the leachate migrating from the area around the landfill gas plant toward the lower leachate lagoon. Overall, surrounding groundwater quality indicates successful leachate containment in this area.
- A small amount of groundwater flows southeastward from the south end of Phase 1 in the direction of Killarney Lake. Southeastward groundwater flow below the landfill is constrained by a constructed clay berm and bedrock grout curtain installed at the south end of the landfill and by drawdown cones associated with the south purge wells (P1, P2, P3, P4 and P10). In 2018/19, water levels in P2, P3, P4 and P10 were similar to those in 2018/19, and remained below 140 m ASL. To address fouling of P1, the well was re-installed at a shallower depth, while maintaining similar or higher leachate collection rates of 1.01 L/s throughout 2019/20. In April 2020, pressure transducer in P1 was re-calibrated to the correct water levels and resulted in approximately 2m change in water level readings. In 2019/20, the water levels in P1 generally remained stable, with average value of 148.05m ASL. Note that the pressure transducer was placed on top of P2 pump at elevation of 136 m ASL after the pump was back to service in May 2020.
- In 2019/20, a total of 32,418 m^3 leachate was removed by the south purge wells, which was 22% lower than the volume removed in 2018/19 (41,568 m^3). The average daily flow in 2019/20 was 92.1 m^3/day, which was approximately 45% lower than that in 2018/19. The reduced volume of leachate collected by the south purge wells may be related to the malfunction of P2 as well as the relatively dry winter. The peak flows (600 m^3/day) were observed in February 2020, in response to intense precipitation events. Water level monitoring in all of the south purge wells should continue to confirm that the south purge wells are functioning properly.
- Groundwater monitors east of Phase 1 (locations 54, 76, 17 and 18) confirm flow from east to west toward the landfill, preventing off-site migration to the east. In 2019/20, water levels in 18-1-1 remained within historical levels, indicating westward hydraulic gradients were restored. Groundwater elevations at location 17,18, 54 and 76 should continue to be closely monitored.

- Similar to previous years, groundwater elevations in the North Ridge area exhibited strong seasonal fluctuations in 2019/20, and the Highland fault continued to function as a barrier to eastward moving groundwater. During the wet fall, winter and early spring months, the horizontal hydraulic gradients between 87, 88 and 62 were steeper and exhibits a more prominent groundwater divergence than is apparent in the summer. In November 2019, four new groundwater monitoring wells (91-1-1, 92-1-1, 93-1-1 and 94-1-1) were installed in North Ridge area, to increase spatial coverage of groundwater monitoring and further define the groundwater divergence and overall groundwater flow regime at Hartland.
- In 2018, geologic mapping of exposed bedrock revealed a number of closed depressions and geologic structures that enhance groundwater recharge below the North Ridge. A pattern of divergent groundwater flow beneath the North Ridge has been confirmed, with a component of flow migrating to the east, south and north. Although a weak groundwater divide is currently present, inward (southward) flow must be maintained to preserve the hydraulic trap leachate containment system. To ensure leachate containment, it is necessary to continue close monitoring of this hydraulic divide and conduct detailed planning (including hydrogeologic modelling) prior to landfill development in this area. Engineered solutions may be required following blasting, levelling and development of the North Ridge to maintain the current level of infiltration and the elevation of the groundwater divergence.

Leachate Level Assessment

- Leachate mounding continues to be present in Phase 1 of the landfill. Leachate elevations in Phase 1 were generally stable and exhibited minor seasonal variations. The leachate mound in the upper portion of the refuse is interpreted as being ‘perched’ above the regional bedrock groundwater flow system, with relatively high water levels and strong downward hydraulic gradients. Between 2015 and 2020, most of leachate elevations in the upper portion of the refuse remained below 155 m, indicating an approximate 5 m decrease in the elevation of the leachate mound since closure in 1997. The highest leachate elevations (155 – 157 m ASL) were typically observed in the east/southeast of the Phase 1(i.e., 48-1-1, VLGW-004D, VLGW-011S), which corresponds with the higher topography/refuse heights. Leachate levels in deeper parts of the refuse respond to seasonal recharge events, indicating that the lower portions of the Phase 1 landfill are in hydraulic connection with the regional groundwater flow system in bedrock.
- Leachate well 89-1-1 was screened at the bottom of the refuse, and water levels rapidly increased by approximately 4m between August 2019 and November 2019. Although the strong water level fluctuations in 89-1-1 were consistent with the seasonal fluctuations observed in other landfill gas wells screened in bedrock, the leachate levels in 89-1-1 may be impacted from leachate entering the standpipe through the breaks in the wells. Moreover, it is suspected that refuse and other material may have entered the well through the break and may be clogging the well screen, which could create artificially high leachate levels.
- Leachate elevations in Phase 2 (Phase 2 Basin) are generally stable and typically around 113 m ASL. 90-2-1 had either dry condition or only few centimeters of leachate above the well screen, ranged from <133.79 to 133.90 m ASL. However, the higher leachate levels (i.e., >125 m ASL) in 82-1-1 and 83-1-1 suggests presence of the localized leachate mound in the northern Phase 2 area. The higher leachate elevations in this area may be a result of the presence of bedrock knob located at the west boundary of Phase 2 – Cell1, which constrains the eastward groundwater/leachate flow below this area. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, and significant leachate mounding has not been observed in the Phase 2 landfill to date.

Groundwater Quality

The groundwater quality results for 2019/20 were similar to those measured over recent years and leachate-impacted groundwater is contained within the landfill property. At the north end of the landfill, leachate-affected groundwater extends just north of the unlined lower leachate lagoon and through the middle of the lined upper leachate lagoon but does not extend off-site. South of the landfill, leachate-affected groundwater does not extend off-site. Leachate related exceedances are confined to the landfill footprint on the east side of Phase 1 and are inferred to extend to the west side of the Phase 2 landfill.

Similar to 2018/19, the occasionally elevated sulphate concentrations in groundwater quality near the Hartland North pad was attributed to nearby construction activities associated with development of the residuals treatment facility, but impacts were restricted to the footprint of the Hartland North pad.

In 2019/20, chloride concentrations in multiple groundwater wells located along the southern and eastern boundaries exhibited increasing statistical trends, and this temporary impact may be a result of application of Garlon™ XRT herbicides in May/June 2020.

In 2019/20, groundwater quality in north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) and surrounding wells were slightly degraded compared to 2018/19, with higher conductivity and ammonia concentrations. The degradation of groundwater quality may be related to less dilution related to improved surface water diversion as well as low pumping rates observed at P7 during winter months in 2018/19 and continuing into 2019/20. The degradation of water quality at some locations on the Hartland North pad due to ongoing construction activities in this area.

Similar to north purge wells, groundwater quality data collected from the south purge wells (P1, P2, P3, P4 and P10) also indicated the water deteriorating over time. In 2019/20, average conductivity values in all south purge wells were higher than those in 2018/19, which is consistent with the decreased leachate flow.

Our review of the 2019/20 groundwater quality data revealed the following:

Comparison to CSR AW and DW Standards

- Compliance monitoring wells and off site monitoring wells met CSR AW and DW standards. All other CSR exceedances in groundwater were observed in on-site monitoring wells in close proximity to the waste footprint, known leachate sources and leachate purge wells.
- Groundwater quality in new well 92-1-1 (Hartland North Pad) marginally exceeded CSR DW standards for aluminum, lithium, lead and vanadium during one sampling event. However, lithium concentrations were well below the regional background concentration of 33 µg/L, therefore is not considered as contaminant concern.

North of the Landfill

- In 2019/20, annual average conductivity in the north purge wells were 3,123 µS/cm (52-4-0-P7), 1,566 µS/cm (80-1-0-P8) and 976 µS/cm (81-1-0-P9) were higher than those in 2018/19, suggesting the slightly degradation of leachate quality. This may be a result of the low well yield in P7 as well as the prolonged dry period during the winter. Water quality at these wells should be closely monitored to monitor temporal changes in leachate quality and verify the effectiveness of leachate collection system.
- Operation of the Phase 1 north purge well system continues to mitigate leachate impacts north of the landfill, as indicated by long-term stable or decreasing concentrations of leachate indicator parameters at locations 40, 20 and 21. However, the average conductivity at location 21 and 40 were approximately 20% higher than those measured in 2018/19, indicating the slightly degradation of water quality. This may be related to prolonged dry period as well as slow flow rate of purge well P7. The north purge wells should continue to reinforce leachate containment and conveyance measures north of Phase 1 by maintaining water levels below the average elevation of the lower leachate lagoon. Groundwater at station 21 remained relatively stable or slightly improved throughout 2019/20. Progressive closure of Phase 1 Cell 1, commissioning of 81-1-0-P9 as a purge well, and dewatering of the lower leachate lagoon to facilitate repairs to leachate conveyance infrastructure appeared to improve groundwater quality around the lower leachate lagoon. Groundwater quality at station 20, 21 and 40 should continue to be closely monitored.
- In 2019/20, water quality at locations 29 and 30 continued to be slightly impacted by road salt application on Willis Point Road, but all parameters were below applicable CSR standards. Concentrations of conductivity and chloride show seasonal fluctuations and exhibit the highest concentrations in winter months, while ammonia concentrations remain relatively low. This suggests that road salt is the primary contributor to water quality degradation north of Willis Point Road. Statistically significant decreasing trends in conductivity and chloride indicate continued improvement in groundwater quality at these locations over the past five years.
- Groundwater quality between the lower leachate lagoon and Willis Point Road continued to show no indications of leachate impacts in 2019/20. All leachate indicator parameters at compliance location 31 remained relatively stable and low, and met applicable CSR AW and DW standards.

- Groundwater quality at locations 36 and 37 indicate minimal impacts to leachate indicator parameters in consideration of their proximity to the Phase 2 basin. Overall, this supports the hydraulic data which indicates that the hydraulic trap leachate collection system is effective at containing leachate north of Phase 2.
- Groundwater quality 100 m north of Phase 2 at locations 25 and 53 continued to show low concentrations of leachate indicator parameters in 2019/20, indicating water quality is not affected by landfill leachate. Groundwater in this area is highly sensitive to slight water level changes and a future hydraulic trap reversal would have the potential to result in northward leachate migration. As such, water levels and quality in this area should continue to be closely monitored for changes.
- Groundwater quality in the shallow well at location 27 (27-1-2) continued to be affected by ongoing aggregate production and blasting activity close to the Toutle Valley, as indicated by elevated conductivity, sulphate and nitrate concentrations. Sulphate continued to be present at concentrations above background concentrations in 2019/20, but continued to decrease from the peak values observed in May 2016. The deep well at this location (27-1-1) shows no signs of impacts from aggregate production.
- Due to the recent construction activities north of Phase 2, upgradient monitoring locations 77 and 78 are no longer considered to be background wells. Groundwater quality at 78 exhibited minor impact from the RTF construction, with increased sulphate and nitrate concentrations. Groundwater quality at 77 remained relatively stable and was not impacted by construction activities.

Hartland North Pad

- Groundwater quality in 43-1-1 located on the Hartland North pad exceeded the BC CSR standard for ammonia and BC CSR DW standard for chloride during the May 2018 sampling event but returned to historical values during all 2019/20 sampling events. The anomalous water quality in 43-1-1 during the May 2018 sampling event may be due to a variety of effects but the concentrations returned to normal by Fall 2018. Groundwater quality in adjacent well 44-1-1 was also slightly degraded, with elevated sulphate concentrations. Groundwater quality at all stations downgradient of the Hartland North Pad should continue to be monitored closely for changes in water quality.
- Groundwater quality in 91-1-1, 92-1-1 and 88-2-1 located on Hartland North Pad showed minor impacted by RTF construction and quarrying activities, evident by slightly elevated conductivity (>300 µs/cm), ammonia (0.07 – 0.22 mg/L), and sulphate concentrations (66-130 mg/L). Groundwater quality in 93-1-1, 94-1-1, 87-1-1, 87-2-1 and 88-1-1 were generally consistent with the background levels, with low conductivity, chloride, sulphate and metal concentrations.

South of the Landfill

- Water quality data from the south end of the landfill met the applicable CSR standards. Although groundwater quality in south purge wells was slightly degraded in 2019/20, most of the wells in this area still showed improving trend in leachate indicator parameters and continued to report slightly elevated concentrations of leachate indicator parameters (conductivity, chloride and ammonia) in 2019/20, as they have since the early 1990s. The slightly increased chloride concentrations in wells located in southern and eastern landfill are likely related to the herbicide application, and the impact should be diminishing over time.
- Any long-term improvements in water quality south of the landfill are largely the result of leachate collection and containment measures instituted since 2001. It is expected that the reconfiguration of P1 will further improve the effectiveness of the south purge well system and may improve downgradient groundwater quality at the south end of the landfill over time. Ongoing improvements to operational and maintenance protocols should continue improving water quality south of the landfill. The application of road salt to trafficable areas continues to complicate interpretation of water quality data. Groundwater quality in this area is known to be sensitive to changes in the operation of the south purge wells and should continue to be monitored closely.

East of the Landfill

- Water quality along the east boundary of the Phase 1 landfill remained similar or slightly improved, with decreased conductivity values. Ammonia and/or nitrate concentrations were occasionally elevated at some locations, but they remained far below CSR standards. The occasionally elevated ammonia and nitrate concentrations may be associated with decaying organic matter including reptiles that have entered well. Groundwater gradients are westward towards the landfill, but groundwater in this area should continue to be closely monitored.

Domestic Well Water Quality

As part of the CRD's groundwater quality monitoring program, nineteen (19) domestic wells were sampled in 2019, including 14 routine locations located within a 2 km radius of the landfill and 5 new wells located north of the Hartland north pad. The water quality monitoring program indicated:

- Lead concentration in domestic well 37 marginally exceeded the max allowable SDWQG and CDWQ for total lead during the September 2019 sampling event. The occasional exceedance in total lead concentration in well 37 may be due to leaching from plumbing or lead service lines.
- Iron concentrations in domestic well 53 were marginally below CDWQ and SDWQG drinking water quality guidelines. Iron concentrations in this well have been reported above the guideline since 2013. However, iron guidelines are not human health objectives and may be related to maintenance of water filtration equipment or household plumbing.
- Manganese concentrations in domestic wells 37 and 38 exceeded the SDWQG of 0.02 mg/L. The SDWQG for manganese in drinking water is an aesthetic objective to protect against staining (e.g., plumbing) but manganese is not deemed toxic at these concentrations.
- Overall, the groundwater quality in the domestic wells sampled in 2019 were consistent with previous results, and landfill leachate did not impact the water quality in the sampled wells. Water quality in all five new domestic wells located northwest of the landfill near the end of Willis Point Road met CDWQ and SDWQG guidelines, indicating these domestic wells were not impacted by leachate from Hartland landfill.

Surface Water Quality

The surface water quality data collected in 2019/20 revealed that nearby surface water bodies, Tod Creek, Durrance Lake and Durrance Creek and Killarney Lake are not impacted by leachate.

Surface water in the vicinity of the landfill met the BCWQG MAC values except for occasional exceedances for pH, nitrate, iron, copper, zinc and TSS. Elevated concentrations were largely related to seasonal flow variability (high and turbid flow) or construction activities. Of 23 stations, total TSS and iron exceeded BCWQG MAC at five (5) stations, dissolved copper and total zinc concentrations exceeded BCWQG MAC values at two (2) stations, nitrate was exceeded once at one station. Moreover, pH at three (3) stations were slightly lower than 6.5 but were still above 6.0. Most of exceedances were observed during the February 2020, followed by the prolonged dry winter. The elevated metal concentrations were generally concurrent with the high TSS, which may be derived from the runoff/flushing from construction/stockpiling. Water quality at background locations (SW-S-52 and CSs2) were below the BCWQG-MAC. Concentrations of leachate indicator concentrations were consistent with previously reported background values.

North of the Landfill

- The leachate release from condensate pipe breach occurred on December 23, 2019 was contained within the landfill footprint and did extend just beyond the upstream sedimentation pond (SW-N-54). At downstream of sedimentation pond and the compliance station SW-N-05, water quality was not impacted by the leachate, evident by low ammonia, conductivity and chloride concentrations.
- Dissolved copper concentrations at compliance stations Sw-N-16 and Sw-S-04 exceeded the BCWQG-MAC during the February 2020 sampling event. Dissolved copper criteria are dependent on temperature, pH,

hardness and DOC, and determined using the BLM. However, the dissolved metal concentrations, especially for dissolved copper and zinc should be interpreted with caution, due to the noticeable discrepancies between parent and duplicate samples (discussion in section 3.2.1).

- Surface water quality at boundary compliance station (Sw-N-16) along the northern property boundary met BCWQG-MAC in 2019/20, except for pH, TSS, dissolved copper, dissolved iron and total iron during one or more sampling events. The low ammonia and chloride concentrations indicated that surface water was not impacted by leachate. Conductivity, sulphate and nitrate concentrations increased slightly during the wet season, indicating that surface water may be impacted by the prolonged dry winter season (i.e., less dilution), as well as nearby construction activities involving blasting, aggregate placement, or excavation of organic soils. The iron exceedances are likely due to the disturbance of sediment during the sampling, evident by high TSS concentrations.
- Surface water quality at boundary compliance station (Sw-N-05) along the northern boundary met BCWQG-MAC for all parameters on all sampling dates. Nitrate concentrations exceeded BCWQG 30-day average concentrations during four out of five sampling events, which may be related to nearby construction activities. Concentrations of sulphate and nitrate showed increase in a statistically significant manner at this location over the last five years, indicating that surface water was impacted by quarrying and aggregate stockpiling areas.
- Surface water quality at station Sw-N-19 (not a compliance location) met BCWQG-MAC values on all sampling dates in 2019/20. The increased nitrate concentrations during the wet season indicated that surface water may be impacted by aggregate runoff. Surface water quality at this station should continue to be closely monitored.
- Surface water quality at station Sw-N-18 and Sw-N-54 (not compliance locations) met BCWQG-MAC values on all sampling dates in 2019/20, except for nitrate at Sw-N-54 during one sampling event. Conductivity, nitrate and sulphate concentrations at these stations increased during the wet season, indicating that surface water may be impacted by blasting residues and runoff from quarrying and aggregate stockpiling areas. An elevated ammonia concentration (2.4 mg/L) was observed at Sw-N-18 in May 2019, while other leachate indicator parameters were within normal ranges. Statistical analysis indicated significant decreasing trends in ammonia at Sw-N-18. Surface water quality at these two stations should continue to be closely monitored.
- Surface water quality at station Sw-N-50 (not a compliance location) met BCWQG-MAC values on all sampling dates in 2019/20. All leachate parameter indicators remained within normal ranges, with slightly elevated conductivity, sulphate and nitrate concentrations during the wet season. Surface water at this station should be closely monitored.

<u>Hartland North Pad</u>

- Surface water at station Sw-N-51 (not compliance location) is typically dry, but samples were collected one in 2019/20 during flowing conditions. Surface water quality at this station met BCWQG-MAC values except for total zinc. As recommended in 2018/19, sampling of this station should be discontinued due to the frequent dry conditions.
- Surface water quality at boundary compliance stations north of the Hartland North pad (Sw-N-41s1 and Sw-N-42s1) met BCWQG-MAC in 2019/20. Conductivity and sulphate concentrations at station Sw-N-41s1 were elevated during the December 2019 sampling event, implying the temporary impact of runoff from a construction activity of the residual treatment facility. Leachate indicator parameters at Sw-N-42s1 remained low in 2019/20, indicating surface water was not impacted by construction activities. The statistically significant increasing trend in sulphate at Sw-N-42s1 station indicates slight impacts of construction activities of RTF.
- Station Sw-N-41s3 (not a compliance location) is located downstream of Sw-N-41s1 where the drainage from the northwest portion of the Hartland North pad flows into Durrance Lake. In 2019/20, all parameters met BCWQG guidelines. Ammonia concentrations were occasionally elevated, but are likely the result of natural drainage from the nearby wetland in the absence of otherwise dilute surface runoff.

<u>South of the Landfill</u>

- Water quality at station Sw-S-52 (not a compliance location) is representative of background water quality. In 2019/20, concentrations of all parameters were below the BCWQG-MAC. Concentrations of leachate indicator parameters were consistent with previously reported values.
- Surface water quality at Sw-S-12 (not a compliance location) met BCWQG-MAC values, except for total iron and TSS on February 2020 sampling event, which coincided with high TSS. The concurrent increase in conductivity, nitrate and sulphate concentrations in October and December 2019 may be due to the runoff from paved areas

surrounding the bin facility or dilute leachate. Given the low ammonia concentrations, it is unlikely that surface water was impacted by leachate. High flows and a slightly orange/yellow color were previously reported/observed. Surface water quality at this station should be closely monitored and investigated to determine the source of elevated ammonia concentrations, typically observed during the winter.

- Surface water quality immediately south of the landfill at Sw-S-03 (not a compliance location) exceeded BCWQG-MAC values for total iron, total zinc and TSS in February 2020. The elevated conductivity, sulphate and nitrate concentrations during the wet season were likely due to upstream runoff from the area surrounding Sw-S-12. Water quality should continue to be closely monitored for quarry and leachate impacts in the area downgradient of the bin facility and south purge wells. The degradation in water quality at this location in February 2020 could be associated with overflow in the manhole that receives water from south purge wells (P1, P2, P3, P4 and P10) in early January 2020.
- Water quality at the property boundary compliance point (Sw-S-04) met the BCWQG-MAC values for all analytes in all samples collected during 2019/20, except for dissolved copper in February 2020. Total zinc, pH and TSS concentrations exceeded BCWQG 30-day average guidelines in one or more sampling events. Conductivity, chloride, nitrate and sulphate concentrations were slightly elevated in October 2019. A statistically significant decreasing trend for chloride was observed at this location over the past five years. Sw-S-04 should continue to be monitored closely for indicators of impacts from leachate and aggregate placement.
- Water quality at Sw-S-27 (not a compliance location) met BCWQG-MAC at all sampling events. TSS and total zinc exceeded the BCWQG 30-day average guideline in February 2020. Concentrations of leachate indicator parameters are very low at this location, and water quality is not impacted by leachate. Surface water quality at this location should continue to be closely monitored.

Leachate

The leachate flow and quality data collected in 2019/20 indicates that:

- Average leachate flow in 2019/20 was 11.75 L/s, with a maximum monthly flow of 86,573 m^3 (32.94 L/s) in January 2020. This was lower than the extreme flows of 39.64 L/s observed during 2006/07, and slightly slower than the long-term (1997 to 2019) average of 11.96 L/s.
- Leachate discharge remained in compliance with the requirements of the Waste Discharge Permit at the Hartland Valve Chamber in 2019/20.Concentrations of trace organics at the Hartland Valve Chamber produced results for the September 2019 sampling event. Of the all 14 analyzed parameters, 2 were reported at detectable concentrations in 2019/20. Statistical trend analysis indicates that leachate quality has been relatively stable to slightly improving at the Hartland Valve Chamber over the past five years.
- The highest concentrations of leachate parameters at Hartland Valve Chamber were observed in September 2019, when precipitation was near the annual minimum.
- Phase 1 leachate exhibited the lowest average values of BOD, COD and sulphide concentrations, compared to other leachate sampling locations.
- Phase 2 leachate exhibited the most reducing conditions, with a peak sulphide concentration of 5.1 mg/L in July 2019. The average total sulphide concentration (2.06 mg/L) in 2019/20 was between those observed in 2018/19 (4.67 mg/L),2017/18 (4.08 mg/L) and 7.19 mg/L in 2016/17.
- The West Face Drainage leachate exhibits the most concentrated leachate, with the highest BOD, COD, conductivity and chloride concentrations. COD exceeded the Waste Discharge Permit criteria on all sampling dates. BOD exceeded the Waste Discharge Permit criteria on one sampling date during 2019/20. Total phenols exceeded the Waste Discharge Permit criteria on nine (9) out of ten sampling dates. However, total sulphide concentrations continued to be low (<0.2 mg/L).

Quality Assurance and Quality Control

- Upon review of the quality assurance and quality control data collected in 2019/20, groundwater, surface water and leachate sampling and laboratory analysis have produced reliable results that are acceptable for the purposes of this monitoring report. Duplicate sampling frequencies were generally acceptable but additional duplicates are warranted for individual leachate sources to allow for an assessment of the precision of analytical results. However, dissolved metals, especially dissolved copper and zinc concentrations should be interpreted with caution. Over 25-50% of duplicate water samples had dissolved copper and zinc concentrations above alarm limit where all parameter concentrations were above the limit of quantification, indicating the potential contamination during the sample handling or filtration process.

Compliance with Operating Certificate and Waste Discharge Permit

Groundwater quality, surface water quality and leachate quality data were used to assess compliance with the Amended Operational Certificate and Waste Discharge Permit and are discussed individually below.

Groundwater

A total of 36 groundwater monitoring wells were identified as Boundary Compliance monitoring locations including wells at locations 4, 18, 20, 21, 28, 29, 30, 31, 39, 41, 42, 50, 53, 55, 56, 57, 71, 72 and 73. Water quality information collected from these wells is compared to the BC CSR Standards for the protection of aquatic life and drinking water to assess compliance with the landfill operating certificate and to protect both current and future uses of the groundwater resource.

With respect to groundwater, the Hartland landfill was in compliance with its Operational Certificate.

Surface Water

A total of five surface water monitoring stations have been identified as Boundary Compliance Monitoring Locations surrounding Hartland landfill including Sw-S-04, Sw-N-05, Sw-N-16, SN-N-41s1 and Sw-N-42s1. These stations are concentrated along the southern and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site, but these impacts are likely unrelated to landfill operations. Water quality data collected from these sites was compared to the BCWQG-MAC values and used to assess compliance with the landfill Operational Certificate.

With respect to surface water, the landfill was in compliance with the Operational Certificate with the exception of the exceedances related to low-flow conditions noted in Table 9-1.

Table ES-1. Surface Water Quality Compliance at Property Boundary Stations

Station	General Parameters	Metals	Recommended Corrective Action
North of the Landfill			
Sw-N-16	TSS (1), Field pH (1)	Total iron (2), Dissolved iron (1), Dissolved Copper (1)	• Exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period. Continued monitoring to assess these anomalous results. Refinement of the Standard Operating Procedure for surface water sampling to minimize the potential for artificially elevated concentrations of metals associated with suspended sediments. • Dissolved copper exceedance may be related to the sample handling/filtration process. Incorporate filter blanks in sampling program and closely monitor laboratory results for elevated concentrations of trace metals. • Field measurement probes should be calibrated daily in advance of monitoring activities. The calibration should be validated at least once in the middle of the day to confirm the readings are accurate. Lab pH should also be analyzed and recorded for QAQC purposes.
South of the Landfill			
Sw-S-04	Field pH (2)	Dissolved Copper (1)	• Dissolved Copper exceedance may be related to the sampling handling/filtration process. Incorporate filter blanks in sampling program and closely monitor laboratory results for elevated concentrations of trace metals. • Field measurement probes should be calibrated daily in advance of monitoring activities. The calibration should be validated at least once in the middle of the day to confirm the readings are accurate. Lab pH should also be analyzed and recorded for QAQC purposes.

Leachate

The Hartland valve chamber is the compliance point for the Waste Discharge Permit. During the monitoring period, leachate discharges at the Hartland valve chamber were in compliance with the Waste Discharge Permit requirements.

Recommendations

Based on the findings of this report, our recommendations are summarized in Table ES-2:

Table ES-2. Summary of Recommendations

Leachate Collection System	
1	Leachate purge wells should continue to be operated on a continuous basis except for periods when the leachate conveyance and storage facilities are at capacity. Regular maintenance and replacement of pumps and wells as a result of ongoing biofouling and encrustation will help ensure that target pumping elevations in purge wells are achieved. Options for maintaining lower leachate levels in P9 should be further investigated to continue improving groundwater quality west of the lower leachate lagoon.
2	Pumping levels and the extent of the drawdown cones surrounding the north and south purge well systems should continue to be validated periodically (next assessment in 2024) to confirm the proper functioning of the wells. All procedures should follow the Standard Operating Procedure (SOP) – North Purge Well Drawdown Cone Verification (AECOM, 2016), with interpretation of results by a qualified professional.
3	Consideration should be given to testing and/or replacement of the pump installed in P7 to improve leachate collection. The lower pumping rate observed in P7 since late 2018 continued through 2019/20. The 2019/20 monitoring data indicated several performance interruptions that may impact leachate collection and downgradient water quality over time. Water levels and quality in the north purge wells should continue to be closely monitored to verify the effectiveness of leachate collection system.
4	Pumping elevations in the south purge wells (P2, P3, P4 and P10) should be maintained at elevations below 140 m ASL. Pumping elevations in P1 should be maintained near the bottom of the screened interval around 146 m ASL. Water level monitoring data indicates the pump installed in P1 and the associated SCADA set points may need to be lowered. Pumps and conveyance piping should be regularly maintained to ensure performance targets are achieved. Consideration should be given to installing a flow meter to monitor the volume of leachate discharge from the south purge wells.
5	Consideration should be given to servicing and/or replacing the pump in south purge well P3 due to the increased frequency of performance interruptions.
6	Quarrying and blasting should continue to be conducted under the direction of a qualified blasting professional to minimize the potential for blast-enhanced fracturing, with possible negative impacts on hydraulic properties, groundwater elevations, groundwater flow rates and leachate containment north of the Phase 2 landfill. There are risks to the performance of the hydraulic trap if blasting is not properly designed and implemented.
7	Future quarry development plans (i.e., quarrying, blasting, etc.) for the north bedrock ridge should be evaluated from a hydrogeological perspective to ensure that the proposed development will not affect groundwater recharge or compromise leachate containment. Future development proposes to expand westward across a mapped regional scale geologic fault that is a known barrier to eastward groundwater flow. Furthermore, the location of aggregate stockpiles and associated surface water management plans should be reviewed from the perspective of potential for impacts to surface and groundwater quality.
8	A detailed assessment of the effectiveness of the hydraulic trap and leachate collection systems including the north purge wells and south purge wells is required to evaluate effectiveness as the landfill extends further north and west, and as additional lifts are constructed. Additional leachate containment or groundwater management measures may need to be implemented at the north end of the Phase 2 landfill to mitigate the potential for off-site leachate migration during future landfill development.
9	An assessment of cumulative contaminant load removal per purge well is recommended for both the north and south purge well systems. There may be opportunities for refinement of the north and south purge well systems to minimize collection and treatment of relatively dilute groundwater (e.g. 81-1-0-P9, P4, etc.) for at least part of the year. The relative benefits of each well should be considered in the context of the elevation of the lower leachate lagoon over the period of the assessment.
Runoff and Infiltration Associated with Aggregate Stockpiles	
10	The location and volume of aggregate stockpiles should continue to be minimized outside of the leachate collection system. Stockpiles should be covered where present to minimize sulphate, ammonia, nitrate and TSS impacts on surface water bodies and downgradient groundwater. Direct runoff from aggregate stockpiles should be diverted away from natural water courses as it is known to exceed BCWQ guidelines for sulphate.

11	Within the footprint of the leachate collection system, progressive closure and temporary tarps should continue to be implemented to minimize infiltration to the underlying leachate collection system. The aggregate is a known source of sulphate, which may be contributing to elevated sulphide concentrations in the Phase 2 basin relative to other areas of the landfill, where aggregate is not produced, stored or used as cover material. Aggregate provides a large source of sulphur that may require further sulphide management prior to discharge to the leachate pipeline at the Hartland Valve Chamber.
Groundwater Monitoring Program	
12	Groundwater and surface water sampling programs should continue to be scheduled at times of year that are optimal for collection of samples, and when wells and streams are likely to contain sufficient water for sampling. The current timing of sampling events has precluded collection of a number of groundwater and surface water samples. If streams are not flowing at the time of sampling, the sampling schedule should be modified with the goal of collecting samples reflective of wet and dry season conditions at a minimum. Efforts should be focused on obtaining a complete record of groundwater levels, groundwater quality and surface water quality data for the month of September each year because fall data is relied upon heavily when interpreting groundwater flow, groundwater quality and surface water quality at the landfill.
13	Groundwater levels should continue to be closely monitored at locations east of the landfill (i.e., 18, 76, 17 and 54) to confirm groundwater flow is toward the landfill, although pressure transducers installed in wells 18-1-1, 76-1-1, 17-1-1 and 54-1-1 indicated that the westward groundwater gradients are restored in 2019/20.
14	The elevation of the leachate mound in Phase 1 and 2 should be determined at least once every five years (i.e., next assessment in 2025). The existing protocols should be refined to ensure successive triplicate water level measurements produce the same result. Several inconsistencies have been recently identified, which are interpreted to be the result of highly conductive condensate in landfill gas wells.
15	Groundwater quality data at compliance wells 4-2-1 and 72-2-1 has not been collected since 2016 due to very slow recharge. These wells should be decommissioned to satisfy the requirements of the *Water Sustainability Act*. The need for replacement wells should be evaluated in the context of the overall monitoring plan.
16	Groundwater quality at locations 40, 20, and 21 should continue to be closely monitored due to elevated concentrations of conductivity, chloride, and ammonia in monitoring wells located close to the property boundary, and to monitor the performance of the north purge well system.
17	Groundwater quality at locations 85, 60, 72, 7 and 73 should continue to be closely monitored to confirm the south leachate collection system is performing adequately. This will help determine the net effect of modifications made to P1 in 2018 and confirm whether elevated conductivity and chloride concentrations are related to the use of road salt at the bin facility.
18	Monitoring wells on the north ridge and at Hartland North should continue to be monitored to characterize daily groundwater level fluctuations, further define the groundwater divergence and monitor groundwater flow behavior over time after construction of the Residuals Treatment Facility is complete. These wells should be protected from site development activities and damage by heavy equipment. Monitoring of these wells will also be important as the extents of the quarry within Phase 2 migrate northward. Furthermore, any westward expansion of the quarry may be accompanied by an increase in groundwater flow reporting to the leachate collection system as the Highland Fault is inferred to behave as a barrier to eastward groundwater flow.
19	There should be a routine review of the landfill development plan and filling plan every two years to ensure the existing monitoring network and monitoring program remain sufficient.
20	As required by the Amended Operational Certificate, the results of the annual monitoring program should continue to be reviewed and interpreted by a Qualified Professional experienced in assessing the impacts of landfill leachate at large municipal landfills similar to Hartland.
Surface and Leachate Monitoring Program	
21	The source of ammonia and nitrate observed at Sw-S-12 and Sw-S-03 should be investigated further. Additional waste has been placed on the western and southern portions of Phase 2 over recent years and occasional leachate seeps and runoff from the truck wash have been noted in the past. A multilevel monitoring well cluster should be established west of the bin facility and well 85-1-1 to resolve whether the source of impacts to surface water are due to runoff or discharge of leachate impacted groundwater.
22	The recent update to the BCWQG in August 2019 modified guidelines for the protection of aquatic life for dissolved copper and should be considered in 2020/21.Dissolved organic carbon (DOC) should be collected at all surface water stations on all sampling dates to assess dissolved copper criteria using BLM.
23	In addition to the Sewer Use Criteria, leachate quality results for trace organic compounds should be compared to BC CSR standards for the protection of drinking water and aquatic life to allow for screening of data to identify parameters in leachate that exceed CSR standards, and guide any refinements to the monitoring program in future years.
24	Sampling at surface water at station Sw-N-51 (not compliance location) should be discontinued due to the frequent dry conditions.
Construction Management	

25	Appropriate erosion control measures should continue to be implemented to minimize runoff from construction areas for all projects involving excavation, aggregate placement or soil relocation.
26	The placement of aggregate, road salt, dust suppressant and herbicides should be carefully considered and documented to help understand the causes of potential future concentrations of conductivity, ammonia, chloride, nitrate, sulphate and select metals at groundwater and surface water monitoring locations.
Quality Assurance and Quality Control	
27	Quality assurance for laboratory analyses should continue to be evaluated quarterly, and any discrepancies should be resolved with the laboratory and CRD sampling personnel within one month of receiving the laboratory results. The appropriate notation should be added to the data files to explain the reason for the low precision and the steps taken, if any, to improve the sampling or laboratory procedures.
28	Consider utilizing a different brand of in-line filters to eliminate trace metal concentrations observed in dissolved metals samples. Although the detection limits of these trace metals were generally low, it may interfere the analytical results and subsequent interpretation, especially for metals that have stringent water quality guidelines. Filter blanks should be added to the analytical program and in-line filters should be flushed with sample water for at least 30 seconds (e.g. 500 ml) in advance of sampling to remove residual trace metals.
29	Field measurement probes should be calibrated daily in advance of monitoring activities. The calibration should be validated at least once in the middle of the day to confirm the readings are accurate. Lab pH should also be analyzed and recorded for QAQC purposes.

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1. Introduction

Hartland landfill is located at the end of Hartland Avenue approximately 14 kilometres (km) north of Victoria (Figure 1-1). Filling with waste commenced at the site in the 1950s. The site was owned and operated by a private company until 1975 when the property was purchased by the Capital Regional District (CRD). The landfill is currently owned and operated by the CRD and is the primary solid waste disposal site for the 13 member municipalities and three electoral areas of the Capital Region.

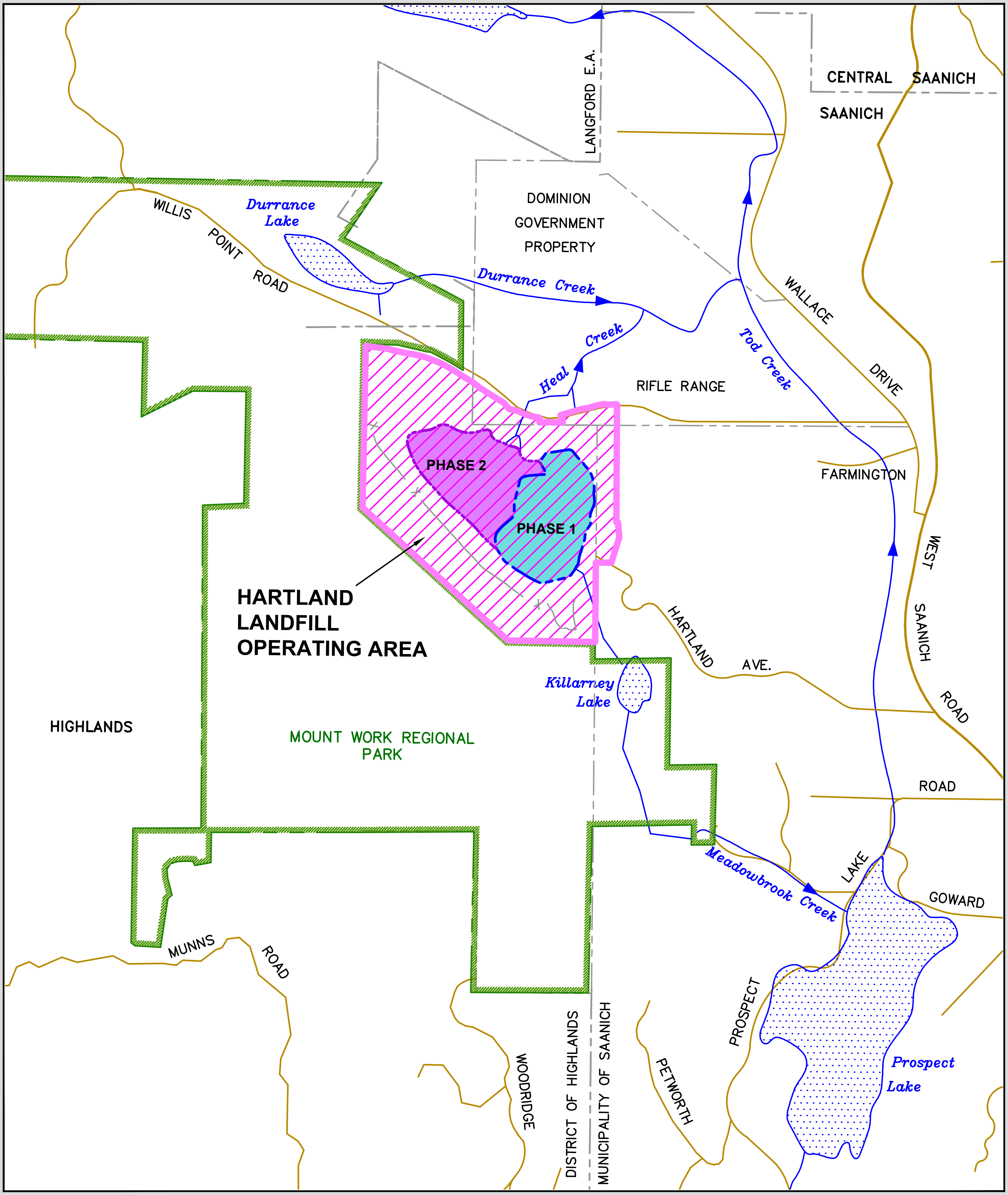
The CRD initiated a surface water and groundwater monitoring program for the landfill in 1983. Annual monitoring reports have been prepared and issued by Gartner Lee and AECOM since 1988. The present Hartland Monitoring Program is part of an Amended Operational Certificate # 12659 last amended January 27, 2010 that is required and approved by the BC Ministry of Environment and Climate Change Strategy (ENV).

The Hartland landfill is divided into two distinct areas referred to as Phase 1 and Phase 2. Initially, waste was deposited in Phase 1, which reached capacity in 1996 and was capped in 1997. Phase 2 is currently receiving waste. Filling of Phase 2 Cell 1 was completed in 2004 and was capped in 2011. During the summer of 2004, the west face of Phase 2 Cell 1 was capped with a geomembrane to reduce passive gas venting and provide an internal leachate collection system for future development of Phase 2 Cell 2. This area is referred to as the West Face closure. In 2016, Phase 2 Cell 3 was developed on the west side of Phase 2 along with new leachate collection infrastructure.

Leachate and surface runoff from the active landfill areas are directed to two leachate lagoons at the north end of the landfill. The leachate is then transported by a pipeline to the Northwest Trunk sewer system and ultimately, the Macaulay Point deep ocean outfall. Leachate discharge to sewer is authorized by Waste Discharge Permit SC97.001 last amended on March 1, 2011. The permit is issued by the CRD Regional Source Control Program and is subject to the CRD Sewer Use Bylaw.

This 2019/20 monitoring report presents our interpretation of water quality results and groundwater flow conditions to:

1. Assess the potential impact of landfill leachate and operational activities on groundwater and surface water quality.
2. Evaluate the effectiveness of the leachate containment and collection systems.
3. Determine if leachate flow and leachate quality are changing over time.
4. Determine the elevation of leachate mound in Phase 1 and Phase 2, which is required at least once every 5 years.



N W E S

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UTM Zone 10N, NAD83

Legend

- ROAD
- MUNICIPAL BOUNDARIES
- SURFACE DRAINAGE
- PHASE 1
- PHASE 2
- HARTLAND LANDFILL OPERATIONAL BOUNDARY

CRD
Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Site Location Map

AECOM

Figure 1-1
Version 1

File Name: FIG1.1-Site Location-60631284-43-20200623.dwg
Reviewed by: KJ Prepared by: NT
Date Issued: JUNE 2020 Project Number: 60631284

Date Plotted: 2016-08-24   File Location: P:\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C431 - 2019-20 Annual Report\2. Figures\Draft CAD Figures\FIG1.1-Site Location-60631284-430-20200622.dwg

2. Site Description

2.1 Physiography

Hartland landfill is located in the Tod Creek watershed, in the bedrock highlands of the Gowlland Range northwest of Victoria. The terrain is moderately rugged with relief of up to 446 metres (m) in the area. Undeveloped CRD property (about 320 hectares (ha) in total) lies to the west and south of the landfill site. Mount Work Regional Park lies to the west and the Department of National Defence rifle range is situated north of the landfill. Private residential properties are located to the east and southeast of the landfill.

The landfill is situated in a north-south trending bedrock saddle. Mount Work lies to the west of the landfill and a bedrock ridge lies to the east. The crest of the landfill forms a drainage divide between the Heal Creek drainage basin to the north and the Killarney Creek drainage basin to the south.

2.2 Geology

A thin veneer of glacial till composed of silty, gravelly sand, with interspersed cobbles and boulders mantles the bedrock in areas of gentle slopes and in valley bottoms. Fluvial deposits consisting of well-sorted sands and gravels are also present in localized bedrock depressions and channels.

The bedrock geology in the area surrounding the landfill mainly comprises Wark Diorite Gneiss with Colquitz Gneiss outcropping in the northern and eastern margins of the landfill site with thin overlying veneer of glacial till. The Wark Diorite Gneiss is dark green to black in colour. It is competent, except locally in shear zones, where it has been chloritized and weathered into soft, sand size grains and clay. Discontinuities, including joints, shear zones and altered veins have been observed on the bedrock outcrops and noted in borehole logs. Geologic mapping of an exposed bedrock outcrop north of the Phase 2 landfill (AECOM, 2018) characterized the undulating bedrock surface and confirmed the presence a complex network of lithologic contacts, faults and fractures observed in exposed bedrock excavations (sub-vertical quarry walls) including the Highland Fault and other faults that were previously inferred based on lineaments identified on aerial photographs (Thurber, 1987). Hydrogeologic investigations have confirmed the existence of several faults and shear zones. Permeability testing has determined that faults and shear zones behave as either conduits or barriers to groundwater flow.

2.3 Climate

The climate of this area is classified as "cool Mediterranean". Long-term (1981–2010) average climatic data is available for the Victoria International Airport Climatological Station located approximately 9 km from the landfill. Average annual temperature is 10.0ºC and mean monthly values range from a low of 4.0ºC in December to a high of 16.9ºC in July. Mean annual precipitation is 882.9 mm.

In 1994, the CRD established a climate station (Victoria Hartland CS) at the landfill office. The original Hartland climate station was replaced in 2009/10 with new equipment at a location on top of Phase 1. The new weather station records temperature, precipitation, wind direction, wind speed, barometric pressure and relative humidity directly to CRD's SCADA system.

Hartland daily precipitation measurements for 2019/20 are provided in Appendix C. The precipitation measured at Hartland Landfill for April 2019 to March 2020 was 674 mm, which was approximately 23% lower than the 30-year average of 882.9 mm/yr. reported for Victoria International Airport. This data indicates that 2019/20 was a drier year with respect to precipitation. The drier annual condition is primarily due to the extremely low precipitation in November and December 2019, with average precipitation of 12.5 mm. However, January 2020 was one of the wettest months of January on record for Victoria, with a total of 225 mm of rainfall recorded by the Hartland weather station.

Climate change projections for the Capital Regional District were developed by the Pacific Climate Impacts Consortium to better understand the details of how climate may change in the Capital Region (CRD, 2017). Overall, the results indicate that the region can expect warmer winter temperatures, fewer days below freezing, more extreme hot days in the summer, longer dry spells in summer months, more precipitation in fall, winter and spring, and more intense, extreme weather events. A water surplus occurs primarily in the cool, wet winter months (November, December and January) with water deficit conditions occurring in the warm, dry summer months (July, August, and September).

2.4 Significant Site Activities in 2019/20

CRD staff maintain a log of activities at the landfill that are relevant to landfill operations, leachate containment and compliance monitoring activities. Activities that are considered important from a compliance monitoring perspective are paraphrased below:

- Residuals Treatment Facility (RTF): Development in the vicinity of the RTF began in 2017 and will continue through 2019/20. Activities in 2019/20 included paving the Hartland North access road, excavation and blasting at Hartland North area, construction of the RTF components, conveyance infrastructure installation, pump station installation, potable water service and storage installation. CRD staff continued to coordinate construction to support ongoing Hartland needs and environmental controls. Construction of RTF is expected to be completed in September 2020.
- Water Supply Main to RTF: A water main was installed on East Perimeter Road with a water service installed between leachate lagoons to northeast corner of Hartland property. The new water main connects RTF with Saanich's new water reservoir built on Hartland's East boundary line (near their existing reservoir which will be abandoned). The new water service also supplies water to the newly built Pump Station No. 4, which is a part of the Wastewater Treatment Project's Residual Solids Conveyance line.
- Aggregate Storage Development: Tree falling and clearing activities were completed in early March 2020 to develop the aggregate storage area located in the Northeast corner of the Landfill Property. The development work will continue in 2020.
- Maintenance of Leachate Collection Infrastructure: Leachate pipeline was pigged in February 2019 and June 2019 to increase the leachate flow rate. The leachate pipeline was deactivated in June 2019 to facilitate the construction of an RTF pipeline adjacent to it. The lagoons were filled throughout the summer until the pipeline was reactivated at end of August 2019. While leachate line was deactivated, CRD staff conducted weekly lagoon monitoring, including lagoon stability survey, groundwater level monitoring and leachate samples from the Lower and Upper Lagoons.
- Maintenance/Verification of North and South Purge Well System: Flow tests were regularly conducted at P1, P7 and P8 to monitor the pump efficiency. The pumps and pressure transducers installed in several leachate collection wells (P1, P2, and P7) were serviced or replaced as part of routine maintenance activities. In April 2019, pressure transducer elevations in P1 were also recalibrated to the correct water elevation.
- Herbicide Application: Herbicide was applied in May and June 2019, mostly along the east fence, Phase 2 North Face Closure and south of Household Hazardous Waste.
- Leachate Leaks: A leachate condensate pipe along the Northwest Slope Road was damaged by a vehicle in December 2019. The breach was contained soon afterwards, and samples were immediately collected from downstream locations, including sedimentation ponds, Sw-N-45 and Sw-N-05. The leachate was contained within the landfill footprint.
- Groundwater Monitoring Network Upgrades: In November 2019, a new leachate well GW-90-1-1 (deep) was installed in Phase 2 to evaluate the presence of leachate mounding and verify leachate capture and support management decisions. In addition, four new monitoring wells (GW-91-1-1, GW-92-1-1, GW-93-1-1, GW-94-1-1) were installed in Hartland North to characterize the hydrogeological conditions, which may be affected by the RTF construction (AECOM, 2019b).
- Landfill Criteria Conformance Assessment: A conformance assessment respecting the Revised Landfill Criteria for Municipal Solid Waste (ENV) was conducted in 2018. The Revised Landfill Criteria requires submission of a

Landfill Criteria Conformance Assessment and Upgrading Plan for the next SWMP review or within five years of issuance of the Landfill Criteria (2021). The conformance assessment and Upgrading Plan will be finalized in 2020, well before the deadline.

- Master Filling Plan (Detailed Phase 2 Filling Plan and Vision 2100): In 2017/18, CRD initiated development of a master filling plan that will span an approximate 20-year timeframe. The plan is to assess and optimize remaining landfill airspace capacity and develop future expansion plans for Phase 3 and Phase 4 to take the landfill life to year 2100 (i.e. Vision 2100). An updated detailed filling plan design for an approximate 20-year timeframe will be prepared in 2019/20.

2.5 Applicable Regulatory Criteria

The Hartland landfill is required to operate in accordance with the monitoring requirements outlined in the following:

- Amended Operational Certificate (#12659) approved by the BC Ministry of Environment, last amended on January 27, 2010.
- Waste Discharge Permit SC97.001 issued by the CRD Regional Source Control Program, last amended on March 1, 2011, and subject to the CRD Sewer Use Bylaw.
- Legally enforceable standards defined by the British Columbia Contaminated Sites Regulation (BC CSR).

The Stage 10 (Omnibus) and Stage 11 (Housekeeping) amendments to the BC CSR became effective on November 1, 2017. The Stage 10 and 11 amendments to the CSR included updating over 8,500 environmental quality standards and the updated standards are considered in this report. Stage 12 amendments to the CSR were issued January 24, 2019 and included clerical errors related to the Stage 10 and 11 amendments. All reference to CSR standards in this report include up to January 24, 2019 amendments to the CSR.

As part of the update of Stage 10 (Omnibus) and Stage 11 (Housekeeping) amendments, a number of emerging contaminants were added to the water and soil schedules due to their persistence in the environment, toxicity, and relevance to contaminated sites in BC. In April 2017, AECOM conducted a focused review on the applicability of emerging contaminants at the Hartland Landfill based on Schedule 2 activities in the BC CSR. In 2018, AECOM conducted a detailed emerging contaminant review, to confirm regulatory compliance and to recommend an approach for future monitoring (AECOM, 2018). It was recommended to continue sampling and analyzing of emerging contaminants at Hartland Valve Chamber, on a quarterly basis for EE2, 1,4 Dioxane, PFOA and PFOS in conjunction with the trace organics sampling program.

2.5.1 Groundwater

In February 2016, CSR Protocol 21 (P21), Water Use Determination, became legally enforceable. For the purposes of this report, Protocol 21 (Version 2.0, effective October 31, 2017) is considered when determining applicable water use standards at Hartland landfill.

Groundwater quality data were compared to the BC CSR Schedule 3.2 Generic Numerical Water Standards Column 3 Aquatic Life (AW) and Column 6 Drinking Water (DW), as required by CSR Protocol 21, Water Use Determination.

Freshwater aquatic life (AW) use standards apply to the groundwater because the landfill is “within 500 m of a surface water body containing aquatic life” (Heal Creek, Durrance Creek, Durrance Lake, Killarney Creek and Killarney Lake).

The future drinking water (DW) standards apply to the Site because the aquifer that underlies the Site has:

- A hydraulic conductivity greater than 10^{-6} m/s and a yield greater than 1.3 L/min.
- Groundwater with natural total dissolved solids (TDS) concentrations of less than 4,000 mg/L.
- An average confined aquifer saturated thickness greater than 1 m.
- An overlying silt or clay aquitard that is less than 5 m thick.

The DW standards for iron and manganese do not apply to municipal landfills, based on the Stage 8 Amendments to the CSR that came into effect on January 24, 2013, and as presented on BC CSR Schedule 3.2 effective November 1, 2017.

As stated in BC ENV Technical Bulletin 3 (July 31, 2019), the interim cobalt background concentration estimate (20 µg/L) remains in effect until regional background concentration estimates are established. This value was originally established on October 4, 2002 but as part of the Stage 11 amendment to the Contaminated Sites Regulation was changed to 1 µg/L. The interim background groundwater concentration estimate for cobalt is expected to remain in effect while the ENV concludes the development of background groundwater estimates for selected metals on a region by region basis for the Province.

BC ENV Technical Bulletin 3 (July 31, 2019) presents established regional background concentration estimates for arsenic, lithium, selenium, vanadium and uranium in groundwater. Groundwater that contains a substance concentration above the applicable CSR standard but below the regional background concentration for that substance is not considered contaminated under the CSR. Regional background concentrations are provided in Table 1 of the BC ENV Technical Bulletin 3. Regional background concentrations for the Southern Vancouver Island region have been considered when assessing groundwater quality data collected at the Hartland Landfill.

2.5.2 Surface Water

Surface water quality data are compared to the *British Columbia Approved and Working Water Quality Guidelines* (BCWQG) (BC MOE 1998a, updated in August 2019 and June 2017, respectively) for the protection of aquatic life and drinking water because CSR Technical Guidance 15 (April 2013) indicates that groundwater in receiving environments (i.e., within 10 m of the high water mark of a surface water body) should be compared to the BCWQG. Furthermore, there are two sets of BCWQG criteria for AW use:

- 30-day average (long-term)
- Maximum allowable concentration (short-term)

The purpose of the 30-day average guideline is to protect the most sensitive species and life stages against chronic exposure. To properly compare data against 30-day average guidelines, the 30-day average concentration is typically calculated by averaging the results of five or more samples collected within a 30-day period.

The maximum allowable concentration (MAC) guideline is established to protect the most sensitive species and life stages against short-term exposure (e.g., less than 96 hours). BCWQGs for MACs are typically used to assess risks associated with short-term exposures.

The dissolved copper data evaluation has been updated to reflect the updated copper BCWQG for protection of aquatic life (August 2019 version). The dissolved copper BCWQG varies with hardness, pH, dissolved organic carbon (DOC) and temperature, and is calculated using the Biotic Ligand Model (BLM). BLM is a series of linked equations that predict the toxicity of dissolved copper to aquatic life under specific conditions. Dissolved organic carbon were only collected at compliance stations during the March 2020 monitoring event. Therefore, only dissolved copper concentrations with paired DOC in this report were compared with BCWQG criteria. In order to properly compare dissolved copper concentrations to the BCWQG, DOC should be collected for all future surface water samples during all sampling events.

The BCWQG apply to surface water on site and on adjacent sites under provincial jurisdiction. The Federal Water Quality Guidelines (CCME) apply on the property owned by the federal government located to the north of the site. Both the BCWQG and CCME criteria are guidelines and do not have the same regulatory force as the BC CSR Omnibus standards.

2.5.3 Leachate

Discharges from the leachate pipeline are subject to the CRD Regional Source Control Program (RSCP) Waste Discharge Permit (Waste Discharge Permit Number SC97.001) authorizing the discharge of non-domestic waste to the sanitary sewer in accordance with the CRD's Sewer Use Bylaw 2922. Sampling is conducted monthly.

The compliance monitoring location for leachate at Hartland landfill is the Hartland valve chamber (flow detection chamber) at the start of the leachate pipeline. Authorized discharge limits are identified within the permit.

In 2019/20, CRD collected a total of nine (9) samples from the Harland Valve Chamber for analysis of emerging contaminants. The samples were submitted for analysis of 1,4-Dioxane, PFBC, PFOA and PFOS.

3. Methodology and Quality Assurance

3.1 Field Techniques

Sampling locations are shown on Figure 4-1. Boreholes and monitoring wells are identified using a standard system adopted by the CRD consisting of three numbers (e.g., 02-02-01). The first number refers to the site, the second to the borehole at that site (there may be more than one) and the third number refers to the monitoring well in that borehole (there may be two or three at different depths in older installations). If the third number is a zero, it indicates an open borehole where no PVC monitoring well has been installed. Several leachate purge wells have been installed at Hartland. Each purge well is designated with a "P" in front of the purge well number (e.g., P1).

Monitoring well construction details including location coordinates and elevations are summarized in Appendix A.1. Appendix A.1 also lists the status of all the groundwater monitoring wells at the site together with comments describing any problems associated with each monitoring well. Monitoring wells are categorized as active (fully functioning) or inactive (non-functioning or destroyed). In 2019/20, there were 129 active groundwater monitoring wells at 75 locations in the vicinity of Hartland landfill, of which 8 are active purge wells and 13 are landfill gas wells that were regularly used to measure leachate levels in Phase 1. South purge well P1 was replaced and reinstalled in November 2018.

The methods used to develop and sample each monitoring well are indicated in Appendix A.2. The Standard Operating Practice (SOP) for groundwater sampling is periodically updated. A variety of techniques are used depending on the depth of the monitoring well, the groundwater level in the monitoring well, and the permeability of the surrounding geologic formation. A number of dedicated submersible pumps have been installed by CRD in the deeper monitoring wells and open boreholes at the landfill to facilitate more efficient sampling and have resulted in improved data quality. Sampling events were scheduled to avoid heavy rainfall events to prevent skewing data due to sample dilution.

In 2019/20, the monitoring program consisted of the following:

- Groundwater level measurements four times per year.
- Continuous water level monitoring with pressure transducers at north end of the Phase 2 landfill.
- Continuous water level monitoring with pressure transducers at the north and south purge well systems.
- Continuous water level monitoring with a pressure transducer east of Phase 1 landfill and Hartland North.
- Quarterly monitoring of wells near the property boundary and key locations to assess the effectiveness of leachate containment.
- Semi-annual monitoring stations with relatively stable long-term historical data.
- Annual sampling of 19 residential wells, including 14 wells within a 2 km radius of the landfill and 5 domestic wells located at north of the Hartland North Pad.
- Quarterly sampling of surface water stations at property boundary points and other selected monitoring locations.
- Quarterly testing of the leachate discharge for trace organic compounds.
- Monthly testing of the leachate for conventional parameters and metals at the point of discharge and select locations within the leachate collection system.
- Monthly testing for select emerging contaminants at the Hartland Valve Chamber.

As in previous years, CRD staff carried out surface water, groundwater and leachate sampling and groundwater level measurements at the locations shown in tables in Appendix B and on figures in Appendix E. Further information on the monitoring program field procedures is contained in the CRD Monitoring Procedure Manual.

The CRD employs a continuous improvement and quality assurance program. As part of this work, field methods were updated, and written protocols were updated in 2017. Additionally, AECOM evaluated the sampling network and schedule (AECOM, 2016b). The review recommended modifications to the groundwater, surface water and leachate monitoring program, which were implemented for the entire 2018/19 monitoring year.

3.2 Quality Assurance

In 2019/20, routine surface water, groundwater and domestic well water laboratory analyses were performed by Maxxam Analytics in Victoria and Burnaby, British Columbia. Maxxam Analytics also analyzed leachate chemistry samples which included analysis of trace organic compounds.

A quality assurance program is in place assess the validity of the chemical analysis results. This has involved the submission of randomly selected field replicate, trip blank and "reference" Victoria municipal water samples to the laboratory for analysis. Table 3-1 and Table 3-2 present quality assurance of groundwater and surface water, respectively. There were 22 surface water and 38 groundwater samples submitted in duplicate between April 2019 and March 2020. Table 3-3 and Table 3-4 present quality assurance results for the Hartland valve chamber. Three samples from the Hartland valve chamber were also submitted in duplicate for analysis of conventional parameters, organics, PAHs and metals. In this report, each set of replicates were taken from the same source and/or site, and under the same conditions. In all cases, the field replicates were submitted 'blind' to the laboratory. This resulted in duplicate sampling frequencies of 13% (38/288 samples) for groundwater, 24% (22/91 samples) for surface water, 25% (3/12 samples) for the Hartland valve chamber compliance point and 3.9% (3/76 samples) for the overall leachate sampling program. Overall, approximately 14% (63/455) of samples were duplicated, which met the targeted duplicate sampling rate of 10%.

The submission of duplicate samples provides an estimate of the total uncertainty associated with the data. Typically, one duplicate sample is collected for every ten samples (10%) as part of quality control measures. Total uncertainty is the variability (precision plus bias) associated with the sample collection and sample analyses. In addition, Limit of Quantification (LOQ) should be considered because analytical concentrations just above the Method of Detection Limit (MDL) where the precision is known to be poor. The LOQ should be five times the method detection limit for each parameter as outlined in Part E of the 2013 British Columbia Field Sampling Manual.

The CRD has used several different statistical methods for checking the precision and accuracy of its monitoring program. The CRD uses the relative percent difference (RPD) method, as recommended by ENV, which uses duplicate analyses to determine precision of the analytical results. This method expresses percent of difference between two values as the ratio of their absolute difference to the average value of the sample and the duplicate, as shown in the equation below:

$$RPD= [(|x_1-x_2|)/((x_1+x_2)/2)]$$

Where:

x_1 is the initial sample concentration (mg/L)
x_2 is the duplicate sample concentration (mg/L)

Parameters with RPD values exceeded RPD criteria should be interpreted with caution. Alarm limits were set as per the BC Ministry of Environment Environmental Laboratory Manual. Duplicate samples with RPD values within 30% for general inorganics and metals and within 45% for organic compounds are considered to meet the Data Quality Objectives (DQOs).

3.2.1 Groundwater and Surface Water

Table 3-1 and Table 3-2 present the calculated RPD values for replicate groundwater and surface water samples collected near the landfill. In both tables, RPD values were highlighted with an “a” if they were above 30% and it was noted with a “b” if one or more of the parameter concentrations were below the limit of quantification.

Table 3-1 indicates the following for groundwater samples collected at the landfill in 2019/20:

- A total of 38 duplicate samples were collected and analyzed for 45 parameters. Thirty-three (23) samples had parameters with RPD values greater than 30% when all concentrations were above the limit of quantification for an overall total of 37 out of 1,710 analyses.
- RPD values for alkalinity (1 sample), dissolved aluminum (2 samples), boron (1 sample), cadmium (2 samples), copper (14 samples), iron (3 samples), lead (1 sample), nickel (1 sample), uranium (1 sample), zinc (10 samples) were greater than 30% target for at least one duplicate sample when all concentrations were above the limit of quantification.
- Groundwater field replicates showed good precision for most parameters and the majority of RPD values for the 2019/20 monitoring year were within the acceptable range, except for dissolved copper and zinc. Over 25% of the duplicate samples had dissolved copper and zinc concentrations above the alarm limit of 30%, indicating potential contamination during the sample handling or filtration process. It is suspected that the contamination may be introduced by the Waterra® 0.45-micron water filters, as this type of filters usually contains detectable levels of trace metals.
- Overall, groundwater quality data is acceptably precise for the purpose of this report. However, dissolved copper and zinc concentrations should be interpreted with caution. Field blanks should be collected to further investigate/evaluate if the filters are the source of metal contamination. It is recommended that in-line filters be flushed with sample water for at least 30 seconds (or 500 ml) to remove any trace metal particulate in advance of sampling.

Table 3-2 indicates the following for surface water samples collected at the landfill in 2019/20:

- A total of 22 duplicate samples were collected and analyzed for 40 parameters. Fourteen (14) samples had parameters with RPD values greater than 30% when all concentrations were above the limit of quantification for a total of 57 out of 880 analyses.
- RPD values for TSS (3 samples), total aluminum (3 samples), total cadmium (2 samples), total cobalt (1 sample), total copper (1 sample), total iron (3 samples), total manganese (5 samples), total ammonia (2 samples), dissolved aluminum (1 sample), dissolved copper (9 samples), dissolved iron (7 samples), dissolved lead (4 samples) and dissolved zinc (12 samples) were greater than 30% on at least one occasion when all concentrations were above the limit of quantification.
- Overall, surface water field replicates showed good precision for most parameters and the majority of RPD values for the 2019/20 monitoring year were within the acceptable range, with the exception of dissolved iron, copper and zinc concentrations. Some of the high RPD values (i.e., iron, aluminum etc.) may be contributed by the disturbance of the sediments/low flow condition during the drier months. However, over 30-50% of duplicate water samples had dissolved copper and zinc concentrations above alarm limit of 30%, indicating the potential contamination during the sample handling or filtration process. It is suspected that the contamination may be introduced by the Waterra® 0.45-micron water filters, as this type of filters usually contains detectable levels of trace metals.
- Overall, Surface water quality data is acceptably precise for the purposes of this report. However, dissolved metals, especially dissolved copper and zinc concentrations should be interpreted with caution. Field blanks should be collected to further investigate/evaluate if the filters are the source of metal contamination. It is recommended to flush the in-line filters with sample water for at least 30 seconds (or 500 ml) to remove residue trace metals

3.2.2 Leachate

Three (3) duplicate leachate samples were collected during April 2019, December 2019 and February 2020 events and analyzed for various parameters. As shown in Table 3-4, a total of two (2) samples and three parameters had calculated RPDs exceeded the maximum acceptable RPD values when concentrations in both replicates were above the limit of quantification.

Given that landfill leachate is a complex analytical matrix, leachate field replicates showed good precision for most parameters and the majority of RPD values for the 2019/20 monitoring year were within the acceptable range. Leachate quality data is acceptably precise for the purposes of this report.

3.3 Statistical Assessment of Temporal Trends

Seasonal variability in water quality parameters can mask the overall trend of parameters in groundwater, surface water and leachate quality data. To better understand long-term trends in water quality, a non-parametric statistical analysis has been employed to evaluate trends in water quality data at Hartland landfill since 2005. This test, known as the Mann-Kendall test was used to evaluate temporal trends in contaminant concentrations. The analysis of trends is intended to promote early detection of statistically significant trends (at the 95% confidence level) in groundwater chemistry at each sampling location. This method does not require normally distributed data and allows for missing data (non-detects) and irregularly spaced measurement periods in the dataset. Non-detect measurements are assigned the value of the detection limit for the purposes of the statistical analysis. Water and leachate quality data at Hartland landfill often includes concentrations below detection limits and samples are not always collected at regularly spaced intervals. The hypothesis of both increasing and decreasing trends are tested at the same time. The Mann-Kendall test can be used for virtually any water quality or leachate parameter and provides a quantitative means of determining if a given parameter is changing (increasing or decreasing) in a statistically significant manner over time.

A statistical analysis was conducted utilizing data collected between April 2015 and March 2020. A five-year time frame is consistent with the time interval over which most water quality data is plotted within this report and is anticipated to provide a good balance between seasonal variation and the detection of long-term trends in water quality. This analysis is used to identify areas of the landfill where water quality is degrading and/or improving. The time frame over which trend analysis is conducted should be carefully evaluated in conjunction with management and operational changes.

All field and lab replicates were removed from the data set prior to the analysis. Conductivity, ammonia and chloride concentrations were tested for trends using the Mann-Kendall test as they are considered indicators of leachate at Hartland landfill. Trends in sulphate and nitrate concentrations were also evaluated because high concentrations have been observed in relation to aggregate generated and used at the site.

The analysis was conducted using data collected from a total of 81 groundwater monitoring wells (34 compliance and 47 routine), 8 leachate purge wells, 23 surface water monitoring stations (5 compliance and 18 routine), and the leachate compliance monitoring station (Hartland Valve Chamber). The rest of locations are either inactive or do not have sufficient data to run to Mann-Kendall analysis. The results of the statistical trend analysis for groundwater, surface water and leachate are provided in Appendices G-1, G-2 and G-3, respectively and discussed in the relevant sections of this report.

Table 3-1 Groundwater Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.01	0.1	0.1	1	0.5	0.02	0.02	0.02	0.01	0.005
				Limit of Quantitation (5 x MDL)	0.05	0.5	0.5	5	2.5	0.1	0.1	0.1	0.05	0.025
				Parameter	pH	Specific Conductivity - 25°C.	Temperature	Alkalinity - Total - Ph 4.5	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth
				Fraction	TOT	TOT	TOT	TOT	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Comments	Date Sampled										
18-1-1	FR1	Y	0	9/6/2019	6.92	280.	12.5	170.	2.09	0.597	1.7	10.9	< 0.01	< 0.005
18-1-1	FR2			9/6/2019	6.92	280.	12.5	170.	1.63	0.608	1.66	11.1	< 0.01	< 0.005
18-1-1	FRM		Mean of duplicates	9/6/2019	6.92	280.	12.5	170.	1.86	0.602 5	1.68	11.	< 0.01	< 0.005
18-1-1	RPD		RPD of duplicates	9/6/2019	0.0%	0.0%	0.0%	0.0%	24.7%	1.8%	2.4%	1.8%	0.0%	0.0%
18-1-1	FR1	Y	0	11/29/2019	7.06	27.	8.7	170.	3.39	0.604	1.83	11.2	< 0.01	< 0.005
18-1-1	FR2			11/29/2019	7.06	27.	8.7	170.	1.79	0.58	1.81	10.8	< 0.01	< 0.005
18-1-1	FRM		Mean of duplicates	11/29/2019	7.06	27.	8.7	170.	2.59	0.592	1.82	11.	< 0.01	< 0.005
18-1-1	RPD		RPD of duplicates	11/29/2019	0.0%	0.0%	0.0%	0.0%	61.8% b	4.1%	1.1%	3.6%	0.0%	0.0%
18-1-1	FR1	Y	d colourless, contains some c	2/27/2020	6.87	220.	10.1	150.	12.4	0.811	1.19	13.7	< 0.01	< 0.005
18-1-1	FR2			2/27/2020	6.87	220.	10.1	150.	15.1	0.785	1.29	12.6	< 0.01	< 0.005
18-1-1	FRM		Mean of duplicates	2/27/2020	6.87	220.	10.1	150.	13.75	0.798	1.24	13.15	< 0.01	< 0.005
18-1-1	RPD		RPD of duplicates	2/27/2020	0.0%	0.0%	0.0%	0.0%	19.6%	3.3%	8.1%	8.4%	0.0%	0.0%
21-1-1	FR1	Y		10/2/2019	8.08	138.	12.2	72.	2.7	< 0.04	2.28	1.94	< 0.02	< 0.01
21-1-1	FR2			10/2/2019	8.08	138.	12.2	71.	13.4	< 0.1	2.11	2.33	< 0.05	< 0.025
21-1-1	FRM		Mean of duplicates	10/2/2019	8.08	138.	12.2	71.5	8.05	< 0.07	2.195	2.135	< 0.035	< 0.017 5
21-1-1	RPD		RPD of duplicates	10/2/2019	0.0%	0.0%	0.0%	1.4%	132.9% a	85.7% b	7.7%	18.3%	85.7% b	85.7% b
21-1-1	FR1	Y		11/21/2019	8.22	132.	11.6	68.	6.6	< 0.1	2.32	1.54	< 0.05	< 0.025
21-1-1	FR2			11/21/2019	8.22	132.	11.6	68.	7.9	< 0.1	2.38	1.44	< 0.05	< 0.025
21-1-1	FRM		Mean of duplicates	11/21/2019	8.22	132.	11.6	68.	7.25	< 0.1	2.35	1.49	< 0.05	< 0.025
21-1-1	RPD		RPD of duplicates	11/21/2019	0.0%	0.0%	0.0%	0.0%	17.9%	0.0%	2.6%	6.7%	0.0%	0.0%
21-1-1	FR1	Y		2/20/2020	8.06	125.	10.5	71.	1.3	< 0.04	2.17	1.63	< 0.02	< 0.01
21-1-1	FR2			2/20/2020	8.06	125.	10.5	71.	1.2	< 0.04	2.09	1.49	< 0.02	< 0.01
21-1-1	FRM		Mean of duplicates	2/20/2020	8.06	125.	10.5	71.	1.25	< 0.04	2.13	1.56	< 0.02	< 0.01
21-1-1	RPD		RPD of duplicates	2/20/2020	0.0%	0.0%	0.0%	0.0%	8.0%	0.0%	3.8%	9.0%	0.0%	0.0%
21-1-2	FR1	Y	0	5/30/2019	6.24	366.5	12.2	170.	1.43	< 0.02	1.47	19.6	< 0.01	< 0.005
21-1-2	FR2			5/30/2019	6.24	366.5	12.2	180.	1.03	< 0.02	1.47	20.9	< 0.01	< 0.005
21-1-2	FRM		Mean of duplicates	5/30/2019	6.24	366.5	12.2	175.	1.23	< 0.02	1.47	20.25	< 0.01	< 0.005
21-1-2	RPD		RPD of duplicates	5/30/2019	0.0%	0.0%	0.0%	5.7%	32.5% b	0.0%	0.0%	6.4%	0.0%	0.0%
21-1-2	FR1	Y	0	9/26/2019	6.29	532.	12.9	220.	1.43	0.022	1.46	24.6	< 0.01	< 0.005
21-1-2	FR2			9/26/2019	6.29	532.	12.9	220.	1.8	0.022	1.5	24.3	< 0.01	< 0.005
21-1-2	FRM		Mean of duplicates	9/26/2019	6.29	532.	12.9	220.	1.615	0.022	1.48	24.45	< 0.01	< 0.005
21-1-2	RPD		RPD of duplicates	9/26/2019	0.0%	0.0%	0.0%	0.0%	22.9%	0.0%	2.7%	1.2%	0.0%	0.0%
21-1-2	FR1	Y	0	11/21/2019	6.8	454.	11.5	200.	0.84	< 0.02	1.44	22.5	< 0.01	< 0.005
21-1-2	FR2			11/21/2019	6.8	454.	11.5	200.	0.85	< 0.02	1.47	23.6	< 0.01	< 0.005
21-1-2	FRM		Mean of duplicates	11/21/2019	6.8	454.	11.5	200.	0.845	< 0.02	1.455	23.05	< 0.01	< 0.005
21-1-2	RPD		RPD of duplicates	11/21/2019	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%	2.1%	4.8%	0.0%	0.0%
21-1-2	FR1	Y	Clear and colourless	2/20/2020	6.67	318.	11.5	170.	0.74	0.025	1.41	15.5	< 0.01	< 0.005
21-1-2	FR2			2/20/2020	6.67	318.	11.5	170.	0.64	< 0.02	1.39	15.2	< 0.01	< 0.005
21-1-2	FRM		Mean of duplicates	2/20/2020	6.67	318.	11.5	170.	0.69	0.022 5	1.4	15.35	< 0.01	< 0.005
21-1-2	RPD		RPD of duplicates	2/20/2020	0.0%	0.0%	0.0%	0.0%	14.5%	22.2%	1.4%	2.0%	0.0%	0.0%
21-2-1	FR1	Y	0	9/26/2019	6.57	554.	12.7	220.	1.18	0.03	2.57	22.3	< 0.01	< 0.005
21-2-1	FR2			9/26/2019	6.57	554.	12.7	230.	1.89	0.035	2.6	24.2	< 0.01	< 0.005
21-2-1	FRM		Mean of duplicates	9/26/2019	6.57	554.	12.7	225.	1.535	0.032 5	2.585	23.25	< 0.01	< 0.005
21-2-1	RPD		RPD of duplicates	9/26/2019	0.0%	0.0%	0.0%	4.4%	46.3% b	15.4%	1.2%	8.2%	0.0%	0.0%
21-2-1	FR1	Y	0	11/21/2019	6.84	433.	10.5	200.	1.	< 0.02	1.65	20.5	< 0.01	< 0.005
21-2-1	FR2			11/21/2019	6.84	433.	10.5	200.	3.4	< 0.02	1.59	20.4	< 0.01	< 0.005
21-2-1	FRM		Mean of duplicates	11/21/2019	6.84	433.	10.5	200.	2.2	< 0.02	1.62	20.45	< 0.01	< 0.005
21-2-1	RPD		RPD of duplicates	11/21/2019	0.0%	0.0%	0.0%	0.0%	109.1% b	0.0%	3.7%	0.5%	0.0%	0.0%
21-2-1	FR1	Y	Clear and moderately orange	2/20/2020	6.44	317.	10.1	170.	2.58	0.042	1.81	16.6	< 0.01	< 0.005
21-2-1	FR2			2/20/2020	6.44	317.	10.1	170.	1.08	0.024	1.86	16.5	< 0.01	< 0.005
21-2-1	FRM		Mean of duplicates	2/20/2020	6.44	317.	10.1	170.	1.83	0.033	1.835	16.55	< 0.01	< 0.005
21-2-1	RPD		RPD of duplicates	2/20/2020	0.0%	0.0%	0.0%	0.0%	82.0% b	54.5% b	2.7%	0.6%	0.0%	0.0%
25-1-2	FR1	N	0	6/13/2019	6.29	216.	12.1	120.	2.05	0.036	0.217	3.54	< 0.01	< 0.005
25-1-2	FR2			6/13/2019	6.29	216.	12.1	110.	1.49	0.029	0.213	3.56	< 0.01	< 0.005
25-1-2	FRM		Mean of duplicates	6/13/2019	6.29	216.	12.1	115.	1.77	0.032 5	0.215	3.55	< 0.01	< 0.005
25-1-2	RPD		RPD of duplicates	6/13/2019	0.0%	0.0%	0.0%	8.7%	31.6% b	21.5%	1.9%	0.6%	0.0%	0.0%
27-1-1	FR1	N	0	5/22/2019	7.4	127.6	11.5	73.	3.57	< 0.02	0.401	2.31	< 0.01	< 0.005
27-1-1	FR2			5/22/2019	7.4	127.6	11.5	69.	1.51	< 0.02	0.083	1.92	< 0.01	< 0.005
27-1-1	FRM		Mean of duplicates	5/22/2019	7.4	127.6	11.5	71.	2.54	< 0.02	0.242	2.115	< 0.01	< 0.005
27-1-1	RPD		RPD of duplicates	5/22/2019	0.0%	0.0%	0.0%	5.6%	81.1% b	0.0%	131.4% b	18.4%	0.0%	0.0%
31-1-1	FR1	N	0	12/2/2019	7.13	251.	9.8	130.	0.77	0.059	0.326	1.9	< 0.01	< 0.005
31-1-1	FR2			12/2/2019	7.13	251.	9.8	130.	0.92	0.053	0.315	1.91	< 0.01	< 0.005
31-1-1	FRM		Mean of duplicates	12/2/2019	7.13	251.	9.8	130.	0.845	0.056	0.320 5	1.905	< 0.01	< 0.005
31-1-1	RPD		RPD of duplicates	12/2/2019	0.0%	0.0%	0.0%	0.0%	17.8%	10.7%	3.4%	0.5%	0.0%	0.0%
39-1-1	FR1	Y	0	9/25/2019	7.45	260.	11.7	160.	0.92	0.158	0.555	1.85	< 0.01	< 0.005
39-1-1	FR2			9/25/2019	7.45	260.	11.7	160.	2.79	0.157	0.551	1.87	< 0.01	< 0.005
39-1-1	FRM		Mean of duplicates	9/25/2019	7.45	260.	11.7	160.	1.855	0.157 5	0.553	1.86	< 0.01	< 0.005
39-1-1	RPD		RPD of duplicates	9/25/2019	0.0%	0.0%	0.0%	0.0%	100.8% b	0.6%	0.7%	1.1%	0.0%	0.0%
39-1-1	FR1	Y	0	11/20/2019	7.25	177.	10.7	110.	1.77	0.082	0.369	6.16	< 0.01	< 0.005
39-1-1	FR2			11/20/2019	7.25	177.	10.7	100.	1.98	0.076	0.376	6.39	< 0.01	< 0.005
39-1-1	FRM		Mean of duplicates	11/20/2019	7.25	177.	10.7	105.	1.875	0.079	0.372 5	6.275	< 0.01	< 0.005
39-1-1	RPD		RPD of duplicates	11/20/2019	0.0%	0.0%	0.0%	9.5%	11.2%	7.6%	1.9%	3.7%	0.0%	0.0%
39-1-1	FR1	Y	Clear and colourless	2/20/2020	7.46	184.	11.2	100.	2.97	0.101	0.361	6.17	< 0.01	< 0.005
39-1-1	FR2			2/20/2020	7.46	184.	11.2	100.	1.3	0.093	0.37	5.78	< 0.01	< 0.005
39-1-1	FRM		Mean of duplicates	2/20/2020	7.46	184.	11.2	100.	2.135	0.097	0.365 5	5.975	< 0.01	< 0.005
39-1-1	RPD		RPD of duplicates	2/20/2020	0.0%	0.0%	0.0%	0.0%	78.2% b	8.2%	2.5%	6.5%	0.0%	0.0%

Table 3-1 Groundwater Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.01	0.1	0.1	1	0.5	0.02	0.02	0.02	0.01	0.005
				Limit of Quantitation (5 x MDL)	0.05	0.5	0.5	5	2.5	0.1	0.1	0.1	0.05	0.025
				Parameter	pH	Specific Conductivity - 25°C.	Temperature	Alkalinity - Total - Ph 4.5	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth
				Fraction	TOT	TOT	TOT	TOT	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Comments	Date Sampled										
39-2-1	FR1	Y	0	5/24/2019	6.83	2 693.	11.2	170.	0.63	0.177	0.478	2.	< 0.01	< 0.005
39-2-1	FR2			5/24/2019	6.83	269.3	11.2	170.	0.89	0.174	0.484	2.04	< 0.01	< 0.005
39-2-1	FRM		Mean of duplicates	5/24/2019	6.83	1 481.15	11.2	170.	0.76	0.175 5	0.481	2.02	< 0.01	< 0.005
39-2-1	RPD		RPD of duplicates	5/24/2019	0.0%	163.6%	0.0%	0.0%	34.2% b	1.7%	1.2%	2.0%	0.0%	0.0%
41-1-1	FR1	Y	0	9/19/2019	7.09	361.	10.3	160.	1.15	0.036	4.41	2.51	< 0.01	< 0.005
41-1-1	FR2			9/19/2019	7.09	361.	10.3	160.	0.54	0.03	4.44	2.38	< 0.01	< 0.005
41-1-1	FRM		Mean of duplicates	9/19/2019	7.09	361.	10.3	160.	0.845	0.033	4.425	2.445	< 0.01	< 0.005
41-1-1	RPD		RPD of duplicates	9/19/2019	0.0%	0.0%	0.0%	0.0%	72.2% b	18.2%	0.7%	5.3%	0.0%	0.0%
41-1-1	FR1	Y	0	12/2/2019	7.23	363.	10.8	160.	2.42	0.032	3.04	3.01	< 0.01	< 0.005
41-1-1	FR2			12/2/2019	7.23	363.	10.8	150.	2.52	0.029	3.	3.02	< 0.01	< 0.005
41-1-1	FRM		Mean of duplicates	12/2/2019	7.23	363.	10.8	155.	2.47	0.030 5	3.02	3.015	< 0.01	< 0.005
41-1-1	RPD		RPD of duplicates	12/2/2019	0.0%	0.0%	0.0%	6.5%	4.0%	9.8%	1.3%	0.3%	0.0%	0.0%
41-1-1	FR1	Y	Clear and colourless	3/4/2020	7.25	319.	9.7	150.	2.84	0.056	3.25	2.17	< 0.01	< 0.005
41-1-1	FR2			3/4/2020	7.25	319.	9.7	150.	3.33	0.051	3.37	2.4	< 0.01	< 0.005
41-1-1	FRM		Mean of duplicates	3/4/2020	7.25	319.	9.7	150.	3.085	0.053 5	3.31	2.285	< 0.01	< 0.005
41-1-1	RPD		RPD of duplicates	3/4/2020	0.0%	0.0%	0.0%	0.0%	15.9%	9.3%	3.6%	10.1%	0.0%	0.0%
42-1-1	FR1	Y	0	5/23/2019	6.24	286.5	9.3	200.	5.41	< 0.02	0.168	12.	< 0.01	< 0.005
42-1-1	FR2			5/23/2019	6.24	286.5	9.3	200.	5.71	< 0.02	0.137	11.9	0.011	< 0.005
42-1-1	FRM		Mean of duplicates	5/23/2019	6.24	286.5	9.3	200.	5.56	< 0.02	0.152 5	11.95	0.010 5	< 0.005
42-1-1	RPD		RPD of duplicates	5/23/2019	0.0%	0.0%	0.0%	0.0%	5.4%	0.0%	20.3%	0.8%	9.5%	0.0%
42-1-1	FR1	Y	0	12/2/2019	6.87	394.	9.9	200.	4.58	< 0.02	0.229	14.8	< 0.01	< 0.005
42-1-1	FR2			12/2/2019	6.87	394.	9.9	190.	4.35	< 0.02	0.222	14.8	< 0.01	< 0.005
42-1-1	FRM		Mean of duplicates	12/2/2019	6.87	394.	9.9	195.	4.465	< 0.02	0.225 5	14.8	< 0.01	< 0.005
42-1-1	RPD		RPD of duplicates	12/2/2019	0.0%	0.0%	0.0%	5.1%	5.2%	0.0%	3.1%	0.0%	0.0%	0.0%
42-1-1	FR1	Y	Clear and colourless	3/4/2020	6.67	255.	9.1	200.	9.02	< 0.02	0.151	13.7	< 0.01	< 0.005
42-1-1	FR2			3/4/2020	6.67	255.	9.1	190.	6.64	< 0.02	0.143	13.3	< 0.01	< 0.005
42-1-1	FRM		Mean of duplicates	3/4/2020	6.67	255.	9.1	195.	7.83	< 0.02	0.147	13.5	< 0.01	< 0.005
42-1-1	RPD		RPD of duplicates	3/4/2020	0.0%	0.0%	0.0%	5.1%	**30.4%** a	0.0%	5.4%	3.0%	0.0%	0.0%
58-1-0	FR1	N	0	5/29/2019	6.63	5 664.	19.9	1 900.	13.4	0.44	1.84	36.	< 0.05	< 0.025
58-1-0	FR2			5/29/2019	6.63	5 664.	19.9	2 000.	13.5	0.46	1.89	36.	< 0.05	< 0.025
58-1-0	FRM		Mean of duplicates	5/29/2019	6.63	5 664.	19.9	1 950.	13.45	0.45	1.865	36.	< 0.05	< 0.025
58-1-0	RPD		RPD of duplicates	5/29/2019	0.0%	0.0%	0.0%	5.1%	0.7%	4.4%	2.7%	0.0%	0.0%	0.0%
71-1-1	FR1	Y	0	5/16/2019	6.84	230.1	10.3	140.	3.79	0.026	0.416	5.73	< 0.01	< 0.005
71-1-1	FR2			5/16/2019	6.84	230.1	10.3	136.	1.22	0.036	0.433	5.68	< 0.01	< 0.005
71-1-1	FRM		Mean of duplicates	5/16/2019	6.84	230.1	10.3	138.	2.505	0.031	0.424 5	5.705	< 0.01	< 0.005
71-1-1	RPD		RPD of duplicates	5/16/2019	0.0%	0.0%	0.0%	2.9%	102.6% b	32.3% b	4.0%	0.9%	0.0%	0.0%
71-1-1	FR1	Y	0	9/12/2019	7.02	231.	10.6	170.	1.06	0.045	0.286	5.91	< 0.01	< 0.005
71-1-1	FR2			9/12/2019	7.02	231.	10.6	170.	1.11	0.042	0.283	5.87	< 0.01	< 0.005
71-1-1	FRM		Mean of duplicates	9/12/2019	7.02	231.	10.6	170.	1.085	0.043 5	0.284 5	5.89	< 0.01	< 0.005
71-1-1	RPD		RPD of duplicates	9/12/2019	0.0%	0.0%	0.0%	0.0%	4.6%	6.9%	1.1%	0.7%	0.0%	0.0%
71-1-1	FR1	Y	0	11/6/2019	7.52	263.	10.2	160.	3.49	0.061	0.255	6.26	< 0.01	< 0.005
71-1-1	FR2			11/6/2019	7.52	263.	10.2	160.	3.2	0.051	0.276	6.23	< 0.01	< 0.005
71-1-1	FRM		Mean of duplicates	11/6/2019	7.52	263.	10.2	160.	3.345	0.056	0.265 5	6.245	< 0.01	< 0.005
71-1-1	RPD		RPD of duplicates	11/6/2019	0.0%	0.0%	0.0%	0.0%	8.7%	17.9%	7.9%	0.5%	0.0%	0.0%
71-1-1	FR1	Y	Clear and colourless	2/13/2020	7.45	245.	9.7	140.	1.21	0.091	0.387	8.76	< 0.01	< 0.005
71-1-1	FR2			2/13/2020	7.45	245.	9.7	140.	1.14	0.081	0.409	7.1	< 0.01	< 0.005
71-1-1	FRM		Mean of duplicates	2/13/2020	7.45	245.	9.7	140.	1.175	0.086	0.398	7.93	< 0.01	< 0.005
71-1-1	RPD		RPD of duplicates	2/13/2020	0.0%	0.0%	0.0%	0.0%	6.0%	11.6%	5.5%	20.9%	0.0%	0.0%
72-1-1	FR1	Y	0	5/16/2019	7.05	450.4	10.8	163.	1.23	< 0.02	0.285	13.5	< 0.01	< 0.005
72-1-1	FR2			5/16/2019	7.05	450.4	10.8	158.	1.13	< 0.02	0.269	13.5	< 0.01	< 0.005
72-1-1	FRM		Mean of duplicates	5/16/2019	7.05	450.4	10.8	160.5	1.18	< 0.02	0.277	13.5	< 0.01	< 0.005
72-1-1	RPD		RPD of duplicates	5/16/2019	0.0%	0.0%	0.0%	3.1%	8.5%	0.0%	5.8%	0.0%	0.0%	0.0%
72-1-1	FR1	Y	0	9/11/2019	7.27	494.	10.6	160.	0.89	< 0.02	0.219	12.7	< 0.01	< 0.005
72-1-1	FR2			9/11/2019	7.27	494.	10.6	160.	0.97	< 0.02	0.211	13.2	< 0.01	< 0.005
72-1-1	FRM		Mean of duplicates	9/11/2019	7.27	494.	10.6	160.	0.93	< 0.02	0.215	12.95	< 0.01	< 0.005
72-1-1	RPD		RPD of duplicates	9/11/2019	0.0%	0.0%	0.0%	0.0%	8.6%	0.0%	3.7%	3.9%	0.0%	0.0%
72-1-1	FR1	Y	0	11/6/2019	7.63	428.	10.9	150.	4.1	< 0.04	0.057	12.7	< 0.02	< 0.01
72-1-1	FR2			11/6/2019	7.63	428.	10.9	150.	4.	< 0.04	< 0.04	12.5	< 0.02	< 0.01
72-1-1	FRM		Mean of duplicates	11/6/2019	7.63	428.	10.9	150.	4.05	< 0.04	0.048 5	12.6	< 0.02	< 0.01
72-1-1	RPD		RPD of duplicates	11/6/2019	0.0%	0.0%	0.0%	0.0%	2.5%	0.0%	35.1% b	1.6%	0.0%	0.0%
72-1-1	FR1	Y	Clear and colourless	2/12/2020	7.56	438.	10.2	160.	0.8	< 0.02	0.168	12.9	< 0.01	< 0.005
72-1-1	FR2			2/12/2020	7.56	438.	10.2	160.	0.9	< 0.02	0.186	12.8	< 0.01	< 0.005
72-1-1	FRM		Mean of duplicates	2/12/2020	7.56	438.	10.2	160.	0.85	< 0.02	0.177	12.85	< 0.01	< 0.005
72-1-1	RPD		RPD of duplicates	2/12/2020	0.0%	0.0%	0.0%	0.0%	11.8%	0.0%	10.2%	0.8%	0.0%	0.0%
73-1-1	FR1	Y	0	9/12/2019	7.02	332.	10.9	160.	1.27	0.025	0.239	12.9	< 0.01	< 0.005
73-1-1	FR2			9/12/2019	7.02	332.	10.9	160.	0.54	< 0.02	0.237	12.8	< 0.01	< 0.005
73-1-1	FRM		Mean of duplicates	9/12/2019	7.02	332.	10.9	160.	0.905	0.022 5	0.238	12.85	< 0.01	< 0.005
73-1-1	RPD		RPD of duplicates	9/12/2019	0.0%	0.0%	0.0%	0.0%	80.7% b	22.2%	0.8%	0.8%	0.0%	0.0%
73-3-1	FR1	Y	0	11/6/2019	6.51	248.	10.6	78.	2.33	0.032	0.11	17.4	< 0.01	< 0.005
73-3-1	FR2			11/6/2019	6.51	248.	10.6	93.	2.34	0.031	0.098	17.6	< 0.01	< 0.005
73-3-1	FRM		Mean of duplicates	11/6/2019	6.51	248.	10.6	85.5	2.335	0.031 5	0.104	17.5	< 0.01	< 0.005
73-3-1	RPD		RPD of duplicates	11/6/2019	0.0%	0.0%	0.0%	17.5%	0.4%	3.2%	11.5%	1.1%	0.0%	0.0%
78-2-1	FR1	N	0	9/18/2019	6.42	303.	7.6	110.	1.13	0.09	0.218	12.8	< 0.01	< 0.005
78-2-1	FR2			9/18/2019	6.42	303.	7.6	110.	1.12	0.099	0.229	13.	< 0.01	< 0.005
78-2-1	FRM		Mean of duplicates	9/18/2019	6.42	303.	7.6	110.	1.125	0.094 5	0.223 5	12.9	< 0.01	< 0.005
78-2-1	RPD		RPD of duplicates	9/18/2019	0.0%	0.0%	0.0%	0.0%	0.9%	9.5%	4.9%	1.6%	0.0%	0.0%

Notes:

SS Single sample
FR1 Field replicate 1
FR2 Field replicate 2
FRM Average of field replicates
RPD Relative percent difference of field replicates
na - Not applicable, some replicates less than the detection limit.

a *- Coefficient of variation greater than 30% and all replicates greater than the limit of quantitation.*

b *- Coefficient of variation greater than 30% with some replicates less than the limit of quantitation.*

Table 3-1 Groundwater Quality QA/QC - Relative Percent Difference 2019-2020

Station	Sample Type	Compliance Well (Y/N)?	Comments	Date Sampled	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead	Lithium	Magnesium
				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	10	0.005	0.05	1	0.1	0.01	0.01	0.5	1	0.005	0.5	0.05
				Limit of Quantitation (5 x MDL)	50	0.025	0.25	5	0.5	0.05	0.05	2.5	5	0.025	2.5	0.25
				Parameter	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead	Lithium	Magnesium
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L
18-1-1	FR1	Y	0	9/6/2019	19.	0.030 3	61.	3.4	< 0.1	0.069 1	0.398	181.	2.7	0.038 4	0.61	7.
18-1-1	FR2			9/6/2019	19.	0.025 2	61.6	3.8	< 0.1	0.070 8	0.254	182.	< 1.	0.009 6	0.62	6.91
18-1-1	FRM		Mean of duplicates	9/6/2019	19.	0.027 75	61.3	3.6	< 0.1	0.069 95	0.326	181.5	1.85	0.024	0.615	6.955
18-1-1	RPD		RPD of duplicates	9/6/2019	0.0%	18.4%	1.0%	11.1%	0.0%	2.4%	44.2% a	0.6%	91.9% b	120.0% b	1.6%	1.3%
18-1-1	FR1	Y	0	11/29/2019	21.	0.016 1	62.6	3.7	< 0.1	0.005 2	0.288	187.	3.4	0.007 5	0.67	7.39
18-1-1	FR2			11/29/2019	20.	0.006 4	62.2	4.1	< 0.1	0.005 7	0.221	185.	< 1.	< 0.005	0.67	7.26
18-1-1	FRM		Mean of duplicates	11/29/2019	20.5	0.011 25	62.4	3.9	< 0.1	0.005 45	0.254 5	186.	2.2	0.006 25	0.67	7.325
18-1-1	RPD		RPD of duplicates	11/29/2019	4.9%	86.2% b	0.6%	10.3%	0.0%	9.2%	26.3%	1.1%	109.1% b	40.0% b	0.0%	1.8%
18-1-1	FR1	Y	d colourless, contains some c	2/27/2020	24.	0.078 8	55.3	3.7	0.17	0.19	1.42	164.	105.	0.085 6	0.55	6.19
18-1-1	FR2			2/27/2020	22.	0.070 1	55.2	3.6	< 0.1	0.173	0.59	164.	44.9	0.058 2	0.57	6.4
18-1-1	FRM		Mean of duplicates	2/27/2020	23.	0.074 45	55.25	3.65	0.135	0.181 5	1.005	164.	74.95	0.071 9	0.56	6.295
18-1-1	RPD		RPD of duplicates	2/27/2020	8.7%	11.7%	0.2%	2.7%	51.9% b	9.4%	82.6% a	0.0%	80.2% a	38.1% a	3.6%	3.3%
21-1-1	FR1	Y		10/2/2019	3 890.	< 0.01	21.4	3.7	< 0.2	< 0.01	< 0.1	68.7	3.	< 0.01	1.1	3.72
21-1-1	FR2			10/2/2019	4 070.	< 0.025	22.3	3.6	< 0.5	< 0.025	< 0.25	71.6	15.6	< 0.025	< 2.5	3.84
21-1-1	FRM		Mean of duplicates	10/2/2019	3 980.	< 0.017 5	21.85	3.65	< 0.35	< 0.017 5	< 0.175	70.15	9.3	< 0.017 5	1.8	3.78
21-1-1	RPD		RPD of duplicates	10/2/2019	4.5%	85.7% b	4.1%	2.7%	85.7% b	85.7% b	85.7% b	4.1%	135.5% b	85.7% b	77.8% b	3.2%
21-1-1	FR1	Y		11/21/2019	3 850.	< 0.025	20.2	3.7	< 0.5	< 0.025	< 0.25	64.8	< 5.	< 0.025	< 2.5	3.49
21-1-1	FR2			11/21/2019	3 910.	< 0.025	20.1	3.5	< 0.5	< 0.025	< 0.25	64.9	5.5	< 0.025	< 2.5	3.57
21-1-1	FRM		Mean of duplicates	11/21/2019	3 880.	< 0.025	20.15	3.6	< 0.5	< 0.025	< 0.25	64.85	5.25	< 0.025	< 2.5	3.53
21-1-1	RPD		RPD of duplicates	11/21/2019	1.5%	0.0%	0.5%	5.6%	0.0%	0.0%	0.0%	0.2%	9.5%	0.0%	0.0%	2.3%
21-1-1	FR1	Y		2/20/2020	3 730.	< 0.01	20.4	3.5	< 0.2	< 0.01	0.15	66.1	2.8	< 0.01	1.3	3.67
21-1-1	FR2			2/20/2020	3 580.	< 0.01	19.4	3.7	< 0.2	< 0.01	< 0.01	62.5	2.5	< 0.01	1.1	3.44
21-1-1	FRM		Mean of duplicates	2/20/2020	3 655.	< 0.01	19.9	3.6	< 0.2	< 0.01	0.08	64.3	2.65	< 0.01	1.2	3.555
21-1-1	RPD		RPD of duplicates	2/20/2020	4.1%	0.0%	5.0%	5.6%	0.0%	0.0%	175.0% b	5.6%	11.3%	0.0%	16.7%	6.5%
21-1-2	FR1	Y	0	5/30/2019	1 030.	0.007	45.2	35.	0.21	0.942	0.211	150.	953.	0.006 2	< 0.5	8.93
21-1-2	FR2			5/30/2019	726.	< 0.005	49.5	43.	0.22	1.02	0.213	165.	1 090.	< 0.005	< 0.5	10.1
21-1-2	FRM		Mean of duplicates	5/30/2019	878.	0.006	47.35	39.	0.215	0.981	0.212	157.5	1 021.5	0.005 6	< 0.5	9.515
21-1-2	RPD		RPD of duplicates	5/30/2019	34.6% a	33.3% b	9.1%	20.5%	4.7%	8.0%	0.9%	9.5%	13.4%	21.4%	0.0%	12.3%
21-1-2	FR1	Y	0	9/26/2019	816.	0.006	68.2	72.	0.33	1.43	0.366	226.	1 550.	0.007 6	< 0.5	13.4
21-1-2	FR2			9/26/2019	859.	0.006 6	66.3	73.	0.29	1.44	0.392	221.	1 540.	0.007	< 0.5	13.4
21-1-2	FRM		Mean of duplicates	9/26/2019	837.5	0.006 3	67.25	72.5	0.31	1.435	0.379	223.5	1 545.	0.007 3	< 0.5	13.4
21-1-2	RPD		RPD of duplicates	9/26/2019	5.1%	9.5%	2.8%	1.4%	12.9%	0.7%	6.9%	2.2%	0.6%	8.2%	0.0%	0.0%
21-1-2	FR1	Y	0	11/21/2019	836.	0.005 5	58.4	60.	0.2	1.39	0.303	194.	1 290.	0.008 1	< 0.5	11.8
21-1-2	FR2			11/21/2019	873.	0.008 2	60.5	58.	0.18	1.44	0.317	202.	1 340.	0.008	< 0.5	12.4
21-1-2	FRM		Mean of duplicates	11/21/2019	854.5	0.006 85	59.45	59.	0.19	1.415	0.31	198.	1 315.	0.008 05	< 0.5	12.1
21-1-2	RPD		RPD of duplicates	11/21/2019	4.3%	39.4% b	3.5%	3.4%	10.5%	3.5%	4.5%	4.0%	3.8%	1.2%	0.0%	5.0%
21-1-2	FR1	Y	Clear and colourless	2/20/2020	659.	0.005 4	36.7	26.	0.2	0.993	0.438	124.	794.	0.006	< 0.5	7.88
21-1-2	FR2			2/20/2020	695.	< 0.005	37.4	25.	0.19	0.991	0.413	126.	782.	< 0.005	< 0.5	7.86
21-1-2	FRM		Mean of duplicates	2/20/2020	677.	0.005 2	37.05	25.5	0.195	0.992	0.425 5	125.	788.	0.005 5	< 0.5	7.87
21-1-2	RPD		RPD of duplicates	2/20/2020	5.3%	7.7%	1.9%	3.9%	5.1%	0.2%	5.9%	1.6%	1.5%	18.2%	0.0%	0.3%
21-2-1	FR1	Y	0	9/26/2019	808.	0.016 7	68.8	78.	0.24	1.7	0.864	228.	1 870.	0.012 5	< 0.5	13.6
21-2-1	FR2			9/26/2019	839.	0.016 1	68.4	86.	0.27	1.71	1.73	227.	1 910.	0.041 8	< 0.5	13.7
21-2-1	FRM		Mean of duplicates	9/26/2019	823.5	0.016 4	68.6	82.	0.255	1.705	1.297	227.5	1 890.	0.027 15	< 0.5	13.65
21-2-1	RPD		RPD of duplicates	9/26/2019	3.8%	3.7%	0.6%	9.8%	11.8%	0.6%	66.8% a	0.4%	2.1%	107.9%	0.0%	0.7%
21-2-1	FR1	Y	0	11/21/2019	759.	0.011 7	56.6	58.	0.22	1.47	0.488	190.	1 260.	0.012 4	< 0.5	11.7
21-2-1	FR2			11/21/2019	751.	0.010 4	56.6	59.	0.24	1.42	0.581	189.	1 270.	0.018 3	< 0.5	11.7
21-2-1	FRM		Mean of duplicates	11/21/2019	755.	0.011 05	56.6	58.5	0.23	1.445	0.534 5	189.5	1 265.	0.015 35	< 0.5	11.7
21-2-1	RPD		RPD of duplicates	11/21/2019	1.1%	11.8%	0.0%	1.7%	8.7%	3.5%	17.4%	0.5%	0.8%	38.4% b	0.0%	0.0%
21-2-1	FR1	Y	Clear and moderately orange	2/20/2020	607.	0.012 6	43.6	28.	0.27	1.11	1.77	146.	1 000.	0.044 2	< 0.5	9.09
21-2-1	FR2			2/20/2020	664.	0.010 2	46.9	28.	0.19	1.2	0.379	158.	945.	0.009 4	< 0.5	9.91
21-2-1	FRM		Mean of duplicates	2/20/2020	635.5	0.011 4	45.25	28.	0.23	1.155	1.074 5	152.	972.5	0.026 8	< 0.5	9.5
21-2-1	RPD		RPD of duplicates	2/20/2020	9.0%	21.1%	7.3%	0.0%	34.8% b	7.8%	129.5% a	7.9%	5.7%	129.9% b	0.0%	8.6%
25-1-2	FR1	N	0	6/13/2019	54.	< 0.005	47.9	5.	< 0.1	0.066 9	0.636	133.	24.5	< 0.005	< 0.5	3.21
25-1-2	FR2			6/13/2019	54.	< 0.005	47.9	2.9	< 0.1	0.080 4	0.629	133.	25.1	< 0.005	< 0.5	3.25
25-1-2	FRM		Mean of duplicates	6/13/2019	54.	< 0.005	47.9	3.95	< 0.1	0.073 65	0.632 5	133.	24.8	< 0.005	< 0.5	3.23
25-1-2	RPD		RPD of duplicates	6/13/2019	0.0%	0.0%	0.0%	53.2% b	0.0%	18.3%	1.1%	0.0%	2.4%	0.0%	0.0%	1.2%
27-1-1	FR1	N	0	5/22/2019	247.	< 0.005	18.6	3.4	0.25	0.034 5	1.78	69.6	148.	0.137	0.66	5.63
27-1-1	FR2			5/22/2019	233.	< 0.005	18.5	3.4	< 0.1	0.014 5	0.229	69.9	13.2	0.005	0.64	5.73
27-1-1	FRM		Mean of duplicates	5/22/2019	240.	< 0.005	18.55	3.4	0.175	0.024 5	1.004 5	69.75	80.6	0.071	0.65	5.68
27-1-1	RPD		RPD of duplicates	5/22/2019	5.8%	0.0%	0.5%	0.0%	85.7% b	81.6% b	154.4% a	0.4%	167.2% a	185.9% b	3.1%	1.8%
31-1-1	FR1	N	0	12/2/2019	44.	0.018 3	60.3	6.4	< 0.1	0.144	0.274	170.	10.5	< 0.005	< 0.5	4.72
31-1-1	FR2			12/2/2019	46.	0.018 9	61.1	6.6	< 0.1	0.134	0.267	172.	10.	< 0.005	< 0.5	4.81
31-1-1	FRM		Mean of duplicates	12/2/2019	45.	0.018 6	60.7	6.5	< 0.1	0.139	0.270 5	171.	10.25	< 0.005	< 0.5	4.765
31-1-1	RPD		RPD of duplicates	12/2/2019	4.4%	3.2%	1.3%	3.1%	0.0%	7.2%	2.6%	1.2%	4.9%	0.0%	0.0%	1.9%
39-1-1	FR1	Y	0	9/25/2019	998.	< 0.005	61.8	4.4	< 0.1	0.010 4	0.188	178.	< 1.	< 0.005	< 0.5	5.81
39-1-1	FR2			9/25/2019	1 010.	< 0.005	60.9	4.4	< 0.1	0.011 9	0.237	176.	1.6	< 0.005	< 0.5	5.82
39-1-1	FRM		Mean of duplicates	9/25/2019	1 004.	< 0.005	61.35	4.4	< 0.1	0.011 15	0.212 5	177.	1.3	< 0.005	< 0.5	5.815
39-1-1	RPD		RPD of duplicates	9/25/2019	1.2%	0.0%	1.5%	0.0%	0.0%	13.5%	23.1%	1.1%	46.2% b	0.0%	0.0%	0.2%
39-1-1	FR1	Y	0	11/20/2019	15.	0.010 3	38.	2.4	< 0.1	0.017 8	0.183	110.	1.4	< 0.005	< 0.5	3.56
39-1-1	FR2			11/20/2019	16.	0.012 1	37.7	2.4	< 0.1	0.016 8	0.172	108.	1.3	0.006 7	< 0.5	3.49
39-1-1	FRM		Mean of duplicates	11/20/2019	15.5	0.011 2	37.85	2.4	< 0.1	0.017 3	0.177 5	109.	1.35	0.005 85	< 0.5	3.525
39-1-1	RPD		RPD of duplicates	11/20/2019	6.5%	16.1%	0.8%	0.0%	0.0%	5.8%	6.2%	1.8%	7.4%	29.1%	0.0%	2.0%
39-1-1	FR1	Y	Clear and colourless	2/20/2020	15.	0.010 2	37.2	2.4	< 0.1	0.020 8	0.553	107.	5.	0.019 5	< 0.5	3.42
39-1-1	FR2			2/20/2020	14.	0.009 3	38.1	2.6	< 0.1	0.015 4	0.188	109.	< 1.	< 0.005	< 0.5	3.4
39-1-1	FRM		Mean of duplicates	2/20/2020	14.5	0.009 75	37.65	2.5	< 0.1	0.018 1	0.370 5	108.	3.	0.012 25	< 0.5	3.41
39-1-1	RPD		RPD of duplicates	2/20/2020	6.9%	9.2%	2.4%	8.0%	0.0%	29.8%	98.5% a	1.9%	133.3% b	118.4% b	0.0%	0.6%

Station	Sample Type	Complance Well (Y/N)?	Comments	Date Sampled	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead	Lithium	Magnesium
				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	10	0.005	0.05	1	0.1	0.01	0.01	0.5	1	0.005	0.5	0.05
				Limit of Quantitation (5 x MDL)	50	0.025	0.25	5	0.5	0.05	0.05	2.5	5	0.025	2.5	0.25
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L
39-2-1	FR1	Y	0	5/24/2019	881.	< 0.005	63.9	4.4	< 0.1	0.014	0.126	185.	7.4	< 0.005	< 0.5	6.2
39-2-1	FR2			5/24/2019	862.	< 0.005	61.	4.1	< 0.1	0.016 3	0.124	179.	7.4	< 0.005	< 0.5	6.39
39-2-1	FRM		Mean of duplicates	5/24/2019	871.5	< 0.005	62.45	4.25	< 0.1	0.015 15	0.125	182.	7.4	< 0.005	< 0.5	6.295
39-2-1	RPD		RPD of duplicates	5/24/2019	2.2%	0.0%	4.6%	7.1%	0.0%	15.2%	1.6%	3.3%	0.0%	0.0%	0.0%	3.0%
41-1-1	FR1	Y	0	9/19/2019	28.	0.202	81.3	4.9	< 0.1	0.161	0.31	237.	14.1	0.008 4	< 0.5	8.29
41-1-1	FR2			9/19/2019	28.	0.012 4	79.8	4.4	< 0.1	0.159	0.165	234.	12.7	< 0.005	< 0.5	8.32
41-1-1	FRM		Mean of duplicates	9/19/2019	28.	0.107 2	80.55	4.65	< 0.1	0.16	0.237 5	235.5	13.4	0.006 7	< 0.5	8.305
41-1-1	RPD		RPD of duplicates	9/19/2019	0.0%	176.9% b	1.9%	10.8%	0.0%	1.3%	**61.1% a**	1.3%	10.4%	50.7% b	0.0%	0.4%
41-1-1	FR1	Y	0	12/2/2019	27.	0.017 4	82.5	4.8	< 0.1	0.126	0.425	244.	8.3	0.010 2	< 0.5	9.21
41-1-1	FR2			12/2/2019	26.	0.017	81.8	4.5	< 0.1	0.134	0.283	242.	8.2	0.006 7	< 0.5	9.12
41-1-1	FRM		Mean of duplicates	12/2/2019	26.5	0.017 2	82.15	4.65	< 0.1	0.13	0.354	243.	8.25	0.008 45	< 0.5	9.165
41-1-1	RPD		RPD of duplicates	12/2/2019	3.8%	2.3%	0.9%	6.5%	0.0%	6.2%	**40.1% a**	0.8%	1.2%	41.4% b	0.0%	1.0%
41-1-1	FR1	Y	Clear and colourless	3/4/2020	25.	0.006	71.9	4.8	< 0.1	0.111	0.231	215.	31.8	0.007 3	< 0.5	8.7
41-1-1	FR2			3/4/2020	24.	0.008 8	70.6	4.6	< 0.1	0.11	0.475	212.	36.4	0.019 1	< 0.5	8.65
41-1-1	FRM		Mean of duplicates	3/4/2020	24.5	0.007 4	71.25	4.7	< 0.1	0.110 5	0.353	213.5	34.1	0.013 2	< 0.5	8.675
41-1-1	RPD		RPD of duplicates	3/4/2020	4.1%	37.8% b	1.8%	4.3%	0.0%	0.9%	**69.1% a**	1.4%	13.5%	89.4% b	0.0%	0.6%
42-1-1	FR1	Y	0	5/23/2019	86.	< 0.005	88.1	11.	0.15	0.048 1	0.086	242.	697.	0.006 7	< 0.5	5.4
42-1-1	FR2			5/23/2019	87.	< 0.005	90.3	10.	0.13	0.047 5	< 0.05	248.	714.	0.005 3	< 0.5	5.41
42-1-1	FRM		Mean of duplicates	5/23/2019	86.5	< 0.005	89.2	10.5	0.14	0.047 8	0.068	245.	705.5	0.006	< 0.5	5.405
42-1-1	RPD		RPD of duplicates	5/23/2019	1.2%	0.0%	2.5%	9.5%	14.3%	1.3%	52.9% b	2.4%	2.4%	23.3%	0.0%	0.2%
42-1-1	FR1	Y	0	12/2/2019	81.	< 0.005	97.3	14.	0.2	0.052 2	0.069	267.	684.	0.005 3	< 0.5	5.85
42-1-1	FR2			12/2/2019	81.	< 0.005	97.3	13.	0.21	0.053 1	0.05	268.	691.	0.005	< 0.5	6.03
42-1-1	FRM		Mean of duplicates	12/2/2019	81.	< 0.005	97.3	13.5	0.205	0.052 65	0.059 5	267.5	687.5	0.005 15	< 0.5	5.94
42-1-1	RPD		RPD of duplicates	12/2/2019	0.0%	0.0%	0.0%	7.4%	4.9%	1.7%	31.9% b	0.4%	1.0%	5.8%	0.0%	3.0%
42-1-1	FR1	Y	Clear and colourless	3/4/2020	71.	< 0.005	88.7	10.	0.16	0.041 7	0.075	247.	650.	0.005 4	< 0.5	6.15
42-1-1	FR2			3/4/2020	72.	0.022 6	89.1	11.	0.15	0.045 6	0.107	248.	653.	0.008 3	< 0.5	6.11
42-1-1	FRM		Mean of duplicates	3/4/2020	71.5	0.013 8	88.9	10.5	0.155	0.043 65	0.091	247.5	651.5	0.006 85	< 0.5	6.13
42-1-1	RPD		RPD of duplicates	3/4/2020	1.4%	127.5% b	0.4%	9.5%	6.5%	8.9%	**35.2% a**	0.4%	0.5%	42.3% b	0.0%	0.7%
58-1-0	FR1	N	0	5/29/2019	3 690.	0.074	461.	910.	11.1	59.5	5.84	1 730.	3 640.	0.308	< 2.5	141.
58-1-0	FR2			5/29/2019	3 720.	0.075	458.	930.	10.7	58.4	5.45	1 720.	3 590.	0.321	< 2.5	140.
58-1-0	FRM		Mean of duplicates	5/29/2019	3 705.	0.074 5	459.5	920.	10.9	58.95	5.645	1 725.	3 615.	0.314 5	< 2.5	140.5
58-1-0	RPD		RPD of duplicates	5/29/2019	0.8%	1.3%	0.7%	2.2%	3.7%	1.9%	6.9%	0.6%	1.4%	4.1%	0.0%	0.7%
71-1-1	FR1	Y	0	5/16/2019	599.	0.007	46.4	8.1	< 0.1	0.091	0.092	143.	6.1	0.006	< 0.5	6.49
71-1-1	FR2			5/16/2019	603.	0.007	45.9	7.8	< 0.1	0.088	0.192	141.	7.	0.006	< 0.5	6.39
71-1-1	FRM		Mean of duplicates	5/16/2019	601.	0.007	46.15	7.95	< 0.1	0.089 5	0.142	142.	6.55	0.006	< 0.5	6.44
71-1-1	RPD		RPD of duplicates	5/16/2019	0.7%	0.0%	1.1%	3.8%	0.0%	3.4%	**70.4% a**	1.4%	13.7%	0.0%	0.0%	1.6%
71-1-1	FR1	Y	0	9/12/2019	403.	< 0.005	56.1	8.9	< 0.1	0.059 5	< 0.05	169.	7.2	< 0.005	< 0.5	7.09
71-1-1	FR2			9/12/2019	397.	0.008 3	55.2	8.8	< 0.1	0.062 5	0.106	167.	6.9	< 0.005	< 0.5	7.02
71-1-1	FRM		Mean of duplicates	9/12/2019	400.	0.006 65	55.65	8.85	< 0.1	0.061	0.078	168.	7.05	< 0.005	< 0.5	7.055
71-1-1	RPD		RPD of duplicates	9/12/2019	1.5%	49.6% b	1.6%	1.1%	0.0%	4.9%	71.8% b	1.2%	4.3%	0.0%	0.0%	1.0%
71-1-1	FR1	Y	0	11/6/2019	449.	0.094 3	55.6	8.8	< 0.1	0.106	0.147	170.	19.4	0.007 3	< 0.5	7.52
71-1-1	FR2			11/6/2019	449.	0.050 7	55.8	9.	< 0.1	0.113	0.166	171.	20.1	0.008 2	< 0.5	7.57
71-1-1	FRM		Mean of duplicates	11/6/2019	449.	0.072 5	55.7	8.9	< 0.1	0.109 5	0.156 5	170.5	19.75	0.007 75	< 0.5	7.545
71-1-1	RPD		RPD of duplicates	11/6/2019	0.0%	**60.1% a**	0.4%	2.2%	0.0%	6.4%	12.1%	0.6%	3.5%	11.6%	0.0%	0.7%
71-1-1	FR1	Y	Clear and colourless	2/13/2020	544.	< 0.005	50.6	7.7	< 0.1	0.132	1.43	156.	7.9	0.040 9	< 0.5	7.09
71-1-1	FR2			2/13/2020	541.	0.006 3	49.8	7.6	< 0.1	0.135	0.122	153.	5.4	0.005 1	< 0.5	6.91
71-1-1	FRM		Mean of duplicates	2/13/2020	542.5	0.005 65	50.2	7.65	< 0.1	0.133 5	0.776	154.5	6.65	0.023	< 0.5	7.
71-1-1	RPD		RPD of duplicates	2/13/2020	0.6%	23.0%	1.6%	1.3%	0.0%	2.2%	**168.6% a**	1.9%	**37.6% a**	155.7% b	0.0%	2.6%
72-1-1	FR1	Y	0	5/16/2019	1 630.	< 0.005	87.	73.	< 0.1	0.161	< 0.05	275.	399.	0.006	< 0.5	14.
72-1-1	FR2			5/16/2019	1 650.	0.005	87.6	72.	< 0.1	0.155	0.084	276.	386.	0.009	< 0.5	13.9
72-1-1	FRM		Mean of duplicates	5/16/2019	1 640.	0.005	87.3	72.5	< 0.1	0.158	0.067	275.5	392.5	0.007 5	< 0.5	13.95
72-1-1	RPD		RPD of duplicates	5/16/2019	1.2%	0.0%	0.7%	1.4%	0.0%	3.8%	50.7% b	0.4%	3.3%	40.0% b	0.0%	0.7%
72-1-1	FR1	Y	0	9/11/2019	1 450.	< 0.005	85.	82.	< 0.1	0.049 5	< 0.05	265.	375.	< 0.005	< 0.5	12.9
72-1-1	FR2			9/11/2019	1 430.	< 0.005	85.	83.	0.1	0.051 7	< 0.05	265.	378.	< 0.005	< 0.5	12.8
72-1-1	FRM		Mean of duplicates	9/11/2019	1 440.	< 0.005	85.	82.5	0.1	0.050 6	< 0.05	265.	376.5	< 0.005	< 0.5	12.85
72-1-1	RPD		RPD of duplicates	9/11/2019	1.4%	0.0%	0.0%	1.2%	0.0%	4.3%	0.0%	0.0%	0.8%	0.0%	0.0%	0.8%
72-1-1	FR1	Y	0	11/6/2019	1 590.	< 0.01	83.3	71.	< 0.2	0.091	< 0.1	264.	385.	< 0.01	< 1.	13.7
72-1-1	FR2			11/6/2019	1 620.	0.059	83.2	69.	< 0.2	0.099	0.26	264.	383.	< 0.01	< 1.	13.7
72-1-1	FRM		Mean of duplicates	11/6/2019	1 605.	0.034 5	83.25	70.	< 0.2	0.095	0.18	264.	384.	< 0.01	< 1.	13.7
72-1-1	RPD		RPD of duplicates	11/6/2019	1.9%	142.0% b	0.1%	2.9%	0.0%	8.4%	88.9% b	0.0%	0.5%	0.0%	0.0%	0.0%
72-1-1	FR1	Y	Clear and colourless	2/12/2020	1 650.	0.019 9	88.6	67.	0.1	0.076 5	0.073	280.	404.	< 0.005	0.58	14.2
72-1-1	FR2			2/12/2020	1 650.	0.005 6	87.8	72.	< 0.1	0.076 1	0.121	277.	393.	< 0.005	0.5	14.
72-1-1	FRM		Mean of duplicates	2/12/2020	1 650.	0.012 75	88.2	69.5	0.1	0.076 3	0.097	278.5	398.5	< 0.005	0.54	14.1
72-1-1	RPD		RPD of duplicates	2/12/2020	0.0%	112.2% b	0.9%	7.2%	0.0%	0.5%	**49.5% a**	1.1%	2.8%	0.0%	14.8%	1.4%
73-1-1	FR1	Y	0	9/12/2019	115.	0.015 3	64.9	24.	< 0.1	0.173	0.288	206.	4.3	0.018 7	< 0.5	10.6
73-1-1	FR2			9/12/2019	113.	0.011 3	63.9	24.	< 0.1	0.164	0.188	204.	< 1.	0.016 6	< 0.5	10.8
73-1-1	FRM		Mean of duplicates	9/12/2019	114.	0.013 3	64.4	24.	< 0.1	0.168 5	0.238	205.	2.65	0.017 65	< 0.5	10.7
73-1-1	RPD		RPD of duplicates	9/12/2019	1.8%	30.1% b	1.6%	0.0%	0.0%	5.3%	**42.0% a**	1.0%	124.5% b	11.9%	0.0%	1.9%
73-3-1	FR1	Y	0	11/6/2019	70.	0.027 6	29.5	26.	< 0.1	0.030 6	0.332	95.	1.6	0.005 4	1.55	5.22
73-3-1	FR2			11/6/2019	72.	0.058 1	29.3	28.	< 0.1	0.036 1	0.407	94.8	3.5	0.006 4	1.61	5.25
73-3-1	FRM		Mean of duplicates	11/6/2019	71.	0.042 85	29.4	27.	< 0.1	0.033 35	0.369 5	94.9	2.55	0.005 9	1.58	5.235
73-3-1	RPD		RPD of duplicates	11/6/2019	2.8%	**71.2% a**	0.7%	7.4%	0.0%	16.5%	20.3%	0.2%	74.5% b	16.9%	3.8%	0.6%
78-2-1	FR1	N	0	9/18/2019	237.	0.543	63.6	4.1	0.25	0.078 1	0.441	198.	< 1.	< 0.005	1.21	9.51
78-2-1	FR2			9/18/2019	239.	0.53	63.6	4.1	0.26	0.081	0.453	198.	< 1.	< 0.005	1.2	9.45
78-2-1	FRM		Mean of duplicates	9/18/2019	238.	0.536 5	63.6	4.1	0.255	0.079 55	0.447	198.	< 1.	< 0.005	1.205	9.48
78-2-1	RPD		RPD of duplicates	9/18/2019	0.8%	2.4%	0.0%	0.0%	3.9%	3.6%	2.7%	0.0%	0.0%	0.0%	0.8%	0.6%

Notes:

SS Single sample
FR1 Field replicate 1
FR2 Field replicate 2
FRM Average of field replicates
RPD Relative percent difference of field replicates
na - Not applicable, some replicates less than the detection limit.

***a** - Coefficient of variation greater than 30% and all replicates greater than the limit of qua*

***b** - Coefficient of variation greater than 30% with some replicates less than the limit of qua*

Table 3-1 Groundwater Quality QA/QC - Relative Percent Difference 2019-2020

					Manganese	Molybdenum	Ammonia	Nitrite	Nitrate	Nitrite + Nitrate	Nickel	Phosphorus	Potassium	Selenium
				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.05	0.05	0.015	0.005	0.02	0.02	0.04	2	0.05	0.04
				Limit of Quantitation (5 x MDL)	0.25	0.25	0.075	0.025	0.1	0.1	0.12	10	0.25	0.2
				Parameter	Manganese	Molybdenum	Ammonia	Nitrite	Nitrate	Nitrite + Nitrate	Nickel	Phosphorus	Potassium	Selenium
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	mg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Comments	Date Sampled										
18-1-1	FR1	Y	0	9/6/2019	20.7	0.383	< 0.015	< 0.005	< 0.02	< 0.02	0.353	6.2	< 0.25	0.077
18-1-1	FR2			9/6/2019	20.6	0.361	< 0.015	< 0.005	< 0.02	< 0.02	0.366	6.6	< 0.25	0.069
18-1-1	FRM		Mean of duplicates	9/6/2019	20.65	0.372	< 0.015	< 0.005	< 0.02	< 0.02	0.359 5	6.4	< 0.25	0.073
18-1-1	RPD		RPD of duplicates	9/6/2019	0.5%	5.9%	0.0%	0.0%	0.0%	0.0%	3.6%	6.2%	0.0%	11.0%
18-1-1	FR1	Y	0	11/29/2019	0.524	0.394	< 0.015	< 0.005	< 0.02	< 0.02	0.244		0.202	0.063
18-1-1	FR2			11/29/2019	0.43	0.383	< 0.015	< 0.005	< 0.02	< 0.02	0.252		0.192	0.069
18-1-1	FRM		Mean of duplicates	11/29/2019	0.477	0.388 5	< 0.015	< 0.005	< 0.02	< 0.02	0.248		0.197	0.066
18-1-1	RPD		RPD of duplicates	11/29/2019	19.7%	2.8%	0.0%	0.0%	0.0%	0.0%	3.2%		5.1%	9.1%
18-1-1	FR1	Y	d colourless, contains some c	2/27/2020	35.8	0.534	< 0.015	< 0.005	0.201	0.201	1.02	17.5	0.251	0.089
18-1-1	FR2			2/27/2020	36.4	0.491	< 0.015	< 0.005	0.201	0.201	0.858	16.7	0.245	0.121
18-1-1	FRM		Mean of duplicates	2/27/2020	36.1	0.512 5	< 0.015	< 0.005	0.201	0.201	0.939	17.1	0.248	0.105
18-1-1	RPD		RPD of duplicates	2/27/2020	1.7%	8.4%	0.0%	0.0%	0.0%	0.0%	17.3%	4.7%	2.4%	30.5% b
21-1-1	FR1	Y		10/2/2019	9.1	0.55	< 0.015	< 0.005	< 0.02	< 0.02	0.052	< 4.	0.22	< 0.08
21-1-1	FR2			10/2/2019	6.55	0.64	< 0.015	< 0.005	< 0.02	< 0.02	0.58	< 10.	< 0.25	< 0.2
21-1-1	FRM		Mean of duplicates	10/2/2019	7.825	0.595	< 0.015	< 0.005	< 0.02	< 0.02	0.316	< 7.	0.235	< 0.14
21-1-1	RPD		RPD of duplicates	10/2/2019	**32.6%** a	15.1%	0.0%	0.0%	0.0%	0.0%	167.1% b	85.7% b	12.8%	85.7% b
21-1-1	FR1	Y		11/21/2019	6.24	0.38	0.017	< 0.005	< 0.02	< 0.02	< 0.1	< 10.	< 0.25	< 0.2
21-1-1	FR2			11/21/2019	6.39	0.28	< 0.015	< 0.005	< 0.02	< 0.02	0.1	< 10.	< 0.25	< 0.2
21-1-1	FRM		Mean of duplicates	11/21/2019	6.315	0.33	0.016	< 0.005	< 0.02	< 0.02	0.1	< 10.	< 0.25	< 0.2
21-1-1	RPD		RPD of duplicates	11/21/2019	2.4%	**30.3%** a	12.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
21-1-1	FR1	Y		2/20/2020	5.82	0.49	< 0.015	< 0.005	< 0.02	< 0.02	< 0.04	8.4	0.2	< 0.08
21-1-1	FR2			2/20/2020	5.55	0.47	< 0.015	< 0.005	< 0.02	< 0.02	< 0.04	6.9	0.19	< 0.08
21-1-1	FRM		Mean of duplicates	2/20/2020	5.685	0.48	< 0.015	< 0.005	< 0.02	< 0.02	< 0.04	7.65	0.195	< 0.08
21-1-1	RPD		RPD of duplicates	2/20/2020	4.7%	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%	19.6%	5.1%	0.0%
21-1-2	FR1	Y	0	5/30/2019	1 830.	0.758	5.2	< 0.005	< 0.02	< 0.02	1.95	8.6	6.35	< 0.04
21-1-2	FR2			5/30/2019	2 070.	0.809	5.3	< 0.005	< 0.02	< 0.02	2.12	9.6	7.2	< 0.04
21-1-2	FRM		Mean of duplicates	5/30/2019	1 950.	0.783 5	5.25	< 0.005	< 0.02	< 0.02	2.035	9.1	6.775	< 0.04
21-1-2	RPD		RPD of duplicates	5/30/2019	12.3%	6.5%	1.9%	0.0%	0.0%	0.0%	8.4%	11.0%	12.5%	0.0%
21-1-2	FR1	Y	0	9/26/2019	2 740.	0.699	7.2	< 0.005	< 0.02	< 0.02	3.02	7.1	7.62	< 0.04
21-1-2	FR2			9/26/2019	2 760.	0.675	7.4	< 0.005	< 0.02	< 0.02	3.06	7.9	7.52	< 0.04
21-1-2	FRM		Mean of duplicates	9/26/2019	2 750.	0.687	7.3	< 0.005	< 0.02	< 0.02	3.04	7.5	7.57	< 0.04
21-1-2	RPD		RPD of duplicates	9/26/2019	0.7%	3.5%	2.7%	0.0%	0.0%	0.0%	1.3%	10.7%	1.3%	0.0%
21-1-2	FR1	Y	0	11/21/2019	2 360.	0.776	7.1	< 0.005	< 0.02	< 0.02	2.71	8.7	7.44	< 0.04
21-1-2	FR2			11/21/2019	2 450.	0.783	7.	< 0.005	< 0.02	< 0.02	2.89	8.9	7.69	< 0.04
21-1-2	FRM		Mean of duplicates	11/21/2019	2 405.	0.779 5	7.05	< 0.005	< 0.02	< 0.02	2.8	8.8	7.565	< 0.04
21-1-2	RPD		RPD of duplicates	11/21/2019	3.7%	0.9%	1.4%	0.0%	0.0%	0.0%	6.4%	2.3%	3.3%	0.0%
21-1-2	FR1	Y	Clear and colourless	2/20/2020	1 510.	0.895	5.6	< 0.005	< 0.02	< 0.02	1.46	8.8	5.84	< 0.04
21-1-2	FR2			2/20/2020	1 520.	0.898	5.5	< 0.005	< 0.02	< 0.02	1.47	9.	5.95	< 0.04
21-1-2	FRM		Mean of duplicates	2/20/2020	1 515.	0.896 5	5.55	< 0.005	< 0.02	< 0.02	1.465	8.9	5.895	< 0.04
21-1-2	RPD		RPD of duplicates	2/20/2020	0.7%	0.3%	1.8%	0.0%	0.0%	0.0%	0.7%	2.2%	1.9%	0.0%
21-2-1	FR1	Y	0	9/26/2019	2 940.	0.685	7.6	< 0.005	0.064	0.064	3.65	8.9	7.62	< 0.04
21-2-1	FR2			9/26/2019	2 900.	0.714	7.1	< 0.005	0.042	0.042	3.67	8.5	7.56	< 0.04
21-2-1	FRM		Mean of duplicates	9/26/2019	2 920.	0.699 5	7.35	< 0.005	0.053	0.053	3.66	8.7	7.59	< 0.04
21-2-1	RPD		RPD of duplicates	9/26/2019	1.4%	4.1%	6.8%	0.0%	41.5% b	41.5% b	0.5%	4.6%	0.8%	0.0%
21-2-1	FR1	Y	0	11/21/2019	2 480.	0.773	7.1	< 0.005	< 0.02	< 0.02	2.85	8.4	7.56	< 0.04
21-2-1	FR2			11/21/2019	2 460.	0.778	7.	0.005 2	< 0.02	0.021	2.78	8.7	7.36	< 0.04
21-2-1	FRM		Mean of duplicates	11/21/2019	2 470.	0.775 5	7.05	0.005 1	< 0.02	0.020 5	2.815	8.55	7.46	< 0.04
21-2-1	RPD		RPD of duplicates	11/21/2019	0.8%	0.6%	1.4%	3.9%	0.0%	4.9%	2.5%	3.5%	2.7%	0.0%
21-2-1	FR1	Y	Clear and moderately orange	2/20/2020	1 850.	0.944	5.9	< 0.005	< 0.02	< 0.02	1.56	8.2	6.48	< 0.04
21-2-1	FR2			2/20/2020	2 010.	0.943	5.8	< 0.005	< 0.02	< 0.02	1.6	7.9	7.09	< 0.04
21-2-1	FRM		Mean of duplicates	2/20/2020	1 930.	0.943 5	5.85	< 0.005	< 0.02	< 0.02	1.58	8.05	6.785	< 0.04
21-2-1	RPD		RPD of duplicates	2/20/2020	8.3%	0.1%	1.7%	0.0%	0.0%	0.0%	2.5%	3.7%	9.0%	0.0%
25-1-2	FR1	N	0	6/13/2019	42.6	0.563	0.066	< 0.005	0.032	0.032	0.29	7.5	0.213	0.046
25-1-2	FR2			6/13/2019	42.3	0.552	0.053	< 0.005	0.029	0.029	0.341	7.4	0.216	< 0.04
25-1-2	FRM		Mean of duplicates	6/13/2019	42.45	0.557 5	0.059 5	< 0.005	0.030 5	0.030 5	0.315 5	7.45	0.214 5	0.043
25-1-2	RPD		RPD of duplicates	6/13/2019	0.7%	2.0%	21.8%	0.0%	9.8%	9.8%	16.2%	1.3%	1.4%	14.0%
27-1-1	FR1	N	0	5/22/2019	21.3	0.392	0.024	< 0.005	< 0.02	< 0.02	0.216	5.	0.099	< 0.04
27-1-1	FR2			5/22/2019	20.6	0.184	< 0.015	< 0.005	< 0.02	< 0.02	0.049	5.3	0.097	< 0.04
27-1-1	FRM		Mean of duplicates	5/22/2019	20.95	0.288	0.019 5	< 0.005	< 0.02	< 0.02	0.132 5	5.15	0.098	< 0.04
27-1-1	RPD		RPD of duplicates	5/22/2019	3.3%	72.2% b	46.2% b	0.0%	0.0%	0.0%	126.0% b	5.8%	2.0%	0.0%
31-1-1	FR1	N	0	12/2/2019	44.9	0.997	< 0.015	< 0.005	1.81	1.81	0.201	10.9	0.537	0.107
31-1-1	FR2			12/2/2019	45.9	1.03	< 0.015	< 0.005	1.98	1.98	0.158	9.9	0.552	0.097
31-1-1	FRM		Mean of duplicates	12/2/2019	45.4	1.013 5	< 0.015	< 0.005	1.895	1.895	0.179 5	10.4	0.544 5	0.102
31-1-1	RPD		RPD of duplicates	12/2/2019	2.2%	3.3%	0.0%	0.0%	9.0%	9.0%	24.0%	9.6%	2.8%	9.8%
39-1-1	FR1	Y	0	9/25/2019	2.28	1.23	< 0.015	< 0.005	0.027	0.027	0.081	< 2.	0.196	0.084
39-1-1	FR2			9/25/2019	2.27	1.22	< 0.015	< 0.005	0.045	0.045	0.101	< 2.	0.195	0.077
39-1-1	FRM		Mean of duplicates	9/25/2019	2.275	1.225	< 0.015	< 0.005	0.036	0.036	0.091	< 2.	0.195 5	0.080 5
39-1-1	RPD		RPD of duplicates	9/25/2019	0.4%	0.8%	0.0%	0.0%	50.0% b	50.0% b	22.0%	0.0%	0.5%	8.7%
39-1-1	FR1	Y	0	11/20/2019	0.057	1.82	< 0.015	< 0.005	0.074	0.074	0.148	3.1	0.259	0.074
39-1-1	FR2			11/20/2019	< 0.05	1.86	< 0.015	< 0.005	0.075	0.075	0.133	3.5	0.257	0.08
39-1-1	FRM		Mean of duplicates	11/20/2019	0.053 5	1.84	< 0.015	< 0.005	0.074 5	0.074 5	0.140 5	3.3	0.258	0.077
39-1-1	RPD		RPD of duplicates	11/20/2019	13.1%	2.2%	0.0%	0.0%	1.3%	1.3%	10.7%	12.1%	0.8%	7.8%
39-1-1	FR1	Y	Clear and colourless	2/20/2020	0.06	2.13	< 0.015	< 0.005	0.053	0.053	0.381	3.7	0.261	0.193
39-1-1	FR2			2/20/2020	< 0.05	2.1	< 0.015	< 0.005	0.064	0.064	0.118	3.2	0.253	0.181
39-1-1	FRM		Mean of duplicates	2/20/2020	0.055	2.115	< 0.015	< 0.005	0.058 5	0.058 5	0.249 5	3.45	0.257	0.187
39-1-1	RPD		RPD of duplicates	2/20/2020	18.2%	1.4%	0.0%	0.0%	18.8%	18.8%	105.4% b	14.5%	3.1%	6.4%

Table 3-1 Groundwater Quality QA/QC - Relative Percent Difference 2019-2020

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.05	0.05	0.015	0.005	0.02	0.02	0.04	2	0.05	0.04
				Limit of Quantitation (5 x MDL)	0.25	0.25	0.075	0.025	0.1	0.1	0.12	10	0.25	0.2
				Parameter	Manganese	Molybdenum	Ammonia	Nitrite	Nitrate	Nitrite + Nitrate	Nickel	Phosphorus	Potassium	Selenium
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	mg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Comments	Date Sampled										
39-2-1	FR1	Y	0	5/24/2019	11.2	1.14	< 0.015	< 0.005	0.04	0.04	0.168	3.5	0.2	0.122
39-2-1	FR2			5/24/2019	11.8	1.16	< 0.015	< 0.005	0.033	0.033	0.068	< 2.	0.199	0.12
39-2-1	FRM		Mean of duplicates	5/24/2019	11.5	1.15	< 0.015	< 0.005	0.036 5	0.036 5	0.118	2.75	0.199 5	0.121
39-2-1	RPD		RPD of duplicates	5/24/2019	5.2%	1.7%	0.0%	0.0%	19.2%	19.2%	84.7% b	54.5% b	0.5%	1.7%
41-1-1	FR1	Y	0	9/19/2019	550.	2.12	0.056	< 0.005	< 0.02	< 0.02	0.176	2.3	0.976	< 0.04
41-1-1	FR2			9/19/2019	557.	2.12	0.064	< 0.005	< 0.02	< 0.02	0.157	2.8	0.993	< 0.04
41-1-1	FRM		Mean of duplicates	9/19/2019	553.5	2.12	0.06	< 0.005	< 0.02	< 0.02	0.166 5	2.55	0.984 5	< 0.04
41-1-1	RPD		RPD of duplicates	9/19/2019	1.3%	0.0%	13.3%	0.0%	0.0%	0.0%	11.4%	19.6%	1.7%	0.0%
41-1-1	FR1	Y	0	12/2/2019	646.	2.19	0.034	< 0.005	< 0.02	< 0.02	0.277	5.1	1.19	< 0.04
41-1-1	FR2			12/2/2019	651.	2.15	0.032	< 0.005	< 0.02	< 0.02	0.272	4.6	1.2	< 0.04
41-1-1	FRM		Mean of duplicates	12/2/2019	648.5	2.17	0.033	< 0.005	< 0.02	< 0.02	0.274 5	4.85	1.195	< 0.04
41-1-1	RPD		RPD of duplicates	12/2/2019	0.8%	1.8%	6.1%	0.0%	0.0%	0.0%	1.8%	10.3%	0.8%	0.0%
41-1-1	FR1	Y	Clear and colourless	3/4/2020	165.	1.68	0.019	< 0.005	0.055	0.055	0.088	< 2.	0.981	< 0.04
41-1-1	FR2			3/4/2020	163.	1.66	0.035	< 0.005	0.057	0.057	0.088	2.7	0.967	< 0.04
41-1-1	FRM		Mean of duplicates	3/4/2020	164.	1.67	0.027	< 0.005	0.056	0.056	0.088	2.35	0.974	< 0.04
41-1-1	RPD		RPD of duplicates	3/4/2020	1.2%	1.2%	59.3% b	0.0%	3.6%	3.6%	0.0%	29.8%	1.4%	0.0%
42-1-1	FR1	Y	0	5/23/2019	155.	0.21	0.069	< 0.005	< 0.02	< 0.02	0.084	7.	0.742	< 0.04
42-1-1	FR2			5/23/2019	153.	0.205	0.058	< 0.005	< 0.02	< 0.02	0.093	7.	0.733	< 0.04
42-1-1	FRM		Mean of duplicates	5/23/2019	154.	0.207 5	0.063 5	< 0.005	< 0.02	< 0.02	0.088 5	7.	0.737 5	< 0.04
42-1-1	RPD		RPD of duplicates	5/23/2019	1.3%	2.4%	17.3%	0.0%	0.0%	0.0%	10.2%	0.0%	1.2%	0.0%
42-1-1	FR1	Y	0	12/2/2019	157.	0.248	0.53	< 0.005	< 0.02	< 0.02	0.107	5.5	0.831	< 0.04
42-1-1	FR2			12/2/2019	161.	0.253	0.074	< 0.005	< 0.02	< 0.02	0.128	7.7	0.858	< 0.04
42-1-1	FRM		Mean of duplicates	12/2/2019	159.	0.250 5	0.302	< 0.005	< 0.02	< 0.02	0.117 5	6.6	0.844 5	< 0.04
42-1-1	RPD		RPD of duplicates	12/2/2019	2.5%	2.0%	151.0% b	0.0%	0.0%	0.0%	17.9%	33.3% b	3.2%	0.0%
42-1-1	FR1	Y	Clear and colourless	3/4/2020	153.	0.21	0.082	< 0.005	< 0.02	< 0.02	0.104	5.4	0.86	< 0.04
42-1-1	FR2			3/4/2020	153.	0.197	0.077	< 0.005	< 0.02	< 0.02	0.115	6.6	0.847	< 0.04
42-1-1	FRM		Mean of duplicates	3/4/2020	153.	0.203 5	0.079 5	< 0.005	< 0.02	< 0.02	0.109 5	6.	0.853 5	< 0.04
42-1-1	RPD		RPD of duplicates	3/4/2020	0.0%	6.4%	6.3%	0.0%	0.0%	0.0%	10.0%	20.0%	1.5%	0.0%
58-1-0	FR1	N	0	5/29/2019	7 570.	7.	97.	0.045 8	< 0.02	0.051	88.6	87.	45.8	0.42
58-1-0	FR2			5/29/2019	7 590.	7.24	95.	0.044 8	< 0.02	0.051	87.6	85.	45.9	0.38
58-1-0	FRM		Mean of duplicates	5/29/2019	7 580.	7.12	96.	0.045 3	< 0.02	0.051	88.1	86.	45.85	0.4
58-1-0	RPD		RPD of duplicates	5/29/2019	0.3%	3.4%	2.1%	2.2%	0.0%	0.0%	1.1%	2.3%	0.2%	10.0%
71-1-1	FR1	Y	0	5/16/2019	52.9	0.422	< 0.015	< 0.005	< 0.02	< 0.02	0.425	13.6	0.238	< 0.04
71-1-1	FR2			5/16/2019	51.8	0.421	0.022	< 0.005	< 0.02	< 0.02	0.404	13.2	0.235	< 0.04
71-1-1	FRM		Mean of duplicates	5/16/2019	52.35	0.421 5	0.018 5	< 0.005	< 0.02	< 0.02	0.414 5	13.4	0.236 5	< 0.04
71-1-1	RPD		RPD of duplicates	5/16/2019	2.1%	0.2%	37.8% b	0.0%	0.0%	0.0%	5.1%	3.0%	1.3%	0.0%
71-1-1	FR1	Y	0	9/12/2019	53.5	0.364	< 0.015	< 0.005	< 0.02	< 0.02	0.29	11.1	0.25	< 0.04
71-1-1	FR2			9/12/2019	53.2	0.361	< 0.015	< 0.005	< 0.02	< 0.02	0.272	11.3	0.247	< 0.04
71-1-1	FRM		Mean of duplicates	9/12/2019	53.35	0.362 5	< 0.015	< 0.005	< 0.02	< 0.02	0.281	11.2	0.248 5	< 0.04
71-1-1	RPD		RPD of duplicates	9/12/2019	0.6%	0.8%	0.0%	0.0%	0.0%	0.0%	6.4%	1.8%	1.2%	0.0%
71-1-1	FR1	Y	0	11/6/2019	80.4	0.376	< 0.015	< 0.005	< 0.02	< 0.02	0.444	13.1	< 0.25	< 0.04
71-1-1	FR2			11/6/2019	81.4	0.424	< 0.015	< 0.005	< 0.02	< 0.02	0.449	13.9	< 0.25	< 0.04
71-1-1	FRM		Mean of duplicates	11/6/2019	80.9	0.4	< 0.015	< 0.005	< 0.02	< 0.02	0.446 5	13.5	< 0.25	< 0.04
71-1-1	RPD		RPD of duplicates	11/6/2019	1.2%	12.0%	0.0%	0.0%	0.0%	0.0%	1.1%	5.9%	0.0%	0.0%
71-1-1	FR1	Y	Clear and colourless	2/13/2020	89.1	0.618	< 0.015	< 0.005	< 0.02	< 0.02	0.558	13.8	0.293	< 0.04
71-1-1	FR2			2/13/2020	87.3	0.571	< 0.015	< 0.005	< 0.02	< 0.02	0.567	12.9	0.287	< 0.04
71-1-1	FRM		Mean of duplicates	2/13/2020	88.2	0.594 5	< 0.015	< 0.005	< 0.02	< 0.02	0.562 5	13.35	0.29	< 0.04
71-1-1	RPD		RPD of duplicates	2/13/2020	2.0%	7.9%	0.0%	0.0%	0.0%	0.0%	1.6%	6.7%	2.1%	0.0%
72-1-1	FR1	Y	0	5/16/2019	127.	0.703	< 0.015	< 0.005	< 0.02	< 0.02	2.2	10.	0.253	< 0.04
72-1-1	FR2			5/16/2019	125.	0.718	0.016	< 0.005	< 0.02	< 0.02	2.01	9.5	0.25	< 0.04
72-1-1	FRM		Mean of duplicates	5/16/2019	126.	0.710 5	0.015 5	< 0.005	< 0.02	< 0.02	2.105	9.75	0.251 5	< 0.04
72-1-1	RPD		RPD of duplicates	5/16/2019	1.6%	2.1%	6.5%	0.0%	0.0%	0.0%	9.0%	5.1%	1.2%	0.0%
72-1-1	FR1	Y	0	9/11/2019	119.	0.685	0.021	< 0.005	< 0.02	< 0.02	1.69	8.4	0.246	< 0.04
72-1-1	FR2			9/11/2019	121.	0.649	0.021	< 0.005	< 0.02	< 0.02	1.7	9.3	0.249	< 0.04
72-1-1	FRM		Mean of duplicates	9/11/2019	120.	0.667	0.021	< 0.005	< 0.02	< 0.02	1.695	8.85	0.247 5	< 0.04
72-1-1	RPD		RPD of duplicates	9/11/2019	1.7%	5.4%	0.0%	0.0%	0.0%	0.0%	0.6%	10.2%	1.2%	0.0%
72-1-1	FR1	Y	0	11/6/2019	120.	0.63	< 0.015	< 0.005	< 0.02	< 0.02	1.91	13.	< 0.25	< 0.08
72-1-1	FR2			11/6/2019	119.	0.65	< 0.015	< 0.005	< 0.02	< 0.02	1.73	11.5	< 0.25	< 0.08
72-1-1	FRM		Mean of duplicates	11/6/2019	119.5	0.64	< 0.015	< 0.005	< 0.02	< 0.02	1.82	12.25	< 0.25	< 0.08
72-1-1	RPD		RPD of duplicates	11/6/2019	0.8%	3.1%	0.0%	0.0%	0.0%	0.0%	9.9%	12.2%	0.0%	0.0%
72-1-1	FR1	Y	Clear and colourless	2/12/2020	122.	0.701	< 0.015	< 0.005	< 0.02	< 0.02	1.79	11.5	0.268	< 0.04
72-1-1	FR2			2/12/2020	123.	0.693	0.016	< 0.005	< 0.02	< 0.02	1.88	11.1	0.269	< 0.04
72-1-1	FRM		Mean of duplicates	2/12/2020	122.5	0.697	0.015 5	< 0.005	< 0.02	< 0.02	1.835	11.3	0.268 5	< 0.04
72-1-1	RPD		RPD of duplicates	2/12/2020	0.8%	1.1%	6.5%	0.0%	0.0%	0.0%	4.9%	3.5%	0.4%	0.0%
73-1-1	FR1	Y	0	9/12/2019	95.6	0.88	< 0.015	< 0.005	< 0.02	< 0.02	0.816	11.3	0.388	< 0.04
73-1-1	FR2			9/12/2019	96.8	0.887	< 0.015	< 0.005	< 0.02	< 0.02	0.801	11.7	0.391	< 0.04
73-1-1	FRM		Mean of duplicates	9/12/2019	96.2	0.883 5	< 0.015	< 0.005	< 0.02	< 0.02	0.808 5	11.5	0.389 5	< 0.04
73-1-1	RPD		RPD of duplicates	9/12/2019	1.2%	0.8%	0.0%	0.0%	0.0%	0.0%	1.9%	3.5%	0.8%	0.0%
73-3-1	FR1	Y	0	11/6/2019	0.194	0.296	< 0.015	0.019 9	0.609	0.629	0.578	16.8	0.55	0.059
73-3-1	FR2			11/6/2019	0.829	0.305	< 0.015	0.021 6	0.581	0.602	0.579	17.1	0.56	0.049
73-3-1	FRM		Mean of duplicates	11/6/2019	0.511 5	0.300 5	< 0.015	0.020 75	0.595	0.615 5	0.578 5	16.95	0.555	0.054
73-3-1	RPD		RPD of duplicates	11/6/2019	124.1% b	3.0%	0.0%	8.2%	4.7%	4.4%	0.2%	1.8%	1.8%	18.5%
78-2-1	FR1	N	0	9/18/2019	0.17	1.89	0.022	0.010 8	4.8	4.81	4.16	21.5	0.27	0.987
78-2-1	FR2			9/18/2019	0.149	1.79	0.026	0.011 1	4.81	4.82	4.08	20.	0.269	0.986
78-2-1	FRM		Mean of duplicates	9/18/2019	0.159 5	1.84	0.024	0.010 95	4.805	4.815	4.12	20.75	0.269 5	0.986 5
78-2-1	RPD		RPD of duplicates	9/18/2019	13.2%	5.4%	16.7%	2.7%	0.2%	0.2%	1.9%	7.2%	0.4%	0.1%

Notes:

SS Single sample
FR1 Field replicate 1
FR2 Field replicate 2
FRM Average of field replicates
RPD Relative percent difference of field replicates
na - Not applicable, some replicates less than the detection limit.
a *- Coefficient of variation greater than 30% and all replicates greater than the limit of qua*
b *- Coefficient of variation greater than 30% with some replicates less than the limit of qua*

Table 3-1 Groundwater Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	50	0.005	0.05	0.05	1	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1
				Limit of Quantitation (5 x MDL)	250	0.025	0.25	0.25	5	15	0.01	1	2.5	0.01	1	0.5	0.5
				Parameter	Silicon	Silver	Sodium	Strontium	Sulphate	Sulfur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Station	Sample Type	Compliance Well (Y/N)?	Comments	Date Sampled													
18-1-1	FR1	Y	0	9/6/2019	7 040.	< 0.005	3.98	88.4	24.	< 15.	0.002 7	< 0.2	< 0.5	0.129	0.96	1.66	< 0.1
18-1-1	FR2			9/6/2019	6 970.	< 0.005	3.98	86.4	19.	< 15.	0.003 3	< 0.2	< 0.5	0.128	0.9	1.11	< 0.1
18-1-1	FRM		Mean of duplicates	9/6/2019	7 005.	< 0.005	3.98	87.4	21.5	< 15.	0.003	< 0.2	< 0.5	0.128 5	0.93	1.385	< 0.1
18-1-1	RPD		RPD of duplicates	9/6/2019	1.0%	0.0%	0.0%	2.3%	23.3%	0.0%	20.0%	0.0%	0.0%	0.8%	6.5%	39.7% a	0.0%
18-1-1	FR1	Y	0	11/29/2019	7 050.	< 0.005	4.56	83.8	19.	6.7	< 0.002	< 0.2	< 0.5	0.139	0.78	1.65	< 0.1
18-1-1	FR2			11/29/2019	7 230.	< 0.005	4.37	83.6	19.	6.6	< 0.002	< 0.2	< 0.5	0.135	0.74	0.76	< 0.1
18-1-1	FRM		Mean of duplicates	11/29/2019	7 140.	< 0.005	4.465	83.7	19.	6.65	< 0.002	< 0.2	< 0.5	0.137	0.76	1.205	< 0.1
18-1-1	RPD		RPD of duplicates	11/29/2019	2.5%	0.0%	4.3%	0.2%	0.0%	1.5%	0.0%	0.0%	0.0%	2.9%	5.3%	73.9% a	0.0%
18-1-1	FR1	Y	d colourless, contains some c	2/27/2020	7 630.	< 0.005	4.11	81.8	22.	7.5	< 0.002	< 0.2	0.58	0.112	0.92	13.	< 0.1
18-1-1	FR2			2/27/2020	7 670.	< 0.005	4.17	83.9	22.	7.8	< 0.002	< 0.2	0.89	0.122	0.97	3.88	< 0.1
18-1-1	FRM		Mean of duplicates	2/27/2020	7 650.	< 0.005	4.14	82.85	22.	7.65	< 0.002	< 0.2	0.735	0.117	0.945	8.44	< 0.1
18-1-1	RPD		RPD of duplicates	2/27/2020	0.5%	0.0%	1.4%	2.5%	0.0%	3.9%	0.0%	0.0%	42.2% b	8.5%	5.3%	108.1% a	0.0%
21-1-1	FR1	Y		10/2/2019	19 800.	< 0.01	8.33	493.	11.	< 6.	< 0.004	< 0.4	< 1.	0.042 1	< 0.4	0.41	< 0.2
21-1-1	FR2			10/2/2019	20 400.	< 0.025	8.62	500.	11.	< 15.	< 0.01	< 1.	3.	0.06	< 1.	1.21	< 0.5
21-1-1	FRM		Mean of duplicates	10/2/2019	20 100.	< 0.017 5	8.475	496.5	11.	< 10.5	< 0.007	< 0.7	2.	0.051 05	< 0.7	0.81	< 0.35
21-1-1	RPD		RPD of duplicates	10/2/2019	3.0%	85.7% b	3.4%	1.4%	0.0%	85.7% b	85.7% b	85.7% b	100.0% b	35.1% a	85.7% b	98.8% b	85.7% b
21-1-1	FR1	Y		11/21/2019	19 100.	< 0.025	8.5	450.	11.	< 15.	< 0.01	< 1.	< 2.5	0.016	< 1.	1.08	< 0.5
21-1-1	FR2			11/21/2019	19 200.	< 0.025	8.49	461.	10.	< 15.	< 0.01	< 1.	< 2.5	0.016	< 1.	1.25	< 0.5
21-1-1	FRM		Mean of duplicates	11/21/2019	19 150.	< 0.025	8.495	455.5	10.5	< 15.	< 0.01	< 1.	< 2.5	0.016	< 1.	1.165	< 0.5
21-1-1	RPD		RPD of duplicates	11/21/2019	0.5%	0.0%	0.1%	2.4%	9.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.6%	0.0%
21-1-1	FR1	Y		2/20/2020	19 000.	< 0.01	8.43	455.	11.	< 6.	< 0.004	< 0.4	< 1.	0.021 2	< 0.4	2.25	< 0.2
21-1-1	FR2			2/20/2020	18 300.	< 0.01	8.04	436.	10.	< 6.	< 0.004	< 0.4	< 1.	0.023 4	< 0.4	2.09	< 0.2
21-1-1	FRM		Mean of duplicates	2/20/2020	18 650.	< 0.01	8.235	445.5	10.5	< 6.	< 0.004	< 0.4	< 1.	0.022 3	< 0.4	2.17	< 0.2
21-1-1	RPD		RPD of duplicates	2/20/2020	3.8%	0.0%	4.7%	4.3%	9.5%	0.0%	0.0%	0.0%	0.0%	9.9%	0.0%	7.4%	0.0%
21-1-2	FR1	Y	0	5/30/2019	12 000.	< 0.005	28.3	494.	12.2	4.5	0.004 8	< 0.2	< 0.5	0.069 7	0.44	2.29	< 0.1
21-1-2	FR2			5/30/2019	12 900.	< 0.005	31.3	529.	13.3	4.8	0.004 5	< 0.2	0.6	0.076 4	0.56	0.38	< 0.1
21-1-2	FRM		Mean of duplicates	5/30/2019	12 450.	< 0.005	29.8	511.5	12.75	4.65	0.004 65	< 0.2	0.55	0.073 05	0.5	1.335	< 0.1
21-1-2	RPD		RPD of duplicates	5/30/2019	7.2%	0.0%	10.1%	6.8%	8.6%	6.5%	6.5%	0.0%	18.2%	9.2%	24.0%	143.1% b	0.0%
21-1-2	FR1	Y	0	9/26/2019	13 200.	< 0.005	35.2	627.	12.	4.4	0.003 1	< 0.2	< 0.5	0.114	0.31	0.28	< 0.1
21-1-2	FR2			9/26/2019	12 800.	< 0.005	35.3	622.	12.	4.2	0.003 4	< 0.2	< 0.5	0.118	0.36	0.31	< 0.1
21-1-2	FRM		Mean of duplicates	9/26/2019	13 000.	< 0.005	35.25	624.5	12.	4.3	0.003 25	< 0.2	< 0.5	0.116	0.335	0.295	< 0.1
21-1-2	RPD		RPD of duplicates	9/26/2019	3.1%	0.0%	0.3%	0.8%	0.0%	4.7%	9.2%	0.0%	0.0%	3.4%	14.9%	10.2%	0.0%
21-1-2	FR1	Y	0	11/21/2019	14 200.	< 0.005	35.1	547.	13.	4.8	0.003 2	< 0.2	< 0.5	0.095	0.32	0.2	< 0.1
21-1-2	FR2			11/21/2019	14 500.	< 0.005	36.2	565.	13.	5.1	0.003	< 0.2	< 0.5	0.099 2	0.33	0.49	< 0.1
21-1-2	FRM		Mean of duplicates	11/21/2019	14 350.	< 0.005	35.65	556.	13.	4.95	0.003 1	< 0.2	< 0.5	0.097 1	0.325	0.345	< 0.1
21-1-2	RPD		RPD of duplicates	11/21/2019	2.1%	0.0%	3.1%	3.2%	0.0%	6.1%	6.5%	0.0%	0.0%	4.3%	3.1%	84.1% b	0.0%
21-1-2	FR1	Y	Clear and colourless	2/20/2020	11 600.	< 0.005	27.6	385.	17.	5.2	0.003 9	< 0.2	< 0.5	0.053 7	0.35	2.76	< 0.1
21-1-2	FR2			2/20/2020	11 800.	< 0.005	27.3	375.	15.	5.	0.003 3	< 0.2	< 0.5	0.057 6	0.33	2.46	< 0.1
21-1-2	FRM		Mean of duplicates	2/20/2020	11 700.	< 0.005	27.45	380.	16.	5.1	0.003 6	< 0.2	< 0.5	0.055 65	0.34	2.61	< 0.1
21-1-2	RPD		RPD of duplicates	2/20/2020	1.7%	0.0%	1.1%	2.6%	12.5%	3.9%	16.7%	0.0%	0.0%	7.0%	5.9%	11.5%	0.0%
21-2-1	FR1	Y	0	9/26/2019	12 900.	< 0.005	40.5	618.	13.	4.4	0.002 4	< 0.2	< 0.5	0.139	0.38	3.01	< 0.1
21-2-1	FR2			9/26/2019	12 800.	< 0.005	40.	613.	15.	4.6	0.002 2	< 0.2	< 0.5	0.145	0.35	6.59	< 0.1
21-2-1	FRM		Mean of duplicates	9/26/2019	12 850.	< 0.005	40.25	615.5	14.	4.5	0.002 3	< 0.2	< 0.5	0.142	0.365	4.8	< 0.1
21-2-1	RPD		RPD of duplicates	9/26/2019	0.8%	0.0%	1.2%	0.8%	14.3%	4.4%	8.7%	0.0%	0.0%	4.2%	8.2%	74.6% a	0.0%
21-2-1	FR1	Y	0	11/21/2019	13 500.	< 0.005	38.5	530.	14.	5.1	0.003 7	< 0.2	< 0.5	0.093 6	0.38	1.45	< 0.1
21-2-1	FR2			11/21/2019	13 500.	< 0.005	37.8	520.	14.	4.7	0.002 9	< 0.2	< 0.5	0.090 5	0.34	2.02	< 0.1
21-2-1	FRM		Mean of duplicates	11/21/2019	13 500.	< 0.005	38.15	525.	14.	4.9	0.003 3	< 0.2	< 0.5	0.092 05	0.36	1.735	< 0.1
21-2-1	RPD		RPD of duplicates	11/21/2019	0.0%	0.0%	1.8%	1.9%	0.0%	8.2%	24.2%	0.0%	0.0%	3.4%	11.1%	32.9% a	0.0%
21-2-1	FR1	Y	Clear and moderately orange	2/20/2020	13 300.	< 0.005	27.9	411.	15.	6.	0.003 6	< 0.2	< 0.5	0.052 8	0.27	9.07	< 0.1
21-2-1	FR2			2/20/2020	14 100.	< 0.005	30.4	446.	15.	7.	0.003 6	< 0.2	< 0.5	0.055 7	0.27	3.48	< 0.1
21-2-1	FRM		Mean of duplicates	2/20/2020	13 700.	< 0.005	29.15	428.5	15.	6.5	0.003 6	< 0.2	< 0.5	0.054 25	0.27	6.275	< 0.1
21-2-1	RPD		RPD of duplicates	2/20/2020	5.8%	0.0%	8.6%	8.2%	0.0%	15.4%	0.0%	0.0%	0.0%	5.3%	0.0%	89.1% a	0.0%
25-1-2	FR1	N	0	6/13/2019	6 550.	< 0.005	3.08	99.4	33.	10.7	< 0.002	< 0.2	< 0.5	0.107	0.4	0.21	< 0.1
25-1-2	FR2			6/13/2019	6 500.	< 0.005	3.15	102.	34.	10.8	< 0.002	< 0.2	< 0.5	0.11	0.37	0.47	< 0.1
25-1-2	FRM		Mean of duplicates	6/13/2019	6 525.	< 0.005	3.115	100.7	33.5	10.75	< 0.002	< 0.2	< 0.5	0.108 5	0.385	0.34	< 0.1
25-1-2	RPD		RPD of duplicates	6/13/2019	0.8%	0.0%	2.2%	2.6%	3.0%	0.9%	0.0%	0.0%	0.0%	2.8%	7.8%	76.5% b	0.0%
27-1-1	FR1	N	0	5/22/2019	17 100.	< 0.005	7.17	39.5	11.2	< 3.	< 0.002	< 0.2	< 0.5	0.016 7	< 0.2	3.22	< 0.1
27-1-1	FR2			5/22/2019	17 100.	< 0.005	7.19	39.9	11.2	3.1	< 0.002	< 0.2	< 0.5	0.018 7	< 0.2	0.13	< 0.1
27-1-1	FRM		Mean of duplicates	5/22/2019	17 100.	< 0.005	7.18	39.7	11.2	3.05	< 0.002	< 0.2	< 0.5	0.017 7	< 0.2	1.675	< 0.1
27-1-1	RPD		RPD of duplicates	5/22/2019	0.0%	0.0%	0.3%	1.0%	0.0%	3.3%	0.0%	0.0%	0.0%	11.3%	0.0%	184.5% b	0.0%
31-1-1	FR1	N	0	12/2/2019	4 930.	< 0.005	5.1	193.	38.	11.9	< 0.002	< 0.2	< 0.5	0.165	0.29	0.68	< 0.1
31-1-1	FR2			12/2/2019	5 050.	< 0.005	5.2	199.	39.	12.4	< 0.002	< 0.2	< 0.5	0.162	0.23	0.76	< 0.1
31-1-1	FRM		Mean of duplicates	12/2/2019	4 990.	< 0.005	5.15	196.	38.5	12.15	< 0.002	< 0.2	< 0.5	0.163 5	0.26	0.72	< 0.1
31-1-1	RPD		RPD of duplicates	12/2/2019	2.4%	0.0%	1.9%	3.1%	2.6%	4.1%	0.0%	0.0%	0.0%	1.8%	23.1%	11.1%	0.0%
39-1-1	FR1	Y	0	9/25/2019	8 480.	< 0.005	3.85	287.	20.	6.2	< 0.002	< 0.2	< 0.5	0.155	1.25	< 0.1	< 0.1
39-1-1	FR2			9/25/2019	8 370.	< 0.005	3.82	287.	20.	6.6	< 0.002	< 0.2	< 0.5	0.153	1.23	< 0.1	< 0.1
39-1-1	FRM		Mean of duplicates	9/25/2019	8 425.	< 0.005	3.835	287.	20.	6.4	< 0.002	< 0.2	< 0.5	0.154	1.24	< 0.1	< 0.1
39-1-1	RPD		RPD of duplicates	9/25/2019	1.3%	0.0%	0.8%	0.0%	0.0%	6.2%	0.0%	0.0%	0.0%	1.3%	1.6%	0.0%	0.0%
39-1-1	FR1	Y	0	11/20/2019	5 310.	< 0.005	4.24	235.	20.	6.1	< 0.002	< 0.2	< 0.5	0.131	2.	1.02	< 0.1
39-1-1	FR2			11/20/2019	5 390.	< 0.005	4.23	230.	19.	6.1	< 0.002	< 0.2	< 0.5	0.132	1.92	1.22	< 0.1
39-1-1	FRM		Mean of duplicates	11/20/2019	5 350.	< 0.005	4.235	232.5	19.5	6.1	< 0.002	< 0.2	< 0.5	0.131 5	1.96	1.12	< 0.1
39-1-1	RPD		RPD of duplicates	11/20/2019	1.5%	0.0%	0.2%	2.2%	5.1%	0.0%	0.0%	0.0%	0.0%	0.8%	4.1%	17.9%	0.0%
39-1-1	FR1	Y	Clear and colourless	2/20/2020	5 100.	< 0.005	4.16	237.	21.	6.2	< 0.002	< 0.2	< 0.5	0.144	1.97	4.65	< 0.1
39-1-1	FR2			2/20/2020	5 170.	< 0.005	4.12	238.	20.	6.	< 0.002	< 0.2	< 0.5	0.142	1.96	3.23	< 0.1
39-1-1	FRM		Mean of duplicates	2/20/2020	5 135.	< 0.005	4.14	237.5	20.5	6.1	< 0.002	< 0.2	< 0.5	0.143	1.965	3.94	< 0.1
39-1-1	RPD		RPD of duplicates	2/20/2020	1.4%	0.0%	1.0%	0.4%	4.9%	3.3%	0.0%	0.0%	0.0%	1.4%	0.5%	36.0% a	0.0%

Table 3-1 Groundwater Quality QA/QC - Relative Percent Difference 2019-2020

					Silicon	Silver	Sodium	Strontium	Sulphate	Sulfur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	50	0.005	0.05	0.05	1	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1
				Limit of Quantitation (5 x MDL)	250	0.025	0.25	0.25	5	15	0.01	1	2.5	0.01	1	0.5	0.5
				Parameter	Silicon	Silver	Sodium	Strontium	Sulphate	Sulfur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Comments	Date Sampled													
39-2-1	FR1	Y	0	5/24/2019	8 310.	< 0.005	3.54	318.	21.	5.9	< 0.002	< 0.2	< 0.5	0.167	1.14	0.11	< 0.1
39-2-1	FR2			5/24/2019	7 900.	< 0.005	3.55	323.	20.	6.5	< 0.002	< 0.2	< 0.5	0.165	1.17	< 0.1	< 0.1
39-2-1	FRM		Mean of duplicates	5/24/2019	8 105.	< 0.005	3.545	320.5	20.5	6.2	< 0.002	< 0.2	< 0.5	0.166	1.155	0.105	< 0.1
39-2-1	RPD		RPD of duplicates	5/24/2019	5.1%	0.0%	0.3%	1.6%	4.9%	9.7%	0.0%	0.0%	0.0%	1.2%	2.6%	9.5%	0.0%
41-1-1	FR1	Y	0	9/19/2019	7 600.	< 0.005	4.92	222.	71.	22.6	0.003 9	< 0.2	< 0.5	0.306	< 0.2	0.65	< 0.1
41-1-1	FR2			9/19/2019	7 680.	< 0.005	4.85	227.	82.	23.3	0.003 5	< 0.2	< 0.5	0.315	< 0.2	0.1	< 0.1
41-1-1	FRM		Mean of duplicates	9/19/2019	7 640.	< 0.005	4.885	224.5	76.5	22.95	0.003 7	< 0.2	< 0.5	0.310 5	< 0.2	0.375	< 0.1
41-1-1	RPD		RPD of duplicates	9/19/2019	1.0%	0.0%	1.4%	2.2%	14.4%	3.1%	10.8%	0.0%	0.0%	2.9%	0.0%	146.7% b	0.0%
41-1-1	FR1	Y	0	12/2/2019	7 230.	< 0.005	5.49	257.	97.	30.4	0.004	< 0.2	< 0.5	0.327	< 0.2	1.33	< 0.1
41-1-1	FR2			12/2/2019	7 180.	< 0.005	5.5	251.	91.	29.8	0.004 4	< 0.2	< 0.5	0.328	< 0.2	0.53	< 0.1
41-1-1	FRM		Mean of duplicates	12/2/2019	7 205.	< 0.005	5.495	254.	94.	30.1	0.004 2	< 0.2	< 0.5	0.327 5	< 0.2	0.93	< 0.1
41-1-1	RPD		RPD of duplicates	12/2/2019	0.7%	0.0%	0.2%	2.4%	6.4%	2.0%	9.5%	0.0%	0.0%	0.3%	0.0%	**86.0% a**	0.0%
41-1-1	FR1	Y	Clear and colourless	3/4/2020	6 630.	< 0.005	5.41	207.	80.	22.	< 0.002	< 0.2	< 0.5	0.249	< 0.2	0.89	< 0.1
41-1-1	FR2			3/4/2020	6 470.	< 0.005	5.21	205.	78.	21.5	< 0.002	< 0.2	< 0.5	0.253	< 0.2	0.97	< 0.1
41-1-1	FRM		Mean of duplicates	3/4/2020	6 550.	< 0.005	5.31	206.	79.	21.75	< 0.002	< 0.2	< 0.5	0.251	< 0.2	0.93	< 0.1
41-1-1	RPD		RPD of duplicates	3/4/2020	2.4%	0.0%	3.8%	1.0%	2.5%	2.3%	0.0%	0.0%	0.0%	1.6%	0.0%	8.6%	0.0%
42-1-1	FR1	Y	0	5/23/2019	6 200.	< 0.005	8.77	356.	46.9	17.6	< 0.002	< 0.2	< 0.5	0.041 1	0.74	0.53	< 0.1
42-1-1	FR2			5/23/2019	6 460.	< 0.005	8.75	348.	47.4	16.5	< 0.002	< 0.2	< 0.5	0.039 6	0.73	0.16	< 0.1
42-1-1	FRM		Mean of duplicates	5/23/2019	6 330.	< 0.005	8.76	352.	47.15	17.05	< 0.002	< 0.2	< 0.5	0.040 35	0.735	0.345	< 0.1
42-1-1	RPD		RPD of duplicates	5/23/2019	4.1%	0.0%	0.2%	2.3%	1.1%	6.5%	0.0%	0.0%	0.0%	3.7%	1.4%	107.2% b	0.0%
42-1-1	FR1	Y	0	12/2/2019	6 480.	< 0.005	9.72	383.	74.	23.1	< 0.002	< 0.2	< 0.5	0.058 6	0.95	0.37	< 0.1
42-1-1	FR2			12/2/2019	6 580.	< 0.005	9.95	388.	67.	23.6	< 0.002	< 0.2	< 0.5	0.059 3	0.91	0.22	< 0.1
42-1-1	FRM		Mean of duplicates	12/2/2019	6 530.	< 0.005	9.835	385.5	70.5	23.35	< 0.002	< 0.2	< 0.5	0.058 95	0.93	0.295	< 0.1
42-1-1	RPD		RPD of duplicates	12/2/2019	1.5%	0.0%	2.3%	1.3%	9.9%	2.1%	0.0%	0.0%	0.0%	1.2%	4.3%	50.8% b	0.0%
42-1-1	FR1	Y	Clear and colourless	3/4/2020	5 540.	< 0.005	9.96	359.	69.	20.	< 0.002	< 0.2	< 0.5	0.047 5	0.77	0.78	< 0.1
42-1-1	FR2			3/4/2020	5 650.	< 0.005	9.8	352.	67.	19.7	< 0.002	< 0.2	< 0.5	0.047 3	0.73	0.92	< 0.1
42-1-1	FRM		Mean of duplicates	3/4/2020	5 595.	< 0.005	9.88	355.5	68.	19.85	< 0.002	< 0.2	< 0.5	0.047 4	0.75	0.85	< 0.1
42-1-1	RPD		RPD of duplicates	3/4/2020	2.0%	0.0%	1.6%	2.0%	2.9%	1.5%	0.0%	0.0%	0.0%	0.4%	5.3%	16.5%	0.0%
58-1-0	FR1	N	0	5/29/2019	18 500.	< 0.025	523.	4 070.	62.	24.	< 0.01	1.1	6.4	0.418	27.5	7.2	2.57
58-1-0	FR2			5/29/2019	18 900.	< 0.025	523.	4 120.	63.	24.	< 0.01	1.1	7.4	0.408	27.1	7.07	2.33
58-1-0	FRM		Mean of duplicates	5/29/2019	18 700.	< 0.025	523.	4 095.	62.5	24.	< 0.01	1.1	6.9	0.413	27.3	7.135	2.45
58-1-0	RPD		RPD of duplicates	5/29/2019	2.1%	0.0%	0.0%	1.2%	1.6%	0.0%	0.0%	0.0%	14.5%	2.4%	1.5%	1.8%	9.8%
71-1-1	FR1	Y	0	5/16/2019	12 100.	< 0.005	6.55	127.	17.2	5.5	0.003	< 0.2	< 0.5	0.233	0.26	0.33	< 0.1
71-1-1	FR2			5/16/2019	12 000.	< 0.005	6.54	123.	16.7	5.3	0.004	< 0.2	< 0.5	0.231	0.24	0.37	< 0.1
71-1-1	FRM		Mean of duplicates	5/16/2019	12 050.	< 0.005	6.545	125.	16.95	5.4	0.003 5	< 0.2	< 0.5	0.232	0.25	0.35	< 0.1
71-1-1	RPD		RPD of duplicates	5/16/2019	0.8%	0.0%	0.2%	3.2%	2.9%	3.7%	28.6%	0.0%	0.0%	0.9%	8.0%	11.4%	0.0%
71-1-1	FR1	Y	0	9/12/2019	11 400.	< 0.005	6.44	155.	19.	4.4	< 0.002	< 0.2	< 0.5	0.246	0.29	0.13	< 0.1
71-1-1	FR2			9/12/2019	11 000.	< 0.005	6.3	149.	19.	5.2	< 0.002	< 0.2	< 0.5	0.241	0.33	0.3	< 0.1
71-1-1	FRM		Mean of duplicates	9/12/2019	11 200.	< 0.005	6.37	152.	19.	4.8	< 0.002	< 0.2	< 0.5	0.243 5	0.31	0.215	< 0.1
71-1-1	RPD		RPD of duplicates	9/12/2019	3.6%	0.0%	2.2%	3.9%	0.0%	16.7%	0.0%	0.0%	0.0%	2.1%	12.9%	79.1% b	0.0%
71-1-1	FR1	Y	0	11/6/2019	12 800.	< 0.005	6.64	158.	18.	< 15.	0.005	< 0.2	< 0.5	0.269	0.21	0.82	< 0.1
71-1-1	FR2			11/6/2019	12 600.	< 0.005	6.57	158.	17.	< 15.	0.004 3	< 0.2	< 0.5	0.261	0.25	1.47	< 0.1
71-1-1	FRM		Mean of duplicates	11/6/2019	12 700.	< 0.005	6.605	158.	17.5	< 15.	0.004 65	< 0.2	< 0.5	0.265	0.23	1.145	< 0.1
71-1-1	RPD		RPD of duplicates	11/6/2019	1.6%	0.0%	1.1%	0.0%	5.7%	0.0%	15.1%	0.0%	0.0%	3.0%	17.4%	**56.8% a**	0.0%
71-1-1	FR1	Y	Clear and colourless	2/13/2020	12 400.	< 0.005	9.48	142.	23.	6.6	0.006 5	< 0.2	< 0.5	0.331	0.45	1.41	< 0.1
71-1-1	FR2			2/13/2020	12 400.	< 0.005	9.22	142.	23.	7.4	0.006 3	< 0.2	< 0.5	0.326	0.46	1.82	< 0.1
71-1-1	FRM		Mean of duplicates	2/13/2020	12 400.	< 0.005	9.35	142.	23.	7.	0.006 4	< 0.2	< 0.5	0.328 5	0.455	1.615	< 0.1
71-1-1	RPD		RPD of duplicates	2/13/2020	0.0%	0.0%	2.8%	0.0%	0.0%	11.4%	3.1%	0.0%	0.0%	1.5%	2.2%	25.4%	0.0%
72-1-1	FR1	Y	0	5/16/2019	18 800.	< 0.005	8.91	290.	47.	15.5	< 0.002	< 0.2	< 0.5	0.02	< 0.2	0.33	< 0.1
72-1-1	FR2			5/16/2019	18 600.	< 0.005	8.86	281.	43.	15.3	< 0.002	< 0.2	< 0.5	0.021	< 0.2	0.23	< 0.1
72-1-1	FRM		Mean of duplicates	5/16/2019	18 700.	< 0.005	8.885	285.5	45.	15.4	< 0.002	< 0.2	< 0.5	0.020 5	< 0.2	0.28	< 0.1
72-1-1	RPD		RPD of duplicates	5/16/2019	1.1%	0.0%	0.6%	3.2%	8.9%	1.3%	0.0%	0.0%	0.0%	4.9%	0.0%	35.7% b	0.0%
72-1-1	FR1	Y	0	9/11/2019	18 200.	< 0.005	8.32	295.	48.	13.4	< 0.002	< 0.2	< 0.5	0.022 2	< 0.2	< 0.1	< 0.1
72-1-1	FR2			9/11/2019	18 000.	< 0.005	8.42	297.	47.	13.2	< 0.002	< 0.2	< 0.5	0.021 1	< 0.2	< 0.1	< 0.1
72-1-1	FRM		Mean of duplicates	9/11/2019	18 100.	< 0.005	8.37	296.	47.5	13.3	< 0.002	< 0.2	< 0.5	0.021 65	< 0.2	< 0.1	< 0.1
72-1-1	RPD		RPD of duplicates	9/11/2019	1.1%	0.0%	1.2%	0.7%	2.1%	1.5%	0.0%	0.0%	0.0%	5.1%	0.0%	0.0%	0.0%
72-1-1	FR1	Y	0	11/6/2019	20 800.	< 0.01	8.77	296.	44.	< 15.	< 0.004	< 0.4	< 1.	0.019 1	< 0.4	0.89	< 0.2
72-1-1	FR2			11/6/2019	20 200.	< 0.01	8.94	285.	44.	< 15.	< 0.004	< 0.4	< 1.	0.020 9	< 0.4	1.54	< 0.2
72-1-1	FRM		Mean of duplicates	11/6/2019	20 500.	< 0.01	8.855	290.5	44.	< 15.	< 0.004	< 0.4	< 1.	0.02	< 0.4	1.215	< 0.2
72-1-1	RPD		RPD of duplicates	11/6/2019	2.9%	0.0%	1.9%	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	9.0%	0.0%	**53.5% a**	0.0%
72-1-1	FR1	Y	Clear and colourless	2/12/2020	19 900.	< 0.005	8.83	302.	42.	15.4	< 0.002	< 0.2	< 0.5	0.018 5	< 0.2	0.67	< 0.1
72-1-1	FR2			2/12/2020	19 600.	< 0.005	8.88	302.	47.	15.6	< 0.002	< 0.2	< 0.5	0.018 3	< 0.2	0.19	< 0.1
72-1-1	FRM		Mean of duplicates	2/12/2020	19 750.	< 0.005	8.855	302.	44.5	15.5	< 0.002	< 0.2	< 0.5	0.018 4	< 0.2	0.43	< 0.1
72-1-1	RPD		RPD of duplicates	2/12/2020	1.5%	0.0%	0.6%	0.0%	11.2%	1.3%	0.0%	0.0%	0.0%	1.1%	0.0%	111.6% b	0.0%
73-1-1	FR1	Y	0	9/12/2019	8 810.	< 0.005	6.52	199.	37.	13.	0.002 5	< 0.2	< 0.5	0.283	0.51	0.93	< 0.1
73-1-1	FR2			9/12/2019	8 640.	< 0.005	6.58	202.	42.	11.9	0.002 4	< 0.2	< 0.5	0.284	0.51	0.48	< 0.1
73-1-1	FRM		Mean of duplicates	9/12/2019	8 725.	< 0.005	6.55	200.5	39.5	12.45	0.002 45	< 0.2	< 0.5	0.283 5	0.51	0.705	< 0.1
73-1-1	RPD		RPD of duplicates	9/12/2019	1.9%	0.0%	0.9%	1.5%	12.7%	8.8%	4.1%	0.0%	0.0%	0.4%	0.0%	63.8% b	0.0%
73-3-1	FR1	Y	0	11/6/2019	6 920.	< 0.005	18.9	79.6	23.	< 15.	0.007 5	< 0.2	< 0.5	0.029 9	0.24	1.16	< 0.1
73-3-1	FR2			11/6/2019	7 080.	< 0.005	18.9	80.5	25.	< 15.	0.007 6	< 0.2	< 0.5	0.027 6	0.28	1.15	< 0.1
73-3-1	FRM		Mean of duplicates	11/6/2019	7 000.	< 0.005	18.9	80.05	24.	< 15.	0.007 55	< 0.2	< 0.5	0.028 75	0.26	1.155	< 0.1
73-3-1	RPD		RPD of duplicates	11/6/2019	2.3%	0.0%	0.0%	1.1%	8.3%	0.0%	1.3%	0.0%	0.0%	8.0%	15.4%	0.9%	0.0%
78-2-1	FR1	N	0	9/18/2019	11 800.	< 0.005	5.16	106.	85.	27.2	0.013 8	< 0.2	< 0.5	0.157	0.51	198.	< 0.1
78-2-1	FR2			9/18/2019	11 800.	< 0.005	5.04	103.	76.	27.8	0.013 8	< 0.2	< 0.5	0.159	0.5	196.	< 0.1
78-2-1	FRM		Mean of duplicates	9/18/2019	11 800.	< 0.005	5.1	104.5	80.5	27.5	0.013 8	< 0.2	< 0.5	0.158	0.505	197.	< 0.1
78-2-1	RPD		RPD of duplicates	9/18/2019	0.0%	0.0%	2.4%	2.9%	11.2%	2.2%	0.0%	0.0%	0.0%	1.3%	2.0%	1.0%	0.0%

Notes:

SS Single sample
FR1 Field replicate 1
FR2 Field replicate 2
FRM Average of field replicates
RPD Relative percent difference of field replicates
na - Not applicable, some replicates less than the detection limit.
a *- Coefficient of variation greater than 30% and all replicates greater than the limit of quai*
b *- Coefficient of variation greater than 30% with some replicates less than the limit of qua*

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.01	1	0.1	3	0.02	10	0.005	1	0.01	0.1
				Limit of Quantitation (5 x MDL)	0.05	5	0.5	15	0.1	50	0.025	5	0.05	0.5
				Parameter	pH	Specific Conductivity - 25°C.	Temperature	Aluminum	Arsenic	Boron	Cadmium	Chloride	Cobalt	Copper
				Fraction	TOT	TOT	TOT	TOT	TOT	TOT	TOT	DIS	TOT	TOT
				Unit	pH	µS/cm	°C	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled	Comments										
SW-N-05	FR1	Y	03-May-2019		6.9	206.	10.1	44.6	0.113	31.	0.005	5.3	0.217	1.21
SW-N-05	FR2		03-May-2019		6.9	206.	10.1	57.9	0.122	31.	0.006	5.4	0.249	1.29
SW-N-05	FRM		03-May-2019		6.9	206.	10.1	51.25	0.117 5	31.	0.005 5	5.35	0.233	1.25
SW-N-05	RPD		03-May-2019		0.0%	0.0%	0.0%	26.0%	7.7%	0.0%	18.2%	1.9%	13.7%	6.4%
SW-N-05	FR1	Y	08-Oct-2019		7.18	291.	12.	396.	0.159	32.	0.008 7	8.	0.538	4.95
SW-N-05	FR2		08-Oct-2019		7.18	291.	12.	343.	0.125	39.	0.012 3	7.4	0.5	4.98
SW-N-05	FRM		08-Oct-2019		7.18	291.	12.	369.5	0.142	35.5	0.010 5	7.7	0.519	4.965
SW-N-05	RPD		08-Oct-2019		0.0%	0.0%	0.0%	14.3%	23.9%	19.7%	34.3% b	7.8%	7.3%	0.6%
SW-N-05	FR1	Y	05-Dec-2019		6.58	505.	9.1	32.1	0.125	55.	0.035 1	6.	0.164	1.72
SW-N-05	FR2		05-Dec-2019		6.58	505.	9.1	26.1	0.127	55.	0.092 2	5.3	0.132	1.72
SW-N-05	FRM		05-Dec-2019		6.58	505.	9.1	29.1	0.126	55.	0.063 65	5.65	0.148	1.72
SW-N-05	RPD		05-Dec-2019		0.0%	0.0%	0.0%	20.6%	1.6%	0.0%	**89.7%** a	12.4%	21.6%	0.0%
SW-N-05	FR1	Y	07-Feb-2020		7.16	324.	7.9	77.6	0.128	39.	0.017	4.8	0.134	1.66
SW-N-05	FR2		07-Feb-2020		7.16	324.	7.9	77.4	0.136	39.	0.010 8	4.8	0.133	1.72
SW-N-05	FRM		07-Feb-2020		7.16	324.	7.9	77.5	0.132	39.	0.013 9	4.8	0.133 5	1.69
SW-N-05	RPD		07-Feb-2020		0.0%	0.0%	0.0%	0.3%	6.1%	0.0%	44.6% b	0.0%	0.7%	3.6%
SW-N-05	FR1	Y	17-Mar-2020		6.96	270.	8.	72.1	0.102	50.	< 0.005	5.3	0.102	1.25
SW-N-05	FR2		17-Mar-2020		6.96	270.	8.	215.	0.111	48.	0.007	5.3	0.284	1.84
SW-N-05	FRM		17-Mar-2020		6.96	270.	8.	143.55	0.106 5	49.	< 0.006	5.3	0.193	1.545
SW-N-05	RPD		17-Mar-2020		0.0%	0.0%	0.0%	**99.5%** a	8.5%	4.1%	33.3% b	0.0%	**94.3%** a	**38.2%** a
SW-N-16	FR1	Y	02-May-2019		7.3	355.	10.5	68.1	0.303	101.	0.04	11.	1.03	5.96
SW-N-16	FR2		02-May-2019		7.3	355.	10.5	57.2	0.276	104.	0.028	11.	0.917	5.65
SW-N-16	FRM		02-May-2019		7.3	355.	10.5	62.65	0.289 5	102.5	0.034	11.	0.973 5	5.805
SW-N-16	RPD		02-May-2019		0.0%	0.0%	0.0%	17.4%	9.3%	2.9%	**35.3%** a	0.0%	11.6%	5.3%
SW-N-16	FR1	Y	09-Oct-2019		6.94	401.	9.3	19.2	0.33	75.	0.014 6	13.	0.7	3.12
SW-N-16	FR2		09-Oct-2019		6.94	401.	9.3	19.6	0.346	77.	0.010 7	13.	0.727	3.04
SW-N-16	FRM		09-Oct-2019		6.94	401.	9.3	19.4	0.338	76.	0.012 65	13.	0.713 5	3.08
SW-N-16	RPD		09-Oct-2019		0.0%	0.0%	0.0%	2.1%	4.7%	2.6%	30.8% b	0.0%	3.8%	2.6%
SW-N-16	FR1	Y	04-Dec-2019		6.66	389.	6.3	11.6	0.208	90.	0.016 4	10.	0.32	4.28
SW-N-16	FR2		04-Dec-2019		6.66	389.	6.3	30.5	0.218	89.	0.016 5	10.	0.34	4.43
SW-N-16	FRM		04-Dec-2019		6.66	389.	6.3	21.05	0.213	89.5	0.016 45	10.	0.33	4.355
SW-N-16	RPD		04-Dec-2019		0.0%	0.0%	0.0%	**89.8%** a	4.7%	1.1%	0.6%	0.0%	6.1%	3.4%
SW-N-16	FR1	Y	07-Feb-2020		7.26	203.	7.3	97.1	0.217	40.	0.015	3.8	0.248	15.4
SW-N-16	FR2		07-Feb-2020		7.26	203.	7.3	108.	0.245	41.	0.014 3	3.8	0.253	15.
SW-N-16	FRM		07-Feb-2020		7.26	203.	7.3	102.55	0.231	40.5	0.014 65	3.8	0.250 5	15.2
SW-N-16	RPD		07-Feb-2020		0.0%	0.0%	0.0%	10.6%	12.1%	2.5%	4.8%	0.0%	2.0%	2.6%
SW-N-16	FR1	Y	24-Mar-2020	slightly yellow with organics	6.53	254.	7.1	16.	0.216	73.	0.016 8	8.5	0.531	5.17
SW-N-16	FR2		24-Mar-2020		6.53	254.	7.1	15.2	0.219	74.	0.018 4	9.3	0.539	5.27
SW-N-16	FRM		24-Mar-2020		6.53	254.	7.1	15.6	0.217 5	73.5	0.017 6	8.9	0.535	5.22
SW-N-16	RPD		24-Mar-2020		0.0%	0.0%	0.0%	5.1%	1.4%	1.4%	9.1%	9.0%	1.5%	1.9%
SW-N-41S1	FR1	Y	09-Oct-2019		7.95	328.	9.4	59.8	0.256	23.	0.009 7	4.4	0.297	0.38
SW-N-41S1	FR2		09-Oct-2019		7.95	328.	9.4	58.9	0.253	22.	0.010 4	5.4	0.319	0.41
SW-N-41S1	FRM		09-Oct-2019		7.95	328.	9.4	59.35	0.254 5	22.5	0.010 05	4.9	0.308	0.395
SW-N-41S1	RPD		09-Oct-2019		0.0%	0.0%	0.0%	1.5%	1.2%	4.4%	7.0%	20.4%	7.1%	7.6%
SW-N-41S1	FR1		06-Dec-2019		7.3	488.	8.6	10.2	0.144	19.	0.005 1	3.9	0.135	0.234
SW-N-41S1	FR2		06-Dec-2019		7.3	488.	8.6	11.9	0.149	19.	0.007 9	3.7	0.124	0.204
SW-N-41S1	FRM		06-Dec-2019		7.3	488.	8.6	11.05	0.146 5	19.	0.006 5	3.8	0.129 5	0.219
SW-N-41S1	RPD		06-Dec-2019		0.0%	0.0%	0.0%	15.4%	3.4%	0.0%	43.1% b	5.3%	8.5%	13.7%

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.01	1	0.1	3	0.02	10	0.005	1	0.01	0.1
				Limit of Quantitation (5 x MDL)	0.05	5	0.5	15	0.1	50	0.025	5	0.05	0.5
				Parameter	pH	Specific Conductivity - 25°C.	Temperature	Aluminum	Arsenic	Boron	Cadmium	Chloride	Cobalt	Copper
				Fraction	TOT	TOT	TOT	TOT	TOT	TOT	TOT	DIS	TOT	TOT
				Unit	pH	µS/cm	°C	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled	Comments										
SW-N-41S1	FR1	Y	06-Feb-2020		7.11	210.	8.1	171.	0.244	15.	0.005 4	3.5	0.17	0.69
SW-N-41S1	FR2		06-Feb-2020		7.11	210.	8.1	188.	0.251	17.	0.006	3.4	0.18	0.72
SW-N-41S1	FRM		06-Feb-2020		7.11	210.	8.1	179.5	0.247 5	16.	0.005 7	3.45	0.175	0.705
SW-N-41S1	RPD		06-Feb-2020		0.0%	0.0%	0.0%	9.5%	2.8%	12.5%	10.5%	2.9%	5.7%	4.3%
SW-N-41S1	FR1	Y	17-Mar-2020		7.62	274.	7.1	23.8	0.131	32.	< 0.005	4.	0.085	0.21
SW-N-41S1	FR2		17-Mar-2020		7.62	274.	7.1	19.8	0.138	30.	< 0.005	4.1	0.082	0.25
SW-N-41S1	FRM		17-Mar-2020		7.62	274.	7.1	21.8	0.134 5	31.	< 0.005	4.05	0.083 5	0.23
SW-N-41S1	RPD		17-Mar-2020		0.0%	0.0%	0.0%	18.3%	5.2%	6.5%	0.0%	2.5%	3.6%	17.4%
SW-N-42S1	FR1	Y	09-Oct-2019		6.94	382.	9.	11.3	0.163	48.	< 0.005	15.	0.070 7	0.376
SW-N-42S1	FR2		09-Oct-2019		6.94	382.	9.	12.	0.148	49.	0.006 5	15.	0.069 3	0.455
SW-N-42S1	FRM		09-Oct-2019		6.94	382.	9.	11.65	0.155 5	48.5	0.005 75	15.	0.07	0.415 5
SW-N-42S1	RPD		09-Oct-2019		0.0%	0.0%	0.0%	6.0%	9.6%	2.1%	26.1%	0.0%	2.0%	19.0%
SW-N-42S1	FR1	Y	04-Dec-2019		7.25	401.	6.8	11.5	0.12	59.	< 0.005	10.	0.106	0.385
SW-N-42S1	FR2		04-Dec-2019		7.25	401.	6.8	12.7	0.11	59.	< 0.005	11.	0.116	0.43
SW-N-42S1	FRM		04-Dec-2019		7.25	401.	6.8	12.1	0.115	59.	< 0.005	10.5	0.111	0.407 5
SW-N-42S1	RPD		04-Dec-2019		0.0%	0.0%	0.0%	9.9%	8.7%	0.0%	0.0%	9.5%	9.0%	11.0%
SW-N-42S1	FR1	Y	07-Feb-2020		6.88	198.	7.5	46.4	0.079	53.	< 0.005	7.9	0.069	1.
SW-N-42S1	FR2		07-Feb-2020		6.88	198.	7.5	42.3	0.079	55.	< 0.005	7.9	0.067	0.95
SW-N-42S1	FRM		07-Feb-2020		6.88	198.	7.5	44.35	0.079	54.	< 0.005	7.9	0.068	0.975
SW-N-42S1	RPD		07-Feb-2020		0.0%	0.0%	0.0%	9.2%	0.0%	3.7%	0.0%	0.0%	2.9%	5.1%
SW-N-42S1	FR1	Y	17-Mar-2020		7.45	282.	6.4	11.1	0.068	60.	< 0.005	9.6	0.063	0.55
SW-N-42S1	FR2		17-Mar-2020		7.45	282.	6.4	8.7	0.052	50.	< 0.005	9.6	0.058 1	0.419
SW-N-42S1	FRM		17-Mar-2020		7.45	282.	6.4	9.9	0.06	55.	< 0.005	9.6	0.060 55	0.484 5
SW-N-42S1	RPD		17-Mar-2020		0.0%	0.0%	0.0%	24.2%	26.7%	18.2%	0.0%	0.0%	8.1%	27.0%
SW-S-04	FR1	Y	08-Oct-2019		6.27	288.	11.1	19.8	0.088	83.	0.020 4	31.	0.089 4	1.57
SW-S-04	FR2		08-Oct-2019		6.27	288.	11.1	14.4	0.085	85.	0.019 9	35.	0.086 7	1.5
SW-S-04	FRM		08-Oct-2019		6.27	288.	11.1	17.1	0.086 5	84.	0.020 15	33.	0.088 05	1.535
SW-S-04	RPD		08-Oct-2019		0.0%	0.0%	0.0%	31.6% a	3.5%	2.4%	2.5%	12.1%	3.1%	4.6%
SW-S-04	FR1	Y	05-Dec-2019		6.95	250.	8.5	21.4	0.09	63.	0.018	27.	0.088 2	1.45
SW-S-04	FR2		05-Dec-2019		6.95	250.	8.5	14.9	0.084	62.	0.016 3	26.	0.085 9	1.51
SW-S-04	FRM		05-Dec-2019		6.95	250.	8.5	18.15	0.087	62.5	0.017 15	26.5	0.087 05	1.48
SW-S-04	RPD		05-Dec-2019		0.0%	0.0%	0.0%	35.8%	6.9%	1.6%	9.9%	3.8%	2.6%	4.1%
SW-S-04	FR1	Y	06-Feb-2020		6.96	119.	6.7	369.	0.16	38.	0.029 2	15.	0.39	4.73
SW-S-04	FR2		06-Feb-2020		6.96	119.	6.7	350.	0.143	35.	0.018 1	15.	0.381	4.43
SW-S-04	FRM		06-Feb-2020		6.96	119.	6.7	359.5	0.151 5	36.5	0.023 65	15.	0.385 5	4.58
SW-S-04	RPD		06-Feb-2020		0.0%	0.0%	0.0%	5.3%	11.2%	8.2%	46.9% b	0.0%	2.3%	6.6%
SW-S-04	FR1	Y	17-Mar-2020		6.24	169.	6.2	52.4	0.108	87.	0.011 6	21.	0.111	1.97
SW-S-04	FR2		17-Mar-2020		6.24	169.	6.2	45.2	0.093	79.	0.008 4	21.	0.1	1.85
SW-S-04	FRM		17-Mar-2020		6.24	169.	6.2	48.8	0.100 5	83.	0.01	21.	0.105 5	1.91
SW-S-04	RPD		17-Mar-2020		0.0%	0.0%	0.0%	14.8%	14.9%	9.6%	32.0% b	0.0%	10.4%	6.3%

Notes:

SS — *Single sample*
FR1 — *Field replicate 1*
FR2 — *Field replicate 2*
FRM — *Average of field replicates*
RPD — Relative percent difference of field replicates
na - Not applicable, some replicates less than the detection limit.

a *- Coefficient of variation greater than 30% and all replicates greater than the limit of quantitation.*

b *- Coefficient of variation greater than 30% with some replicates less than the limit of quantitation.*

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.5	5	0.02	0.1	0.05	0.015	0.005	0.2	0.1	0.04
				Limit of Quantitation (5 x MDL)	2.5	25	0.1	0.5	0.25	0.075	0.025	1	0.5	0.2
				Parameter	Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	N - Nh3 (As N)	N - No2 (As N)	N - No3 (As N)	Nickel	Selenium
				Fraction	TOT	TOT	TOT	TOT	TOT	TOT	DIS	DIS	TOT	TOT
				Unit	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	µg/L	µg/L
Station	Sample Type	Compliance Well (Y/N)?	Date Sampled	Comments										
SW-N-05	FR1	Y	03-May-2019		166.	57.6	< 0.02	2.18	0.888	0.2	< 0.005	4.75	0.39	0.313
SW-N-05	FR2		03-May-2019		167.	81.4	< 0.02	3.23	0.866	0.32	< 0.005	5.17	0.58	0.316
SW-N-05	FRM		03-May-2019		166.5	69.5	< 0.02	2.705	0.877	0.26	< 0.005	4.96	0.485	0.314 5
SW-N-05	RPD		03-May-2019		0.6%	34.2%	0.0%	38.8% a	2.5%	46.2% a	0.0%	8.5%	39.2%	1.0%
SW-N-05	FR1	Y	08-Oct-2019		173.	647.	0.074	12.8	0.582	0.059	< 0.005	5.14	1.12	0.337
SW-N-05	FR2		08-Oct-2019		200.	607.	0.077 8	11.4	0.635	0.024	< 0.005	5.01	1.	0.38
SW-N-05	FRM		08-Oct-2019		186.5	627.	0.075 9	12.1	0.608 5	0.041 5	< 0.005	5.075	1.06	0.358 5
SW-N-05	RPD		08-Oct-2019		14.5%	6.4%	5.0%	11.6%	8.7%	84.3% b	0.0%	2.6%	11.3%	12.0%
SW-N-05	FR1	Y	05-Dec-2019		363.	46.2	0.012	2.23	1.44	< 0.015	< 0.005	10.9	0.617	0.817
SW-N-05	FR2		05-Dec-2019		360.	30.4	0.013 2	1.62	1.42	< 0.015	< 0.005	11.	0.623	0.807
SW-N-05	FRM		05-Dec-2019		361.5	38.3	0.012 6	1.925	1.43	< 0.015	< 0.005	10.95	0.62	0.812
SW-N-05	RPD		05-Dec-2019		0.8%	41.3%	9.5%	31.7% a	1.4%	0.0%	0.0%	0.9%	1.0%	1.2%
SW-N-05	FR1	Y	07-Feb-2020		215.	99.7	0.022	1.66	1.11	< 0.015	< 0.005	5.91	0.6	0.484
SW-N-05	FR2		07-Feb-2020		223.	98.2	0.02	1.95	1.17	< 0.015	< 0.005	5.82	0.62	0.497
SW-N-05	FRM		07-Feb-2020		219.	98.95	0.021	1.805	1.14	< 0.015	< 0.005	5.865	0.61	0.490 5
SW-N-05	RPD		07-Feb-2020		3.7%	1.5%	9.5%	16.1%	5.3%	0.0%	0.0%	1.5%	3.3%	2.7%
SW-N-05	FR1	Y	17-Mar-2020		187.	110.	< 0.02	2.82	1.14	< 0.015	< 0.005	1.86	0.37	0.255
SW-N-05	FR2		17-Mar-2020		185.	326.	0.057	10.9	1.08	< 0.015	< 0.005	1.87	0.61	0.255
SW-N-05	FRM		17-Mar-2020		186.	218.	< 0.038 5	6.86	1.11	< 0.015	< 0.005	1.865	0.49	0.255
SW-N-05	RPD		17-Mar-2020		1.1%	99.1% a	96.1% a	117.8% a	5.4%	0.0%	0.0%	0.5%	49.0%	0.0%
SW-N-16	FR1	Y	02-May-2019		225.	1 800.	0.125	976.	0.933	0.13	0.005 4	0.106	2.32	0.129
SW-N-16	FR2		02-May-2019		223.	1 710.	0.105	833.	0.92	2.9	0.005 7	0.111	2.21	0.11
SW-N-16	FRM		02-May-2019		224.	1 755.	0.115	904.5	0.926 5	1.515	0.005 55	0.108 5	2.265	0.119 5
SW-N-16	RPD		02-May-2019		0.9%	5.1%	17.4%	15.8%	1.4%	182.8% a	5.4%	4.6%	4.9%	15.9%
SW-N-16	FR1	Y	09-Oct-2019		265.	1 040.	0.037	400.	0.938	0.08	0.006	0.05	2.04	0.132
SW-N-16	FR2		09-Oct-2019		272.	1 440.	0.039	427.	0.987	0.073	0.007 1	0.046	2.1	0.112
SW-N-16	FRM		09-Oct-2019		268.5	1 240.	0.038	413.5	0.962 5	0.076 5	0.006 55	0.048	2.07	0.122
SW-N-16	RPD		09-Oct-2019		2.6%	32.3% b	5.3%	6.5%	5.1%	9.2%	16.8%	8.3%	2.9%	16.4%
SW-N-16	FR1	Y	04-Dec-2019		277.	246.	0.011 6	353.	0.609	0.31	0.143	6.54	1.39	0.086
SW-N-16	FR2		04-Dec-2019		271.	472.	0.031 5	337.	0.605	0.31	0.154	5.97	1.42	0.093
SW-N-16	FRM		04-Dec-2019		274.	359.	0.021 55	345.	0.607	0.31	0.148 5	6.255	1.405	0.089 5
SW-N-16	RPD		04-Dec-2019		2.2%	63.0% a	92.3%	4.6%	0.7%	0.0%	7.4%	9.1%	2.1%	7.8%
SW-N-16	FR1	Y	07-Feb-2020		121.	228.	0.04	30.2	0.676	0.021	< 0.005	3.08	1.98	0.127
SW-N-16	FR2		07-Feb-2020		121.	257.	0.041	30.7	0.641	0.022	< 0.005	3.38	1.97	0.11
SW-N-16	FRM		07-Feb-2020		121.	242.5	0.040 5	30.45	0.658 5	0.021 5	< 0.005	3.23	1.975	0.118 5
SW-N-16	RPD		07-Feb-2020		0.0%	12.0%	2.5%	1.6%	5.3%	4.7%	0.0%	9.3%	0.5%	14.3%
SW-N-16	FR1	Y	24-Mar-2020		163.	686.	0.014 1	516.	0.591	0.19	< 0.005	0.198	1.37	0.089
SW-N-16	FR2		24-Mar-2020	slightly yellow	164.	682.	0.014 1	520.	0.577	0.18	< 0.005	0.188	1.44	0.106
SW-N-16	FRM		24-Mar-2020	with organics	163.5	684.	0.014 1	518.	0.584	0.185	< 0.005	0.193	1.405	0.097 5
SW-N-16	RPD		24-Mar-2020		0.6%	0.6%	0.0%	0.8%	2.4%	5.4%	0.0%	5.2%	5.0%	17.4%
SW-N-41S1	FR1	Y	09-Oct-2019		369.	235.	0.068	255.	0.403	0.022	< 0.005	0.555	0.28	0.236
SW-N-41S1	FR2		09-Oct-2019		367.	231.	0.062	285.	0.381	0.027	< 0.005	0.55	0.33	0.254
SW-N-41S1	FRM		09-Oct-2019		368.	233.	0.065	270.	0.392	0.024 5	< 0.005	0.552 5	0.305	0.245
SW-N-41S1	RPD		09-Oct-2019		0.5%	1.7%	9.2%	11.1%	5.6%	20.4%	0.0%	0.9%	16.4%	7.3%
SW-N-41S1	FR1		06-Dec-2019		367.	57.7	0.012 2	106.	0.365	< 0.015	< 0.005	0.621	0.203	0.205
SW-N-41S1	FR2		06-Dec-2019		371.	53.7	0.012 8	102.	0.331	< 0.015	< 0.005	0.622	0.164	0.184
SW-N-41S1	FRM		06-Dec-2019		369.	55.7	0.012 5	104.	0.348	< 0.015	< 0.005	0.621 5	0.183 5	0.194 5
SW-N-41S1	RPD		06-Dec-2019		1.1%	7.2%	4.8%	3.8%	9.8%	0.0%	0.0%	0.2%	21.3%	10.8%

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				Parameter	Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	N - Nh3 (As N)	N - No2 (As N)	N - No3 (As N)	Nickel	Selenium
				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.5	5	0.02	0.1	0.05	0.015	0.005	0.2	0.1	0.04
				Limit of Quantitation (5 x MDL)	2.5	25	0.1	0.5	0.25	0.075	0.025	1	0.5	0.2
				Fraction	TOT	TOT	TOT	TOT	TOT	TOT	DIS	DIS	TOT	TOT
				Unit	mg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	µg/L	µg/L
Station	**Sample Type**	**Complance Well (Y/N)?**	**Date Sampled**	**Comments**										
SW-N-41S1	FR1	Y	06-Feb-2020		140.	260.	0.115	73.4	0.236	0.045	< 0.005	0.471	0.28	0.088
SW-N-41S1	FR2		06-Feb-2020		143.	279.	0.127	82.	0.246	< 0.015	< 0.005	0.474	0.29	0.091
SW-N-41S1	FRM		06-Feb-2020		141.5	269.5	0.121	77.7	0.241	< 0.03	< 0.005	0.472 5	0.285	0.089 5
SW-N-41S1	RPD		06-Feb-2020		2.1%	7.1%	9.9%	11.1%	4.1%	100.0% b	0.0%	0.6%	3.5%	3.4%
SW-N-41S1	FR1	Y	17-Mar-2020		199.	51.3	< 0.02	46.4	0.301	0.015	< 0.005	0.209	0.12	0.088
SW-N-41S1	FR2		17-Mar-2020		206.	49.6	< 0.02	45.7	0.278	0.065	< 0.005	0.211	0.13	0.088
SW-N-41S1	FRM		17-Mar-2020		202.5	50.45	< 0.02	46.05	0.289 5	0.04	< 0.005	0.21	0.125	0.088
SW-N-41S1	RPD		17-Mar-2020		3.5%	3.4%	0.0%	1.5%	7.9%	125.0% b	0.0%	1.0%	8.0%	0.0%
SW-N-42S1	FR1	Y	09-Oct-2019		249.	27.3	0.010 3	15.8	0.437	0.044	< 0.005	0.037	0.178	0.058
SW-N-42S1	FR2		09-Oct-2019		254.	28.6	0.014 5	16.2	0.432	0.026	< 0.005	0.037	0.189	0.057
SW-N-42S1	FRM		09-Oct-2019		251.5	27.95	0.012 4	16.	0.434 5	0.035	< 0.005	0.037	0.183 5	0.057 5
SW-N-42S1	RPD		09-Oct-2019		2.0%	4.7%	33.9%	2.5%	1.2%	51.4% b	0.0%	0.0%	6.0%	1.7%
SW-N-42S1	FR1	Y	04-Dec-2019		283.	36.6	0.018 7	43.	0.315	< 0.015	< 0.005	0.122	0.208	0.062
SW-N-42S1	FR2		04-Dec-2019		280.	42.5	0.022 3	44.2	0.328	< 0.015	< 0.005	0.127	0.228	0.082
SW-N-42S1	FRM		04-Dec-2019		281.5	39.55	0.020 5	43.6	0.321 5	< 0.015	< 0.005	0.124 5	0.218	0.072
SW-N-42S1	RPD		04-Dec-2019		1.1%	14.9%	17.6%	2.8%	4.0%	0.0%	0.0%	4.0%	9.2%	27.8%
SW-N-42S1	FR1	Y	07-Feb-2020		114.	45.6	0.029	10.8	0.301	< 0.015	< 0.005	0.229	0.16	0.052
SW-N-42S1	FR2		07-Feb-2020		114.	40.6	0.029	8.75	0.312	< 0.015	< 0.005	0.228	0.14	0.055
SW-N-42S1	FRM		07-Feb-2020		114.	43.1	0.029	9.775	0.306 5	< 0.015	< 0.005	0.228 5	0.15	0.053 5
SW-N-42S1	RPD		07-Feb-2020		0.0%	11.6%	0.0%	21.0%	3.6%	0.0%	0.0%	0.4%	13.3%	5.6%
SW-N-42S1	FR1	Y	17-Mar-2020		194.	25.7	< 0.02	18.2	0.441	0.015	< 0.005	0.082	0.14	0.056
SW-N-42S1	FR2		17-Mar-2020		196.	22.3	0.009 8	18.	0.408	< 0.015	< 0.005	0.078	0.139	0.058
SW-N-42S1	FRM		17-Mar-2020		195.	24.	< 0.014 9	18.1	0.424 5	< 0.015	< 0.005	0.08	0.139 5	0.057
SW-N-42S1	RPD		17-Mar-2020		1.0%	14.2%	68.5% b	1.1%	7.8%	0.0%	0.0%	5.0%	0.7%	3.5%
SW-S-04	FR1	Y	08-Oct-2019		152.	17.7	0.027 3	2.87	0.121	0.015	< 0.005	0.62	0.407	0.067
SW-S-04	FR2		08-Oct-2019		152.	9.6	0.021	1.58	0.121	0.017	< 0.005	0.62	0.425	0.065
SW-S-04	FRM		08-Oct-2019		152.	13.65	0.024 15	2.225	0.121	0.016	< 0.005	0.62	0.416	0.066
SW-S-04	RPD		08-Oct-2019		0.0%	59.3% b	26.1%	**58.0%** a	0.0%	12.5%	0.0%	0.0%	4.3%	3.0%
SW-S-04	FR1	Y	05-Dec-2019		138.	21.3	0.027 6	3.35	0.135	< 0.015	< 0.005	1.04	0.41	0.065
SW-S-04	FR2		05-Dec-2019		139.	11.7	0.019 4	2.04	0.126	< 0.015	< 0.005	1.08	0.443	0.07
SW-S-04	FRM		05-Dec-2019		138.5	16.5	0.023 5	2.695	0.130 5	< 0.015	< 0.005	1.06	0.426 5	0.067 5
SW-S-04	RPD		05-Dec-2019		0.7%	58.2% b	34.9%	**48.6%** a	6.9%	0.0%	0.0%	3.8%	7.7%	7.4%
SW-S-04	FR1	Y	06-Feb-2020		64.9	632.	0.361	35.3	0.12	0.15	0.016 4	0.924	1.1	0.052
SW-S-04	FR2		06-Feb-2020		61.7	613.	0.339	32.5	0.107	0.13	0.015 3	0.921	1.	0.051
SW-S-04	FRM		06-Feb-2020		63.3	622.5	0.35	33.9	0.113 5	0.14	0.015 85	0.922 5	1.05	0.051 5
SW-S-04	RPD		06-Feb-2020		5.1%	3.1%	6.3%	8.3%	11.5%	14.3%	6.9%	0.3%	9.5%	1.9%
SW-S-04	FR1	Y	17-Mar-2020		98.3	97.5	0.06	6.75	0.201	0.016	< 0.005	1.46	0.45	0.05
SW-S-04	FR2		17-Mar-2020		95.5	67.3	0.04	6.71	0.177	0.02	< 0.005	1.46	0.43	0.054
SW-S-04	FRM		17-Mar-2020		96.9	82.4	0.05	6.73	0.189	0.018	< 0.005	1.46	0.44	0.052
SW-S-04	RPD		17-Mar-2020		2.9%	**36.7%** a	40.0% b	0.6%	12.7%	22.2%	0.0%	0.0%	4.5%	7.7%

Notes:

SS	*Single sample*
FR1	*Field replicate 1*
FR2	*Field replicate 2*
FRM	*Average of field replicates*
RPD	Relative percent difference of field replicates

na - Not applicable, some replicates less than the detection limit.

a *- Coefficient of variation greater than 30% and all replicates greater than the limit of c*

b *- Coefficient of variation greater than 30% with some replicates less than the limit of*

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
				Method Detection Limit (MDL)	0.01	1	1	1	0.5	0.02	10	0.005	0.005	0.05
				Limit of Quantitation (5 x MDL)	0.05	5	5	5	2.5	0.1	50	0.025	0.025	0.25
				Parameter	Silver	Sulphate	TSS	Zinc	Aluminum	Arsenic	Boron	Cadmium	Cobalt	Copper
				Fraction	TOT	DIS	TOT	TOT	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled	Comments										
SW-N-05	FR1	Y	03-May-2019		< 0.01	64.4	< 2.	1.5	5.77	0.114	30.	0.006	0.179	0.974
SW-N-05	FR2		03-May-2019		< 0.01	65.6	< 2.	1.7	5.67	0.111	29.	0.006	0.177	0.998
SW-N-05	FRM		03-May-2019		< 0.01	65.	< 2.	1.6	5.72	0.112 5	29.5	0.006	0.178	0.986
SW-N-05	RPD		03-May-2019		0.0%	1.8%	0.0%	12.5%	1.7%	2.7%	3.4%	0.0%	1.1%	2.4%
SW-N-05	FR1	Y	08-Oct-2019		< 0.01	100.	3.5	3.8	4.8	0.114	31.	0.010 3	0.139	3.67
SW-N-05	FR2		08-Oct-2019		< 0.005	120.	3.7	3.91	4.86	0.126	31.	0.011 2	0.138	3.92
SW-N-05	FRM		08-Oct-2019		< 0.007 5	110.	3.6	3.855	4.83	0.12	31.	0.010 75	0.138 5	3.795
SW-N-05	RPD		08-Oct-2019		66.7% b	18.2%	5.6%	2.9%	1.2%	10.0%	0.0%	8.4%	0.7%	6.6%
SW-N-05	FR1	Y	05-Dec-2019		< 0.005	200.	< 1.	2.82	16.2	0.151	65.	0.025 5	0.138	2.33
SW-N-05	FR2		05-Dec-2019		< 0.005	220.	< 1.	3.23	14.8	0.128	63.	0.018 8	0.138	1.95
SW-N-05	FRM		05-Dec-2019		< 0.005	210.	< 1.	3.025	15.5	0.139 5	64.	0.022 15	0.138	2.14
SW-N-05	RPD		05-Dec-2019		0.0%	9.5%	0.0%	13.6%	9.0%	16.5%	3.1%	30.2% b	0.0%	17.8%
SW-N-05	FR1	Y	07-Feb-2020		< 0.01	160.	2.	2.9	21.	0.089	41.	0.011 5	0.076 2	2.4
SW-N-05	FR2		07-Feb-2020		< 0.01	150.	2.	2.8	22.4	0.102	42.	0.020 4	0.085 1	9.79
SW-N-05	FRM		07-Feb-2020		< 0.01	155.	2.	2.85	21.7	0.095 5	41.5	0.015 95	0.080 65	6.095
SW-N-05	RPD		07-Feb-2020		0.0%	6.5%	0.0%	3.5%	6.5%	13.6%	2.4%	55.8% b	11.0%	121.2% a
SW-N-05	FR1	Y	17-Mar-2020		< 0.01	110.	1.2	1.7	13.1	0.124	33.	0.006 1	0.050 3	1.18
SW-N-05	FR2		17-Mar-2020		< 0.01	110.	1.6	2.9	14.6	0.133	33.	0.009 1	0.054 9	1.54
SW-N-05	FRM		17-Mar-2020		< 0.01	110.	1.4	2.3	13.85	0.128 5	33.	0.007 6	0.052 6	1.36
SW-N-05	RPD		17-Mar-2020		0.0%	0.0%	28.6%	52.2% b	10.8%	7.0%	0.0%	39.5% b	8.7%	26.5%
SW-N-16	FR1	Y	02-May-2019		< 0.01	73.7	20.	13.5	5.72	0.322	93.	0.016	0.564	10.3
SW-N-16	FR2		02-May-2019		< 0.01	72.7	21.	12.	5.47	0.251	93.	0.014	0.551	4.32
SW-N-16	FRM		02-May-2019		< 0.01	73.2	20.5	12.75	5.595	0.286 5	93.	0.015	0.557 5	7.31
SW-N-16	RPD		02-May-2019		0.0%	1.4%	2.5%	11.8%	4.5%	24.8%	0.0%	13.3%	2.3%	81.8% a
SW-N-16	FR1	Y	09-Oct-2019		< 0.01	140.	21.	4.4	8.7	0.325	69.	0.005 6	0.685	2.32
SW-N-16	FR2		09-Oct-2019		< 0.01	120.	16.	4.2	9.03	0.344	67.	< 0.005	0.693	1.9
SW-N-16	FRM		09-Oct-2019		< 0.01	130.	18.5	4.3	8.865	0.334 5	68.	0.005 3	0.689	2.11
SW-N-16	RPD		09-Oct-2019		0.0%	15.4%	27.0%	4.7%	3.7%	5.7%	2.9%	11.3%	1.2%	19.9%
SW-N-16	FR1	Y	04-Dec-2019		< 0.005	140.	2.	12.5	6.99	0.197	100.	0.026 4	0.318	6.95
SW-N-16	FR2		04-Dec-2019		< 0.005	130.	1.4	13.3	6.41	0.191	101.	0.019 9	0.311	4.16
SW-N-16	FRM		04-Dec-2019		< 0.005	135.	1.7	12.9	6.7	0.194	100.5	0.023 15	0.314 5	5.555
SW-N-16	RPD		04-Dec-2019		0.0%	7.4%	35.3% b	6.2%	8.7%	3.1%	1.0%	28.1%	2.2%	50.2% a
SW-N-16	FR1	Y	07-Feb-2020		< 0.01	54.	1.6	7.6	29.5	0.181	41.	0.010 6	0.199	14.
SW-N-16	FR2		07-Feb-2020		< 0.01	57.	2.	8.	30.1	0.205	42.	0.013 5	0.193	19.1
SW-N-16	FRM		07-Feb-2020		< 0.01	55.5	1.8	7.8	29.8	0.193	41.5	0.012 05	0.196	16.55
SW-N-16	RPD		07-Feb-2020		0.0%	5.4%	22.2%	5.1%	2.0%	12.4%	2.4%	24.1%	3.1%	30.8% a
SW-N-16	FR1	Y	24-Mar-2020		< 0.005	59.	2.8	9.14	8.34	0.205	72.	0.018 2	0.535	11.8
SW-N-16	FR2		24-Mar-2020	slightly yellow with organics	< 0.005	66.	10.	9.27	8.44	0.212	72.	0.018 8	0.53	10.9
SW-N-16	FRM		24-Mar-2020		< 0.005	62.5	6.4	9.205	8.39	0.208 5	72.	0.018 5	0.532 5	11.35
SW-N-16	RPD		24-Mar-2020		0.0%	11.2%	112.5% a	1.4%	1.2%	3.4%	0.0%	3.2%	0.9%	7.9%
SW-N-41S1	FR1	Y	09-Oct-2019		< 0.01	200.	28.	2.	24.	0.234	18.	0.009 3	0.231	2.22
SW-N-41S1	FR2		09-Oct-2019		< 0.01	200.	12.	2.4	22.7	0.222	18.	0.007 7	0.226	2.49
SW-N-41S1	FRM		09-Oct-2019		< 0.01	200.	20.	2.2	23.35	0.228	18.	0.008 5	0.228 5	2.355
SW-N-41S1	RPD		09-Oct-2019		0.0%	0.0%	80.0%	18.2%	5.6%	5.3%	0.0%	18.8%	2.2%	11.5%
SW-N-41S1	FR1		06-Dec-2019		< 0.005	240.	1.	5.61	3.22	0.16	20.	0.007 3	0.119	1.02
SW-N-41S1	FR2		06-Dec-2019		< 0.005	240.	< 1.	7.04	3.64	0.167	17.	0.006 3	0.119	0.419
SW-N-41S1	FRM		06-Dec-2019		< 0.005	240.	1.	6.325	3.43	0.163 5	18.5	0.006 8	0.119	0.719 5
SW-N-41S1	RPD		06-Dec-2019		0.0%	0.0%	0.0%	22.6%	12.2%	4.3%	16.2%	14.7%	0.0%	83.5% a

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%		30%		30%		30%		30%		30%		30%		30%		30%		30%	
				Method Detection Limit (MDL)	0.01		1		1		1		0.5		0.02		10		0.005		0.005		0.05	
				Limit of Quantitation (5 x MDL)	0.05		5		5		5		2.5		0.1		50		0.025		0.025		0.25	
				Parameter	Silver		Sulphate		TSS		Zinc		Aluminum		Arsenic		Boron		Cadmium		Cobalt		Copper	
				Fraction	TOT		DIS		TOT		TOT		DIS		DIS		DIS		DIS		DIS		DIS	
				Unit	µg/L		mg/L		mg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
Station	Sample Type	Compliance Well (Y/N)?	Date Sampled	Comments																				
SW-N-41S1	FR1	Y	06-Feb-2020		< 0.01		71.		8.		1.4		11.9		0.175		15.		< 0.005		0.047 6		1.1	
SW-N-41S1	FR2		06-Feb-2020		< 0.01		72.		13.		1.4		9.63		0.192		15.		< 0.005		0.047 6		7.48	
SW-N-41S1	FRM		06-Feb-2020		< 0.01		71.5		10.5		1.4		10.765		0.183 5		15.		< 0.005		0.047 6		4.29	
SW-N-41S1	RPD		06-Feb-2020		0.0%		1.4%		**47.6%**	**a**	0.0%		21.1%		9.3%		0.0%		0.0%		0.0%		**148.7%**	**a**
SW-N-41S1	FR1	Y	17-Mar-2020		< 0.01		90.		< 1.		< 1.		4.07		0.14		19.		< 0.005		0.064 7		6.57	
SW-N-41S1	FR2		17-Mar-2020		< 0.01		88.		< 1.		< 1.		8.26		0.135		18.		0.006 2		0.069 6		0.594	
SW-N-41S1	FRM		17-Mar-2020		< 0.01		89.		< 1.		< 1.		6.165		0.137 5		18.5		< 0.005 6		0.067 15		3.582	
SW-N-41S1	RPD		17-Mar-2020		0.0%		2.2%		0.0%		0.0%		**68.0%**	**a**	3.6%		5.4%		21.4%		7.3%		**166.8%**	**a**
SW-N-42S1	FR1	Y	09-Oct-2019		< 0.005		120.		< 1.		0.81		6.61		0.183		47.		< 0.005		0.066 6		0.923	
SW-N-42S1	FR2		09-Oct-2019		< 0.005		120.		< 1.		1.1		6.49		0.169		47.		0.006 5		0.064 3		0.904	
SW-N-42S1	FRM		09-Oct-2019		< 0.005		120.		< 1.		0.955		6.55		0.176		47.		0.005 75		0.065 45		0.913 5	
SW-N-42S1	RPD		09-Oct-2019		0.0%		0.0%		0.0%		30.4%	b	1.8%		8.0%		0.0%		26.1%		3.5%		2.1%	
SW-N-42S1	FR1	Y	04-Dec-2019		< 0.005		150.		1.3		4.69		4.58		0.091		65.		< 0.005		0.089 5		0.477	
SW-N-42S1	FR2		04-Dec-2019		< 0.005		180.		1.6		6.15		4.23		0.116		64.		< 0.005		0.093 6		1.07	
SW-N-42S1	FRM		04-Dec-2019		< 0.005		165.		1.45		5.42		4.405		0.103 5		64.5		< 0.005		0.091 55		0.773 5	
SW-N-42S1	RPD		04-Dec-2019		0.0%		18.2%		20.7%		26.9%		7.9%		24.2%		1.6%		0.0%		4.5%		**76.7%**	**a**
SW-N-42S1	FR1	Y	07-Feb-2020		< 0.01		61.		1.6		< 1.		15.9		0.054		58.		< 0.005		0.055 1		1.61	
SW-N-42S1	FR2		07-Feb-2020		< 0.01		60.		2.		1.1		16.7		0.068		58.		< 0.005		0.049 2		7.58	
SW-N-42S1	FRM		07-Feb-2020		< 0.01		60.5		1.8		< 1.05		16.3		0.061		58.		< 0.005		0.052 15		4.595	
SW-N-42S1	RPD		07-Feb-2020		0.0%		1.7%		22.2%		9.5%		4.9%		23.0%		0.0%		0.0%		11.3%		**129.9%**	**a**
SW-N-42S1	FR1	Y	17-Mar-2020		< 0.01		90.		1.2		< 1.		6.34		0.068		47.		< 0.005		0.053 1		0.545	
SW-N-42S1	FR2		17-Mar-2020		< 0.005		91.		< 1.		0.63		5.88		0.07		47.		0.005 1		0.050 6		0.516	
SW-N-42S1	FRM		17-Mar-2020		< 0.007 5		90.5		< 1.1		< 0.815		6.11		0.069		47.		< 0.005 05		0.051 85		0.530 5	
SW-N-42S1	RPD		17-Mar-2020		66.7%	b	1.1%		18.2%		45.4%		7.5%		2.9%		0.0%		2.0%		4.8%		5.5%	
SW-S-04	FR1	Y	08-Oct-2019		< 0.005		76.		2.7		2.18		8.84		0.085		74.		0.019 8		0.070 2		1.51	
SW-S-04	FR2		08-Oct-2019		< 0.005		73.		1.5		1.9		8.68		0.107		72.		0.021 4		0.078 9		1.53	
SW-S-04	FRM		08-Oct-2019		< 0.005		74.5		2.1		2.04		8.76		0.096		73.		0.020 6		0.074 55		1.52	
SW-S-04	RPD		08-Oct-2019		0.0%		4.0%		57.1%	b	13.7%		1.8%		22.9%		2.7%		7.8%		11.7%		1.3%	
SW-S-04	FR1	Y	05-Dec-2019		< 0.005		59.		< 1.		1.27		10.5		0.099		69.		0.016 6		0.080 2		2.25	
SW-S-04	FR2		05-Dec-2019		< 0.005		60.		< 1.		1.68		10.5		0.104		69.		0.016 7		0.082 5		2.45	
SW-S-04	FRM		05-Dec-2019		< 0.005		59.5		< 1.		1.475		10.5		0.101 5		69.		0.016 65		0.081 35		2.35	
SW-S-04	RPD		05-Dec-2019		0.0%		1.7%		0.0%		27.8%		0.0%		4.9%		0.0%		0.6%		2.8%		8.5%	
SW-S-04	FR1	Y	06-Feb-2020		< 0.01		15.		8.		13.8		34.7		0.177		35.		0.010 8		0.075 6		4.01	
SW-S-04	FR2		06-Feb-2020		< 0.01		15.		5.6		12.6		38.5		0.156		36.		0.007 2		0.078		3.16	
SW-S-04	FRM		06-Feb-2020		< 0.01		15.		6.8		13.2		36.6		0.166 5		35.5		0.009		0.076 8		3.585	
SW-S-04	RPD		06-Feb-2020		0.0%		0.0%		**35.3%**	**a**	9.1%		10.4%		12.6%		2.8%		40.0%	b	3.1%		23.7%	
SW-S-04	FR1	Y	17-Mar-2020		< 0.01		24.		2.4		3.6		21.6		0.098		58.		0.011 2		0.080 3		1.79	
SW-S-04	FR2		17-Mar-2020		< 0.01		23.		10.		2.4		18.1		0.113		59.		0.012 5		0.08		1.81	
SW-S-04	FRM		17-Mar-2020		< 0.01		23.5		6.2		3.		19.85		0.105 5		58.5		0.011 85		0.080 15		1.8	
SW-S-04	RPD		17-Mar-2020		0.0%		4.3%		122.6%	b	40.0%	b	17.6%		14.2%		1.7%		11.0%		0.4%		1.1%	

Notes:

SS *Single sample*
FR1 *Field replicate 1*
FR2 *Field replicate 2*
FRM *Average of field replicates*
RPD Relative percent difference of field replicates
na - Not applicable, some replicates less than the detection limit.

a *- Coefficient of variation greater than 30% and all replicates greater than the limit of c*

b *- Coefficient of variation greater than 30% with some replicates less than the limit of*

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

					Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Zinc	Dissolved Organic Carbon
				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	45%
				Method Detection Limit (MDL)	0.5	1	0.005	0.05	0.05	0.02	0.04	0.005	0.1	0.5
				Limit of Quantitation (5 x MDL)	2.5	5	0.025	0.25	0.25	0.1	0.2	0.025	0.5	2.5
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	Dissolved
				Unit	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled	Comments										
SW-N-05	FR1	Y	03-May-2019		169.	4.1	0.007	0.181	0.884	0.33	0.283	< 0.005	1.06	
SW-N-05	FR2		03-May-2019		168.	4.1	< 0.005	0.183	0.875	0.345	0.285	< 0.005	1.22	
SW-N-05	FRM		03-May-2019		168.5	4.1	< 0.006	0.182	0.879 5	0.337 5	0.284	< 0.005	1.14	
SW-N-05	RPD		03-May-2019		0.6%	0.0%	33.3% b	1.1%	1.0%	4.4%	0.7%	0.0%	14.0%	
SW-N-05	FR1	Y	08-Oct-2019		185.	13.7	0.016	0.528	0.655	0.563	0.345	< 0.005	3.31	
SW-N-05	FR2		08-Oct-2019		183.	18.9	0.022 4	0.583	0.644	0.585	0.35	< 0.005	3.93	
SW-N-05	FRM		08-Oct-2019		184.	16.3	0.019 2	0.555 5	0.649 5	0.574	0.347 5	< 0.005	3.62	
SW-N-05	RPD		08-Oct-2019		1.1%	**31.9%** a	33.3% b	9.9%	1.7%	3.8%	1.4%	0.0%	17.1%	
SW-N-05	FR1	Y	05-Dec-2019		373.	16.3	0.014 8	1.38	1.64	0.61	0.778	< 0.005	3.54	
SW-N-05	FR2		05-Dec-2019		374.	12.9	0.005 9	1.3	1.66	0.601	0.785	< 0.005	2.6	
SW-N-05	FRM		05-Dec-2019		373.5	14.6	0.010 35	1.34	1.65	0.605 5	0.781 5	< 0.005	3.07	
SW-N-05	RPD		05-Dec-2019		0.3%	23.3%	86.0% b	6.0%	1.2%	1.5%	0.9%	0.0%	**30.6%** a	
SW-N-05	FR1	Y	07-Feb-2020		213.	10.3	0.037 8	0.43	1.07	0.514	0.478	< 0.005	2.84	
SW-N-05	FR2		07-Feb-2020		212.	23.	0.226	0.596	1.08	0.515	0.466	< 0.005	6.42	
SW-N-05	FRM		07-Feb-2020		212.5	16.65	0.131 9	0.513	1.075	0.514 5	0.472	< 0.005	4.63	
SW-N-05	RPD		07-Feb-2020		0.5%	**76.3%** a	**142.7%** a	**32.4%** a	0.9%	0.2%	2.5%	0.0%	**77.3%** a	
SW-N-05	FR1	Y	17-Mar-2020		190.	36.9	0.011	0.628	1.1	0.311	0.268	< 0.005	2.45	1.4
SW-N-05	FR2		17-Mar-2020		187.	23.6	0.022 5	0.558	1.15	0.28	0.276	< 0.005	3.84	1.5
SW-N-05	FRM		17-Mar-2020		188.5	30.25	0.016 75	0.593	1.125	0.295 5	0.272	< 0.005	3.145	1.45
SW-N-05	RPD		17-Mar-2020		1.6%	**44.0%** a	68.7% b	11.8%	4.4%	10.5%	2.9%	0.0%	**44.2%** a	6.9%
SW-N-16	FR1	Y	02-May-2019		224.	170.	0.417	440.	0.892	2.25	0.093	< 0.005	11.9	
SW-N-16	FR2		02-May-2019		218.	166.	0.053	436.	0.83	2.04	0.096	< 0.005	6.37	
SW-N-16	FRM		02-May-2019		221.	168.	0.235	438.	0.861	2.145	0.094 5	< 0.005	9.135	
SW-N-16	RPD		02-May-2019		2.7%	2.4%	**154.9%** a	0.9%	7.2%	9.8%	3.2%	0.0%	**60.5%** a	
SW-N-16	FR1	Y	09-Oct-2019		237.	428.	0.033 7	404.	0.967	2.12	0.095	< 0.005	5.7	
SW-N-16	FR2		09-Oct-2019		232.	512.	0.011 8	392.	0.889	2.05	0.104	< 0.005	2.89	
SW-N-16	FRM		09-Oct-2019		234.5	470.	0.022 75	398.	0.928	2.085	0.099 5	< 0.005	4.295	
SW-N-16	RPD		09-Oct-2019		2.1%	17.9%	96.3% b	3.0%	8.4%	3.4%	9.0%	0.0%	**65.4%** a	
SW-N-16	FR1	Y	04-Dec-2019		295.	126.	0.030 9	392.	0.682	1.48	0.087	< 0.005	17.2	
SW-N-16	FR2		04-Dec-2019		293.	106.	0.022 7	397.	0.655	1.42	0.074	< 0.005	17.4	
SW-N-16	FRM		04-Dec-2019		294.	116.	0.026 8	394.5	0.668 5	1.45	0.080 5	< 0.005	17.3	
SW-N-16	RPD		04-Dec-2019		0.7%	17.2%	30.6% b	1.3%	4.0%	4.1%	16.1%	0.0%	1.2%	
SW-N-16	FR1	Y	07-Feb-2020		126.	95.7	0.040 9	28.6	0.725	1.9	0.141	< 0.005	9.07	
SW-N-16	FR2		07-Feb-2020		123.	99.	0.194	27.8	0.741	2.	0.136	< 0.005	10.2	
SW-N-16	FRM		07-Feb-2020		124.5	97.35	0.117 45	28.2	0.733	1.95	0.138 5	< 0.005	9.635	
SW-N-16	RPD		07-Feb-2020		2.4%	3.4%	**130.4%** a	2.8%	2.2%	5.1%	3.6%	0.0%	11.7%	
SW-N-16	FR1	Y	24-Mar-2020	slightly yellow with organics	169.	146.	0.175	530.	0.564	1.52	0.076	< 0.005	12.4	8.9
SW-N-16	FR2		24-Mar-2020		167.	160.	0.157	523.	0.572	1.52	0.067	< 0.005	12.3	7.9
SW-N-16	FRM		24-Mar-2020		168.	153.	0.166	526.5	0.568	1.52	0.071 5	< 0.005	12.35	8.4
SW-N-16	RPD		24-Mar-2020		1.2%	9.2%	10.8%	1.3%	1.4%	0.0%	12.6%	0.0%	0.8%	11.9%
SW-N-41S1	FR1	Y	09-Oct-2019		324.	140.	0.044 1	196.	0.397	0.275	0.209	< 0.005	3.57	
SW-N-41S1	FR2		09-Oct-2019		325.	168.	0.040 8	196.	0.412	0.326	0.226	< 0.005	3.66	
SW-N-41S1	FRM		09-Oct-2019		324.5	154.	0.042 45	196.	0.404 5	0.300 5	0.217 5	< 0.005	3.615	
SW-N-41S1	RPD		09-Oct-2019		0.3%	18.2%	7.8%	0.0%	3.7%	17.0%	7.8%	0.0%	2.5%	
SW-N-41S1	FR1		06-Dec-2019		371.	21.7	0.024 3	94.6	0.365	0.252	0.187	< 0.005	4.34	
SW-N-41S1	FR2		06-Dec-2019		360.	15.6	0.008	96.8	0.319	0.234	0.159	< 0.005	1.27	
SW-N-41S1	FRM		06-Dec-2019		365.5	18.65	0.016 15	95.7	0.342	0.243	0.173	< 0.005	2.805	
SW-N-41S1	RPD		06-Dec-2019		3.0%	**32.7%** a	100.9% b	2.3%	13.5%	7.4%	16.2%	0.0%	**109.4%** a	

Table 3-2 Surface Water Quality QA/QC - Relative Percent Difference 2019-2020

AECOM

				MAX Acceptable RPD	30%	30%	30%	30%	30%	30%	30%	30%	30%	45%
				Method Detection Limit (MDL)	0.5	1	0.005	0.05	0.05	0.02	0.04	0.005	0.1	0.5
				Limit of Quantitation (5 x MDL)	2.5	5	0.025	0.25	0.25	0.1	0.2	0.025	0.5	2.5
				Parameter	Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Zinc	Dissolved Organic Carbon
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	Dissolved
				Unit	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Station	Sample Type	Complance Well (Y/N)?	Date Sampled	Comments										
SW-N-41S1	FR1	Y	06-Feb-2020		142.	17.6	0.019 3	20.7	0.246	0.144	0.088	< 0.005	2.46	
SW-N-41S1	FR2		06-Feb-2020		141.	19.2	0.204	21.	0.263	0.16	0.083	< 0.005	5.43	
SW-N-41S1	FRM		06-Feb-2020		141.5	18.4	0.111 65	20.85	0.254 5	0.152	0.085 5	< 0.005	3.945	
SW-N-41S1	RPD		06-Feb-2020		0.7%	8.7%	165.4% b	1.4%	6.7%	10.5%	5.8%	0.0%	**75.3%** a	
SW-N-41S1	FR1	Y	17-Mar-2020		205.	35.2	0.184	39.5	0.315	0.329	0.096	< 0.005	4.25	1.4
SW-N-41S1	FR2		17-Mar-2020		207.	26.3	0.018 5	40.2	0.269	0.199	0.112	< 0.005	1.14	1.3
SW-N-41S1	FRM		17-Mar-2020		206.	30.75	0.101 25	39.85	0.292	0.264	0.104	< 0.005	2.695	1.35
SW-N-41S1	RPD		17-Mar-2020		1.0%	28.9%	163.5% b	1.8%	15.8%	**49.2%** a	15.4%	0.0%	**115.4%** a	7.4%
SW-N-42S1	FR1	Y	09-Oct-2019		221.	22.5	0.021 4	11.5	0.452	0.281	0.041	< 0.005	3.75	
SW-N-42S1	FR2		09-Oct-2019		223.	23.6	0.017 7	11.5	0.456	0.263	0.05	< 0.005	3.32	
SW-N-42S1	FRM		09-Oct-2019		222.	23.05	0.019 55	11.5	0.454	0.272	0.045 5	< 0.005	3.535	
SW-N-42S1	RPD		09-Oct-2019		0.9%	4.8%	18.9%	0.0%	0.9%	6.6%	19.8%	0.0%	12.2%	
SW-N-42S1	FR1	Y	04-Dec-2019		302.	18.6	0.011 3	31.6	0.987	0.194	0.07	< 0.005	5.3	
SW-N-42S1	FR2		04-Dec-2019		300.	26.3	0.024	31.	1.07	0.251	0.073	< 0.005	7.88	
SW-N-42S1	FRM		04-Dec-2019		301.	22.45	0.017 65	31.3	1.028 5	0.222 5	0.071 5	< 0.005	6.59	
SW-N-42S1	RPD		04-Dec-2019		0.7%	**34.3%** a	72.0% b	1.9%	8.1%	25.6%	4.2%	0.0%	**39.2%** a	
SW-N-42S1	FR1	Y	07-Feb-2020		114.	16.7	0.036 7	5.43	0.289	0.116	0.075	< 0.005	0.83	
SW-N-42S1	FR2		07-Feb-2020		112.	18.1	0.202	5.56	0.3	0.18	0.078	< 0.005	3.74	
SW-N-42S1	FRM		07-Feb-2020		113.	17.4	0.119 35	5.495	0.294 5	0.148	0.076 5	< 0.005	2.285	
SW-N-42S1	RPD		07-Feb-2020		1.8%	8.0%	138.5%	2.4%	3.7%	**43.2%** a	3.9%	0.0%	**127.4%** a	
SW-N-42S1	FR1	Y	17-Mar-2020		182.	14.2	0.011	14.3	0.44	0.162	0.047	< 0.005	1.04	2.8
SW-N-42S1	FR2		17-Mar-2020		182.	14.7	0.015 3	14.2	0.421	0.158	0.042	< 0.005	1.92	3.1
SW-N-42S1	FRM		17-Mar-2020		182.	14.45	0.013 15	14.25	0.430 5	0.16	0.044 5	< 0.005	1.48	2.95
SW-N-42S1	RPD		17-Mar-2020		0.0%	3.5%	32.7% b	0.7%	4.4%	2.5%	11.2%	0.0%	**59.5%** a	10.2%
SW-S-04	FR1	Y	08-Oct-2019		144.	2.	0.009 2	0.771	0.133	0.445	0.072	< 0.005	4.24	
SW-S-04	FR2		08-Oct-2019		141.	2.1	0.008 9	0.687	0.123	0.411	0.069	< 0.005	4.03	
SW-S-04	FRM		08-Oct-2019		142.5	2.05	0.009 05	0.729	0.128	0.428	0.070 5	< 0.005	4.135	
SW-S-04	RPD		08-Oct-2019		2.1%	4.9%	3.3%	11.5%	7.8%	7.9%	4.3%	0.0%	5.1%	
SW-S-04	FR1	Y	05-Dec-2019		146.	18.9	0.027 3	0.776	0.237	0.48	0.064	< 0.005	4.31	
SW-S-04	FR2		05-Dec-2019		145.	7.1	0.029 2	0.758	0.175	0.456	0.061	< 0.005	4.83	
SW-S-04	FRM		05-Dec-2019		145.5	13.	0.028 25	0.767	0.206	0.468	0.062 5	< 0.005	4.57	
SW-S-04	RPD		05-Dec-2019		0.7%	**90.8%** a	6.7%	2.3%	30.1% b	5.1%	4.8%	0.0%	11.4%	
SW-S-04	FR1	Y	06-Feb-2020		60.2	50.	0.044 8	8.37	0.157	0.581	0.061	< 0.005	11.9	
SW-S-04	FR2		06-Feb-2020		61.1	57.	0.031 5	8.73	0.118	0.556	0.058	< 0.005	9.	
SW-S-04	FRM		06-Feb-2020		60.65	53.5	0.038 15	8.55	0.137 5	0.568 5	0.059 5	< 0.005	10.45	
SW-S-04	RPD		06-Feb-2020		1.5%	13.1%	**34.9%** a	4.2%	28.4%	4.4%	5.0%	0.0%	27.8%	
SW-S-04	FR1	Y	17-Mar-2020		95.5	24.8	0.034	1.85	0.155	0.347	0.053	< 0.005	3.49	3.1
SW-S-04	FR2		17-Mar-2020		97.5	17.5	0.023 3	2.14	0.127	0.344	0.054	< 0.005	2.3	2.7
SW-S-04	FRM		17-Mar-2020		96.5	21.15	0.028 65	1.995	0.141	0.345 5	0.053 5	< 0.005	2.895	2.9
SW-S-04	RPD		17-Mar-2020		2.1%	**34.5%** a	37.3% b	14.5%	19.9%	0.9%	1.9%	0.0%	**41.1%** a	13.8%

Notes:

SS — *Single sample*
FR1 — *Field replicate 1*
FR2 — *Field replicate 2*
FRM — *Average of field replicates*
RPD — Relative percent difference of field replicates
na - Not applicable, some replicates less than the detection limit.

***a** - Coefficient of variation greater than 30% and all replicates greater than the limit of c*

***b** - Coefficient of variation greater than 30% with some replicates less than the limit of*

Table 3-3 Hartland Valve Chamber Leachate Chemistry QA/QC - Relative Percent Difference 2019-2020

AECOM

State	Parameter	UNIT	Maximum Acceptable RPD	MDL	LOQ	Hartland Valve Chamber FR1 11/4/219	Hartland Valve Chamber FR2 11/4/219	RPD	Hartland Valve Chamber FR1 3/12/219	Hartland Valve Chamber FR2 3/12/219	RPD	Hartland Valve Chamber FR1 2-Feb-2022	Hartland Valve Chamber FR2 2-Feb-2022	RPD
CONVENTIONALS														
TOT	Total Sulphide	mg/L	3%	0.95	4.75	0.035	0.037	5.6%	< 0.018	0.023	24.4%	< 0.018	< 0.018	0.0%
DISS	Dissolved Sulphide	mg/L	3%	0.95	4.75	0.037	0.032	14.5%	< 0.018	< 0.018	0.0%	< 0.018	< 0.018	0.0%
TOT	TSS	mg/L	3%	2	10	24	26	8.0%	24.4	26	6.3%	8.8	12	30.8% a
TOT	BOD	mg/L	3%	5	25	24	24	0.0%	16	18	11.8%	24	25	4.1%
TOT	COD	mg/L	3%	4	20	370	370	0.0%	402	434	7.7%	404	446	9.9%
DISS	Chloride	µS/cm	3%	1	5	380	340	11.1%	370	360	2.7%	270	270	0.0%
DISS	Sulphate	mg/L	3%	1	5	38	32	17.1%	130	130	0.0%	51	49	4.0%
TOT	Oil & Grease, Total	mg/L	3%	1	5	< 1	< 1	0.0%	1.3	< 1	26.1%	< 1	< 1	0.0%
TOT	Oil & Grease, Mineral	CFU/1 mL	45%	2	10	< 2	< 2	0.0%	< 2	< 2	0.0%	< 2	< 2	0.0%
TOT	Cyanide - SAD (total)	mg/L	3%	0.5	2.5	0.00965	0.0102	5.5%	0.0172	0.0177	2.9%	0.0126	0.0132	4.7%
TOT	Cyanide - WAD	mg/L	3%	0.5	2.5	0.00398	0.00414	3.9%	0.0088	0.0103	15.7%	0.00472	0.00454	3.9%
TOT	Phenols	mg/L	45%	0.1	0.5	0.15	0.17	12.5%	0.18	0.25	32.6% b	0.3	0.3	0.0%
TOT	Ammonia	mg/L	3%	7.5	37.5	230	230	0.0%	260	270	3.8%	240	250	4.1%
TOT	Nitrite	mg/L	3%	0.5	2.5	3.89	3.61	7.5%	1.8	1.79	0.6%	0.421	0.408	---
TOT	Nitrate	mg/L	3%	0.2	1	12.9	12.4	4.0%	9.29	9.18	1.2%	< 0.2	< 0.2	---
TOT	pH	mg/L	3%	-	-	7.42	7.42	0.0%	7.37	7.37	0.0%	7.51	7.51	0.0%
TOT	Conductivity	mg/L	3%	-	-	2540	2540	0.0%	3242	3242	0.0%	2852	2852	0.0%
TOT	Temperature	mV	3%	-	-	13.6	13.6	0.0%	11	11	0.0%	11.2	11.2	0.0%
TOT	Dissolved Oxygen	pH	3%	-	-	0.64	0.64	0.0%	1.82	1.82	0.0%	5.91	5.91	0.0%
TOT	ORP	mg/L	3%	-	-	59	59	0.0%	51	51	0.0%	-48	-48	0.0%
METALS														
TOT	Arsenic	µg/L	3%	0.2	1	1.09	1.13	3.6%	7.31	7.37	0.8%	9.31	9.76	4.7%
TOT	Cadmium	µg/L	3%	0.5	2.5	0.0116	0.0129	10.6%	0.54	0.51	5.7%	0.71	0.79	10.7%
TOT	Chromium	µg/L	3%	0.1	0.5	8.27	9.36	12.4%	40.2	41.9	4.1%	42.9	45.5	5.9%
TOT	Cobalt	µg/L	3%	0.1	0.5	2.52	2.66	5.4%	12.4	13.1	5.5%	11.1	11.7	5.3%
TOT	Copper	µg/L	3%	0.1	0.5	1.94	2.02	4.0%	7.56	8.2	8.1%	17	18.2	6.8%
TOT	Iron	µg/L	3%	5	25	363	378	4.0%	165	173	4.7%	237	245	3.3%
TOT	Lead	µg/L	3%	0.2	1	0.19	0.196	3.1%	0.685	0.692	1.0%	1.43	1.51	5.4%
TOT	Manganese	µg/L	3%	0.1	0.5	123	126	2.4%	753	777	3.1%	591	631	6.5%
TOT	Mercury	µg/L	3%	0.2	1	< 0.02	< 0.02	0.0%	0.16	< 0.04	120.0% b	< 0.38	< 0.38	---
TOT	Molybdenum	µg/L	3%	0.5	2.5	0.55	0.703	24.4%	2.28	2.46	7.6%	3.21	2.7	17.3%
TOT	Nickel	µg/L	3%	0.1	0.5	7.94	7.91	0.4%	37.7	39.9	5.7%	32	33.8	5.5%
TOT	Selenium	µg/L	3%	0.4	2	0.069	0.101	37.6% a	0.344	0.368	6.7%	0.379	0.416	9.3%
TOT	Silver	µg/L	3%	0.1	0.5	< 0.01	< 0.01	0.0%	< 0.2	0.21	4.9%	< 0.2	< 0.2	0.0%
TOT	Zinc	µg/L	3%	1	5	9.6	18.3	62.4% a	14.9	16.5	10.2%	21	22.6	0.0%
POLYCLIC AROMATIC HYDROCARBONS														
TOT	Total PAH	µg/L	45%	0.5	2.5	1.6	1.9	17.1%	11	11	0.0%	15	15	0.0%
TOT	Acenaphthene	µg/L	45%	0.1	0.5	0.082	0.044	60.3% b	2.7	2.4	11.8%	3.8	3.8	0.0%
TOT	Acenaphthylene	µg/L	45%	0.1	0.5	0.016	0.014	13.3%	0.49	0.48	2.1%	0.56	0.54	3.6%
TOT	Anthracene	µg/L	45%	0.1	0.5	0.16	0.17	6.1%	0.24	0.27	11.8%	0.38	0.39	2.6%
TOT	Benzo(a)anthracene	µg/L	45%	0.1	0.5	0.052	0.082	44.8%	0.86	0.11	154.6%	0.12	0.12	0.0%
TOT	Benzo(a)pyrene	µg/L	45%	0.5	2.5	0.014	0.016	13.3%	0.19	0.22	14.6%	0.26	0.24	8.0%
TOT	Benzo(b,j)fluoranthene	µg/L	45%	0.1	0.5	0.014	0.02	35.3%	0.26	0.29	10.9%	0.41	0.37	10.3%
TOT	Benzo(g,h,i)perylene	µg/L	45%	0.2	1	< 0.02	< 0.02	0.0%	< 0.2	< 0.2	0.0%	< 0.2	< 0.2	0.0%
TOT	Benzo(k)fluoranthene	µg/L	45%	0.1	0.5	< 0.01	< 0.01	0.0%	0.11	0.12	8.7%	0.14	0.12	15.4%
TOT	Chrysene	µg/L	45%	0.1	0.5	0.054	0.076	33.8%	0.83	0.11	153.2%	0.11	0.11	0.0%
TOT	Dibenzo(a,h)anthracene	µg/L	45%	0.2	1	< 0.02	< 0.02	0.0%	< 0.2	< 0.2	0.0%	< 0.2	< 0.2	0.0%
TOT	Fluoranthene	µg/L	45%	0.1	0.5	0.39	0.5	24.7%	0.58	0.76	26.9%	1.1	1.2	8.7%
TOT	Fluorene	µg/L	45%	0.1	0.5	0.076	0.057	28.6%	1.6	1.5	6.5%	2.2	2.2	0.0%
TOT	Indeno(1,2,3-c,d)pyrene	µg/L	45%	0.2	1	< 0.02	< 0.02	0.0%	< 0.2	< 0.2	0.0%	< 0.2	< 0.2	0.0%
TOT	Naphthalene	µg/L	45%	0.1	0.5	0.012	< 0.01	18.2%	0.29	0.24	18.9%	2.3	2.2	4.4%
TOT	Phenanthrene	µg/L	45%	0.1	0.5	0.45	0.57	23.5%	1.2	1.3	8.0%	1.6	2	22.2%
TOT	Pyrene	µg/L	45%	0.1	0.5	0.3	0.4	28.6%	0.41	0.54	27.4%	0.75	0.78	3.9%
VOLATILE ORGANIC CARBONS														
DISS	Benzene	µg/L	45%	0.4	2	0.47	0.48	2.1%	0.63	0.64	1.6%	0.68	0.72	5.7%
DISS	Toluene	µg/L	45%	0.4	2	0.59	0.64	8.1%	< 0.4	0.42	4.9%	2.4	2.4	0.0%
DISS	Ethylbenzene	µg/L	45%	0.4	2	0.59	0.59	0.0%	0.57	0.58	1.7%	1.3	1.3	0.0%
DISS	Xylenes	µg/L	45%	0.4	2	0.9	0.95	5.4%	1.4	1.4	0.0%	4	4	0.0%

Notes:

FR1, FR2 - Field replicates 1 and 2.

FRM - Mean of field replicates.

MDL - Method detection limit.

LOQ - Limit of quantification.

RPD - Relative percent difference.

na - Not applicable, some replicates less than the detection limit.

a - Relative Standard Difference greater than 3% for general inorganic parameters/metals and 45% for organic parameters and all replicates greater than the limit of quantitation.

b - Relative Standard Difference greater than 3% for general inorganic parameters/metals and 45% for organic parameters, with some replicates less than the limit of quantitation.

3.4 Summary

In summary, the 2019/20 quality assurance (QA) analysis indicates the following:

- Duplicate sampling frequencies of 13 % (38/288 samples) for groundwater, 24% (22/91 samples) for surface water, 25% (3/12 samples) for the Hartland valve chamber compliance point and 3.9% (3/76 samples) for the overall leachate sampling program. Overall, approximately 14% (63/455) of samples were duplicated, which exceeded the targeted duplicate sampling rate of 10%.
- Groundwater sampling and laboratory analysis have produced reliable results. The QA results indicated a total of 23 samples and 37 analytical results exceeded the RPD alert limits where all parameter concentrations were above the limit of quantification. However, dissolved metals, especially dissolved copper and zinc concentrations should be interpreted with caution. Over 25% of the duplicate samples had dissolved copper and zinc concentrations above the alarm limit where all parameter concentrations were above the limit of quantification, indicating potential contamination during the sample handling or filtration process.
- Surface water sampling and laboratory analysis have produced reliable results. The QA results indicated a total of 14 samples and 57 analytical results exceeded the RPD limits where all parameter concentrations were above the limit of qualification. However, dissolved metals, especially dissolved copper and zinc concentrations should be interpreted with caution. Over 30-50% of duplicate water samples had dissolved copper and zinc concentrations above alarm limit where all parameter concentrations were above the limit of quantification, indicating the potential contamination during the sample handling or filtration process.
- Leachate sampling and laboratory analysis have produced reliable results. A total of 2 samples and 3 parameters had calculated RPDs exceeded the maximum acceptable RPD values when concentrations in both replicates were above the limit of quantification.
- A Mann-Kendall statistical trend analyses was conducted on water quality data collected from 81 groundwater monitoring wells, 8 leachate purge wells, 23 surface water stations and 1 leachate monitoring point for parameters that are known indicators of leachate and aggregate influences to evaluate temporal trends in water quality at the landfill. The results of trend analyses are discussed in the groundwater and surface water quality sections of this report.

4. Groundwater Flow

4.1 Data

A review of the sampling program was undertaken in early 2016 (AECOM, 2016), and recommendations for modifications to the number, location and sampling frequency of compliance monitoring locations were implemented throughout the 2019/20 monitoring year. The groundwater flow interpretation presented in this section is based on the following data:

- Groundwater elevations were measured four times per year in all groundwater monitoring wells.
- Continuous water level and leachate elevation monitoring using the SCADA system for the lower leachate lagoon, upper leachate lagoon, Phase 2 basin, wells 36-1-1 and 37-1-1, and one monitoring well located north of Phase 1 (40-1-1).
- Continuous water levels monitoring in five purge wells south of Phase 1 (P1, P2, P3, P4 and P10).
- Continuous water level monitoring in four wells east of Phase 1 (17-1-1, 18-1-1, 54-1-1 and 76-1-1, 89-1-1, 89-2-1)
- Continuous water level and flow monitoring in or near three north purge wells (80-1-0-P8, 81-1-0-P9 and 52-4-0-P7) and two monitoring wells (52-3-0, 52-1-1) located north of Phase 1.
- Continuous water level monitoring in ten wells north of Phase 2 (41-1-1, 43-1-1, 44-1-1, 62-1-1, 77-1-1, 78-1-1, 87-1-1, 87-2-1, 88-1-1 and 88-2-1).
- Presence and elevation of topography, refuse, engineered covers, temporary tarps, ditches and surface water features.
- Daily precipitation data.

Groundwater elevations for 2019/20 are presented in Appendix A.3. The data indicate that there are two separate groundwater flow systems at Hartland landfill. One is a regional groundwater flow system in the bedrock surrounding and underlying the landfill. The second is a perched system contained within the Phase 1 waste itself. A similar perched system has not been observed within the Phase 2 landfill thus far. Although the two flow systems are separate, the presence of the leachate mound within the waste influences groundwater flow in the bedrock underlying the waste. Understanding these two flow systems is important for evaluating the effectiveness of leachate control and containment measures. The groundwater flow patterns are interpreted based on groundwater elevations measured in August 2018.

Monitoring wells 79-1-1, 79-2-1, 74-1-1 and 74-2-1 were decommissioned in June 2018 to accommodate blasting and site preparation for aggregate storage. The pressure transducer installed in 79-1-1 was removed from the well prior to decommissioning. Four new leachate monitoring wells (89-1-1, 89-2-1, 90-1-1 and 90-2-1) were installed in Phase 1 and Phase 2 between 2018 and 2019 to verify leachate capture and support management decisions.

In April 2020, a total of four (4) pressure transducers were installed at locations 91-1-1, 92-1-1, 93-1-1 and 94-1-1 to continuously monitor water levels at Hartland North Ridge area. Available data should be reviewed and interpreted in the 2020/21 monitoring year.

4.2 Regional Groundwater Flow in the Bedrock

Figure 4-1 presents regional groundwater flow based on groundwater elevations in bedrock wells and deep wells in refuse for August 2018. Within the landfill footprint, several wells (75-1-1, 82-1-1, VLGW-02-D, VLGW-03-D, VLGW-08-D, VLGW-15-D, VLGW-16-D and VLGW-17-D) are screened at or near the bottom of the waste and their water levels are interpreted as being representative of the regional groundwater flow system within bedrock underlying the landfill. Geological structures including the Highland Fault and another inferred fault near monitoring well 77-1-1 are shown in plan on Figure 4-1, and in cross section on Figure 4-2 and Figure 4-3. Measured groundwater levels and hydrogeologic testing indicates these structures influence local-scale groundwater flow patterns. Figure 4-2 is a cross-section that extends from north of the leachate lagoons to south of Phase 1 through the refuse and depicts groundwater flow in a north-south direction. Figure 4-3 depicts groundwater flow in an east-west cross-section extending from the bedrock ridge located north and west of Phase 2 eastward to the eastern property boundary.

Groundwater flow patterns were similar to those observed in previous years. Regional groundwater flow in the vicinity of Hartland landfill is influenced by bedrock structures, topographic relief and the presence of surface water features. Regional groundwater flows from southwest to northeast from Mount Work and toward the north-south trending valley that underlies the northern portions of the Phase 1 and Phase 2 landfill.

Groundwater flow in the bedrock valley that holds the landfill is predominantly northward as shown in Figure 4-1. The majority of the leachate impacted groundwater in the bedrock below the landfill flows northward to the lower leachate lagoon via the Phase 2 basin leachate collection system, microtunnel, leachate springs and the purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) located north of Phase 1.

As shown on Figure 4-1, there is an inferred groundwater flow divide located near the southern end of the landfill and a small portion of groundwater below the southern portion of the Phase 1 landfill flows towards the southeast. This flow divide roughly corresponds to bedrock high in the valley floor beneath the landfill. Southeastward groundwater flow below the landfill is constrained by a constructed clay berm/bedrock grout curtain installed at the south end of the landfill in the 1980s, and by five purge wells (P1, P2, P3, P4 and P10) which commenced pumping leachate in 2001. Leachate collected by the south purge well network is pumped from the south pumping station to the lower leachate lagoon.

Groundwater flow in the vicinity of the North Ridge and Hartland North pad northwest of Phase 2 is also presented in Figure 4-1. Groundwater elevations measured in 2019/20 were consistent with previous years, indicating groundwater flow from this area is divergent from the on site topographic high north of Phase 2, with flow both to the northeast (towards Heal Creek) and to the north (towards Durrance Lake). The groundwater divergence is more apparent during wet fall, winter and early spring months when precipitation inputs increase infiltration and raise groundwater levels. Groundwater levels are several metres higher west of the Highland Fault than they are immediately east of the fault, indicating that the Highland Fault is a barrier to eastward moving groundwater, especially during winter months.

Recent geologic mapping of exposed bedrock on the North Ridge (AECOM, 2018) revealed an undulating bedrock surface with several closed depressions that allow for surface water pooling and enhanced recharge during wet weather, which is important for maintaining current groundwater flow patterns. Groundwater elevations at these locations are generally highest in January and lowest in September, with fluctuations on the order of 15m annually. The significant groundwater fluctuations indicate that close monitoring and management should continue to confirm and ensure functionality of the hydraulic trap as landfill and aggregate storage activities progress at the north end of the Phase 2 landfill.

A bedrock ridge is located east of the landfill boundary, running roughly north-south between the Hartland landfill and Kiowa Place road. Groundwater in the shallow bedrock along the landfill boundary flows inwards toward the northern portion of Phase 1. East of the landfill boundary, the topography begins to slope eastward towards Tod Creek valley and the groundwater flow direction is also likely eastward towards Tod Creek.

4.3 Groundwater and Leachate Flow

4.3.1 East of Phase 1

Figure 4-4 shows groundwater elevations at locations 17, 18, 54 and 76, located on the bedrock ridge east of Phase 1. Dramatic change in water levels at location 18 have occurred occasionally since 2001. In 2016/17, groundwater elevations in the deepest wells at location 18 increased by approximately 8 m relative to years prior, and result in the diminishing of westward hydraulic gradients. In 2019/20, water levels in 18-1-1 were within historical levels, indicating stable westward hydraulic gradients were maintained throughout the year. As per 2018/19 annual monitoring recommendations (AECOM, 2019a), pressure transducers were installed in wells 18-1-1, 76-1-1, 17-1-1 and 54-1-1 to continue monitor the groundwater elevations and confirm groundwater flow is toward the landfill.

Similar to previous years, water level measurements at monitoring location 76 indicated a strong downward gradient in 2019/20. A predominantly downward gradient at monitoring location 18 was also observed. As shown on Figure 4-4, groundwater levels in 18-1-1 returned to historical levels since 2018 and remained approximately 5-7 m lower than those in 76-1-1. Similarly, groundwater elevations at 54-1-1 are consistently higher than those in 17-1-1, indicating a westward component of groundwater flow at these locations. Groundwater levels should continue to be closely monitored in these locations to verify groundwater gradients remain inward toward the landfill.

4.3.2 Phase 1

Groundwater monitors installed at varying depths in Phase 1 provide water level data to confirm leachate levels and flow directions within the refuse. In addition to the monitors, water level data is collected from selected landfill gas wells in Phase 1.

Groundwater levels, equipotential lines and inferred groundwater flow directions are shown on a north-south cross-section through the Phase 1 landfill on Figure 4-2 based on groundwater level measurements taken in August 2019. In general, the leachate mound illustrated in Figure 4-2 resembles the leachate mound observed in previous years. During the operating years of the Phase 1 landfill, the leachate mound within Phase 1 reached elevations of approximately 160 m. Final cover was installed on the Phase 1 landfill in 1997 to limit infiltration. As shown on Figure 4-2, the leachate mound in the upper portion of the refuse is interpreted as being ‘perched’ above the regional bedrock groundwater flow system, with relatively high water levels and strong downward hydraulic gradients. In 2019/20, most leachate elevations within Phase 1 remained below 155 m, indicating an approximate 5 m decrease in the elevation of the leachate mound since closure.

Leachate elevations measured in monitoring wells completed in refuse and bedrock in Phase 1 are shown on Figure 4-5. The data from these monitoring wells show that leachate levels in deeper parts of the landfill respond to seasonal recharge events, and that the lower portions of the Phase 1 landfill are in hydraulic connection with the regional groundwater flow system in bedrock beneath the landfill.

Similar to previous years, the groundwater elevations in well 75-1-1 ranged from approximately 128 to 130 m ASL in 2019/20. Well 75-1-1 is located downgradient of the other wells at the north end of Phase 1 and is connected with the deep regional water table. The higher perched leachate elevations in shallow monitors VLGW-21-D (142 m ASL) and VLGW-26-D (145 m ASL), both located within 50 m of well 75-1-1 and screened in refuse, indicate that strong downward vertical gradients are present in this area of the landfill.

Figure 4-5 presents leachate levels in 14 gas monitors in the Phase 1 landfill. Although it is difficult to accurately measure leachate levels in gas wells, they do provide additional landfill leachate level information. Similar to previous years, leachate levels in the shallow landfill gas monitors typically show minor variations (<1m) in elevation as the refuse has a relatively high porosity and a relatively consistent recharge and discharge. A pressure transducer was installed in 89-1-1 in March 2019, and continuously records leachate levels. As shown on Figure 4.5, leachate elevations in the shallow well 89-2-1 exhibited a minor declining trend in 2019/20, from 151.6 to 150.2 m ASL.

Similar to previous years, leachate elevations in the deep gas monitors (VLGW-02-D, VLGW-03-D, VLGW-08-D, VLGW-15-D, VLGW-16-D and VLGW-17-D) continued to fluctuate in response to seasonal variability in groundwater recharge, indicating that the lower portions of the Phase 1 landfill are in hydraulic connection with the regional groundwater flow system. Leachate monitoring well 89-1-1 was installed in November 2018 to replace the decommissioned well 74-1-1. 89-1-1 was screened at the bottom of the refuse unit to facilitate measurement of leachate mound levels. As shown on Figure 4-5, leachate elevations in 89-1-1 rapidly increased approximately 4m between August 2019 and November 2019, from 146.0 to 149.8 m ASL, and gradually increased to 150.9m ASL between November 2019 and March 2020. Water level fluctuations in 89-1-1 were consistent with the pattern observed in other leachate monitoring wells after November 2019, indicating a period of leachate level recovery following well installation.

Groundwater elevations measured in monitoring and landfill gas wells that exhibit seasonal fluctuations are used as the basis for the interpretation of the regional groundwater flow within the bedrock aquifer in Figure 4-1, Figure 4-2 and Figure 4-3.

4.3.3 North of Phase 1

Water quality data at wells downgradient of the north purge wells indicate that the purge well system operated since 1998 has had a mitigating effect on northward migration of leachate. In July 2016, monitoring well 81-1-0-P9 became operational in an ongoing effort to increase leachate collection capacity upgradient of well 40-1-1. The influence of pumping the north purge wells (80-1-0-P8, 52-4-0-P7 and 81-1-0-P9) on groundwater flow directions is illustrated in plan on Figure 4-1, with the 115 m, 120 m and 125 m water table contours deflected southward due to drawdown of the water table surrounding the north purge wells. In 2019/20, a total of 24,494 m^3 of leachate was removed by the north purge wells, which was slightly lower than that reported in 2018/19 (25,578 m^3) and higher than that reported in 2017/18 (21,092 m^3).

Figure 4-6 presents precipitation and groundwater elevation data for monitoring wells located near the Phase 1 north purge well system (40-1-1, 52-1-1, 52-3-0, 52-4-0-P7, 80-1-0-P8 and 81-1-0-P9). Leachate discharge rates for the north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) are also presented to illustrate the volume of leachate extracted and its relationship to precipitation events. Monitoring well 52-3-0 is the original purge well that operated between 1995 and 1998 and is located within 2 m of well 52-4-0-P7. Water levels in well 52-3-0 are affected by the pumping rate in 52-4-0-P7 and seasonal variations in groundwater recharge. Pressure transducers connected to SCADA are installed in wells 40-1-1, 52-3-0, 52-4-0-P7, 80-1-0-P8 and 81-1-0-P9 to provide long-term monitoring of purge well performance north of Phase 1.

As shown on Figure 4-6, leachate discharge rates increased significantly in January and February 2020, in response to intense rain events. A total of 7438 m^3 of leachate was discharged during that period, with the daily average leachate flows ranged from 96 to 232 m^3/day. In 2019/20, water levels in lower leachate lagoon ranged from 114.38 to 117.16 m ASL, with an average of 114.70 m ASL. The highest water levels were observed in January and February 2020, coincided with the intense rainfall. Since January 2020, water levels in upper lagoon continued to increase to 128.92 m ASL in mid-February 2020 and reached to its 90% of capacity.

In 2019/20, groundwater levels in 40-1-1, 52-3-0 and 52-1-1 remained consistent with previous years. The average water levels in the north purge wells 80-1-0-P8 and 81-1-0-P9 were 113.09 and 118.9 m ASL, which is generally consistent with those reported in 2018/19. The average water levels in 52-4-0-P7 was 112.1 m ASL in 2019/20 and remained relatively stable since re-calibration of the pressure transducer in October 2018. Water levels in 52-4-0-P7 were noticeably (1-2 m) lower than pre-calibration levels prior to September 2018.

Groundwater elevations in the wells surrounding the north purge well system should continue to be monitored closely to confirm that the north purge wells are functioning properly. Regular well maintenance is required to maintain leachate capture and therefore minimize potential future leachate impacts around the lower leachate lagoon at locations 40, 20 and 21.

4.3.4 South of Phase 1

The CRD installed six leachate collection purge wells at the south end of the Phase 1 landfill in August 2000 to intercept leachate migrating south of the Phase 1 groundwater divide. Pumps were installed in four of these wells (P1, P2, P3, and P4) and they have been in operation since September 2001 (continuously since May 2002). The remaining two wells (P5 and P6) were not outfitted with pumps due to low well yield.

Groundwater elevations in the south purge wells have fluctuated since 2007, and although elevations have remained somewhat greater than recommended, the installation of P10 in September 2010 and the pump upgrades to P1 between 2015 and 2017 resulted in significantly improved drawdown. Unfortunately, P1 required significant maintenance due to well fouling by leachate and as a result of the existing design. In November 2018, P1 was re-installed and produces approximately of 1.01 L/s of leachate. The replacement well is screened in refuse only from 6.10 to 12.19 m BGS. Despite the shallower installation depth, the well removes a similar volume of leachate. In April 2020, pressure transducer in P1 was re-calibrated to the correct water levels and resulted in approximately 2m change in readings. In 2019/20, the water levels in P1 generally remained stable, with average value of 148.05m ASL. As shown on Figure 4-7, water levels in P1 gradually increased approximately 1.5 m in January and February 2020, in response to intense precipitation.

The P2 pump malfunctioned in April 2019 and resulted in rising water levels up to 147m ASL. A new pump and pressure transducer were installed in P2 at elevation in May 2019. However, the new transducer is installed above the pump, due to space limitations, but the constant water level readings (as shown on Figure 4-7) indicate that the water levels are below the 136m ASL, and that the P2 pump was functional throughout the year.

In 2019/20, a total of 32,418 m^3 leachate was removed by the south purge wells, which was 22% lower than the volume removed in 2018/19 (41,568 m^3). The average daily flow in 2019/20 was 92.1 m^3/day, which was approximately 45% lower than that in 2018/19. The reduced volume of leachate by the south purge wells is likely related to the dry winter and malfunctioning pump in P2. The average daily leachate flow between October and December was 66.6 m^3, which was approximately 50% of those measured in 2018/19 (114.5 m^3). Significant leachate flows were only observed in January and February 2020, corresponding to intense precipitation events.

Although less leachate was removed in 2019/20, the water levels all purge wells remained within their normal ranges, indicating the south purge well was functional throughout the 2019/20 monitoring year. Water level monitoring in all of the south purge wells should continue to confirm that the south purge wells are functioning properly.

Groundwater elevations measured using pressure transducers in each of the five operational south purge wells are plotted on Figure 4-7. The on/off cycling of the pumps is evident as water levels generally range from approximately 133 to 151 m ASL, which is consistent with previous years. These large and rapid changes in water levels imply the subsurface material has a low transmissivity, low bulk porosity and that the cone of depression associated with each purge well may be limited in lateral extent. Some fluctuations are related to pump maintenance events and short-term power disruptions.

4.3.5 Phase 2 Basin

The Phase 2 landfill is located in a large bedrock basin situated immediately west of the north end of the Phase 1 landfill. The Phase 2 landfill is segregated into multiple cells. Cell 1 and Cell 2 are complete, and Cell 3 is currently active. Leachate from Cell 1 and Cell 2 is captured via the 350 mm diameter microtunnel via gravity and transmitted to the lower leachate lagoon. After reporting to the lower leachate lagoon, all leachate is discharged to the sanitary sewer via the leachate pipeline. A geomembrane liner separates Cell 2 and Cell 3, and leachate from Cell 3 is captured via the new Toutle drain which reports to the upper leachate lagoon prior to final discharge into the leachate pipeline and sanitary sewer.

For proper operation of the hydraulic trap leachate collection system, groundwater levels north of Phase 2 need to be higher than leachate levels inside the Phase 2 basin. During typical operations, leachate levels within the Phase 2 basin are maintained 8 to 10 m lower than groundwater elevations outside the basin. The hydraulic trap design includes a clay liner along the north wall of the Phase 2 basin that allows for short-term leachate storage within Phase 2 during periods of exceptionally wet weather. Pressure transducers installed in monitors 36 and 37, located north of Phase 2, and within the Phase 2 basin continuously record groundwater and leachate elevations that are used to confirm that an inward groundwater gradient is maintained, indicating that the hydraulic trap is functioning effectively.

Figure 4-8 presents hydrographs for the groundwater monitoring wells and leachate wells located north of the Phase 2 basin. Several monitoring wells (82, 83, 84 and 86) were installed to investigate potential leachate mounding within the Phase 2 refuse. Drilling observations and subsequent monitoring indicated that the waste mass was moist, but largely unsaturated. Wells 84 and 86 are no longer operating due to damage and have been decommissioned. As shown on Figure 4-8, water levels in 82-1-1 and 83-1-1 remained relatively stable, with average of 132.85 and 126.65 m ASL. New leachate monitoring wells (90-1-1 and 90-2-1) were installed in November 2018 and November 2019, respectively to verify leachate capture and facilitate measurement of leachate mound levels. Shallow well (90-2-1) was installed to monitor the height of the leachate mound while deeper well (90-1-1) was installed to monitor the deep groundwater flow system near the base of the refuse. In 2019/20, water levels in 90-2-1 were either dry or only few centimeters above the well screen, ranging from <133.79 to 133.90 m ASL. Water level measurement for 90-1-1 will be available for 2020/21 annual monitoring report.

Figure 4-8 also shows a hydrograph of the leachate levels in the lined upper leachate lagoon and the unlined lower leachate lagoon based on transducer readings recorded by the SCADA system. Between May and August 2019, the leachate pipeline was shut off for construction of the new leachate and centrate return line, and resultant leachate storage in the upper lagoon reached 128 m ASL. During January and February 2020, water levels in upper lagoon rose to 129 m ASL (90% capacity) as a result of a 25-year storm event.

Leachate elevations in Phase 2 (Phase 2 Basin) are typically around 113 m ASL. As shown on Figure 4-8, groundwater elevations at locations 36, 37, 38, 39, 62, 77, and 78 remained higher than leachate levels in the Phase 2 basin throughout 2019/20. However, the higher leachate levels (i.e. >125 m ASL) in 82-1-1, 83-1-1 and 90-2-1 suggest the presence of localized leachate mounding in the northern Phase 2 area. The higher leachate elevations in this area may also be related to the presence of condensate, historical tarping or low permeability strata within the refuse. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, indicating that a significant leachate mound is not present in Phase 2.

As landfill development continues, it will be important to continue to confirm leachate levels within each phase of the landfill to verify seismic stability, confirm that the Toutle Leachate Underdrain and Phase 2 hydraulic trap are functioning, and to determine if additional leachate containment measures are necessary. It is recommended that the elevation of the leachate mound within Phase 2 be determined at least once every five years, with the next evaluation required before 2025.

4.3.6 Phase 2 - North Ridge Area

A detailed assessment of hydrogeologic conditions below the north ridge was conducted in 2016, culminating in a hydrogeological conceptual model of the ridge (AECOM, 2016). The report indicated that subvertical strike-slip faults (e.g., Highland Fault near location 87/88 and inferred fault near location 77) behave as barriers to west-east groundwater flow, and create a compartmentalized groundwater flow system, while subhorizontal tensile fractures behave as preferential conduits for groundwater flow. It is likely that bedrock discontinuities contribute to the large fluctuations in groundwater elevations observed beneath the North Ridge in response to seasonal precipitation and infiltration events. These findings were validated through mapping of exposed bedrock in 2018, whereby several closed topographic depressions, subvertical fractures and faults were located and found to contribute to enhanced local groundwater recharge (AECOM, 2018).

Figure 4-9 presents the groundwater elevations in North Ridge area. The location of the groundwater divergence below the North Ridge has important implications for maintaining the hydraulic trap as the landfill expands northward in the future. Since 2006, ten new wells have been installed at five separate locations (77, 78, 79, 87 and 88) north of the High Level Road to better understand the groundwater divergence and direction of groundwater flow north of Phase 2. Groundwater monitoring well 79 was decommissioned in June 2018 to accommodate blasting and site preparation for aggregate storage, Continuous water levels have been recorded at monitoring locations 77-1-1, 78-1-1, 87-1-1, 87-2-1, 88-1-1 and 88-2-1 to better understand natural temporal and spatial variability in groundwater elevations over time. In November 2019, four new groundwater monitoring wells (91-1-1, 92-1-1, 93-1-1 and 94-1-1) were installed in the North Ridge area, to increase spatial coverage of groundwater monitoring and further define the groundwater divergence and overall groundwater flow regime at Hartland. Well 94-1-1 is located in the northwest corner of Hartland North and considered a background well. Pressure transducers were deployed at these four locations in April 2020 to continuously monitor water levels. Interpretation of water level data will be included in 2020/21 monitoring report.

Similar to previous years, groundwater elevations in the North Ridge area exhibited strong seasonal fluctuations in 2019/20, and the Highland fault continued to function as a barrier to eastward moving groundwater. During the dry season, groundwater elevations beneath the North Ridge indicate a relatively broad and gently sloping piezometric surface near 168 m ASL and a weak groundwater divergence that runs in an easterly to westerly direction along the height of land. Summer groundwater elevations were similar on both sides of the Highland Fault and indicated neutral horizontal gradients between locations 87, 88, and 62. During wet fall, winter and early spring months, groundwater elevations beneath the North Ridge are up to 15 m higher than during the dry summer and early fall months. The horizontal hydraulic gradient is steeper and exhibits a more prominent groundwater divergence than is apparent in the summer.

Groundwater discharge to surface near the bottom of the Phase 2 Basin is indicated by the upward groundwater gradients that are typically observed at locations 27, 77, 87, 88 and seeps along the western extent of the bedrock quarry extents and within the Toutle valley. Groundwater from this area and the west side of Phase 1 is captured by the Cell 3 Toutle Valley Leachate Underdrain and the Phase 2 hydraulic trap leachate collection system.

Given the importance of the groundwater divergence for leachate containment, the planned future quarrying in the Toutle Valley and the North Ridge should be conducted under the direction of a qualified blasting professional to minimize the potential for blast-enhanced fracturing, with possible negative impacts on hydraulic properties, groundwater elevations, groundwater flow rates and leachate containment north of the Phase 2 landfill. There are risks to the performance of the hydraulic trap if blasting is not properly designed and implemented.

4.4 Summary

4.4.1 Groundwater Flow

Groundwater flow in 2019/20 generally followed previously established patterns. Regional groundwater flows from Mount Work northeast to the north-south trending valley that underlies the northern portions of the Phase 1 and Phase 2 landfill. Most of the northward groundwater flow in the bedrock below the landfill is captured by the Toutle Valley Underdrain, Phase 2 basin leachate collection system, springs discharging to the lower lagoon and the north and south purge well systems (wells P1, P2, P3, P4, P7, P8, P9 and P10).

Groundwater monitors east of Phase 1 (locations 54, 76, 17 and 18) confirm flow from east to west toward the landfill, preventing off-site migration to the east. In 2019/20, water levels in 18-1-1 remained within historical levels, indicating stable westward hydraulic gradients were maintained throughout the year. Groundwater elevations at location 17, 18, 54 and 76 should continue to be closely monitored.

Pressure transducers installed in wells help delineate the size of the drawdown cone surrounding the north purge wells. In 2019/20, a total of 24,494 m^3 of leachate was removed by the north purge wells, which was slightly lower than that reported in 2018/19 (25,578 m^3) and higher than that reported in 2017/18 (21,092 m^3). Leachate discharge rates increased significantly in January and February 2020, in response to intense precipitation. A total of 7,438 m^3 of leachate was collected by north purge wells during that period, with the average daily leachate flows ranged from 96 to 232 m^3/day. The average water level in 52-4-0-P7 was 112.1 m ASL in 2019/20 and was approximately 1.0-1.5 m lower than those reported in 2018/19. However, the lower water levels in 80-1-0-P7 may be related to pressure transducer re-calibration, as the pumping elevations remained the same. Water levels in 52-4-0-P7 have remained relatively stable since the re-calibration of pressure transducer in October 2018. The average water levels in the north purge wells 80-1-0-P8 and 81-1-0-P9 were 113.09 and 118.9 m ASL, which were generally consistent with those reported in 2018/19. Although leachate indicator concentrations in nearby wells of 81-1-0-P9 have been slowly improving with the current pump settings, consideration should be given to either increasing the pumping rates or adjusting set points to achieve the groundwater elevations required to maintain pumping levels below the lower leachate lagoon and collect more of the leachate migrating from the area around the landfill gas plant toward the lower leachate lagoon. Closure of Phase 2 Cell 1 and the application of tarps to restrict infiltration and leachate generation appears to be slowly improving leachate containment north of the landfill.

A small amount of groundwater flows southeastward from the south end of Phase 1 in the direction of Killarney Lake. Southeastward groundwater flow below the landfill is constrained by a constructed clay berm and bedrock grout curtain installed at the south end of the landfill and by drawdown cones associated with the south purge wells. To address fouling of P1, the well was re-installed at a shallower depth while maintaining similar or higher leachate collection rates of 1.01 L/s. In April 2020, the pressure transducer in P1 was re-calibrated to the correct water levels and resulted in approximately 2m change in water level readings. In 2019/20, the water levels in P1 generally remained stable, with an average value of 148.05m ASL. Water levels in P2, P3, P4 and P10 were similar to those observed in previous years and remained below the 140 m ASL target pumping elevation. The pressure transducer was placed on top of P2 pump at elevation of 136 m ASL after the pump was back to service in May 2019.

In 2019/20, a total of 32,418 m^3 leachate was removed by the south purge wells, which was 22% lower than the volume removed in 2018/19 (41,568 m^3). The average daily flow in 2019/20 was 92.1 m^3/day, which was approximately 45% lower than that in 2018/19. The reduced volume of leachate by the south purge wells may be related to the reduced period of pumping for P2 and dryer winter weather. The average daily leachate flow between

October and December was 66.6 m^3, which was approximately 50% of those measured in 2018/19 (114.5 m^3). Significant leachate flows were only observed in January and February 2020, corresponding with intense precipitation events. Water level monitoring in all of the south purge wells should continue to confirm that the south purge wells are functioning properly.

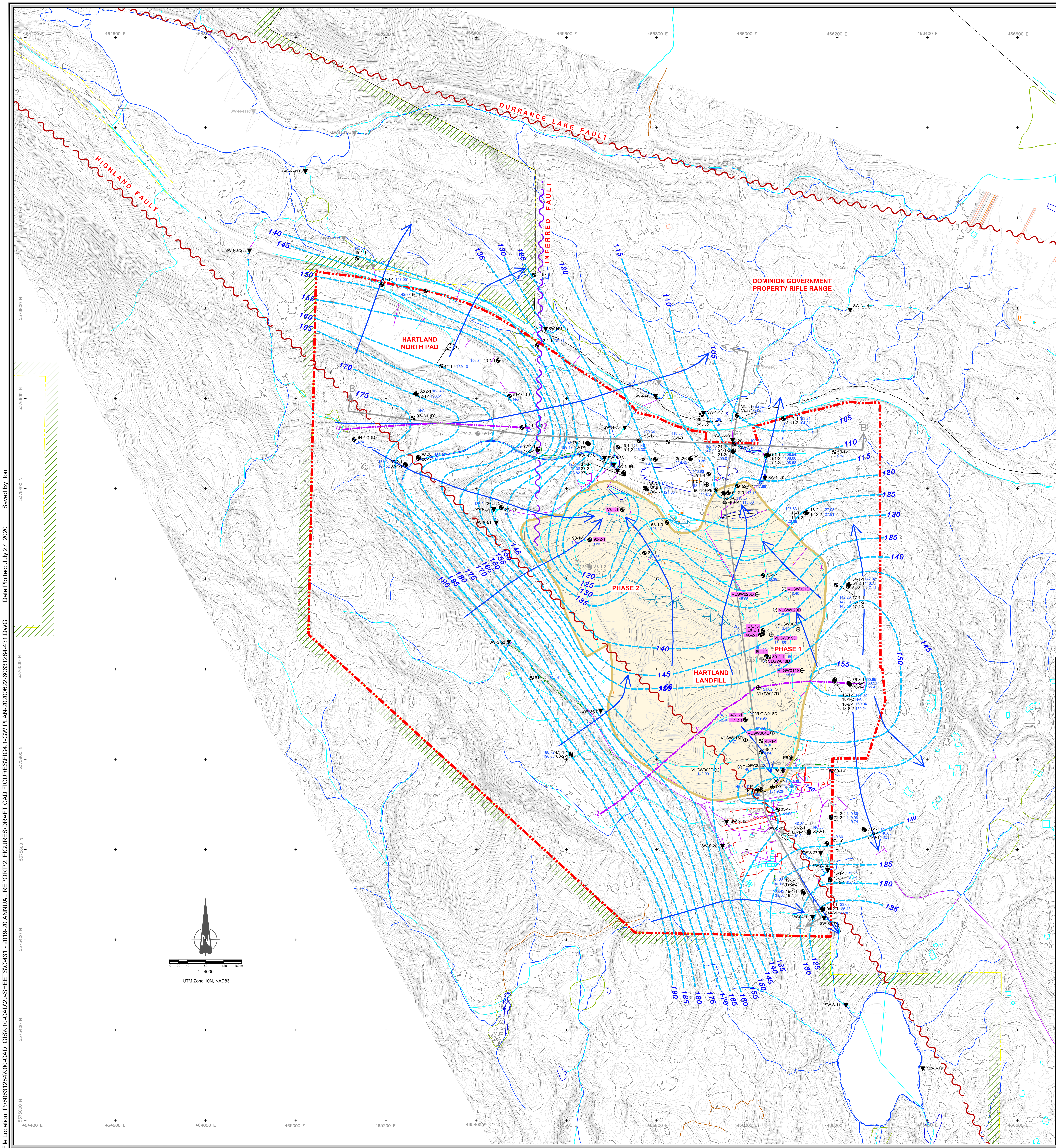
Similar to previous years, groundwater elevations in the North Ridge area exhibited strong seasonal fluctuations in 2019/20, and the Highland fault continued to function as a barrier to eastward moving groundwater. During the wet fall, winter and early spring months, the horizontal hydraulic gradients between 87, 88 and 62 were steeper and exhibits a more prominent groundwater divergence than is apparent in the summer. In November 2019, four new groundwater monitoring wells (91-1-1, 92-1-1, 93-1-1 and 94-1-1) were installed in North Ridge area, to increase spatial coverage of groundwater monitoring and further define the groundwater divergence and overall groundwater flow regime at Hartland.

In 2018, geologic mapping of exposed bedrock revealed several closed depressions and geologic structures that enhance groundwater recharge below the North Ridge. A pattern of divergent groundwater flow beneath the North Ridge has been confirmed, with a component of flow migrating to the east, south and north. Although a weak groundwater divide is currently present, inward (southward) flow must be maintained to preserve the hydraulic trap leachate containment system. To ensure leachate containment, it is necessary to continue close monitoring of this hydraulic divide and conduct detailed planning (including hydrogeologic modelling) prior to landfill development in this area. Engineered solutions may be required following blasting, levelling and development of the North Ridge to maintain the current level of infiltration and the elevation of the groundwater divergence.

4.4.2 Leachate Mound Assessment

Leachate mounding continues to be present in Phase 1 of the landfill. Leachate elevations in Phase 1 were generally stable and exhibited minor seasonal variations. The leachate mound in the upper portion of the refuse is interpreted as being ‘perched’ above the regional bedrock groundwater flow system, with relatively high water levels and strong downward hydraulic gradients. Between 2015 and 2020, leachate elevations in the upper portion of the refuse generally remained below 155 m, indicating an approximate 5 m decrease in the elevation of the leachate mound since closure of the Phase 1 landfill in 1997. The highest leachate elevations (155 – 157 m ASL) were typically observed in the east/southeast area of the Phase 1 (i.e. 48-1-1, VLGW-004D, VLGW-011S), which corresponds with higher topography/refuse heights. Leachate levels in deeper parts of the refuse respond to seasonal recharge events, indicating that the lower portions of the Phase 1 landfill are in hydraulic connection with the regional groundwater flow system in bedrock. Leachate well 89-1-1 was screened at the bottom of the refuse, and water levels exhibited a rapid increase of approximately 4m as it equilibrated with the surrounding formation between August 2019 and November 2019.

Leachate elevations in Phase 2 (Phase 2 Basin) are generally stable and typically around 113 m ASL. 90-2-1 was either dry or contained only few centimeters of leachate above the well screen, with elevations ranging from <133.79 to 133.90 m ASL. However, the higher leachate levels (i.e. >125 m ASL) in 82-1-1 and 83-1-1 suggests presence of the localized leachate mound in the northern Phase 2 area. The higher leachate elevations in this area may be related to historical tarping or low permeability strata within the refuse. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, indicating that a significant leachate mound is not present in Phase 2.



Legend

- BUILDING / STRUCTURE
- ROAD
- FENCE
- LEGAL LOT BOUNDARY
- INDEX CONTOUR (5m)
- INTERMEDIATE CONTOUR (1m)
- TREES/SHRUB/VEGETATION
- DITCH
- DRAINAGE
- PIPE
- FAULT (MULLER, 1980)
- INFERRED FAULT (AECOM, 2017)
- HARTLAND LANDFILL OPERATING AREA BOUNDARY
- SURFACE WATER SAMPLING LOCATION
- SW-N-06 INACTIVE SURFACE WATER SAMPLE
- P3 LEACHATE COLLECTION WELLS
- 03-2-1 ACTIVE GROUNDWATER WELL
- VLGW001D GAS WELL
- 86-1-1 DECOMMISSIONED WELL
- A A' CROSS SECTION LINE
- 158.90 GROUNDWATER LEVEL (m ASL) MEASURED ON AUGUST 2019
- (D) D= DEEP MONITOR (~30m)
- (I) I= INTERMEDIATE MONITOR (~20m)
- (S) S= SHALLOW MONITOR (~10m)
- N/A NO GROUNDWATER LEVEL DATA AVAILABLE
- LG-11-S HIGHLIGHTED DATA INDICATES DATA WAS NOT USED IN BEDROCK GROUNDWATER FLOW ANALYSIS
- ? INFERRED GROUND WATER DIVIDE
- 150 INFERRED WATER TABLE CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION

Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater elevation data collected by CRD, September 2019.
- Contours based on 24-W542_2018-2019 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT April 2020.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.

File Name:FIG4.1-GW PLAN-20200622-60631284-431.DWG
Reviewed by: KJ Prepared by: NT
Date Issued: JUNE 2020 Project Number: 60631284

Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Groundwater Elevations and Flow Directions in Bedrock (August 2019)

AECOM

Figure 4-1
Version 1

File Location: P:\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C431 - 2019-20 ANNUAL REPORT\2. FIGURES\DRAFT CAD FIGURES\FIG4.1-GW PLAN-20200622-60631284-431.DWG Date Plotted: July 27, 2020 Saved By: ton

Legend

- MONITORING WELL (NUMBER) INDICATES DISTANCE WELL IS FROM PLANE OF SECTION. WHERE NOT INDICATED, DISTANCE IS LESS THAN 2 m.
- SCREENED INTERVAL
- 85-1-1 (6.5m) MONITORING WELL WATER LEVEL WAS NOT USED IN THE BEDROCK GROUNDWATER FLOW ANALYSIS
- WATER BEARING FRACTURES
- GROUND SURFACE
- LOCATION OF BEDROCK DERIVED FROM 1954 GROUND CONTOUR OR BEDROCK INTERSECTIONS IN BOREHOLES
- REFUSE
- CLAY BERM
- UNCONSOLIDATED SOIL AND FILL
- INTERPRETED GROUNDWATER POTENTIOMETRIC SURFACE IN BEDROCK
- INFERRED VERTICAL LEACHATE FLOW
- INTERPRETED LEACHATE MOUND
- INFERRED GROUNDWATER POTENTIOMETRIC CONTOUR
- INFERRED GROUNDWATER FLOW DIRECTION IN BEDROCK
- 103.75 GROUNDWATER ELEVATION (mASL) AUGUST 2019
- FAULT (MULLER, 1980)

Map Sources / Notes:
- Contours based on 24W542_2018-2019 base.dwg, provided by the Capital Regional District, April 2020.
- Stratigraphy between boreholes is inferred and may vary from that shown

File Name: FIG4.2-GW SECTIONS-20200622-60631284-431.DWG
Reviewed by: KJ Prepared by: NT
Date Issued: JUNE 2020 Project Number: 60631248

CRD Making a difference...together

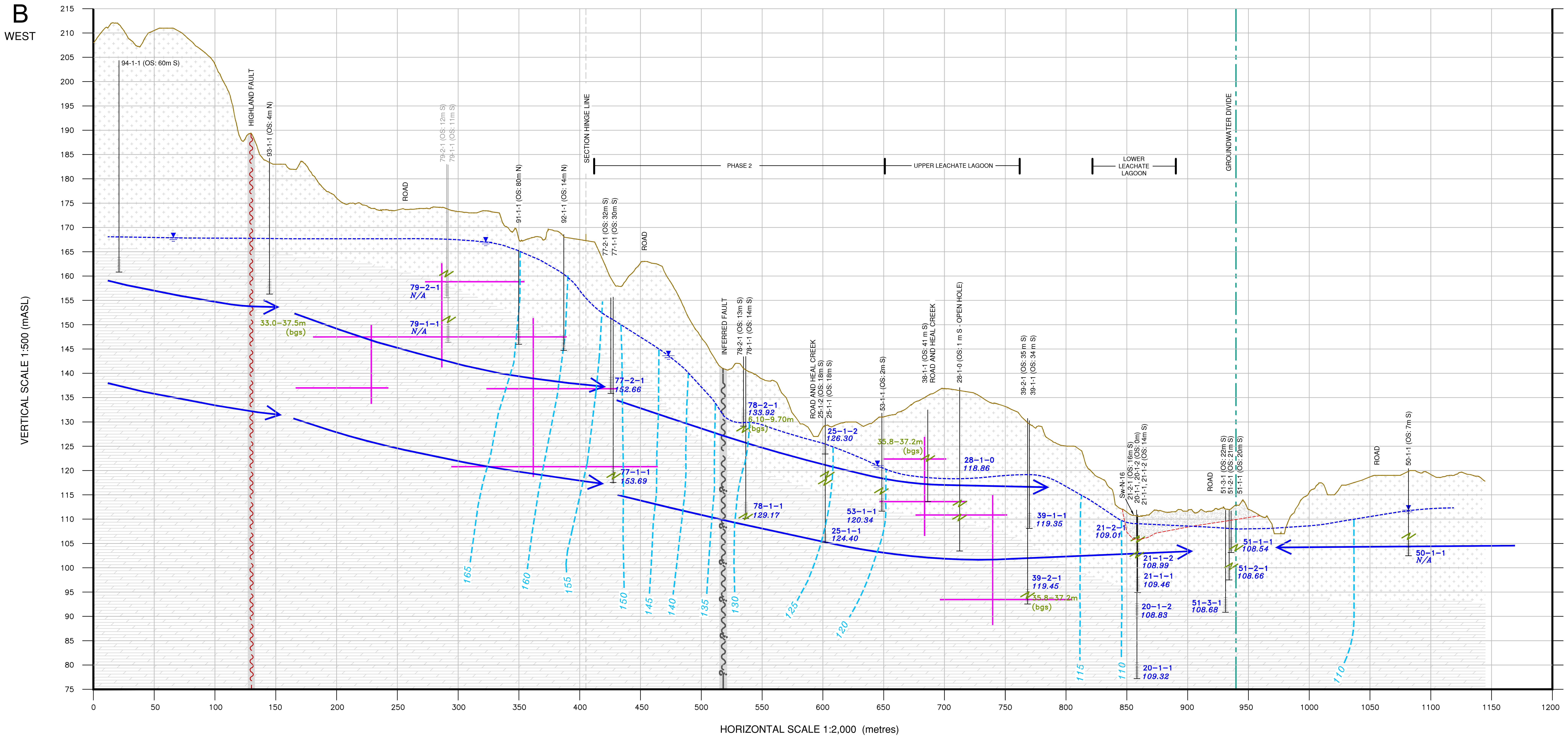
Project: Hartland Landfill Monitoring
Location: Saanich, BC

Groundwater Flow in Cross Section A-A' (August 2019)

AECOM

Figure 4-2
Version 2

File Location: P:\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C431 - 2019-20 ANNUAL REPORT\2. FIGURES\DRAFT CAD FIGURES\FIG4.2-GW SECTIONS-20200622-60631284-431.DWG Date Plotted: July 27, 2020 Saved By: ton



Legend

MONITORING WELL (NUMBER) INDICATES DISTANCE WELL IS FROM PLANE OF SECTION. WHERE NOT INDICATED, DISTANCE IS LESS THAN 2 m. (85-1-1 (6.5m))

SCREENED INTERVAL

85-1-1 (6.5m) — MONITORING WELL WATER LEVEL WAS NOT USED IN THE BEDROCK GROUNDWATER FLOW ANALYSIS

OBSERVED FRACTURES ON DRILLED LOGS

GROUND SURFACE

LOCATION OF BEDROCK DERIVED FROM 1954 GROUND CONTOUR OR BEDROCK INTERSECTIONS IN BOREHOLES

OVERBURDEN

UNCONSOLIDATED SOIL AND FILL

CLAY BERM

SHALLOW WEATHERED AND BLAST ALTERED BEDROCK

DEEP BEDROCK

INTERPRETED GROUNDWATER POTENTIOMETRIC SURFACE IN BEDROCK

INFERRED GROUNDWATER POTENTIOMETRIC CONTOUR

INFERRED GROUNDWATER FLOW DIRECTION IN BEDROCK

112.50 — GROUNDWATER ELEVATION (mASL) AUGUST 2019

INFERRED HYDRAULIC CONNECTIONS

GROUNDWATER DIVIDE

FAULT (MULLER, 1980)

INFERRED FAULT (AECOM, 2017)

Map Sources / Notes:
- Contours based on 24W542_2018-2019 base.dwg, provided by the Capital Regional District, April 2020.
- Stratigraphy between boreholes is inferred and may vary from that shown

0 10 20 40 60 80 m
1 : 2000
Section Looking North

File Name: F4.3-GW Sections-60631284-430-20200622.DWG
Reviewed by: KJ Prepared by: NT
Date Issued: JUNE 2020 Project Number: 60631284

CRD
Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Groundwater Flow in Cross Section B-B' (August 2019)

AECOM

Figure 4-3

File Location: P:\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C\431 - 2019-20 ANNUAL REPORT\2. FIGURES\DRAFT CAD FIGURES\FIG4.3 - GW SECTIONS-20200622-60631284-431.DWG Date Plotted: July 27, 2020 Saved By: ton

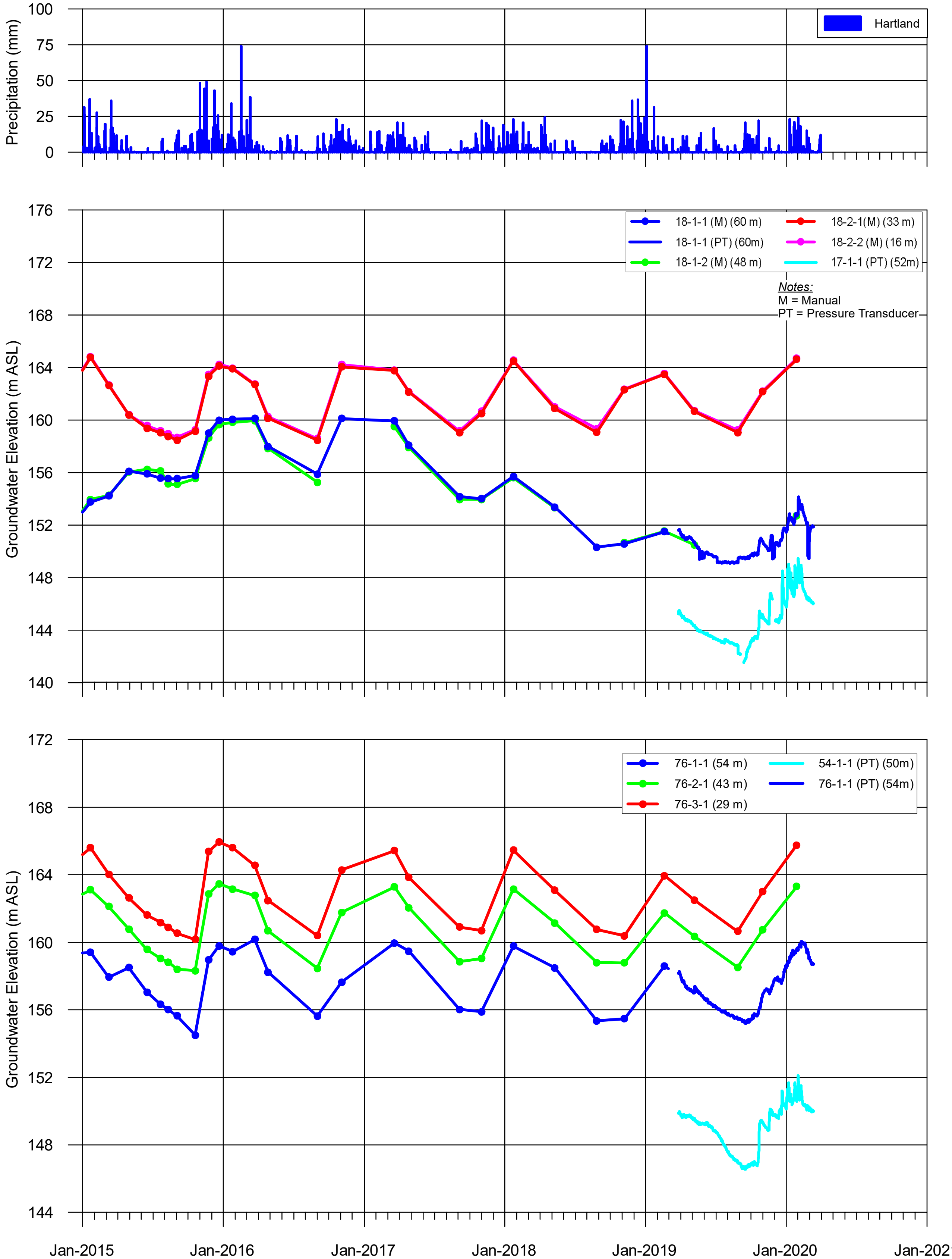


Figure 4-4. Groundwater Elevations East of Phase 1

AECOM

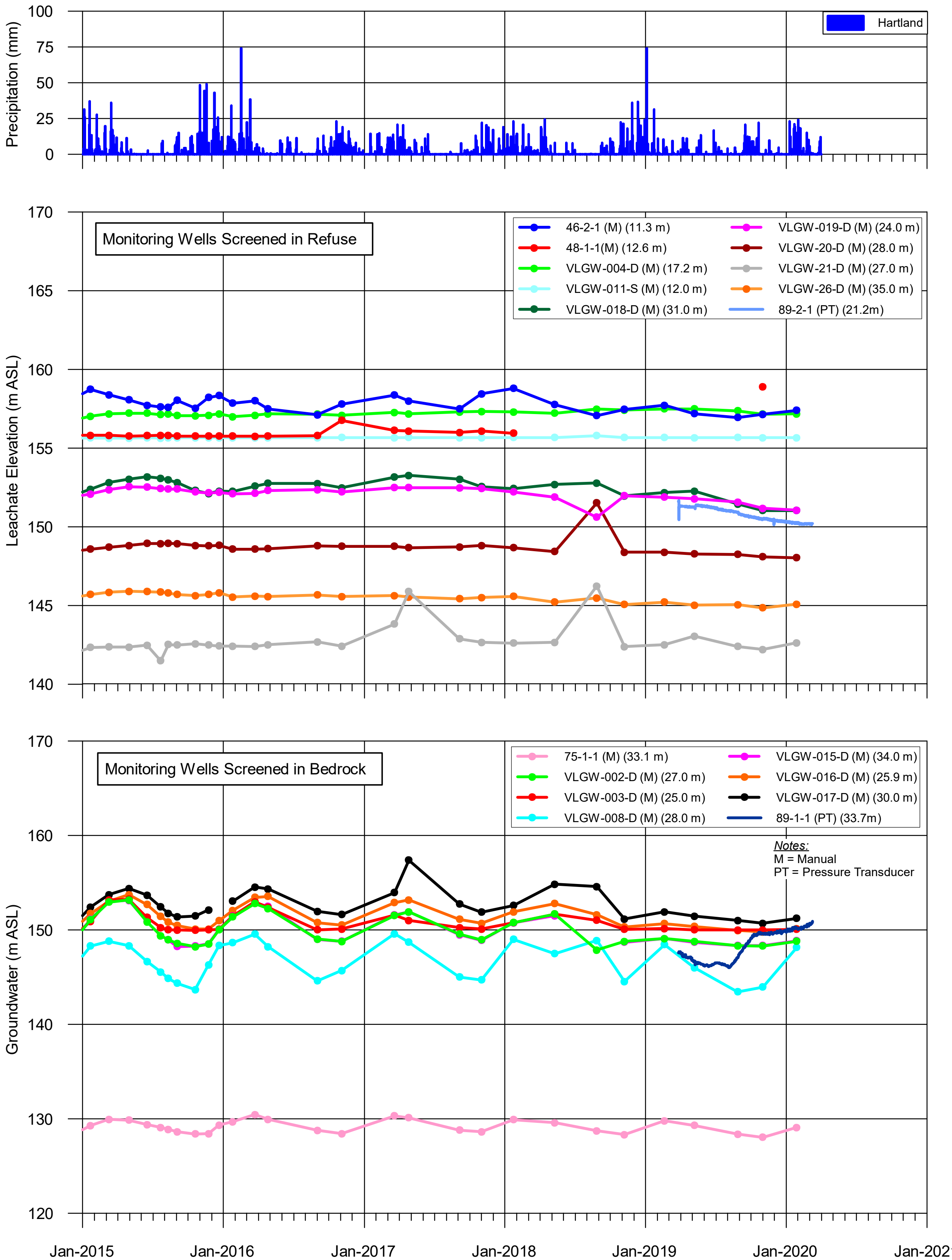


Figure 4-5. Leachate and Groundwater Elevations Within Phase 1

AECOM

Figure 4-6. Groundwater Elevations Surrounding the North Purge Wells

AECOM

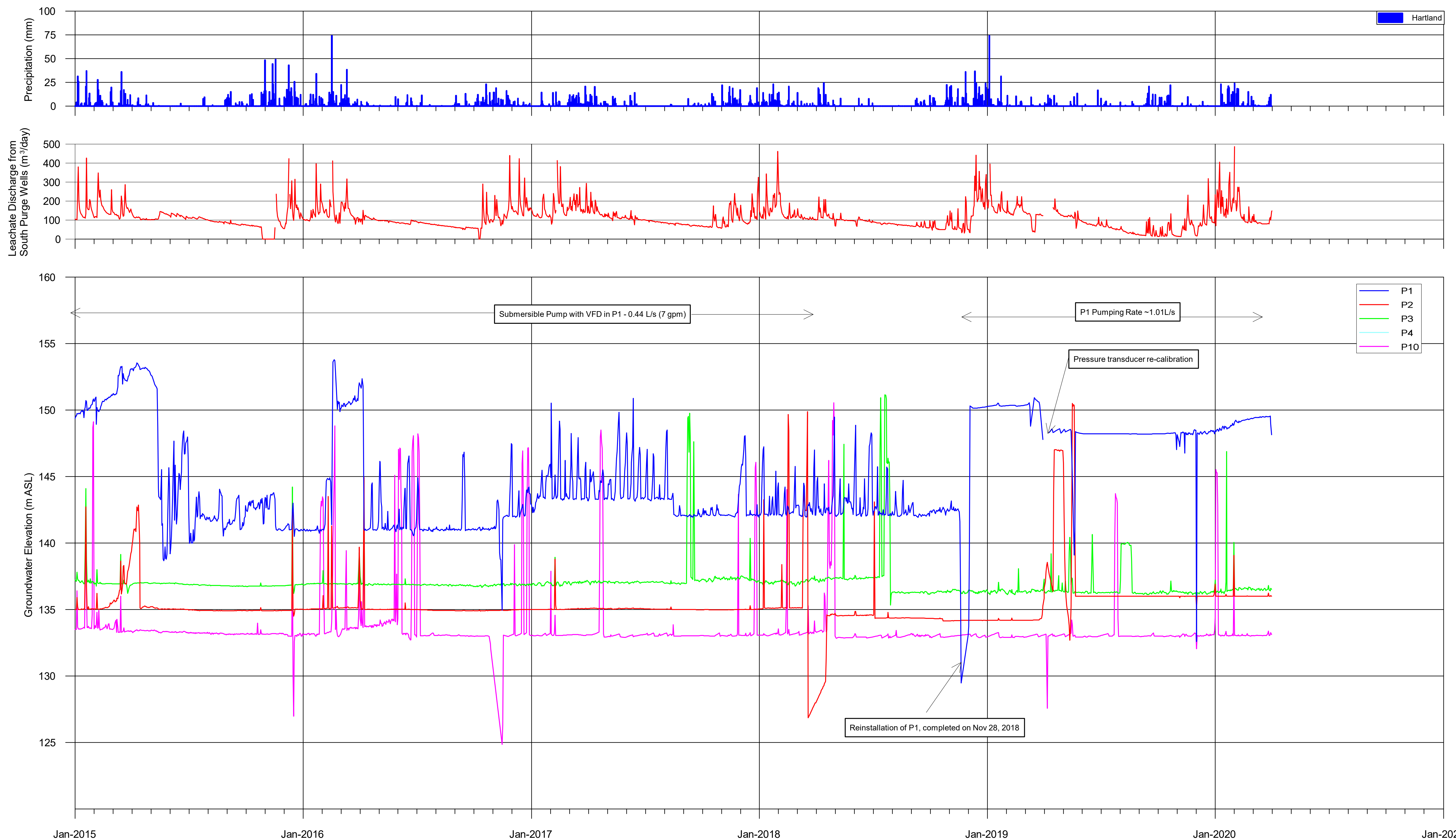


Figure 4-7. Groundwater Elevations in the South Purge Wells

AECOM

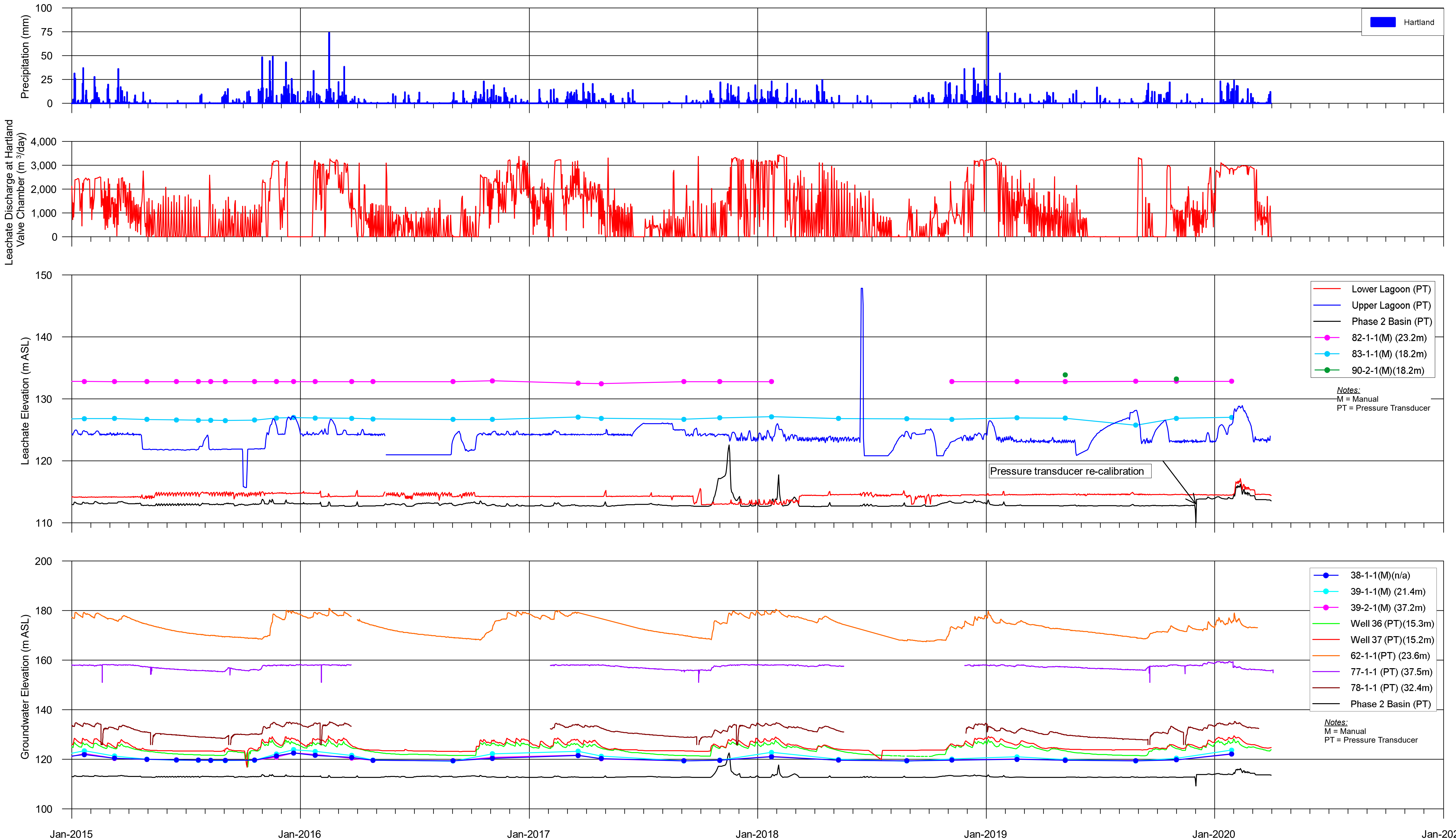


Figure 4-8. Water Elevations Within the Leachate Conveyance System and Surrounding the Phase 2 Basin

AECOM

Figure 4-9. Groundwater Elevations in North Ridge Area

AECOM

5. Groundwater Quality Monitoring Wells

5.1 Compliance Groundwater Monitoring Locations

A total of 36 compliance monitoring wells have been identified at 19 different locations at Hartland landfill. These stations are concentrated along the south, east and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site. With respect to assessing landfill compliance with the landfill operating permit, the monitoring wells listed below are considered Boundary Compliance Wells.

South of the Landfill (10)
- 04-3-1, 04-4-1
- 71-1-1, 71-2-1, 71-3-1
- 72-1-1, 72-3-1
- 73-1-1, 73-2-1, 73-3-1

East of the Landfill (6)
- 17-1-1, 17-1-2, 17-1-3
- 18-1-1, 18-2-1, 18-2-2

North of the Landfill (15)
- 20-1-1, 20-1-2
- 21-1-1, 21-1-2, 21-2-1
- 28-1-0
- 29-1-1, 29-1-2
- 30-1-1, 30-1-2
- 31-1-1, 31-1-2
- 39-1-1, 39-2-1
- 53-1-1

North of the Hartland North Pad (5)
- 41-1-1
- 42-1-1
- 55-1-1
- 56-1-1
- 57-1-1

Compliance was assessed per Section 5.2. All data, including the applicable standards, are provided in Appendix B. Values that exceed the CSR standards are noted with footnotes. The analytical results for groundwater samples collected from monitoring wells for the reporting period are presented in Appendix B.1. Table 5-1 presents a summary of the wells that exceeded CSR standards for one or more parameters in 2019/20. The majority of the exceedances represent groundwater samples collected from leachate collection wells or in close proximity to leachate collection infrastructure.

A review of the sampling program was undertaken in early 2016, and recommendations for modifications to the number, location and sampling frequency of compliance monitoring locations were implemented beginning in the 2016/17 monitoring year. Groundwater quality data at compliance wells 04-2-1 and 72-2-1 has not been collected since 2016 due to the low recharge rate in the wells. These wells are no longer considered compliance locations.

Both DW and AW standards for iron and manganese are no longer applied to municipal landfills, based on the Stage 8 Amendments to the CSR that came into effect on January 24, 2013 and as presented on BC CSR Schedule 3.2 effective November 1, 2017.

Typical quarterly monitoring conducted by the CRD includes both compliance wells and other non-compliance locations that contribute to a fulsome understanding of landfill processes and potential for environmental risk.

5.2 Assessment of Groundwater Quality Impacts

The primary causes for any groundwater quality degradation at the site include leachate, road salt and aggregate production, stockpiling or use for construction purposes. Professional judgement is used to differentiate between different contaminant sources (leachate, road salt and aggregates) and to assess the nature and degree of any impacts. The authors are hydrogeologists and geochemists with considerable experience at other landfills in coastal regions of British Columbia. Groundwater quality may be judged to be impacted relative to background without exceeding regulatory criteria, and therefore compliant. If concentrations exceed CSR AW or DW standards for groundwater quality at the property boundary, standard protocols for notification of affected property owners should be followed. Early on December 23, 2019 a leachate condensation pipe along the Northwest Slope Road was damaged by a vehicle which subsequently led to an escape of leachate. The breach was contained within the boundary of the landfill shortly after the spill was discovered. Surface water samples were collected downstream of the spill and from the breach itself. It is thought that groundwater downgradient of the spill was not impacted.

Relative concentrations and patterns of conductivity, ammonia, chloride, sulphate and nitrate are compared to background concentrations to differentiate between the site's typical contaminant sources as outlined below:

- Background conductivity is typically below 500 µS/cm, but has been observed in some background wells at concentrations up to 1,000 µS/cm immediately after well installation, or following prolonged dry periods. Background ammonia concentrations are typically below 0.1 mg/L, but occasionally reach 0.5 mg/L downgradient of wetland areas. Background chloride concentrations are typically below 20 mg/L. Background sulphate concentrations are typically below 50 mg/L, but are regularly observed at concentrations up to 100 mg/L in wells screened within weathered bedrock and near geologic alteration zones.
- Groundwater is considered to be impacted by leachate when conductivity concentrations are above 1,000 µS/cm, ammonia concentrations are above 1 mg/L and chloride concentrations are above 20 mg/L. Peak concentrations in leachate impacted wells are typically observed during the dry summer and early fall months, when there is limited dilution by precipitation.
- Groundwater is considered impacted by aggregate (e.g., production, stockpiling or site construction works) when sulphate is present at concentrations above 75 mg/L and ammonia or nitrate are present at concentrations above background levels of 0.1 mg/L. Peak concentrations are typically observed during the first sampling event following the onset of wet weather in the fall months.
- Groundwater is considered impacted by road salt when both conductivity (>1,000 µS/cm) and chloride (>20 mg/L) are elevated above background levels, but ammonia and its degradation products (primarily nitrate) are not elevated. Road salt impacted sites must also be located downgradient (or downstream) of surfaces where road salt is known to be applied. Concentrations of conductivity and chloride typically exhibit peaks following cold weather periods when de-icing salt is often applied to roadways.

5.3 Electrical Conductivity

Figure 5-1, presents the electrical conductivity values in plan for samples collected at Hartland landfill in September 2019. Figure 5-2 and Figure 5-3 present north-south and east-west cross-sections through the landfill and north of the landfill that show conductivity values in September 2019. Electrical conductivity is a good indicator of the presence of inorganic parameters and a good indicator of potential leachate contamination when elevated ammonia and chloride are also present. The highest conductivity values are typically observed during the dry season (i.e., August/ September), and were utilized to interpret the conductivity contours. Electrical conductivity values were not available at some of groundwater monitoring locations in September 2019. For wells that were not sampled in 2019/20, it was assumed that conductivity contours remained similar to 2018/19 if current data was not available.

On Figure 5-1, the 1,000 µS/cm conductivity contour line is interpreted as indicating the presence of leachate in groundwater. Figure 5-1 shows that the 1,000 µS/cm contour closely resembles the outline of current refuse disposal and indicates that groundwater in these areas has been affected by leachate. Similar to previous years, conductivity values in north purge wells and south purge wells were generally above 1,000 µS/cm in 2019/20, except for 81-1-0-P9. In September 2019, conductivity values in the north and south purge wells were generally higher than those measured in September 2018, except for P7 and P8. As shown on Figure 5-1, conductivity values at north purge wells were highest in P7, which was above 3,300 µS/cm in September 2019. Conductivity values in the south purge wells ranged between 1,371 and 2,287 µS/cm during the September 2019 sampling event, and the highest conductivity was observed in P3. Similar to 2018/19, leachate in 81-1-0-P9 was less concentrated, with conductivity values below 1,000 µS/cm during three of the four sampling events. The 1,000 µS/cm contour runs north of the north purge well system and lower leachate lagoon, and extends south of P1, P2, P3, P4, P5, P6 and P10 of the south purge well system.

The 500 µS/cm conductivity contour is considered indicative of background groundwater quality. In September 2019, the 500 µS/cm conductivity contour along the north boundary extended slightly further north, and were beyond well 21-2-1 and 40-1-1. In 2019/20, the average conductivity in 21-2-1 and 40-1-1 ranged from 317 to 554 µS/cm and 411 to 541 µS/cm, which were approximately 20% higher than those measured in 2018/19. This indicates the slight degradation of groundwater quality in this area, which may be related to the dry winter and less dilution. Similar to previous years, the 500 µS/cm contour did not extend beyond location 25 at the north end of the landfill. Results from groundwater collected from location 36 showed that conductivity values during all four sampling events were above 500 µS/cm, indicating the 500 µS/cm contour extends beyond location 36. Along the east boundary of the landfill, the 500 µS/cm contour did not extend beyond location 18. At the west boundary, the location of the 500 µS/cm contour could not be determined, due to the absence of monitoring wells. However, the presence of conductivity data for location 27, coupled with eastward and upward groundwater flow in that area indicates the 500 µS/cm contour remains east of location 27. South of the landfill, the 500 µS/cm contour encompassed location 72-3-1 and 07-1-0, and extended marginally beyond the property boundary similar to previous years.

Source control techniques should continue to be implemented throughout the landfill including minimizing the volume of aggregate stockpiles, application of covers and paving of traffic surfaces will be important to maintaining the quality of surface and groundwater in the future.

5.4 Monitors North of the Phase 1 Landfill

Long-term groundwater quality north of the Phase 1 landfill is shown on Figure 5-4.

5.4.1 Monitoring Site 58

Monitoring site 58 (not a boundary compliance well) is located in the transition area between the Phase 1 and Phase 2 landfill 200 m from the property boundary. The well is 19 m deep and screened in bedrock below refuse. Well 58-1-0, has exhibited elevated concentrations of leachate indicator parameters since 2001, shortly after landfilling upslope of the well began. Although concentrations have generally decreased slightly since peak concentrations observed in 2001 to 2004, concentrations of key leachate indicator parameters (conductivity, ammonia, chloride and nitrate) remain highly elevated. Water quality is indicative of leachate-impacted groundwater flowing toward the lower leachate lagoon and the north purge wells.

In 2019/20, four groundwater sampling events were conducted at location 58. Similar to previous years, three of the four samples from well 58-1-0 exhibited concentrations of ammonia, and all four samples exhibited cobalt concentrations that exceeded CSR AW standards. Further, concentrations of chloride, cobalt, nickel, sodium, strontium and vanadium exceeded CSR DW standards during all four sampling events. In 2019/2020, mean concentrations of ammonia and chloride were 94 mg/L and 987 mg/L, respectively. Groundwater quality in 58-1-0 exhibited no trend in conductivity, sulphate and nitrate and an increasing trend in ammonia and chloride concentrations over the past five years. Average ammonia concentrations increased from 72 mg/L to 94 mg/L between 2015 and 2020.

Similar to 2018/19, dissolved cobalt concentrations exceeded both CSR AW and DW interim standards, and nickel, sodium and strontium exceeded CSR DW standards on all sampling dates in 2019/20. Dissolved cobalt concentrations ranged between 0.0540 and 0.0633 mg/L, with a mean concentration of 0.0598 mg/L. Continued water quality monitoring at this well over time is important as it provides an indication of the quality of leachate migrating toward the leachate lagoons and the Phase 1 north purge well system.

5.4.2 Monitoring Sites 52 (P7), 80 (P8) and 81 (P9)

Monitoring sites 52, 80 and 81 (not boundary compliance locations) are located in the centre of the leachate plume between the toe of the Phase 1 landfill and the lower leachate lagoon approximately 100 m from the property boundary. Leachate flows along the bedrock/refuse interface underlying Phase 1 toward the lower leachate lagoon and the north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9). Groundwater quality has been heavily impacted by leachate since monitoring began at these locations in the 1980's.

In 2019/20, groundwater samples were collected from well 52-1-1 (31 m deep) and leachate samples were collected from the north purge wells (80-1-0-P8, 52-4-0-P7 and 81-1-0-P9). Prior to 2016/17, leachate samples had only been collected from the combined discharge at 52-4-0-P7 and 80-1-0-P8.

Similar to previous years, concentrations of chloride in monitoring well 52-1-1 met the CSR DW standard of 250 mg/L during all sampling events in 2019/20. Ammonia concentrations were similar to previously reported values and exceeded CSR AW standards on all four sampling dates. Sodium and strontium concentrations for well 52-1-1-exceeded the CSR DW on all four sampling dates. In 2019/20, the mean annual conductivity concentration in 52-1-1 was 1,725 µS/cm, which is slightly higher than the values observed in 2018/19 (1,657 µS/cm) and 2017/18 (1,589 µS/cm). Statistically significant decreasing trends in conductivity and chloride were observed over the past five years, indicating an improvement in water quality at this location. However, ammonia exhibited a statistically significant increasing trend over the past five years, with concentrations ranging between 16 mg/L and 35 mg/L.

In 2019/20, the mean annual conductivity in the north purge wells were 3,123 µS/cm (52-4-0-P7), 1,566 µS/cm (80-1-0-P8) and 976 µS/cm (81-1-0-P9), indicating leachate is most concentrated in 52-4-0-P7. The average values of conductivity at all three locations were higher than those in 2018/19. Groundwater quality in 52-4-0-P7 exceeded CSR AW standards for ammonia and CSR DW standard for chloride in all four sampling events. Groundwater quality in 80-1-0-P8 exceeded the CSR AW standards for ammonia during all four sampling events and exceeded the CSR DW standards for nitrate and nitrite in September and November sampling events. Groundwater quality in 81-1-0-P9 met all CSR AW and DW standards in 2019/20. Overall, groundwater quality in the north purge wells has slightly degraded in 2019/20 compared to 2018/19 data. The degradation of groundwater quality may be related to the reduced pumping of P7 (i.e. pump malfunction), and therefore reduced dilution by underlying relatively cleaner groundwater. Alternatively, the relatively dry weather observed in 2019/20 may have resulted in less dilution of leachate. Test pumping in January 2020 indicated that the flow rate in P7 was approximately 0.153 L/s, which was only half of that measured in P8. Statistical trends in leachate indicator parameters were found in the north purge wells over the past five years. Increasing trends in ammonia concentrations were observed in 52-4-0-P7, and increasing trends in ammonia, chloride and nitrate concentrations were observed in well 80-1-0-P8. A statistically significant increasing trend in sulphate concentration was also observed in 81-1-0-P9. Water quality at these wells should be closely monitored to monitor temporal changes in leachate quality and verify the effectiveness of leachate collection system.

CRD reported a low well yield in P9 during winter months in 2017/18. In 2019/20, water elevations in P9 were still elevated, so leachate collection volumes are likely to be relatively low over time. Despite the low well yield, the drawdown cone is likely to be relatively narrow and steep and may continue to help improve water quality at 40-1-1 over time. The relatively high leachate levels reported in P9 indicate there are opportunities for improved leachate collection by lowering pump set points, increasing pumping rates, or lowering the pump installed in the well.

Table 5-1. Groundwater Quality Exceedances 2019-2020

AECOM

BC CSR				AW maximum (1)	---	---	---	---	---	90	50	10000	1.5
				DW Maximum (2)	---	---	---	---	9500	6	10	1000	8
Station	Sample Type	Compliance Well (Y/N)	Sample Date	Parameter	PH	Specific Conductivity	Temperature	Alkalinity - Total - Ph 4.5	Aluminum	Antimony	Arsenic	Barium	Beryllium
				Fraction	TOT	TOT	TOT	TOT	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L
52-1-1	SS	N	5/29/2019		6.92	1320	14.7	830	4	< 0.1	0.63	108	< 0.05
			9/30/2019		6.9	1805	16.1	910	4.3	< 0.04	0.259	114	< 0.02
	SS	N	11/14/2019		7.2	1670	13.8	920	3.4	0.043	0.311	118	< 0.02
	SS	N	2/27/2020		6.91	2108	13.8	850	4.6	< 0.04	0.265	118	< 0.02
58-1-0	FRM	N	5/29/2019	Mean of duplicates	6.63	5664	19.9	1950	13.45	0.45	1.865	36	< 0.05
	SS	N	9/25/2019		6.63	5685	19.8	1900	13.9	0.471	1.88	37.9	< 0.02
	SS	N	2/20/2020	Clear and moderately yellow brown	6.6	5104	19.5	1700	12.6	0.399	2.03	33.2	< 0.02
	SS	N	11/20/2109		6.62	5458	19.6	1900	19.6	0.37	1.87	39.7	< 0.05
92-1-1	FRM		5/30/2018	Average of field replicates	7.5	393	10	180	9650 b	0.268	5.82	163	0 1.41

Notes:

- *a* — *Above CSR Schedule 3.2 AW Standard.*
- *b* — *Above CSR Schedule 3.2 DW Standard.*
- *c* — *Detection limits above applicable BC CSR standards.*
- *d* — *Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentrations (South Vanouver Island Region).*
- *SS* — *Single sample*
- *FRM* — *Average of field replicates.*
- *(1)* — *Aquatic Life (AW) Freshwater, Column 3.*
- *(2)* — *Drinking Water (DW), Column 6.*
- *(3)* — *Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
- *(4)* — *Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
- *(5)* — *Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
- *(6)* — *BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
- *(7)* — *Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common form of chromium.*
- *(8)* — *Interim standard used for cobalt.*
- *(9)* — *Regional background concentration (South Vancouver Island Region).*

Table 5-1. Groundwater Quality Exceedances 2019-2020

Station	Sample Type	Compliance Well (Y/N)	Sample Date	Parameter	Bismuth	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron
BC CSR				AW maximum (1)	---	12000	0.5 -4 (5)	---	1500	90 (7)	40	20-90 (5)	---	---
				DW Maximum (2)	---	5000	5	---	250	6000	20 (8)	1500	---	--- (6)
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L
52-1-1	SS	N	5/29/2019		< 0.025	2830	< 0.025	128	190	1.79	1.83	0.91	480	526
			9/30/2019		< 0.01	2800	< 0.01	140	190	1.12	2.36	< 0.1	521	559
	SS	N	11/14/2019		< 0.01	2810	< 0.01	146	200	1.14	2.46	0.15	547	594
	SS	N	2/27/2020		< 0.01	2790	< 0.01	133	190	1.09	2.33	3.36	500	559
58-1-0	FRM	N	5/29/2019	Mean of duplicates	< 0.025	3705	0.0745	459.5	920 b	10.9	58.95 a b	5.645	1725	3615
	SS	N	9/25/2019		< 0.01	3790	0.067	488	1000 b	10.3	63.3 a b	6.57	1800	1980
	SS	N	2/20/2020	Clear and moderately yellow brown	< 0.01	3190	0.029	361	830 b	9.02	54 a b	4	1400	4920
	SS	N	11/20/2109		< 0.025	4010	0.058	422	1200 b	11	63.2 a b	4.97	1660	5280
92-1-1	FRM		5/30/2018	Average of field replicates	0 0.48	437	0.362	101	7.3	22.7	12.3	9.65	343	20800

Notes:

a	*Above CSR Schedule 3.2 AW Standard.*
b	*Above CSR Schedule 3.2 DW Standard.*
c	*Detection limits above applicable BC CSR standards.*
d	*Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentrations (South Vanouver Island Region).*
SS	*Single sample*
FRM	*Average of field replicates.*
(1)	*Aquatic Life (AW) Freshwater, Column 3.*
(2)	*Drinking Water (DW), Column 6.*
(3)	*Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
(4)	*Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
(5)	*Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
(6)	*BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
(7)	*Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common form of chromium.*
(8)	*Interim standard used for cobalt.*
(9)	*Regional background concentration (South Vancouver Island Region).*

Table 5-1. Groundwater Quality Exceedances 2019-2020

AECOM

BC CSR				AW maximum (1)	40-160	---	---	---	10000	1.31-18.4 (3)	0.2-2.0 (4)	400	400
				DW Maximum (2)	10	33 (9)	---	--- (6)	250	---	1	10	10
Station	Sample Type	Compliance Well (Y/N)	Sample Date	Parameter	Lead	Lithium	Magnesium	Manganese	Molybdenum	Ammonia	Nitrite	Nitrate	Nitrite + Nitrate
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L
52-1-1	SS	N	5/29/2019		< 0.025	5.2	38.9	345	0.37	30 *a*	< 0.005	< 0.02	< 0.02
			9/30/2019		< 0.01	5.6	41.5	396	0.33	35 *a*	< 0.005	< 0.02	< 0.02
	SS	N	11/14/2019		< 0.01	5.4	44.3	402	0.31	32 *a*	< 0.005	< 0.02	< 0.02
	SS	N	2/27/2020		0.175	5.5	41	373	0.19	25 *a*	< 0.005	< 0.02	< 0.02
58-1-0	FRM	N	5/29/2019	Mean of duplicates	0.3145	< 2.5	140.5	7580	7.12	96 *a*	0.0453	< 0.02	0.051
	SS	N	9/25/2019		0.278	< 1	140	7350	7.22	140 *a*	0.0145	< 0.02	< 0.02
	SS	N	2/20/2020	Clear and moderately yellow brown	0.282	< 1	120	5740	6.73	140 *a*	< 0.005	0.452	0.452
	SS	N	11/20/2109		0.363	< 2.5	147	7230	6.75	0.042	< 0.005	< 0.02	< 0.02
92-1-1	FRM		5/30/2018	Average of field replicates	12.8 b	***11.5*** d	21.9	694	5.02	0.22	< 0.005	0.023	0.023

Notes:

a	*Above CSR Schedule 3.2 AW Standard.*
b	*Above CSR Schedule 3.2 DW Standard.*
c	*Detection limits above applicable BC CSR standards.*
d	*Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentrations (South Vanouver Island Region).*
SS	*Single sample*
FRM	*Average of field replicates.*
(1)	*Aquatic Life (AW) Freshwater, Column 3.*
(2)	*Drinking Water (DW), Column 6.*
(3)	*Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
(4)	*Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
(5)	*Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
(6)	*BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
(7)	*Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common form of chromium.*
(8)	*Interim standard used for cobalt.*
(9)	*Regional background concentration (South Vancouver Island Region).*

Table 5-1. Groundwater Quality Exceedances 2019-2020

AECOM

BC CSR				AW maximum (1)	250-1500 (5)	---	---	20	---	0.5-15 (5)	---	---	128 - 429 (5)	---
				DW Maximum (2)	80	---	---	10	---	20	200	2500	500	---
Station	Sample Type	Compliance Well (Y/N)	Sample Date	Parameter	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulphate	Sulfur
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	mg/L	µg/L	mg/L	µg/L
52-1-1	SS	N	5/29/2019		13.1	20	13.5	< 0.2	33900	< 0.025	236 b	3070 b	< 1	< 15
			9/30/2019		11.9	15.4	13.9	0.156	38200	< 0.01	235 b	3350 b	< 1	< 6
	SS	N	11/14/2019		12.3	16.7	14.4	0.138	37200	< 0.01	254 b	3510 b	< 1	< 6
	SS	N	2/27/2020		11.5	15.3	13.7	< 0.08	36500	< 0.01	236 b	3430 b	< 1	< 6
58-1-0	FRM	N	5/29/2019	Mean of duplicates	88.1 b	86	45.85	0.4	18700	< 0.025	523 b	4095 b	62.5	24
	SS	N	9/25/2019		85.6 b	75.5	50.4	0.413	19900	< 0.01	547 b	4540 b	58	24.3
	SS	N	2/20/2020	Clear and moderately yellow brown	81.3 b	92.7	49.1	0.523	17900	0.014	512 b	3670 b	69	28.1
	SS	N	11/20/2109		91.1 b	95	54.5	0.47	21000	< 0.025	583 b	4410 b	60	26
92-1-1	FRM		5/30/2018	Average of field replicates	22.5	742	3.42	0.673	21000	0.089	35.5	352	120	37.7

Notes:

a	*Above CSR Schedule 3.2 AW Standard.*
b	*Above CSR Schedule 3.2 DW Standard.*
c	*Detection limits above applicable BC CSR standards.*
d	*Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentrations (South Vanouver Island Region).*
SS	*Single sample*
FRM	*Average of field replicates.*
(1)	*Aquatic Life (AW) Freshwater, Column 3.*
(2)	*Drinking Water (DW), Column 6.*
(3)	*Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
(4)	*Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
(5)	*Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
(6)	*BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
(7)	*Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common form of chromium.*
(8)	*Interim standard used for cobalt.*
(9)	*Regional background concentration (South Vancouver Island Region).*

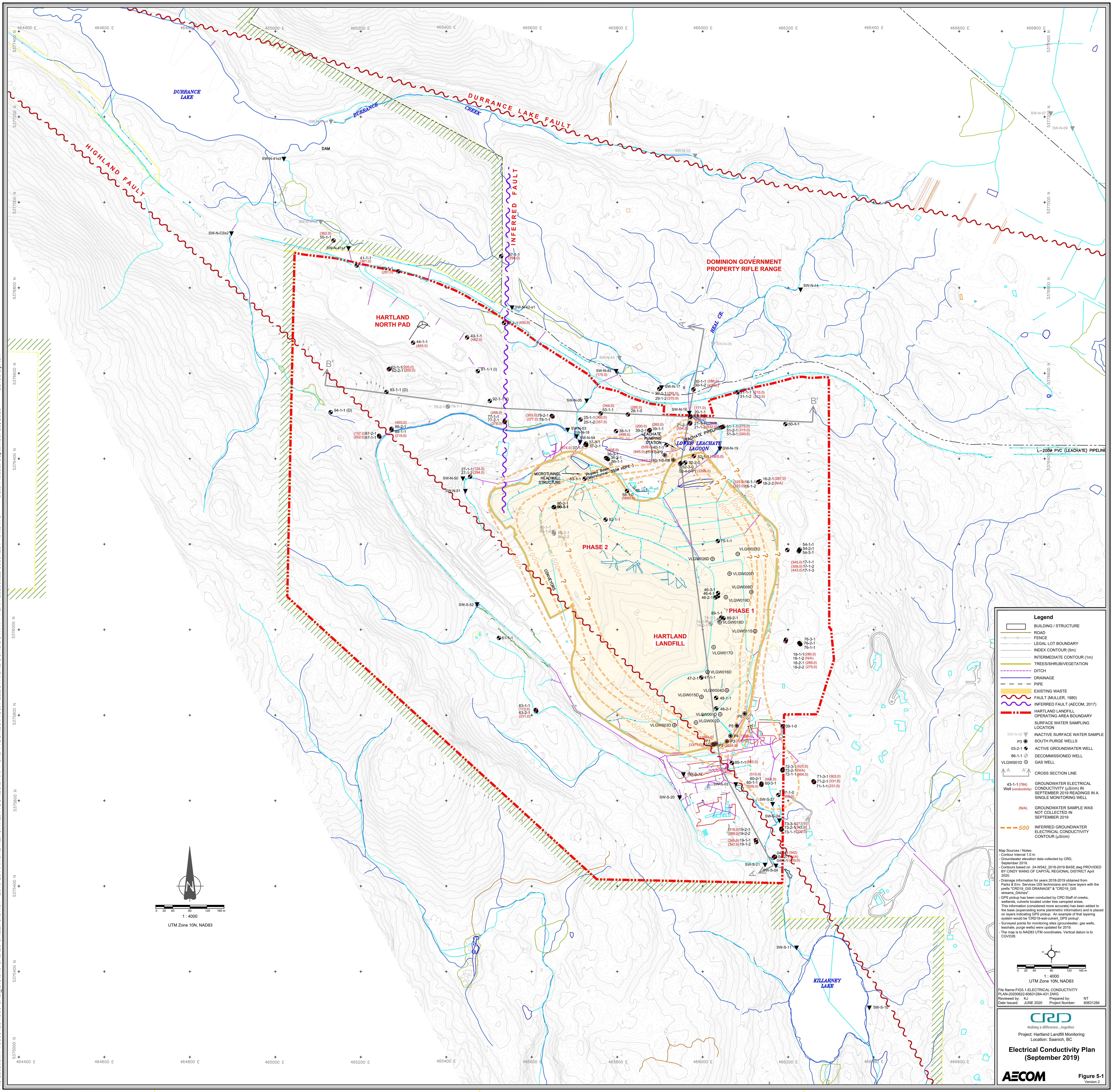
Table 5-1. Groundwater Quality Exceedances 2019-2020

AECOM

BC CSR				AW maximum (1)	3	---	1000	85	---	75-2400 (5)	---
				DW Maximum (2)	---	2500	---	20	20	3000	---
Station	Sample Type	Compliance Well (Y/N)	Sample Date	Parameter	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
52-1-1	SS	N	5/29/2019		0.023	< 1	< 2.5	< 0.01	1	7.16	< 0.5
			9/30/2019		< 0.004	< 0.4	< 1	< 0.004	0.77	0.48	< 0.2
	SS	N	11/14/2019		< 0.004	< 0.4	< 1	< 0.004	0.86	0.78	< 0.2
	SS	N	2/27/2020		< 0.004	< 0.4	< 1	< 0.004	0.88	4.16	< 0.2
58-1-0	FRM	N	5/29/2019	Mean of duplicates	< 0.01	1.1	6.9	0.413	27.3 b	7.135	2.45
	SS	N	9/25/2019		< 0.004	0.75	3.3	0.409	24.8 b	3.35	2.64
	SS	N	2/20/2020	Clear and moderately yellow brown	< 0.004	0.69	3.4	0.349	25.7 b	4.04	2.01
	SS	N	11/20/2109		< 0.01	1.3	4.9	0.409	32 b	3.11	2.56
92-1-1	FRM		5/30/2018	Average of field replicates	0.175	1.4	149	6.81	23.9 b	47.8	2.02

Notes:

a	*Above CSR Schedule 3.2 AW Standard.*
b	*Above CSR Schedule 3.2 DW Standard.*
c	*Detection limits above applicable BC CSR standards.*
d	*Above CSR Schedule 3.2 DW Standard, but Below Regional Background Concentrations (South Vanouver Island Region).*
SS	*Single sample*
FRM	*Average of field replicates.*
(1)	*Aquatic Life (AW) Freshwater, Column 3.*
(2)	*Drinking Water (DW), Column 6.*
(3)	*Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
(4)	*Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
(5)	*Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
(6)	*BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
(7)	*Standard is based on the trivalent (Cr(III)) species. The Cr(III) is the most common form of chromium.*
(8)	*Interim standard used for cobalt.*
(9)	*Regional background concentration (South Vancouver Island Region).*


DURRANCE LAKE
DURRANCE LAKE FAULT
HIGHLAND FAULT
INFERRED FAULT
DURRANCE CREEK
DAM
DOMINION GOVERNMENT PROPERTY RIFLE RANGE
HARTLAND NORTH PAD
HARTLAND LANDFILL
PHASE 1
PHASE 2
LOWER LEACHATE LAGOON
LEACHATE PUMPING STATION
MICROTUNNEL HEADWALL STRUCTURE
L-2004 PVC (LEACHATE) PIPELINE
KILLARNEY LAKE
1 : 4000
UTM Zone 10N, NAD83
Legend
BUILDING / STRUCTURE
ROAD
FENCE
LEGAL LOT BOUNDARY
INDEX CONTOUR (5m)
INTERMEDIATE CONTOUR (1m)
TREES/SHRUB/VEGETATION
DITCH
DRAINAGE
PIPE
EXISTING WASTE
FAULT (MULLER, 1980)
INFERRED FAULT (AECOM, 2017)
HARTLAND LANDFILL OPERATING AREA BOUNDARY
SURFACE WATER SAMPLING LOCATION
SW-N-06 INACTIVE SURFACE WATER SAMPLE
P3 SOUTH PURGE WELLS
03-2-1 ACTIVE GROUNDWATER WELL
86-1-1 DECOMMISSIONED WELL
VLGW001D GAS WELL
A A' CROSS SECTION LINE
43-1-1 (784) Well (conductivity) GROUNDWATER ELECTRICAL CONDUCTIVITY (µS/cm) IN SEPTEMBER 2019 READINGS IN A SINGLE MONITORING WELL
(N/A) GROUNDWATER SAMPLE WAS NOT COLLECTED IN SEPTEMBER 2019
500 INFERRED GROUNDWATER ELECTRICAL CONDUCTIVITY CONTOUR (µS/cm)
Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater elevation data collected by CRD, September 2019.
- Contours based on 24-W542_2018-2019 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT April 2020.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.
1 : 4000
UTM Zone 10N, NAD83
File Name:FIG5.1-ELECTRICAL CONDUCTIVITY PLAN-20200622-60631284-431.DWG
Reviewed by: KJ
Prepared by: NT
Date Issued: JUNE 2020
Project Number: 60631284
Making a difference...together
Project: Hartland Landfill Monitoring
Location: Saanich, BC
Electrical Conductivity Plan (September 2019)
Figure 5-1
Version 2
File Location: P:\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C431 - 2019-20 ANNUAL REPORT\2. FIGURES\DRAFT CAD FIGURES\FIG5.1-ELECTRICAL CONDUCTIVITY PLAN-20200622-60631284-431.DWG
Date Plotted: September 25, 2020
Saved By: ton

Map Sources / Notes:
- Contours based on 24W542_2018-2019 base.dwg, provided by the Capital Regional District, April 2020.
- Stratigraphy between boreholes is inferred and may vary from that shown

1 : 2000
Section Looking West

File Name: FIG5.2 & FIG5.3 - GW SECTIONS AVERAGE CONDUCTIVITY IN 2018 & 2019-20200622-60631284-431.DWG
Reviewed by: KJ Prepared by: NT
Date Issued: JUNE 2020 Project Number: 60631284

Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Electrical Conductivity in Cross Section A-A' (SEPTEMBER 2019)

AECOM

Figure 5-2
Version 1

Map Sources / Notes:
- Contours based on 24W542_2017-2018 base.dwg, provided by the Capital Regional District, July 2019.
- Stratigraphy between boreholes is inferred and may vary from that shown

1 : 2000
Section Looking North

File Name: FIG5.2 & FIG5.3 - GW SECTIONS AVERAGE CONDUCTIVITY IN 2018 & 2019-20200622-60631284-431.DWG
Reviewed by: KJ Prepared by: NT
Date Issued: JUNE. 2020 Project Number: 60631248

Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Electrical Conductivity in Cross Section B-B' (September 2019)

AECOM

Figure 5-3
Version 2

File Location: P:\60631284\900-CAD_GIS\910-CAD\20-SHEETS\C431 - 2019-20 ANNUAL REPORT\2. FIGURES\DRAFT CAD FIGURES\FIG5.2 & FIG5.3 - GW SECTIONS AVERAGE CONDUCTIVITY IN 2018 & 2019-20200622-60631284-431.DWG Date Plotted: July 27, 2020 Saved By: ton

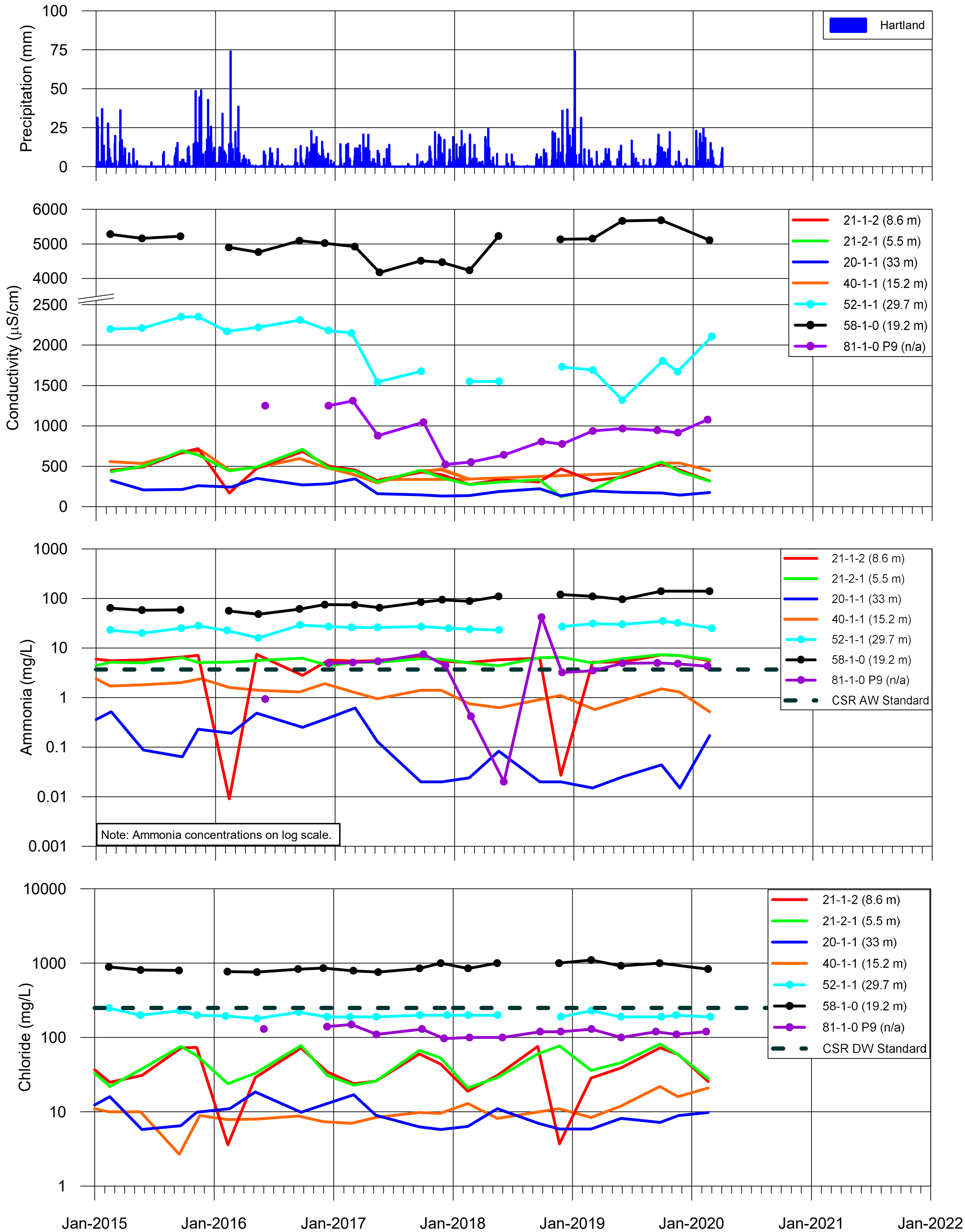


Figure 5-4. Groundwater Quality North of Phase 1

AECOM

5.4.3 Monitoring Site 40

Monitoring well 40-1-1 is not a Boundary Compliance Well and is installed between the upper and lower leachate lagoons approximately 70 m from the property boundary. Groundwater quality at this location has been affected by leachate since 2002 and continued to be slightly affected in 2019/20. In 2019/20, all parameters met the CSR AW and DW standards in all four sampling events. In 2019/20, conductivity values ranged from 411 to 541 µS/cm, with a mean concentration of 484 µS/cm. This value was higher than the mean of 382 µS/cm in 2018/19, but still lower than that measured in 2016/17 (492 µS/cm) and 2015/16 (587 µS/cm). During the September and November 2019 sampling events, groundwater quality at 40-1-1 was likely impacted by construction activities nearby (i.e., PS4), evident by elevated conductivity, sulphate and nitrate concentrations that are typically associated with aggregate placement or stockpiling. The recent degradation of water quality may also be related to less dilution from dry winter as well as slow pumping rate of purge well P7.

Although conductivity values were slightly increased in 2019/20 compared to 2018/19, the long-term concentrations of leachate indicator parameters indicated continuous improvements in groundwater quality, as the result of reduced leachate generation following closure of Phase 2 Cell 1 in 2011 and operation of 81-1-0-P9 as a purge well since 2016. A trend analysis revealed statistically significant decreasing ammonia concentrations over the past five years. Although chloride concentrations exhibited a statistically significant increasing trend, concentrations generally remained below the background value of 20 mg/L. Sulphate concentrations were slightly elevated during the September and November events, but remained much lower than they were prior to the observation of leachate impacts at this location in 2002. Water quality has been investigated at this location in the past and was the subject of a previous report (AECOM 2009a).

Water quality at location 40 should continue to be closely monitored to verify the effectiveness of leachate collection north of the Phase 1 landfill. The ongoing purge well performance evaluation program should be expanded to include P9, with the value of each well assessed based on the rate of contaminant mass removal.

5.4.4 Monitoring Sites 20 and 21

Monitoring locations 20 and 21 are considered Boundary Compliance Wells and are located directly north of the Phase 1 landfill and the lower leachate lagoon and between 5 and 15 m from the landfill property boundary. These monitors are located in the most probable path for any potential subsurface leachate migration below the unlined lower lagoon. The concentrations of leachate indicator parameters in select monitoring wells at locations 20, 21, 40, as well as 52 and 58 are plotted against time in Figure 5-4.

Groundwater quality at location 21 met both CSR AW and DW standards, with slightly higher conductivity, ammonia and chloride concentrations in 2019/20. Similar to 40-1-1, annual average conductivity values at 21-1-2 and 21-2-1 were slightly increased in 2019/20, reached to 418 µS/cm and 422 µS/cm, respectively. Chloride concentrations have remained well below the CSR DW standard (250 mg/L) since 1997 and below 120 mg/L since 2002. The maximum chloride concentration in all three wells at location 21 in 2019/20 was 82 mg/L in shallow well 21-2-1 and was consistent with previous values.

Although both wells 20-1-1 (33 m deep) and 20-1-2 (21 m deep) have been affected by leachate in the past, no exceedances were reported in 2019/20. Similar to 2018/19, ammonia concentrations in well 20-1-1 remained low and close to detection limits. Conductivity values slightly decreased from an average of 184 µS/cm in 2018/19 to 167 µS/cm in 2019/20 and remained significantly lower than 2016/17 (313 µS/cm). Overall, concentrations of leachate indicators in the two deeper wells at location 20 were consistent with background concentrations with exception of ammonia which was slightly higher than typical background concentrations.

Over the past five years, groundwater quality data collected from wells at locations 20 and 21 revealed a statistically significant decreasing trend in conductivity, and sulphate in well 20-1-1, 20-1-2 and 21-2-1 and a decreasing trend in conductivity concentrations in well 21-2-1. Decreasing trends in ammonia were observed in well 20-1-1. Although an increasing trend in nitrate was observed in well 20-1-1, the groundwater quality data indicates concentrations remained near detection limits with a maximum concentration of 0.05 mg/L. The statistically significant decreasing trends in leachate parameters indicate the water quality at these locations has continued to improve.

Overall, groundwater quality at downgradient well 40-1-1 and at location 21 slightly degraded during the fall and winter sampling period, which may be related to nearby construction activities. The delayed response of water quality to upgradient changes is consistent with previously calculated groundwater travel times. These rapid improvements highlight the importance of progressive landfill closure, diversion of clean runoff, and operating and maintaining leachate collection infrastructure at the landfill. Groundwater quality at locations 20 and 21 should continue to be closely monitored.

5.4.5 Monitoring Site 31

Monitoring wells at location 31 are considered Boundary Compliance Wells and they are located along the landfill north property line, south of Willis Point Road and 160 m northeast of the lower leachate lagoon. They are downgradient of the landfill and have the lowest groundwater elevations measured at the Hartland landfill.

In 2019/20, groundwater quality at location 31 met both CSR AW and DW standards. Leachate indicator parameters at both wells remained relatively stable and low, indicating leachate is not affecting groundwater quality at this location.

A statistical trend analysis of groundwater quality data identified a decreasing trend in conductivity in 31-1-1 and continued improvement in groundwater quality. A statistically significant increasing trend in nitrate concentrations was observed at 31-1-2 over the past five years. Water quality at location 31 should continue to be monitored closely.

5.4.6 Monitoring Sites 29 and 30

Monitoring locations 29 and 30 are located north of Willis Point Road and are Boundary Compliance Wells. Conductivity, ammonia and chloride plots for both locations over the past five years are included on Figure 5-5. At locations 29 and 30, all parameters met applicable CSR standards in 2019/20.

At monitoring locations 29 and 30, elevated conductivity and chloride concentrations observed since 2007 are considered related to intermittent road salt application on Willis Point Road. The District of Saanich has confirmed the use of de-icing salt (sodium chloride) on an as-needed basis on this road for several years and that no records of application dates are kept. As shown on Figure 5-5, conductivity and chloride concentrations measured in the shallow monitors at locations 29 and 30 have exhibited seasonal fluctuations for a very long time, with maximum concentrations typically occurring in winter and early spring months. In 2019/20, chloride concentrations were below 100 mg/L. Ammonia concentrations remain very low (<0.1 mg/L) at locations 29 and 30, suggesting that landfill leachate is not contributing to groundwater quality impacts north of Willis Point Road.

Groundwater quality data collected from wells at locations 29 and 30 over the past five years revealed a statistically significant decreasing trend in conductivity in 29-1-1, 29-1-2 and 30-1-1, and a decreasing trend in chloride in 30-1-1. Although statistically significant increasing trends were observed in chloride and nitrate in wells 29-1-1 and 29-1-2 and an increasing trend in sulphate was also observed in 29-1-2, their concentrations remained within acceptable ranges. It is speculated that changes in road salt application result in variable water quality (i.e. conductivity, sodium and chloride concentrations) at these monitoring locations.

5.4.7 Monitoring Sites 28 and 39

Groundwater monitoring wells 28 and 39 are located between the upper leachate lagoon and Willis Point Road and are considered Boundary Compliance Wells. Wells at locations 28 and 39 met CSR standards, did not report elevated concentrations of leachate indicator parameters, and were not impacted by landfill leachate in 2019/20. A statistical trend analysis of groundwater quality data collected from well 28-1-0 over the past five years revealed a statistically significant decreasing trend in conductivity and an increasing trend in nitrate. Historical water quality data indicates that conductivity values in well 28-1-0 remained relatively stable (below 500 µS/cm) from 1997 to 2016 and have decreased to below 300 µS/cm since 2017/18.

A statistical trend analysis of groundwater quality in 39-1-1 and 39-2-1 revealed a statistically significant decreasing trend in conductivity over the past five years. Since 2014, conductivity values in well 39-2-1 have been below 370 µS/cm and have declined to below 300 µS/cm since 2017/18 with the exception of 1,481 µS/cm in May 2019.

Sulphate concentrations in 39-1-1 exhibited a statistically significant increasing trend, but concentrations remained far below CSR standards. Chloride concentrations decreased in a statistically significant manner in 39-1-1 over the past five years. Groundwater quality should continue to be closely monitored at locations north of the upper leachate lagoon.

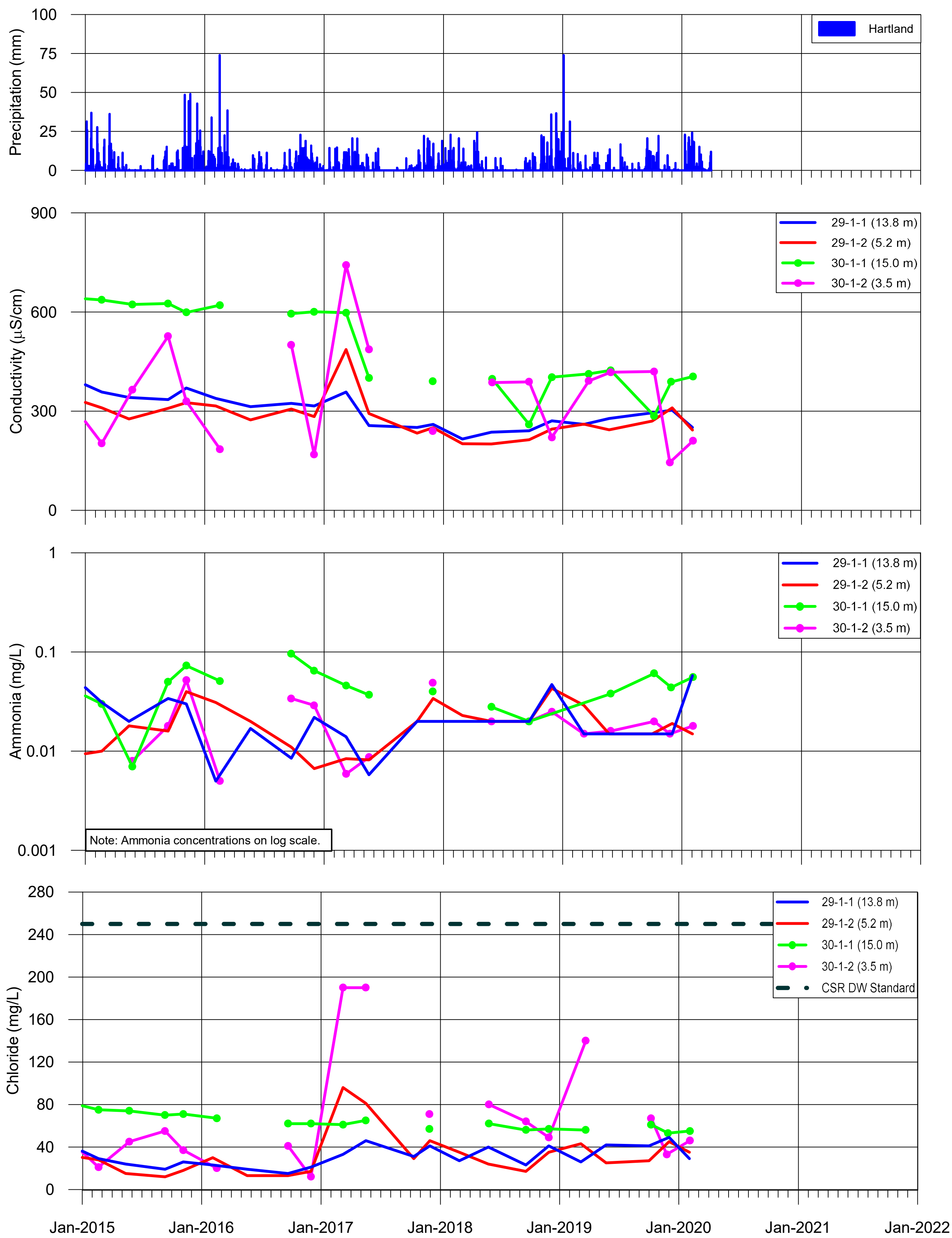


Figure 5-5. Groundwater Quality North of Willis Point Road

AECOM

5.5 Monitors West and North of the Phase 2 Landfill and Near the Hartland North Pad

Background water quality has historically been represented by monitoring location 63 on the west side of Phase 2, and five monitoring locations (77, 78, 79, 87 and 88) north of the Phase 2 landfill. Through winter and spring 2016/17, a portion of the slope between Phase 2 and the Hartland North Pad was cleared of vegetation to allow for construction of a future aggregate storage area. Since clearing, overburden soils have been stripped to expose the bedrock surface that consists of several closed depressions that may impact groundwater recharge. This work was conducted in the vicinity of monitoring locations 77, 78, 79, 87 and 88. Groundwater monitoring wells 79-1-1 and 79-2-1 were decommissioned in May 2018 to allow for construction of an aggregate stockpile in this area. In 2019/20, excavation and blasting were conducted at the North Pad area and east of the Toutle Valley Road. Given recent land clearing, excavation and quarrying activities, water quality data from locations 77, 78, 87 and 88 should no longer be considered representative of background groundwater quality, and groundwater at these wells should be closely monitored for landfill and construction related impacts.

In November 2019, four new monitoring wells (91-1-1, 92-1-1, 93-1-1, 94-1-1) were installed in Hartland North to characterize hydrogeological conditions near the RTF and monitor impacts from construction, quarrying and operations. Well 94-1-1 was installed as a new background well and is located upgradient of the landfill and RTF. Groundwater at these locations was sampled once during March 2020 and the data from this sampling event is included in Appendix B.1.

Six monitoring locations (25, 27, 36, 37, 38 and 53) north of the Phase 2 landfill near the upper leachate lagoon, and eight locations (41, 42, 43, 44, 55, 56, 57 and 62) near the Hartland North pad were monitored for groundwater quality parameters in 2019/20.

5.5.1 Monitoring Site 63

Monitoring well 63 is located at the western edge of the property, and upgradient of the landfill. Well 63 is considered a background location. Similar to previous years, groundwater quality at location 63 in 2019/20 exhibited conductivity concentrations less than 240 µS/cm, ammonia concentrations below 0.1 mg/L, chloride concentrations below 6 mg/L, sulphate concentrations below 12 mg/L and low or non-detectable concentrations of other parameters. This well is located upgradient of Hartland landfill and water quality is considered representative of background groundwater chemistry. Groundwater quality data collected over the past five years revealed a statistically significant decreasing trend in conductivity and sulphate in well 63-1-1 and 63-2-1. Overall, this indicates that groundwater quality improved in 2019/20 and was not impacted by excavation and quarrying activities.

5.5.2 Monitoring Sites 77, 78, 87 and 88

Concentrations of all parameters from samples collected in 2019/20 from wells at locations 77, 78, 87 and 88 (not boundary compliance wells) were below applicable CSR standards. Ammonia, sulphate, chloride and conductivity concentrations were consistent with previous monitoring. However, only two groundwater samples were collected at each monitoring well throughout 2019/20, and therefore the seasonal variability of groundwater quality cannot be evaluated.

In 2019/20, groundwater quality in monitoring wells at location 77 exhibited conductivity values below 380 µS/cm, ammonia concentrations below detection limits and chloride concentrations below 6.5 mg/L. Conductivity and sulphate concentrations at well 77-2-1 show a statistically significant decreasing trend over the past five years, indicating an improvement in water quality over time. Groundwater quality at 77-1-1 has slightly deteriorated as indicated by statistically significant increasing trends in chloride and sulphate over the past five years. However, sulphate concentration in 77-1-1 has decreased from 59 mg/L (2018/19) to 19 mg/L, indicating less impact from the natural flushing of mineral oxidation products from weathered bedrock and aggregate stockpiles.

Water quality at location 78 exhibited conductivity values ranging from 267 µS/cm to 377 µS/cm, low or non-detectable ammonia concentrations, and chloride concentrations generally less than 5 mg/L. Sulphate concentrations at deep well 78-1-1 were relatively stable and ranged between 50 and 52 mg/L. In 2019/20, the sulphate concentrations at well 78-2-1 ranged from 80.5 to 110 mg/L, which was slightly higher than those in 2018/19. Groundwater quality at 78-1-1 exhibited a statistically significant decreasing trend in chloride concentrations and an increasing trend for sulphate concentrations over the past five years. A statistically significant increasing trend in ammonia, chloride and sulphate concentrations was observed at well 78-2-1 over the past five years.

Groundwater nested wells 87 and 88 are located on either side of the Highland Fault. Similar to previous years, water quality at location 87 and 88 exhibited conductivity values generally below 400 µS/cm, low or non-detectable ammonia concentrations, chloride concentrations less than 10 mg/L. In 2019/20, sulphate concentrations at 87 and 88 were generally within the historical ranges (<20 mg/L), except for 88-2-1. Sulphate concentrations at 88-2-1 ranged from 110 mg/L and 130 mg/L during the September and November sampling events and exhibited a statistically significant increasing trend for the past five years. The elevated sulphate concentrations at 88-2-1 indicate that groundwater quality was impacted by the excavation and quarrying activities.

5.5.3 Wells North of Phase 2 Landfill

Wells north of Phase 2 include 25, 27, 37, 38, and 53. The closest groundwater monitoring locations to the Phase 2 landfill are 36 and 37. Leachate indicator parameters in wells at locations 25, 36, 37 and 38 are plotted on Figure 5-6.

5.5.3.1 Monitoring Site 36

Monitoring location 36 is not a Boundary Compliance Well and is located 20 m northeast and downgradient of the Phase 2 basin. Well 36-3-1 was monitored and sampled in 2019/20. Well 36-2-1 has not been monitored since 2016/17 due to well construction related impacts.

Well 36-3-1 is well suited to assess whether leachate is migrating beneath the clay liner along the north side of Phase 2. The elevation of the bottom of the well screen in 36-3-1 is 112 m ASL. The bottom of the Phase 2 basin is at 113 m elevation. The bottom of the clay liner along the north side of the Phase 2 basin is at elevation 114 m. In 2019/20, groundwater quality in 36-3-1 exhibited conductivity values below 1,000 µS/cm, non-detectable ammonia concentrations, chloride concentrations below 15 mg/L and sulphate concentrations at or below 250 mg/L, which is consistent with values measured in 2018/19. Concentrations of leachate (conductivity and ammonia) and aggregate runoff (conductivity, sulphate and nitrate) indicator parameters have decreased in a statistically significant manner over the past five years indicating an overall improvement in water quality in 36-3-1. There is no indication of leachate migration beneath the clay liner at the north edge of Phase 2.

Elevated sulphate concentrations in 36-3-1 observed since 2008 may be related to infiltration of runoff from aggregate stockpiles and/or aggregate use in landfill infrastructure at the north end of Phase 2. Large volumes of aggregate that have been stored in unused parts of Phase 2 since 2012 have the potential to impact water quality in this area if not managed. Aggregate has also been used extensively in landfill infrastructure throughout Phase 2 (i.e., around leachate and landfill gas collectors, road building, landfill cover and to construct the sedimentation pond near location 36). Although it is anticipated that elevated sulphate concentrations are the result of runoff from aggregate stockpiles, continued monitoring will help confirm the causes for groundwater quality changes in this area.

5.5.3.2 Monitoring Site 37

Monitoring location 37 is not a Boundary Compliance Well and it is located 25 m north of the Phase 2 basin. 37-3-1 was routine monitored in 2019/20. Well 37-1-1 has been excluded from the monitoring program due to the limited access. Sampling of 37-2-1 was deemed unwarranted due to its stable and low concentrations of leachate indicator parameters.

Similar to previous years, chloride and nitrate concentrations at shallow well 37-3-1 (14.8 m deep) remained low and consistent with background water quality. Sulphate concentrations ranged between 92 mg/L and 180 mg/L, which were slightly higher than those measured in 2018/19. Ammonia concentrations were slightly above background concentrations and ranged from 0.19 to 0.65 mg/L. Reported conductivity values were also slightly increased in 2019/20, which were consistent with the elevated sulphate concentrations. The elevated conductivity and sulphate concentrations may be related to the infiltration of runoff from aggregate stockpiles and areas where aggregate has been used to construct site infrastructure at the north end of Phase 2. Statistically significant increasing trends were detected at 37-3-1 for sulphate indicating a slight deterioration in groundwater quality at this location. Due to the low ammonia and nitrate concentrations, the degradation in water quality is likely related the onsite aggregate stockpiling, rather than leachate impacts.

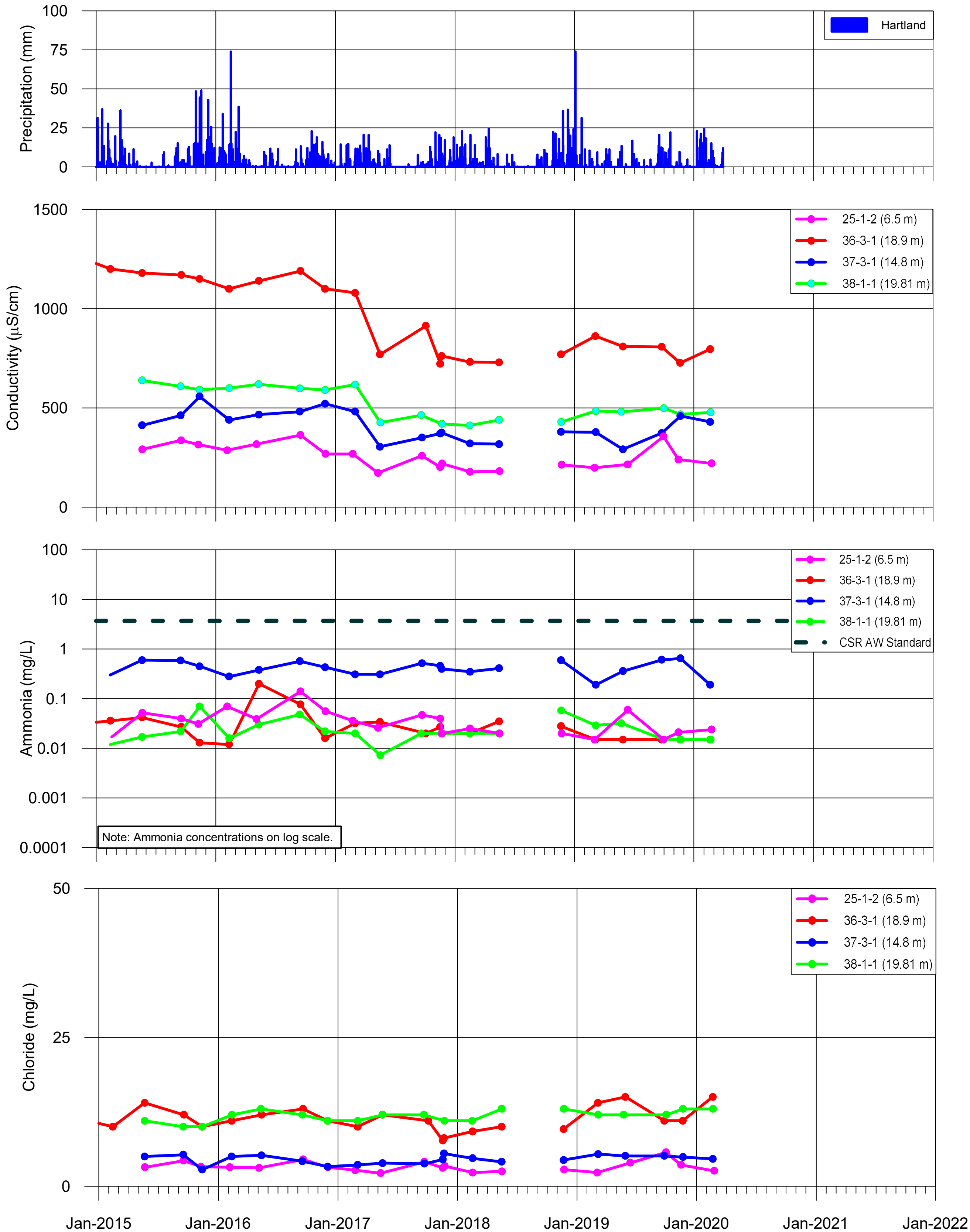


Figure 5-6. Groundwater Quality North of Phase 2

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5.5.3.3 Monitoring Site 38

Location 38 is not a boundary compliance location and is located roughly 80 m north of the Phase 2 basin just north of the upper leachate lagoon. Water quality at this location met CSR standards in 2019/20. As presented on Figure 5-6, well 38-1-1 (18.29 m) exhibited conductivity values slightly less than 500 µS/cm, undetectable to low ammonia concentrations (<0.07 mg/L) and chloride concentrations less than 15 mg/L. Sulphate concentrations ranged between 37 mg/L and 51 mg/L, and were consistent with those measured in 2018/19. Over the past five years a statistically significant decreasing trend in conductivity was observed at this location. Although statistically significant increasing trends in chloride were observed for the past five years, their concentrations remained low. Groundwater quality should continue to be monitored closely for leachate impacts in the future.

5.5.3.4 Monitoring Sites 25 and 53

Wells 25-1-1, 25-1-2 (not Boundary Compliance wells) and 53-1-1 (Boundary Compliance well) are located on an east-west trending ridge 100 m north of the Phase 2 basin near the property boundary. These wells have exhibited good water quality in the past and were not affected by landfill leachate. Since 2009, water quality at all three wells have been relatively stable and met both CSR AW and DW standards in 2019/20. In 2019/20, these wells exhibited conductivity values below 410 µS/cm, ammonia concentrations below 0.1 mg/L and chloride concentrations below 10 mg/L. However, sulphate and nitrate concentrations in 25-1-1 were slightly elevated during the February 2020 sampling event and reached 140 mg/L and 4.31 mg/L, respectively. The concurrent increase in sulphate and nitrate concentrations indicated that groundwater was potentially impacted by blasting/aggregate placement for infrastructure projects, but not leachate.

A statistically significant decreasing trend in conductivity concentrations at 25-1-1; a decreasing trend in conductivity and ammonia at 25-2-1; and a decreasing trend in conductivity, chloride and sulphate at well 53-1-1 were found over the past five years, indicating improved groundwater quality at these locations.

Previous groundwater quality changes in these wells (i.e., increased leachate indicator parameters) following the 2008 leachate storage test indicate that a hydraulic trap reversal would potentially result in northward leachate migration in this area. As such, groundwater quality and water levels should be closely monitored in this area to verify that the hydraulic trap is effective at containing leachate.

5.5.3.5 Monitoring Site 27

Monitoring location 27 is located northwest of Phase 2 and adjacent to aggregate stockpiles, where shallow groundwater is historically impacted by blasting residues and leachate. In 2019/20, groundwater quality in shallow well 27-1-2 was consistent with those in 2018/19 and met all applicable CSR standards. However, water quality continued to be affected by ongoing aggregate production and blasting activity/excavation close to the Toutle Valley.

In 2019/20, nitrate and sulphate concentrations in shallow well 27-1-2 (3.5 m deep) ranged from 1.02 to 3.94 mg/L, and 50 to 190 mg/L, respectively, which were slightly higher than those observed in 2018/19. Because ammonia concentrations remained low, it is likely that the elevated nitrate and sulphate concentrations resulted from infiltration of runoff from blasting areas and aggregate stockpiles near the Toutle Valley. Nitrate concentrations in deep well 27-1-1 (24.5 m deep) remained at detection limits. Nitrate is an oxidation product of ammonia, which is found in blasting residues and leachate. Similar to previous years, ammonia concentrations at both 27-1-1 and 27-1-2 were near detection limits and chloride concentrations were below 5.5 mg/L and within the historical range. Conductivity values in deep well 27-1-1 remained below 200 µS/cm, and sulphate concentrations in the deep bedrock monitor 27-1-1 were less than 12 mg/L and remained within the historical range of values (8 to 15 mg/L) observed since installation in 1997. Sulphate concentrations were less than 20 mg/L in shallow well 27-1-2 prior to the commencement of quarrying and aggregate stockpiling in 2002. Nearby quarrying, stockpiling of aggregate and road building continues to affect shallow water quality at location 27.

Groundwater quality at location 27 revealed a statistically significant decreasing trend in conductivity and ammonia over the past five years. An increasing trend in chloride at shallow well (27-1-2) was observed over the past five years. This increasing trend indicates a slight degradation of the groundwater quality in this well due to quarrying and aggregate stockpiling. Hydraulic conditions and contaminant concentrations should be carefully monitored at this location because groundwater in this area reports to the surface water collection and conveyance system. Although not immediately required, it is recommended that the CRD commence early planning for potential future shallow groundwater and surface water management in this area.

5.5.4 Wells near Hartland North Pad (Residual Treatment Facility)

The Hartland North Pad has had a variety of uses including yard waste composting (1994 – 2004) and aggregate stockpiling (2006 - 2017). Additionally, the area is currently a construction site for the residual treatment facility (RTF) associated with CRD's McLoughlin Point Waste Water Treatment Plant project. With the redevelopment, aggregate stored in this area was removed in winter 2016/2017. In 2019/20, blasting was conducted from January onwards near the south side of the Hartland North Pad. The construction of RTF buildings began in early 2019 and is expected to be completed in September 2020.

Monitoring locations 41, 42, 55, 56 and 57 are considered Boundary Compliance Monitoring Wells around the Hartland North pad. Monitoring locations 43, 44 and 62 are adjacent to the Hartland North pad and are not Boundary Compliance monitoring wells.

5.5.4.1 Monitoring Site 44 and 62

In 2016/17, CRD started collecting groundwater samples to track potential construction related impacts from 44-1-1 (10.67m), which is located on the southwest of monitoring location 43. 44-1-1 generally exhibited background water quality but exhibited minor degradation between 2017 and 2019. In 2018/19, groundwater quality in 44-1-1 was consistent with the range of background values, with slightly increased sulphate concentration (63.8 mg/L) in May 2018. In 2019/20, sulphate concentrations had decreased to background ranges, indicating less or no impact from the construction or blasting activities surrounding this area.

Monitoring location 62 is located southwest of monitoring location 44. Similar to previous years, 62-1-1 (23.7m) and 62-2-1 (18.9m) exhibited water quality that was similar to background values throughout 2019/20. Water quality at this location has not changed since clearing and site preparation activities associated with the RTF began, and all leachate indicator parameters were reflective of background groundwater quality.

5.5.4.2 Monitoring Site 41, 42, 43, 55 and 56

Figure 5-7 shows plots of leachate indicator parameters for monitoring locations 41, 42, 43, 55 and 56. In 2019/20, water quality in all these locations remained relatively stable. Ammonia concentrations in 43-1-1 (not a boundary compliance location) increased significantly from background levels to 87 mg/L in May 2018 and exceeded the CSR AW standard but returned to background concentrations during 2019/2020. Alkalinity, chloride, sodium, potassium concentrations which were highly elevated in May 2018 also returned to background levels in 2019/20.

Well 41-1-1 (a boundary compliance location) exhibited a decreasing trend in conductivity and sulphate concentrations over the past five years with a marked reduction since stockpiles were removed from the Hartland North pad in 2017. A statistically significant increasing trend was observed in chloride concentrations at 41-1-1. Concentrations of chloride have remained within background ranges since 2014. A statistically significant decreasing trend was detected for conductivity in well 42-1-1. Water quality in well 43-1-1 exhibited a statistically significant decreasing trend in conductivity and chloride. Well 55-1-1 exhibited a decreasing trend in conductivity and an increasing trend in chloride. Water quality in well 56-1-1 exhibited statistically significant decreasing trends in conductivity and sulphate and increasing trends in chloride concentrations. A statistically significant decreasing trend was observed in conductivity in groundwater at well 57-1-1 over the past five years. Chloride concentrations at locations 41, 42, 56 and 57 were below background concentrations.

The 2019/20 monitoring results indicated that water quality at station 43 and 44 (not boundary compliance locations) was degraded for a short period during the May 2018 sampling event but has returned to background levels. These short duration impacts are considered related to construction/blasting activities in this area. Groundwater quality at all stations downgradient of the Hartland North Pad should continue to be monitored closely for changes in water quality.

5.5.4.3 Monitoring Site 91, 92, 93 and 94

Figure 5-7 shows plots of leachate indicator parameters for monitoring locations 91, 92, 93 and 94. Wells 91-1-1, 92-1-1, 93-1-1 and 94-1-1 (not compliance wells) located near the Hartland North Pad. Only one groundwater sample was taken from each well during March 2020, because these wells were installed in November 2019. Water quality at all four locations remained below the CSR AW and DW standards except for aluminum, lead, lithium and vanadium which exceeded the CSR DW at location 92-1-1 during the March 2020 sampling event. However, lithium concentrations were well below the regional background of 33 µg/L, and therefore are not considered a contaminant concern. Conductivity, chloride and ammonia concentrations at all four locations were below background groundwater concentrations. Slightly elevated sulphate concentrations in wells 91-1-1, 92-1-1 and 94-1-1 were observed and will continue to be monitored throughout the 2020/21 sampling program. Newly installed monitoring wells often require several sampling events before the influence of drilling has dissipated and groundwater quality stabilizes.

Statistical trend analyzes were not completed for locations 91, 92, 93 or 94, as a minimum data set of five years is required. Groundwater quality at these locations should be closely monitored for changes in water quality due to the RTF construction.

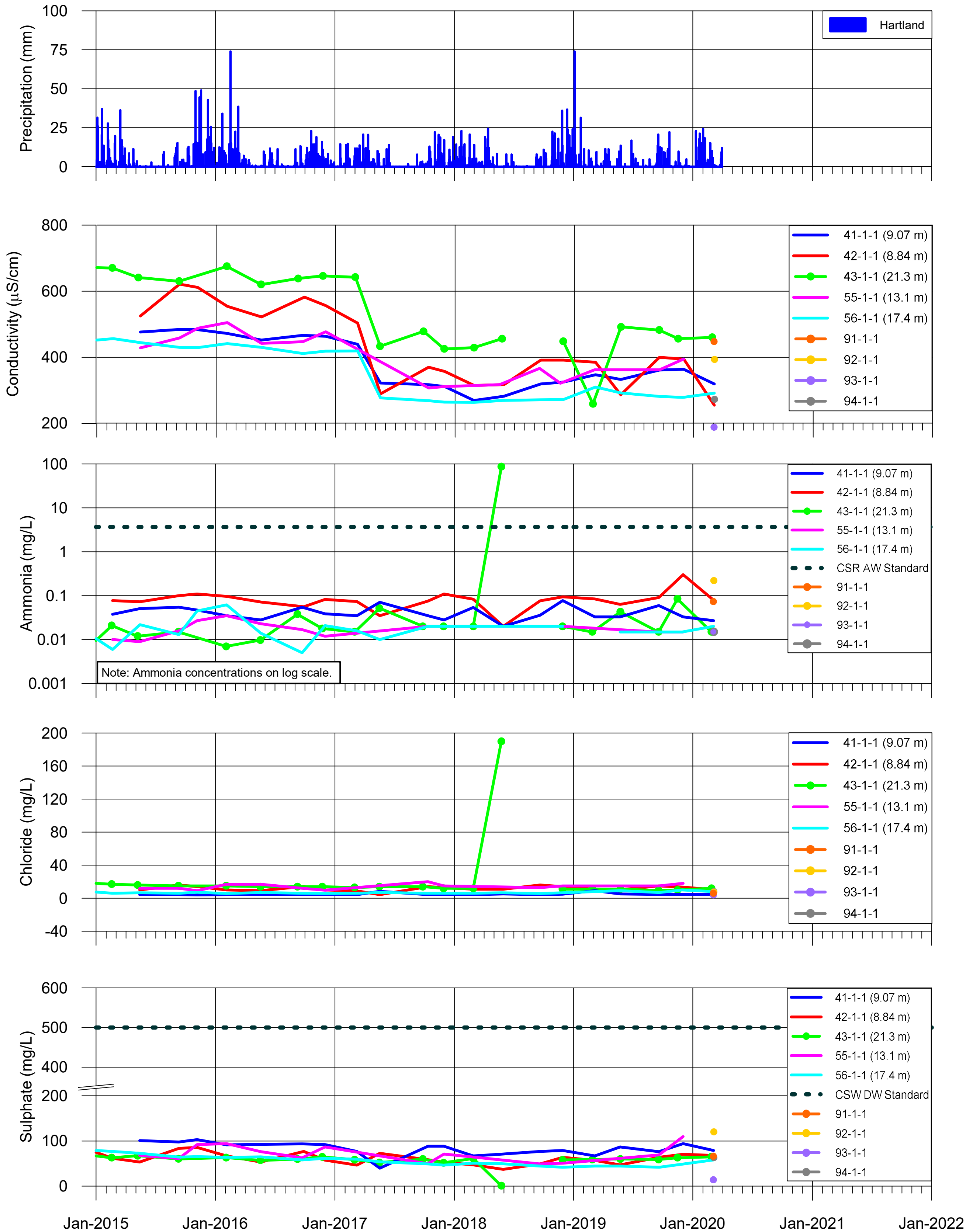

Figure 5-7. Groundwater Quality North of Hartland North Pad

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5.6 Monitors South of the Phase 1 Landfill

Monitoring well locations 4, 7, 19, 60, 71, 72, 73 and 85 are all located south of the Phase 1 landfill. Only wells at locations 4, 71, 72 and 73 are considered Boundary Compliance Wells. Well 71 is located off site along Hartland Avenue. The wells at locations 4, 19, 60, 71, 72 and 73 are multi-level nested monitoring wells, and the well at location 7 is a 37 m deep, drilled well (open borehole) that was used until 1989 for domestic water supply at the landfill. The wells at locations 71, 72 and 73 were installed in 2003. Well 85-1-1 was installed in 2009 to replace well 3-2-1, which was decommissioned to permit construction of the bin facility.

Similar to 2018/19, all analytes met the applicable CSR standards in 2019/20 for all wells. Figure 5-8 shows plots of leachate indicator parameters in wells located south and downgradient of the landfill, and Figure 5-9 plots leachate indicator parameters for wells located southeast of the landfill.

Groundwater quality in these wells is sensitive to the performance of the south purge well system (see Section 4.3.4) When the purge well system is functioning properly, concentrations of leachate indicator parameters have been shown to decline and seasonal fluctuations in concentrations of leachate indicator parameters are dampened. The reported concentrations indicate that the south purge well system is successfully mitigating southward migration of leachate.

5.6.1 South Purge Wells (P1, P2, P3, P4 and P10)

Groundwater quality data collected from the south purge wells (P1, P2, P3, P4 and P10) exhibited statistically significant increasing trends for multiple leachate indicator parameters over the past five years, indicating the degradation of water quality and improved leachate capture. In 2019/20, average conductivity values in all south purge wells were higher than those in 2018/19, which is consistent with the decreased leachate flow.

In 2019/20, conductivity values in the south purge wells ranged between 967 µS/cm (P10) to 2,327 µS/cm (P3) and were observed to be higher than previously seen in recent years. Statically significant increasing trends over the past five years have been observed in south purge wells P1 and P2.

Chloride concentrations in the south purge wells have been increasing slightly in recent years and show statically significant increasing trends for wells P1, P2, P3 and P10 over the past five years. Chloride concentrations in 2019/20 range from 64 mg/L (P10) to 220 mg/L (P3), which is similar to ranges previously seen in these south purge wells.

Ammonia concentrations for the south purge wells have continuously exceeded CSR standards and concentrations have been moderately increasing in recent years. Ammonia concentrations have exhibited a statistically significant increasing trend at wells P1, P2, P3 and P10 over the past five years.

In 2019/20, statistically significant increasing trends for sulphate concentrations were found for wells P1, P2, P3 and P4 over the past five years. Most samples taken during 2019/20 were below the detection limits, similar to previous years. Nitrate concentrations in 2019/20 for the south purge wells were mostly below or close to detection limits.

No statistically significant trends for nitrate were observed at any of the south purge wells over the past five years.

5.6.2 Monitoring Site 85

In well 85-1-1 (not a Boundary Compliance Well), chloride concentrations were typically below 50 mg/L, but increased to peak value of 150 mg/L in February 2017. Chloride concentrations then gradually decreased to historical ranges in 2018/19 but increased to 150 mg/L during May and September 2019 sampling events. Similar to previous years, sulphate concentrations were below 50 mg/L and ammonia concentrations were below 0.5 mg/L. Given the low sulphate and ammonia concentrations, groundwater at this location is unlikely to be impacted by aggregate runoff or dilute leachate. The elevated chloride concentrations may be related to the application of Garlon™ XRT herbicide, which contains chloride (i.e., Triclopyr).

A statistically significant decreasing trends in ammonia and nitrate were observed in well 85-1-1 over the past five years, indicating the benefits of improved performance of the south purge well system in recent years. A statistically significant increasing trend in chloride was exhibited in well 85-1-1 over the past five years. Groundwater quality should be closely monitored at location 85 to monitor the effectiveness of the south purge wells.

5.6.3 Monitoring Site 60

Three monitoring wells are present at location 60: 60-1-1 (23 m), 60-2-1 (16 m) and 60-3-1 (7 m). These wells are not considered Boundary Compliance Wells. Concentrations met the applicable CSR standards in all three wells at this location, but concentrations of leachate indicator parameters remained slightly elevated. In 2019/20, groundwater quality at location 60 was consistent with those measured in 2018/19, with conductivity values near background levels. Groundwater quality in 60-1-1 exhibited a statistically significant decreasing trend in sulphate and an increasing trend in chloride over the past five years. In addition, statistically significant decreasing conductivity and ammonia concentrations were detected in well 60-2-1 over the past five years. Statistically significant decreasing trends in conductivity and ammonia were observed at 60-3-1 over the past five years, indicating continued improvement in groundwater quality at location 60. Although increasing trends in chloride and sulphate were observed at 60-3-1, their concentrations were generally within historical ranges. Overall, groundwater quality at well 60 is generally stable or slightly improved. This indicates upgrades to the south purge well system and maintenance protocols since 2012 are continuing to improve shallow groundwater quality at this location.

Elevated concentrations of leachate indicator parameters and the sensitivity of water quality to performance of the south purge well system demonstrates the need for continued close monitoring of water quality at this location, review of pumping and water level data in the south purge wells, and active management of the south leachate collection system. Recent CRD projects have focused on improving leachate management at the south end of the landfill.

5.6.4 Monitoring Site 07

In 2019/20, all parameters at Boundary Compliance Well 07-1-0 were below applicable CSR standards. Groundwater quality exhibited a statistically significant decreasing trend in ammonia and an increasing trend in chloride concentrations over the past five years. The slightly increased chloride concentrations may be related to the application of Garlon™ XRT herbicide in May 2019. Ammonia concentrations remained relatively stable and low in 2019/20, and were within the historical range of values. Ammonia is often the first parameter detected at the leading edge of an advancing leachate plume, and water quality indicates the plume may be slightly retracting in this location. Water quality south of the landfill should be followed closely to ensure the south leachate collection system is effective.

5.6.5 Monitoring Sites 71, 72, 73

Wells 71, 72 and 73 are located at or near the eastern landfill property boundary south of Phase 1 and are considered Boundary Compliance Wells. Concentrations of leachate indicator parameters are shown on Figure 5-8 for wells at location 73 and on Figure 5-9 for wells at locations 71 and 72.

During 2019/20, all samples collected at location 71 met applicable CSR AW and CSR DW standards for all parameters. Similar to previous years, conductivity ranged between 230 µS/cm and 338 µS/cm, chloride concentrations were below 15 mg/L with the exception of one sample recorded in November in groundwater from well 71-2-1 (24 mg/L). Nitrate concentrations were typically near or below detection limits. Statistically significant decreasing trends were noted for conductivity and sulphate in 71-1-1 and for ammonia in 71-2-1 over the past five years. Sulphate and chloride concentrations in 71-2-1 and 71-3-1 exhibited a statistically increasing trend over the last five years, but concentrations remained below 25 mg/ L and 30 mg/L respectively. Although the ammonia concentration in 71-3-1 exhibited a statistically significant increasing trend, concentrations were well below the CSR AW standard.

All measured concentrations at 72-1-1 and 72-3-1 remained below applicable CSR standards in 2019/20. Similar to 2018/19, conductivity values were close to background levels and ranged from 428 µS/cm to 525 µS/cm. Ammonia concentrations remained below 0.05 mg/L, and nitrate concentrations were below detection limits. Chloride and sulphate concentrations ranged from 49 mg/L to 83 mg/L, and 44 mg/L to 64 mg/L, respectively, which were comparable with those measured in 2018/19. Well 72-1-1 exhibited a statistically significant decreasing trend in conductivity and well 72-3-1 also exhibited decreasing trends in conductivity, ammonia and chloride concentrations over the past five years. Close monitoring confirmed adequate leachate containment south of the landfill and indicates the previously elevated conductivity and chloride concentrations in 2018/19 were related to the use of road salt at the bin facility.

At Boundary Compliance well 73, located further south along the eastern property boundary, all parameters met applicable CSR standards in 2019/20. Conductivity, sulphate and chloride concentrations were relatively stable, and remained close to background levels. Nitrate and ammonia concentrations were near or below detection limits. Overall, concentrations of parameters at location 73 remained within background levels, and water quality continues to improve with distance from Phase 1. A Mann-Kendall trend analysis revealed statistically significant decreasing trends in conductivity in all three wells at location 73, and chloride and sulphate concentrations in 73-1-1 over the past five years. A significantly increasing trend was observed for nitrate in groundwater from well 73-3-1. Based on the graphical and statistical analysis of groundwater chemistry data, it appears that groundwater quality at location 73 is relatively stable and continues to improve.

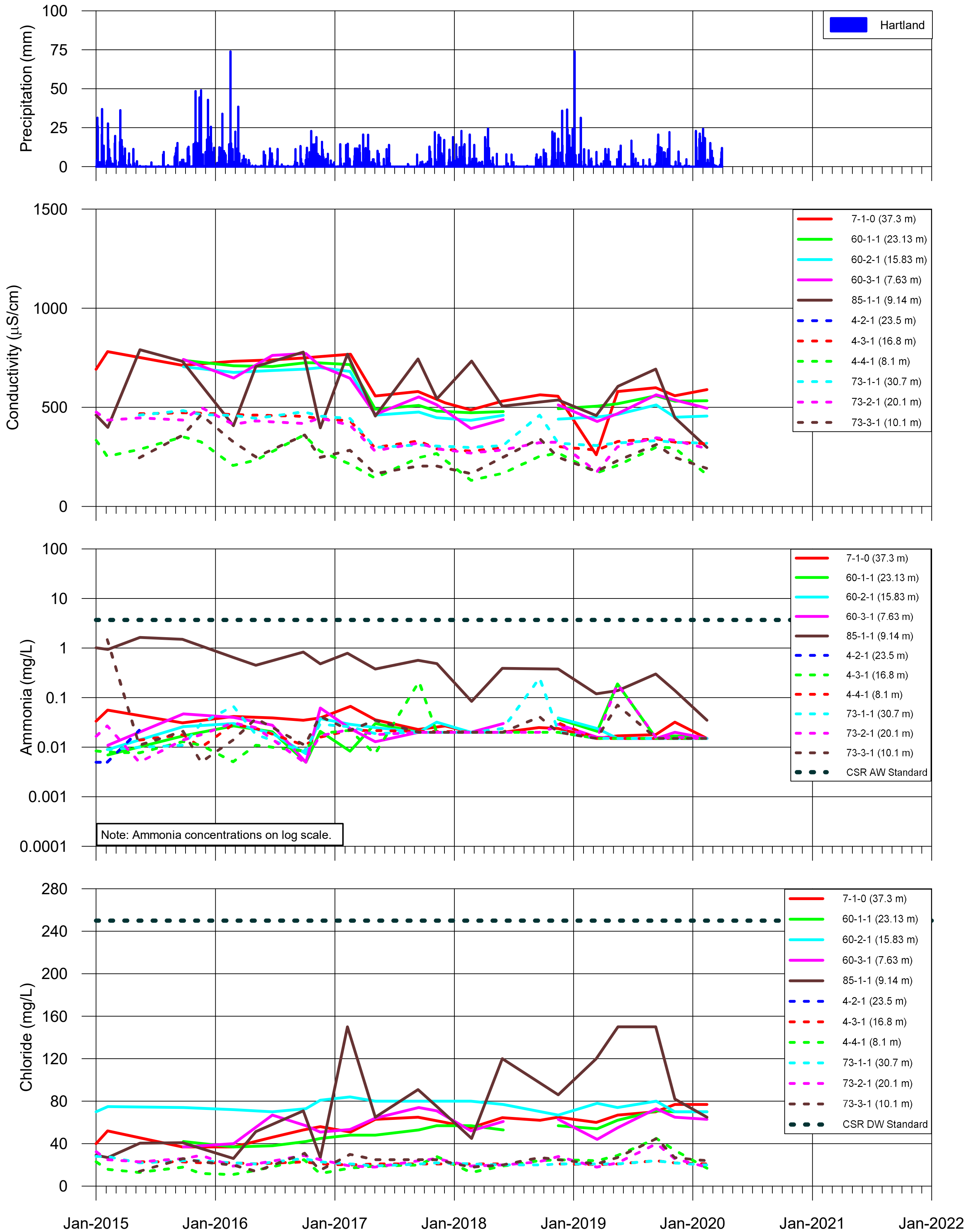

Figure 5-8. Groundwater Quality South of Landfill

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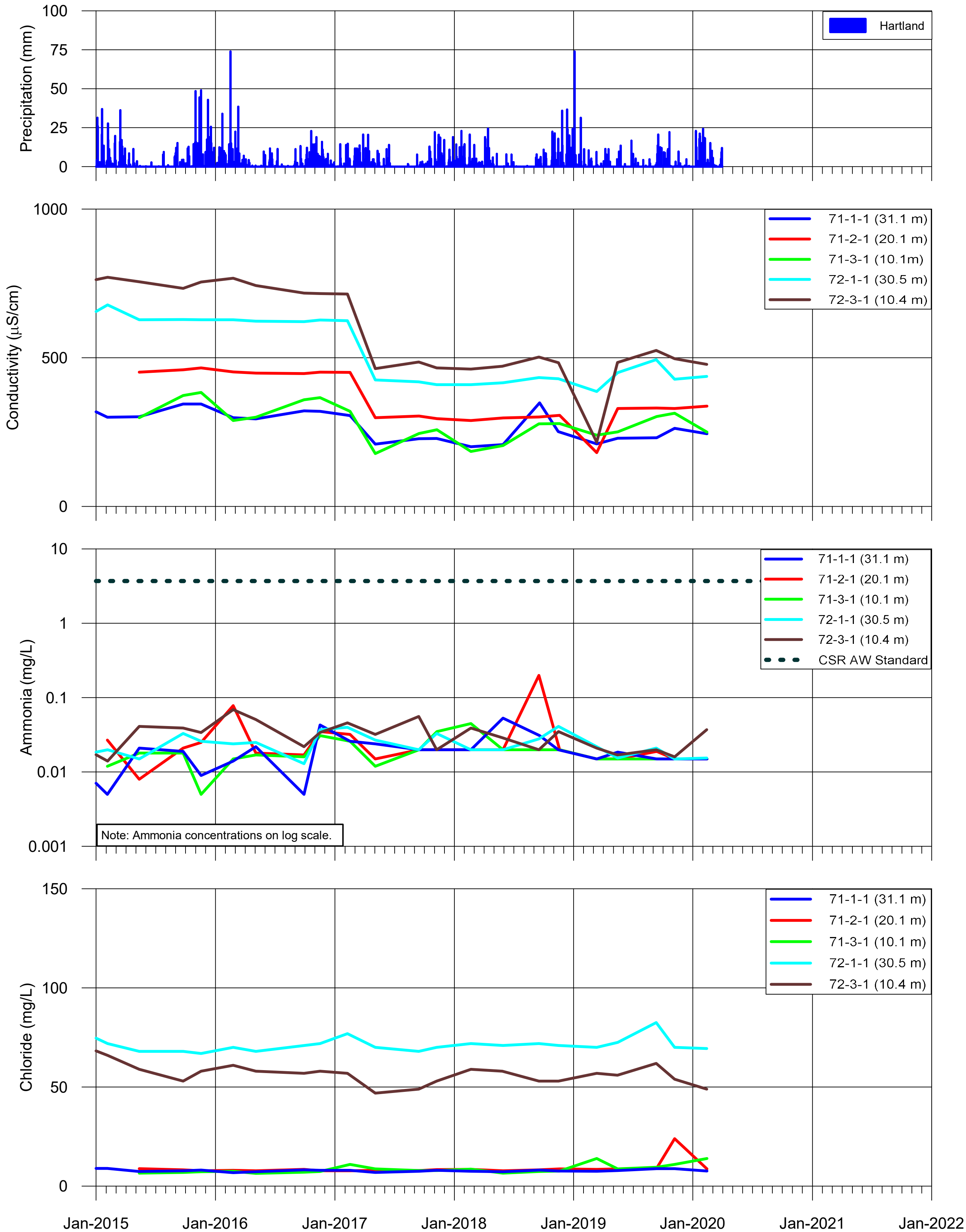


Figure 5-9. Groundwater Quality Southeast of Landfill

5.6.6 Monitoring Site 04

Location 04 is the most southerly groundwater monitoring location at the landfill and is considered a Boundary Compliance well. Groundwater sampling in the deepest monitoring well at location 04-2-1 was discontinued in 2016 due to extremely slow recharge and resultant challenges in collecting representative samples.

All concentrations observed in 04-3-1 and 04-4-1 met the applicable CSR standards in 2019/20. Groundwater quality at both wells continued to report slightly elevated concentrations of chloride in 2019/20, with a maximum concentration of 45 mg/L. Ammonia concentrations were below detection limits on all sampling dates in 04-3-1. Except for one sample at 04-4-1, sulphate concentrations were below the background concentration of 50 mg/L, indicating improvement in groundwater quality at this location.

As shown on Figure 5-8, conductivity, ammonia and chloride values have remained relatively stable over the past five years. A statistical analysis of data collected at location 04 over the past five years indicated statistically significant decreasing trends in conductivity in well 04-3-1 and increasing trends for nitrate in well 04-3-1 and chloride in well 04-4-1. Overall, water quality in wells at location 04 has slightly improved but should continue to be closely monitored for impacts due to leachate, road salt and aggregate placement.

5.6.7 Monitoring Site 19

Four monitoring wells are present at location 19: 19-1-1 (38 m), 19-1-2 (28 m), 19-2-1 (17 m) and 19-2-2 (9 m). These wells are not considered as Boundary Compliance wells. During 2019/20, all samples collected at location 19 met applicable CSR AW and DW standards. Similar to previous years, conductivity in all wells were below 500 µS/cm, ammonia and nitrate concentrations were generally close to detection limits, sulphate concentrations were below 50 mg/L. Similar to wells 85 and 60, chloride concentrations were slightly increased in 2019/20, and may be related to surface drainage from the kitchen scraps transfer station located in close proximity to the well and/or the application of the XRT herbicides. Statistically significant decreasing trends in conductivity were found in wells 19-1-2 and 19-2-2, decreasing in sulphate concentrations were identified in 19-1-1, 19-2-1 and 19-2-2. Statistically significant decreasing trends were also found for ammonia in 19-1-1. Statistically significant increasing trend was observed in chloride concentrations in wells 19-1-1 and 19-2-2.

5.7 Monitors East of the Phase 1 Landfill

Monitoring well locations 16, 17, 18, 50, 54 and 76 are situated along the east boundary of the Phase 1 landfill north of Hartland Avenue. Groundwater quality is no longer monitored at locations 50, 54 and 76 due to continued demonstration of groundwater flow toward the landfill and the presence of water quality reflective of background conditions.

5.7.1 Monitoring Sites 17 and 18

Figure 5-10 presents concentrations of leachate indicator parameters in wells at locations 17 and 18. In 2019/20, concentrations in wells at compliance locations 17 and 18 met applicable CSR standards for all parameters analyzed. Groundwater samples have not been collected at 18-1-2 due to an obstruction in the well since prior to 2010. Because the obstruction cannot be removed, the well should be replaced and decommissioned in accordance with the *Water Sustainability Act.*

In 2019/20, ammonia, chloride, sulphate and conductivity values at location 17 remained below background values, indicating groundwater quality was relatively stable. Nitrate concentrations at 17-1-3 ranged from below detection limits to 0.8 mg/L in November 2019. The slightly elevated nitrate may be derived from the oxidation of ammonia, which is associated with decaying organic matter. Based on field observations and experience at the landfill, the occasionally elevated ammonia and nitrate concentrations generally occurs during the winter, and may be associated with decaying organic matter, including reptiles that have entered well.

Groundwater quality data at location 18 indicated statistically significant decreasing trends in conductivity and chloride (18-1-1, 18-2-1 and 18-2-2) concentrations, and decreasing trend in sulphate (18-1-1). Although an increasing trend for sulphate was observed at well 18-2-1, sulphate concentrations were below 50 mg/L. At location

17, statistically significant decreasing trends were found in conductivity (17-1-1 and 17-1-2), ammonia (17-1-1) and sulphate (17-1-2).

5.7.2 Monitoring Site 16

At monitoring location 16 (not compliance wells), located northeast of Phase 1, concentrations of leachate indicator parameters were indicative of background conditions and applicable CSR standards were met for all parameters in 2019/20. Similar to previous years, nitrate concentrations at 16-1-1, 16-1-2, 16-2-1 and 16-2-2 during the winter increased above background values and reached 0.75 mg/L which is consistent with those observed at location 17, yet unusual for location 16. However, conductivity, sulphate, ammonia and chloride concentrations remained below background values, indicating the elevated nitrate was unlikely due to leachate. Overall, groundwater quality at location 16 has improved over historical concentrations, with statistically significant decreasing trends in conductivity in wells 16-1-1, 16-1-2 and 16-2-2. Water quality should continue to be monitored closely at this location.

5.8 Summary

The groundwater quality results for 2019/20 were similar to those measured over recent years and leachate-impacted groundwater is contained within the landfill property. At the north end of the landfill, leachate-affected groundwater extends just north of the unlined lower leachate lagoon and through the middle of the lined upper leachate lagoon but does not extend off-site. South of the landfill, leachate-affected groundwater does not extend off-site. Leachate related exceedances are confined to the landfill footprint on the east side of Phase 1 and are inferred to extend to the west side of the Phase 2 landfill.

Similar to 2018/19, the occasionally elevated sulphate concentrations in groundwater quality near the Hartland North pad was attributed to nearby construction activities associated with development of the Residuals Treatment Facility, but impacts were restricted to the footprint of the Hartland North pad.

In 2019/20, chloride concentrations in multiple groundwater wells located along the southern and eastern boundaries exhibited increasing statistical trends, and this temporary impact may be a result of application of Garlon™ XRT herbicides in May/June 2020.

In 2019/20, groundwater quality in north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) and surrounding wells were slightly degraded compared to 2018/19, with higher conductivity and ammonia concentrations. The degradation of groundwater quality may be related to less dilution related to lower precipitation, improved surface water diversion or low pumping rates observed at P7 during winter months in 2018/19 and continuing into 2019/20.

Similar to the north purge wells, groundwater quality data collected from the south purge wells (P1, P2, P3, P4 and P10) also indicated deteriorating water quality over time. This may be related to reduced dilution by precipitation or improved leachate collection. In 2019/20, average conductivity values in all south purge wells were higher than those in 2018/19, which is consistent with the decreased leachate flow.

Our review of the 2019/20 groundwater quality data revealed the following:

- Boundary Compliance wells and off-site monitoring wells met CSR AW and DW standards.
- CSR exceedances in groundwater were observed in on-site monitoring wells in close proximity to leachate purge wells and known leachate sources as follows:
  - Similar to previous years, water quality in well 58-1-0 (within the landfill footprint) exceeded CSR AW standards for ammonia on three of the four sampling dates and CSR DW standards for chloride on all four sampling dates in 2019/20. In 2019/20 analysis of more elements revealed that well 58-1-0 exceeded the CSR AW standard for cobalt and the CSR DW standards for cobalt, nickel sodium, strontium and vanadium on all four sampling dates.
  - Groundwater quality in well 52-1-1 (near the north purge wells) exceeded CSR AW standards for ammonia on all four sampling dates and CSR DW standards for sodium and strontium on all four sampling dates.

  - Groundwater quality in north purge well 52-4-0-P7 exceeded CSR AW standards for ammonia on all four sampling dates. It also exceeded CSR DW standards for chloride and sodium on all four sampling dates.
  - Groundwater quality in north purge well 80-1-0-P8 exceeded CSR AW standards for ammonia on all four sampling events. It also exceeded CSR DW standards for nitrite and nitrate during two sampling events.
  - Groundwater quality in the south purge wells (P1, P2, P3 and P4) exceeded CSR AW standards for ammonia on all sampling dates. P10 exceeded CSR ammonia standard on all four sampling dates. P1 exceeded CSR DW standards for barium on all four sampling dates. P10 exceeded the CSR DW for barium on two of the four sampling dates. P2, P3, P4 and P10 exceeded CSR DW standards for sodium on all four sampling events. P1 and P10 also marginally exceeded CSR DW standard for lithium on one or more sampling events. However, lithium concentrations were well below the regional background concentration of 33 µg/L, therefore is not considered as contaminant concern.
  - Groundwater quality in 92-1-1 (Hartland North Pad) marginally exceeded CSR DW standards for aluminum, lithium, lead and vanadium during one sampling event. However, lithium concentrations were well below the regional background concentration of 33 µg/L, therefore is not considered as contaminant concern.
- In 2019/20, annual average conductivity in the north purge wells were 3,123 µS/cm (52-4-0-P7), 1,566 µS/cm (80-1-0-P8) and 976 µS/cm (81-1-0-P9) were higher than those in 2018/19, suggesting a slight degradation of leachate quality. This may be a result of the low well yield in P7 as well as the prolonged dry period during the winter. Water quality at these wells should be closely monitored to monitor temporal changes in leachate quality and verify the effectiveness of leachate collection system.
- Operation of the Phase 1 north purge well system continues to mitigate leachate impacts north of the landfill, as indicated by long-term stable or decreasing concentrations of leachate indicator parameters at locations 40, 20 and 21. However, the average conductivity at location 21 and 40 were approximately 20% higher than those measured in 2018/19, indicating the slightly degradation of water quality. This may be related to prolonged dry period as well as slow flow rate of purge well P7. The north purge wells should continue to reinforce leachate containment and conveyance measures north of Phase 1 by maintaining water levels below the average elevation of the lower leachate lagoon. Groundwater at station 21 remained relatively stale or slightly improved throughout 2019/20. Progressive closure of Phase 1 Cell 1, commissioning of 81-1-0-P9 as a purge well, and dewatering of the lower leachate lagoon to facilitate repairs to leachate conveyance infrastructure appeared to improve groundwater quality around the lower leachate lagoon. Groundwater quality at station 20, 21 and 40 should continue to be closely monitored.
- In 2019/20, water quality at locations 29 and 30 continued to be slightly impacted by road salt application on Willis Point Road, but all parameters were below applicable CSR standards. Concentrations of conductivity and chloride show seasonal fluctuations and exhibit the highest concentrations in winter months, while ammonia concentrations remain relatively low. This suggests that road salt is the primary contributor to water quality degradation north of Willis Point Road. Statistically significant decreasing trends in conductivity and chloride indicate continued improvement in groundwater quality at these locations over the past five years.
- Groundwater quality between the lower leachate lagoon and Willis Point Road continued to show no indications of leachate impacts in 2019/20. All leachate indicator parameters at compliance location 31 remained relatively stable and low, and met applicable CSR AW and DW standards.
- Groundwater quality at locations 36 and 37 indicate minimal impacts to leachate indicator parameters in consideration of their proximity to the Phase 2 basin. Overall, this supports the hydraulic data which indicates that the hydraulic trap leachate collection system is effective at containing leachate north of Phase 2.
- Groundwater quality 100 m north of Phase 2 at locations 25 and 53 continued to show low concentrations of leachate indicator parameters in 2019/20, indicating water quality is not affected by landfill leachate. Groundwater in this area is highly sensitive to slight water level changes and a future hydraulic trap reversal would have the potential to result in northward leachate migration. As such, water levels and quality in this area should continue to be closely monitored for changes.
- Groundwater quality in the shallow well at location 27 (27-1-2) continued to be affected by ongoing aggregate production and blasting activity close to the Toutle Valley, as indicated by elevated conductivity, sulphate and

nitrate concentrations. Sulphate continued to be present at concentrations above background concentrations in 2019/20, but continued to decrease from the peak values observed in May 2016. The deep well at this location (27-1-1) shows no signs of impacts from aggregate production.

- Groundwater quality in 43-1-1 located on the Hartland North pad exceeded the BC CSR standard for ammonia and BC CSR DW standard for chloride during the May 2018 sampling event but returned to historical values during all 2019/20 sampling events. The anomalous water quality in 43-1-1 during the May 2018 sampling event may be due to a variety of effects but the concentrations returned to normal by Fall 2018. Groundwater quality in adjacent well 44-1-1 was also slightly degraded, with elevated sulphate concentrations. Groundwater quality at all stations downgradient of the Hartland North Pad should continue to be monitored closely for changes in water quality.
- Groundwater quality in 91-1-1, 92-1-1 and 88-2-1 located on Hartland North Pad showed minor impacts from RTF construction and quarrying activities, evident by slightly elevated conductivity (>300 µs/cm), ammonia (0.07 – 0.22 mg/L), and sulphate concentrations (66-130 mg/L). Groundwater quality in 93-1-1, 94-1-1, 87-1-1, 87-2-1 and 88-1-1 were generally consistent with the background levels, with low conductivity, chloride, sulphate and metal concentrations.
- Water quality data from the south end of the landfill met the applicable CSR standards. Although groundwater quality in south purge wells was slightly degraded in 2019/20, most of the wells in this area still showed improving trend in leachate indicator parameters and continued to report slightly elevated concentrations of leachate indicator parameters (conductivity, chloride and ammonia) in 2019/20, as they have since the early 1990s. The slightly increased chloride concentrations in wells located in southern and eastern landfill are likely related to the herbicide application, and the impact should be diminishing over time.
- Any long-term improvements in water quality south of the landfill are largely the result of leachate collection and containment measures instituted since 2001. It is expected that the reconfiguration of P1 will further improve the effectiveness of the south purge well system and may improve downgradient groundwater quality at the south end of the landfill over time. Ongoing improvements to operational and maintenance protocols should continue improving water quality south of the landfill. The application of road salt to trafficable areas continues to complicate interpretation of water quality data. Groundwater quality in this area is known to be sensitive to changes in the operation of the south purge wells and should continue to be monitored closely.
- Water quality along the east boundary of the Phase 1 landfill remained similar or slightly improved, with decreased conductivity values. Ammonia and/or nitrate concentrations were occasionally elevated at some locations, but they remained far below CSR standards. The occasionally elevated ammonia and nitrate concentrations may be associated with decaying organic matter including reptiles that have entered well. Groundwater gradients are westward towards the landfill, but groundwater in this area should continue to be closely monitored.

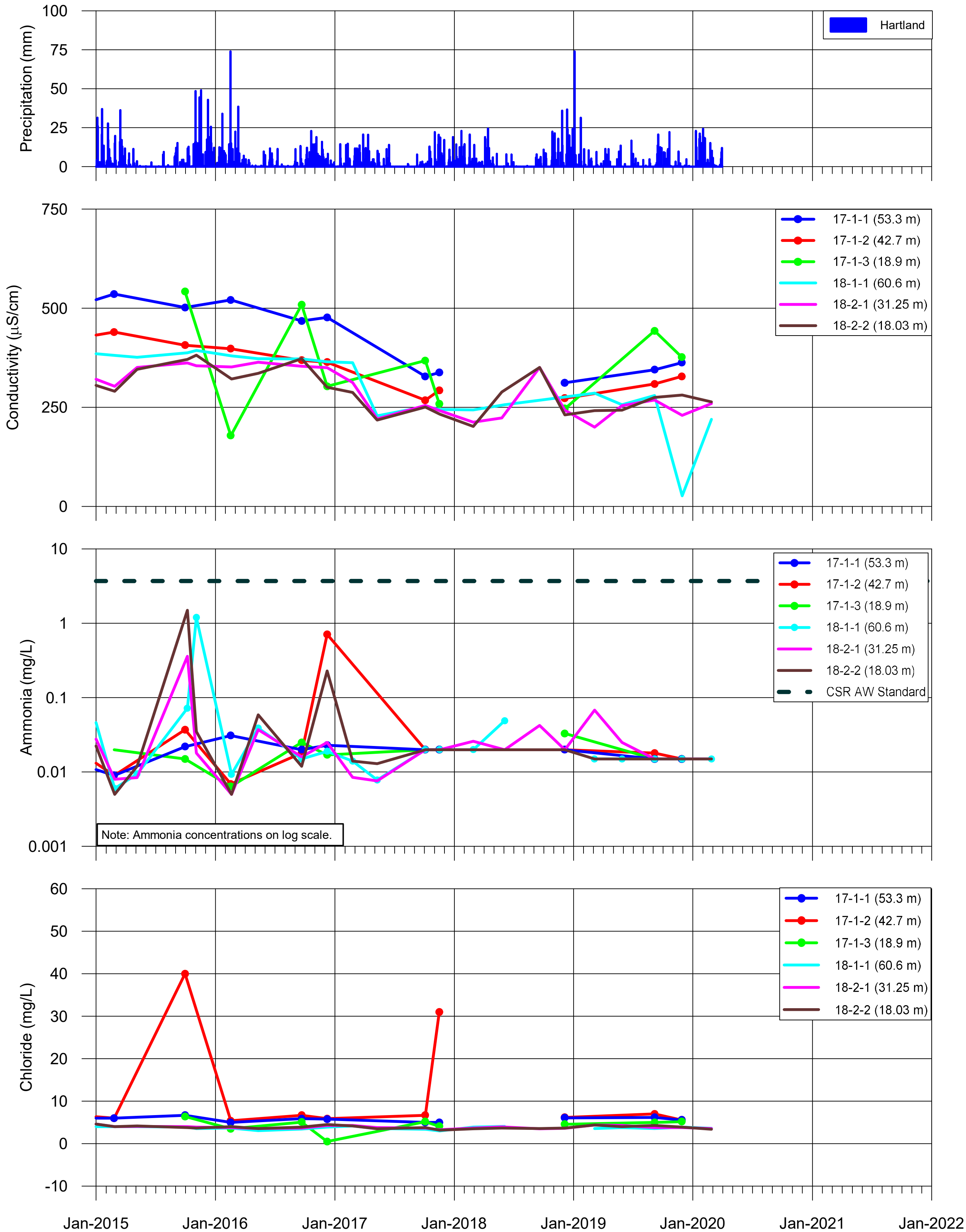


Figure 5-10. Groundwater Quality East of Landfill

AECOM

6. Groundwater Quality in Domestic Wells

6.1 Monitoring Locations

This section of the report is based on our interpretation of water quality data collected between July 17 and September 20, 2019 from domestic wells around Hartland landfill. The sampling program included:

- Single samples were collected in July 2019 from fourteen (14) selected domestic wells located within a 2 km radius of the landfill. Well 30 (Hartland Ave) was added in 2019 to the routine sampling program.
- Two replicate samples were collected from domestic wells 37 and 38.
- Single samples were collected from five (5) additional domestic wells located north of the Hartland North Pad and analyzed for selected parameters (sodium, chloride, ammonia, conductivity and pH).

Since the 1980s, the CRD has performed routine sampling and analysis of domestic wells in the vicinity of the landfill that are used as the primary source of drinking water. The number of wells included in the program has gradually been reduced as municipal water became available and residents chose to connect to the municipal supply system. Most of the domestic wells near Hartland landfill are situated southeast of the landfill as shown on Figure 6-1. The wells are primarily 0.15 m in diameter, drilled wells that penetrate between 30 m and 120 m of bedrock. Three of the wells are shallow dug wells completed in overburden. Well yields are generally low and substantial drawdown occurs during pumping, particularly during the dry summer months.

In 2018, five additional domestic wells located 3-5 km northwest of the landfill near the end of Willis Point Road were sampled at the request of residents, and only submitted for selected parameters (sodium, chloride, ammonia, conductivity and pH).

The routine samples collected in 2019 were analyzed for general water quality parameters and total metals. Tabulated results are presented in Appendix B.2. Results were compared to the *British Columbia Approved Source Drinking Water Quality Guidelines (SDWQGs)* where available and *Guidelines for Canadian Drinking Water Quality* (CDWQ). SDWQGs and CDWQ were updated in 2020 and June 2019, respectively, and a number of parameters (i.e., sulphate, antimony, lead, cobalt, chromium, copper, manganese, nickel etc.) were added to the drinking water guidelines or updated.

6.2 Domestic Well Quality

Groundwater quality in the domestic wells in 2019 was similar to the results that have been reported since 2000. Although concentrations of some parameters have varied since the sampling program began, they are considered representative of natural conditions or related to household water filtration/treatment equipment.

The current water quality met the applicable guidelines and standards in sampled wells with the exception of total lead and the exceedances of CDWQ guideline aesthetic objectives at select locations as described in detail below.

- Groundwater quality in domestic well 37 (at house) marginally exceeded the maximum allowable SDWQG and CDWQ for total lead during the September 2019 sampling event. Lead concentrations at the same well met both guideline during the July 2019 sampling event. Lead concentrations in SDWQG and CDWQ were updated in 2019 and decreased from 0.01 mg/L to 0.005 mg/L. Elevated concentrations of lead have previously been observed in this well and are attributed to water filtration equipment.
- Groundwater quality in domestic wells 37 (at house and well head) and 38 exceeded the SDWQG guideline of 0.02 mg/L for total manganese during July and September sampling events. The SDWQG for total manganese in drinking water is an aesthetic objective to protect against staining and unpleasant taste but is not considered to be toxic at these concentrations. Manganese concentration in SDWQG was updated in 2020, and decreased from 0.05 mg/L to 0.02 mg/L.
- Iron concentrations in well 53 have been reported at concentrations above the SDWQG guideline since 2013 and exceeded the CDWQ and SDWQG guideline of 0.3 mg/L in 2019. The iron exceedances may be

related to maintenance of household water filtration equipment. Iron is naturally present in the soils and the metamorphic rocks found in the vicinity of the landfill. Iron concentrations in groundwater samples collected from these domestic wells are interpreted as originating from natural sources.

The five domestic wells located northwest of the landfill near the end of Willis Point Road met CDWQ and SDWQG guidelines for leachate indicator parameters, indicating these wells were not impacted by leachate from Hartland landfill.

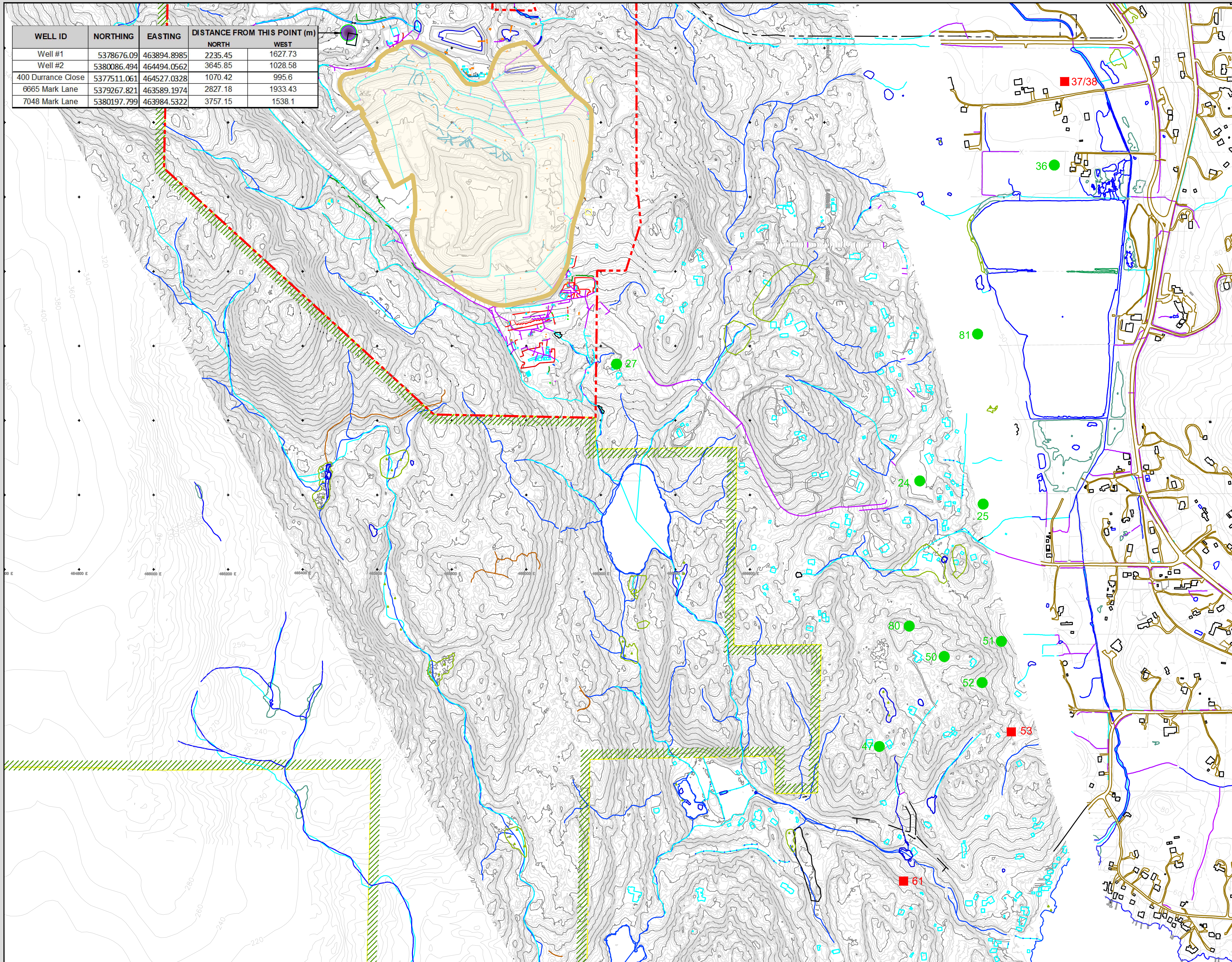
Overall, the 2019 domestic well water quality results are similar to historical data. The data indicates that the domestic wells have not been impacted by leachate from Hartland landfill. The occasional exceedance in total lead concentration in well 37 may be due to leaching from plumbing or lead service lines.

6.3 Summary

As part of the CRD's groundwater quality monitoring program, nineteen (19) domestic wells were sampled in 2019, including 14 routine locations and 5 new wells. The water quality monitoring program indicated:

- Lead concentrations in domestic well 37 marginally exceeded the max allowable SDWQG and CDWQ for total lead during the September 2019 sampling event. The occasional exceedance in total lead concentration in well 37 may be due to leaching from plumbing or lead service lines.
- Iron concentrations in domestic well 53 were marginally below CDWQ and SDWQG drinking water quality guidelines. Iron concentrations in this well have been reported above the guideline since 2013. However, iron guidelines are not human health objectives and may be naturally occurring or related to maintenance of water filtration equipment or household plumbing.
- Manganese concentrations in domestic wells 37 and 38 exceeded the SDWQG of 0.02 mg/L. The SDWQG for manganese in drinking water is an aesthetic objective to protect against staining (e.g., plumbing) but manganese is not deemed toxic at these concentrations.
- Overall, the groundwater quality in the domestic wells sampled in 2019 were consistent with previous results, and landfill leachate did not impact the water quality in the sampled wells. Water quality in all five new domestic wells located northwest of the landfill near the end of Willis Point Road met CDWQ and SDWQG guidelines, indicating these domestic wells were not impacted by leachate from Hartland landfill.

WELL ID	NORTHING	EASTING	DISTANCE FROM THIS POINT (m) NORTH	WEST
Well #1	5378676.09	463894.8985	2235.45	1627.73
Well #2	5380086.494	464494.0562	3645.85	1028.58
400 Durrance Close	5377511.061	464527.0328	1070.42	995.6
6665 Mark Lane	5379267.821	463589.1974	2827.18	1933.43
7048 Mark Lane	5380197.799	463984.5322	3757.15	1538.1



Legend

- BUILDING / STRUCTURE
- ROAD
- FENCE
- LEGAL LOT BOUNDARY
- INDEX CONTOUR (5m)
- INTERMEDIATE CONTOUR (1m)
- TREES/SHRUB/VEGETATION
- DITCH
- DRAINAGE
- PIPE
- EXISTING WASTE
- HARTLAND LANDFILL OPERATING AREA BOUNDARY
- 37 DRILLED DOMESTIC WELL SAMPLED IN JULY, 2019
- 61 DUG DOMESTIC WELL SAMPLED IN JULY, 2019.
- Well #1 DRILLED DOMESTIC WELL SAMPLED IN JULY - AUGUST, 2019.

Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater elevation data collected by CRD, September 2019.
- Contours based on 24-W542_2018-2019 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT April 2020.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.

N W E S

0 50 100 200 300 400 m

1 : 10,000

UTM Zone 10N, NAD83

File Name: FIG6.1-Domestic Well Locations-20200622-60631284-431.dwg

Reviewed by:	KJ	Prepared by:	NT
Date Issued:	JUNE 2020	Project Number:	60631284

CRD
Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Domestic Well Locations

AECOM

Figure 6-1
Version 1

7. Surface Water Quality near the Landfill

7.1 Compliance Monitoring Locations

A total of five surface water compliance monitoring stations have been identified surrounding Hartland landfill. These stations are concentrated along the southern and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site. With respect to assessing landfill compliance with the landfill operating permit, the following are considered boundary compliance stations:

South of the Landfill

- Sw-S-04

North of Phases 1 and 2

- Sw-N-05
- Sw-N-16

North of the Hartland North pad

- Sw-N-41s1
- Sw-N-42s1

Laboratory analytical results are presented in Appendix B.3. A review of the sampling program was undertaken in early 2016 (AECOM, 2016), and the recommended adjustments to the number, location and sampling frequency of sampling at compliance monitoring locations were implemented in the 2016/17 monitoring year. In 2019/20, a total of 23 surface water stations were actively sampled.

7.1.1 Regulatory Comments

As discussed in Section 2.4.2, the results were compared to the BCWQG for the protection of freshwater aquatic life (updated in August 2019). Exceedances of the BCWQ guidelines are noted in Table 7-1. The following specific issues are noted:

- For ammonia, there is no single value for the protection of freshwater aquatic life. The toxicity of ammonia is related to the temperature and pH of the water and the BCWQG include values for acute and chronic effects. The appropriateness of the chronic, or allowable 30-day concentration for the assessment of ongoing operations is currently being evaluated. Based on surface water monitoring data collected, CRD staff calculated the allowable 30-day average concentration of ammonia for the protection of freshwater aquatic life and the maximum allowable concentration (MAC) based on the pH and temperature of each sample as discussed in the footnotes of Table 7-1, with exceedances highlighted based on BCWQG Maximum Allowable Concentrations (MAC's).
- The BCWQG-MAC for sulphate were calculated for each sample based on the hardness measured in each sample. A detailed description is presented in the footnotes of Appendix B.3.
- The BCWQG-MAC and 30-day average values for total suspended solids (TSS) reference a "change from background value" and the flow conditions (i.e. clear or turbid waters). Water quality at stations SW-N-CSs2, SW-N-41s3 and SW-N-14 are taken to represent background surface water quality north of the landfill. Water quality at station SW-S-52 represents background surface water quality south of the landfill. In 2018/19, the background TSS values north and south of the landfill were both <2 mg/L, respectively.
- BCWQG for cadmium, lead, nickel, manganese, silver and zinc are hardness dependent. Total metal concentrations were compared to guidelines based on the associated hardness results for each sample.
- The dissolved copper BCWQG varies with hardness, pH, dissolved organic carbon (DOC) and temperature, and is calculated using the Biotic Ligand Model (BLM). Dissolved organic carbon were only collected at compliance stations during the March 2020 monitoring event. Therefore, only dissolved copper concentrations with accompanied DOC in this report were compared with BCWQG criteria.

Table 7-1 Surface Water Quality Exceedances 2019-2020

AECOM

B.C. Water Quality Guidelines (1)				Aluminum	Arsenic	Boron	Cadmium	Chloride	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead	Manganese
			Short-term Maximum	---	5	---	---	600	110	---	---	1000	3.28 - 416.7 (4)	815 - 33946 (4)
			30-Day Average	---	---	1200	---	150	4	---	---	---	3.43 - 19.57 (4)	767-2585 (4)
Station	**Sample Type**	**Compliance (Y/N)?**	**Sample Date** / Fraction	TOT	TOT	TOT	TOT	DIS	TOT	TOT	TOT	TOT	TOT	TOT
			Units	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L
			Method Detection Limit (MDL)	3	0.02	10	0.005	1	0.01	0.1	0.5	5	0.02	0.1
			Limit Of Quantification (LOQ)	15	0.1	50	0.025	5	0.05	0.5	2.5	25	0.1	0.5
SW-N-05	FRM	Y	03-May-2019	51.25	0.117 5	31.	0.005 5	5.35	0.233	1.25	166.5	69.5	< 0.02	2.705
SW-N-05	FRM		08-Oct-2019	369.5	0.142	35.5	0.010 5	7.7	0.519	4.965	186.5	627.	0.075 9	12.1
SW-N-05	FRM		05-Dec-2019	29.1	0.126	55.	0.063 65	5.65	0.148	1.72	361.5	38.3	0.012 6	1.925
SW-N-05	FRM		07-Feb-2020	77.5	0.132	39.	0.013 9	4.8	0.133 5	1.69	219.	98.95	0.021	1.805
SW-N-14	SS		04-Dec-2019	21.5	0.127	73.	0.005 5	15.	0.098 6	1.31	207.	63.2	0.035 9	6.24
SW-N-16	FRM	Y	02-May-2019	62.65	0.289 5	102.5	0.034	11.	0.973 5	5.805	224.	**1 755.** a	0.115	904.5
SW-N-16	FRM		09-Oct-2019	19.4	0.338	76.	0.012 65	13.	0.713 5	3.08	268.5	**1 240.** a	0.038	413.5
SW-N-16	FRM		04-Dec-2019	21.05	0.213	89.5	0.016 45	10.	0.33	4.355	274.	359.	0.021 55	345.
SW-N-16	FRM		07-Feb-2020	102.55	0.231	40.5	0.014 65	3.8	0.250 5	15.2	121.	242.5	0.040 5	30.45
SW-N-16	FRM		24-Mar-2020	15.6	0.217 5	73.5	0.017 6	8.9	0.535	5.22	163.5	684.	0.014 1	518.
SW-N-17	SS	N	02-May-2019	22.2	0.109	88.	< 0.005	13.	0.265	0.63	153.	66.6	< 0.02	22.4
SW-N-17	SS		08-Oct-2019	22.4	0.094	103.	0.008 1	11.	0.274	0.747	178.	74.3	0.023 3	43.2
SW-N-17	SS		04-Dec-2019	10.1	0.118	100.	0.005	16.	0.106	0.554	269.	16.	< 0.005	7.83
SW-N-17	SS		07-Feb-2020	59.	0.108	66.	0.005 1	8.3	0.099	1.15	173.	77.	0.022	2.58
SW-N-18	SS	N	03-May-2019	34.4	0.065	11.	< 0.005	5.1	0.129	0.33	151.	50.4	0.027	2.08
SW-N-18	SS		09-Oct-2019	10.9	0.074	14.	< 0.005	6.4	0.113	0.388	276.	18.7	0.012 5	0.625
SW-N-18	SS		05-Dec-2019	6.73	0.058	13.	0.005	5.4	0.098 8	0.274	343.	10.	0.009 8	0.476
SW-N-19	SS	N	02-May-2019	17.5	0.242	69.	0.031	12.	0.969	14.9	267.	73.	0.046	82.3
SW-N-19	SS		04-Dec-2019	7.04	0.266	50.	0.007 6	7.1	0.359	8.02	356.	30.5	0.006	22.9
SW-N-19	SS		07-Feb-2020	72.1	0.245	33.	0.013 1	3.2	0.26	22.2	141.	102.	0.024	6.58
SW-N-41S1	FRM	Y	09-Oct-2019	59.35	0.254 5	22.5	0.010 05	4.9	0.308	0.395	368.	233.	0.065	270.
SW-N-41S1	FRM		06-Feb-2020	179.5	0.247 5	16.	0.005 7	3.45	0.175	0.705	141.5	269.5	0.121	77.7
SW-N-41S1	FRM		17-Mar-2020	21.8	0.134 5	31.	< 0.005	4.05	0.083 5	0.23	202.5	50.45	< 0.02	46.05
SW-N-45	SS	N	02-May-2019	22.	0.097	73.	< 0.005	10.	0.245	0.85	165.	26.8	< 0.02	3.05
SW-N-45	SS		04-Dec-2019	7.75	0.113	85.	0.007 3	10.	0.154	0.794	349.	12.6	0.010 7	4.08
SW-N-45	SS		07-Feb-2020	76.5	0.152	47.	0.005 2	6.5	0.127	1.51	220.	93.4	0.017	2.63
SW-N-50	SS	N	08-Oct-2019	6.05	0.054	18.	< 0.005	7.5	0.124	0.366	281.	6.8	0.012 8	0.726
SW-N-50	SS		05-Dec-2019	7.15	0.049	13.	0.005	5.2	0.095 8	0.341	339.	7.2	< 0.005	0.675
SW-N-51	SS	N	07-Feb-2020	25.1	0.048	< 10.	< 0.005	3.9	0.069	0.62	53.9	49.2	0.056	0.73
SW-N-53	SS		07-Feb-2020	234.	0.172	35.	0.006 7	3.3	0.325	1.37	242.	404.	0.041	9.1
SW-N-54	SS		05-Dec-2019	9.76	0.32	47.	0.013 4	4.5	0.247	12.7	419.	15.1	0.005 8	69.7
SW-S-03	SS		08-Oct-2019	54.1	0.253	67.	0.011 8	17.	0.226	8.92	225.	110.	0.066 8	19.8
SW-S-03	SS		06-Feb-2020	3 360.	0.518	47.	0.046 5	15.	3.35	20.1	79.5	**5 930.** a	1.67	237.
SW-S-04	FRM	Y	08-Oct-2019	17.1	0.086 5	84.	0.020 15	33.	0.088 05	1.535	152.	13.65	0.024 15	2.225
SW-S-04	FRM		06-Feb-2020	359.5	0.151 5	36.5	0.023 65	15.	0.385 5	4.58	63.3	622.5	0.35	33.9
SW-S-04	FRM		17-Mar-2020	48.8	0.100 5	83.	0.01	21.	0.105 5	1.91	96.9	82.4	0.05	6.73
SW-S-12	SS	N	03-May-2019	112.	0.282	47.	0.043	12.	0.339	12.	131.	435.	0.119	77.1
SW-S-12	SS		08-Oct-2019	116.	0.398	36.	0.043 2	4.9	0.37	24.4	285.	201.	0.149	9.76
SW-S-12	SS		05-Dec-2019	197.	0.355	38.	0.015 8	8.7	0.452	12.6	178.	387.	0.157	41.9
SW-S-12	SS		06-Feb-2020	5 290.	0.551	61.	0.053 4	11.	**5.44** b	30.5	105.	**9 250.** a	1.7	390.
SW-S-20	SS	N	06-Feb-2020	406.	0.129	11.	0.017 9	4.1	0.431	1.84	33.5	655.	0.11	15.9
SW-S-21	SS		06-Feb-2020	172.	0.097	13.	< 0.005	4.3	0.135	1.46	36.1	219.	0.077	5.08
SW-S-24	SS		06-Feb-2020	555.	0.236	59.	0.029 4	23.	0.666	8.03	85.8	**1 040.** a	0.625	66.2
SW-S-27	SS		06-Feb-2020	103.	0.108	53.	0.037 5	25.	0.175	1.54	74.1	163.	0.316	16.9

Notes:

na	*Not applicable.*
a	*Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*
b	*Above 30-day average British Columbia Water Quality Guideline.*
6.31	*pH values were below the applicable range of 6.5-9, but no significant decrease trend was observed.*
(1)	*British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated August 2019. British Columbia Ministry of Environment and A Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment.The guidelines cited are specific to protection of freshwater aquatic life unless otherwise noted.*
(2)	*Maximum acceptable concentration unless otherwise noted.*
(3)	*Metals guidelines are based on total concentrations, not dissolved, with the exception of iron.*
(4)	*The ammonia guideline is pH and temperature dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*
(5)	*The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*
(6)	*This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*
(7)	*The TSS guidelines are flow rate and "change from background" dependent.*
(8)	*Total copper guideline varies with pH, water hardness, temperature and dissolved organic carbon; Total copper results were only compared with guidelines where DOC was analyzed.*

Table 7-1 Surface Water Quality Exceedances 2019-2020

AECOM

Station	Sample Type	Compliance (Y/N)?	Sample Date	Parameters	Molybdenum	N - NH3 (As N)	N - NO2 (As N)	N - NO3 (As N)	Nickel	Selenium	Silver	Sulphate	TSS	Zinc	pH	Conductivity	Temperature	Aluminum	Arsenic
B.C. Water Quality Guidelines (1)				Short-term Maximum	2000	1.9-24.9 (2)	0.06 - 0.6 (3)	32.8	---	---	0.1-3 (4)	128-429 (4)	Variable (7)	33-340.5 (4)	6.5 to 9.0 (7)	---	---	100(5)	---
				30-Day Average	1000	0.135-1.77 (2)	0.02 - 0.20 (3)	3	---	---	0.05-1.5 (4)	---	Variable (7)	7.5-187.5 (4)	---	---	---	50 (5)	---
				Fraction	TOT	TOT	DIS	DIS	TOT	TOT	TOT	DIS	TOT	TOT	TOT	TOT	TOT	DIS	DIS
				Units	µg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L	pH	µS/cm	°C	µg/L	µg/L
				Method Detection Limit (MDL)	0.05	0.015	0.005	0.2	0.1	0.04	0.01	1	1	1	0.1	1	0.1	0.5	0.02
				Limit Of Quantification (LOQ)	0.25	0.075	0.025	1	0.5	0.2	0.05	5	5	5	0.5	5	0.5	2.5	0.1
SW-N-05	FRM	Y	03-May-2019		0.877	0.26	< 0.005	4.96 b	0.485	0.314 5	< 0.01	65.	< 2.	1.6	6.9	206.	10.1	5.72	0.112 5
SW-N-05	FRM		08-Oct-2019		0.608 5	0.041 5	< 0.005	5.075 b	1.06	0.358 5	< 0.007 5	110.	3.6	3.855	7.18	291.	12.	4.83	0.12
SW-N-05	FRM		05-Dec-2019		1.43	< 0.015	< 0.005	10.95 b	0.62	0.812	< 0.005	210.	< 1.	3.025	6.58	505.	9.1	15.5	0.139 5
SW-N-05	FRM		07-Feb-2020		1.14	< 0.015	< 0.005	5.865 b	0.61	0.490 5	< 0.01	155.	2.	2.85	7.16	324.	7.9	21.7	0.095 5
SW-N-14	SS		04-Dec-2019		0.358	< 0.015	< 0.005	3.34 b	0.357	0.135	< 0.005	110.	1.4	2.94	6.86	310.	6.8	5.52	0.122
SW-N-16	FRM	Y	02-May-2019		0.926 5	1.515	0.005 55	0.108 5	2.265	0.119 5	< 0.01	73.2	**20.5** a b	12.75	7.3	355.	10.5	5.595	0.286 5
SW-N-16	FRM		09-Oct-2019		0.962 5	0.076 5	0.006 55	0.048	2.07	0.122	< 0.01	130.	18.5 b	4.3	6.94	401.	9.3	8.865	0.334 5
SW-N-16	FRM		04-Dec-2019		0.607	0.31	0.148 5	6.255 b	1.405	0.089 5	< 0.005	135.	1.7	12.9	6.66	389.	6.3	6.7	0.194
SW-N-16	FRM		07-Feb-2020		0.658 5	0.021 5	< 0.005	3.23 b	1.975	0.118 5	< 0.01	55.5	1.8	7.8	7.26	203.	7.3	29.8	0.193
SW-N-16	FRM		24-Mar-2020		0.584	0.185	< 0.005	0.193	1.405	0.097 5	< 0.005	62.5	6.4 b	9.205	**6.33** a	254.	7.1	8.39	0.208 5
SW-N-17	SS	N	02-May-2019		0.733	0.034	< 0.005	3.1 b	0.25	0.159	< 0.01	54.6	< 2.	1.1	7.66	249.	10.4	5.41	0.179
SW-N-17	SS		08-Oct-2019		0.643	0.024	< 0.005	2.73	0.28	0.185	< 0.005	92.	**61.** a b	3.14	6.95	398.	10.6	5.07	0.106
SW-N-17	SS		04-Dec-2019		0.542	< 0.015	< 0.005	5.35 b	0.195	0.355	< 0.005	190.	1.1	1.38	7.12	395.	8.1	5.97	0.105
SW-N-17	SS		07-Feb-2020		0.768	< 0.015	< 0.005	3.39 b	0.34	0.287	< 0.01	110.	2.	1.9	7.33	257.	7.2	19.5	0.141
SW-N-18	SS	N	03-May-2019		0.405	2.4 b	< 0.005	2.64	0.15	0.277	< 0.01	56.5	< 2.	1.2	7.76	225.	9.3	2.81	0.158
SW-N-18	SS		09-Oct-2019		0.494	< 0.015	< 0.005	7.47 b	0.148	0.482	< 0.005	170.	< 1.1	3.66	7.77	404.	9.8	4.51	0.1
SW-N-18	SS		05-Dec-2019		0.385	< 0.015	< 0.005	8.96 b	0.155	0.597	< 0.005	250.	< 1.	2.57	7.76	470.	8.8	2.63	0.086
SW-N-19	SS	N	02-May-2019		1.26	0.51	0.013	3.37 b	3.66	0.183	< 0.01	112.	3.	3.9	8.12	404.	12.1	6.59	0.282
SW-N-19	SS		04-Dec-2019		0.798	0.034	0.047 1	12.9 b	2.06	0.147	< 0.005	190.	1.4	3.32	8.07	475.	6.4	7.57	0.269
SW-N-19	SS		07-Feb-2020		0.854	< 0.015	< 0.005	4.32 b	2.71	0.16	< 0.01	65.	< 1.	5.8	7.34	224.	7.6	33.3	0.216
SW-N-41S1	FRM	Y	09-Oct-2019		0.392	0.024 5	< 0.005	0.552 5	0.305	0.245	< 0.01	200.	20. b	2.2	7.95	328.	9.4	23.35	0.228
SW-N-41S1	FRM		06-Feb-2020		0.241	< 0.03	< 0.005	0.472 5	0.285	0.089 5	< 0.01	71.5	10.5 b	1.4	7.11	210.	8.1	10.765	0.183 5
SW-N-41S1	FRM		17-Mar-2020		0.289 5	0.04	< 0.005	0.21	0.125	0.088	< 0.01	89.	< 1.	< 1.	7.62	274.	7.1	6.165	0.137 5
SW-N-45	SS	N	02-May-2019		0.974	0.3	< 0.005	5.41 b	0.22	0.253	< 0.01	64.4	< 2.	5.26	7.34	267.	10.1	5.21	0.125
SW-N-45	SS		04-Dec-2019		0.801	< 0.015	< 0.005	10.3 b	0.26	0.642	< 0.005	210.	10. b	0.94	6.88	495.	8.7	4.64	0.112
SW-N-45	SS		07-Feb-2020		1.04	< 0.015	< 0.005	5.6 b	0.476	0.818	< 0.005	150.	< 1.	2.82	7.48	312.	7.9	17.5	0.096
SW-N-50	SS	N	08-Oct-2019		0.506	0.017	< 0.005	7.84 b	0.121	0.513	< 0.005	160.	< 1.	0.12	7.08	390.	9.1	3.57	0.11
SW-N-50	SS		05-Dec-2019		0.377	< 0.015	< 0.005	8.87 b	0.142	0.677	< 0.005	250.	< 1.	0.16	7.62	463.	8.4	8.86	0.106
SW-N-51	SS	N	07-Feb-2020		0.287	0.028	< 0.005	0.294	0.14	0.104	< 0.01	19.	2.	**38.3** a b	7.37	83.	5.3	4.16	0.027
SW-N-53	SS		07-Feb-2020		0.573	< 0.015	0.021 2	9.06 b	3.	0.721	< 0.01	170.	2.	23.6	8.38	356.	7.9	14.4	0.157
SW-N-54	SS		05-Dec-2019		0.766	< 0.015	0.049 9	**38.2** a b	1.32	0.249	< 0.005	170.	< 1.	0.84	7.51	584.	8.8	4.32	0.381
SW-S-03	SS		08-Oct-2019		0.338	0.022	< 0.005	5.75 b	1.02	0.14	< 0.005	160.	5.1 b	6.18	7.19	429.	15.1	7.26	0.272
SW-S-03	SS		06-Feb-2020		0.212	0.73	0.032 7	1.28	6.34	0.085	0.015	17.	**42.** a b	**34.7** a b	6.64	94.	7.7	34.4	0.279
SW-S-04	FRM	Y	08-Oct-2019		0.121	0.016	< 0.005	0.62	0.416	0.066	< 0.005	74.5	2.1	2.04	**6.27** a	288.	11.1	8.76	0.096
SW-S-04	FRM		06-Feb-2020		0.113 5	0.14	0.015 85	0.922 5	1.05	0.051 5	< 0.01	15.	6.8 b	13.2 b	6.96	119.	6.7	36.6	0.166 5
SW-S-04	FRM		17-Mar-2020		0.189	0.018	< 0.005	1.46	0.44	0.052	< 0.01	23.5	6.2 b	3.	**6.24** a	169.	6.2	19.85	0.105 5
SW-S-12	SS	N	03-May-2019		0.191	0.81	0.014 1	3.49 b	2.75	0.129	< 0.01	48.4	< 2.	4.2	7.03	238.	12.2	17.7	0.324
SW-S-12	SS		08-Oct-2019		0.244	0.026	< 0.005	8.47 b	5.96	0.251	< 0.005	170.	5.9 b	5.38	7.53	474.	15.3	35.1	0.387
SW-S-12	SS		05-Dec-2019		0.172	< 0.015	< 0.005	5.86 b	2.64	0.146	< 0.005	110.	1.6	4.6	7.13	293.	10.2	29.8	0.324
SW-S-12	SS		06-Feb-2020		0.188	1.9 b	0.008 9	1.67	9.97	0.138	0.019	24.	**74.** a b	34. b	6.45	84.	8.4	58.3 b	0.279
SW-S-20	SS	N	06-Feb-2020		0.051	0.043	< 0.005	0.027	0.54	< 0.04	< 0.01	3.1	**77.** a b	32.9 b	6.82	54.	5.9	37.6	0.134
SW-S-21	SS		06-Feb-2020		0.053	< 0.015	< 0.005	0.068	0.32	0.041	< 0.01	3.2	2.8	17.9 b	7.13	55.	5.8	**110.** a b	0.096
SW-S-24	SS		06-Feb-2020		0.166	0.24	0.028 6	1.38	1.83	0.063	< 0.01	24.	9.2 b	14.8 b	7.04	169.	7.3	23.3	0.199
SW-S-27	SS		06-Feb-2020		0.108	< 0.015	< 0.005	0.432	0.44	0.054	< 0.01	20.	2.4	6.	**6.46** a	148.	6.3	22.8	0.172

Notes:

na	*Not applicable.*
a	*Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*
b	*Above 30-day average British Columbia Water Quality Guideline.*
6.31	*pH values were below the applicable range of 6.5-9, but no significant decrease trend was observed.*
(1)	*British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated August 2019. British Columbia Ministry of Environment and A Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment.The guidelines cited are specific to protection of freshwater aquatic life unless otherwise noted.*
(2)	*Maximum acceptable concentration unless otherwise noted.*
(3)	*Metals guidelines are based on total concentrations, not dissolved, with the exception of iron.*
(4)	*The ammonia guideline is pH and temperature dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*
(5)	*The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*
(6)	*This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*
(7)	*The TSS guidelines are flow rate and "change from background" dependent.*
(8)	*Total copper guideline varies with pH, water hardness, temperature and dissolved organic carbon; Total copper results were only compared with guidelines where DOC was analyzed.*

Table 7-1 Surface Water Quality Exceedances 2019-2020

AECOM

B.C. Water Quality Guidelines (1)					Boron	Cadmium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Zinc	Dissolved Organic Carbon
				Short-term Maximum	---	0.038 - 2.8 (4)	---	Variable (8)	---	350	---	---	---	---	---	---	---	---
				30-Day Average	---	0.018 - 0.645 (4)	---	Variable (8)	---	---	---	---	---	---	---	---	---	---
Station	Sample Type	Compliance (Y/N)?	Sample Date	Parameters	Boron	Cadmium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead	Manganese	Molybdenum	Nickel	Selenium	Silver	Zinc	Dissolved Organic Carbon
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	Dissolved
				Units	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
				Method Detection Limit (MDL)	10	0.005	0.005	0.05	0.5	1	0.005	0.05	0.05	0.02	0.04	0.005	0.1	0.5
				Limit Of Quantification (LOQ)	50	0.025	0.025	0.25	2.5	5	0.025	0.25	0.25	0.1	0.2	0.025	0.5	2.5
SW-N-05	FRM	Y	03-May-2019		29.5	0.006	0.178	0.986	168.5	4.1	< 0.006	0.182	0.879 5	0.337 5	0.284	< 0.005	1.14	
SW-N-05	FRM		08-Oct-2019		31.	0.010 75	0.138 5	3.795	184.	16.3	0.019 2	0.555 5	0.649 5	0.574	0.347 5	< 0.005	3.62	
SW-N-05	FRM		05-Dec-2019		64.	0.022 15	0.138	2.14	373.5	14.6	0.010 35	1.34	1.65	0.605 5	0.781 5	< 0.005	3.07	
SW-N-05	FRM		07-Feb-2020		41.5	0.015 95	0.080 65	6.095	212.5	16.65	0.131 9	0.513	1.075	0.514 5	0.472	< 0.005	4.63	
SW-N-14	SS		04-Dec-2019		81.	0.006 6	0.088	1.9	221.	13.5	0.025 4	0.502	0.566	0.314	0.125	< 0.005	4.37	
SW-N-16	FRM	Y	02-May-2019		93.	0.015	0.557 5	7.31	221.	168.	0.235	438.	0.861	2.145	0.094 5	< 0.005	9.135	
SW-N-16	FRM		09-Oct-2019		68.	0.005 3	0.689	2.11	234.5	470. a	0.022 75	398.	0.928	2.085	0.099 5	< 0.005	4.295	
SW-N-16	FRM		04-Dec-2019		100.5	0.023 15	0.314 5	5.555	294.	116.	0.026 8	394.5	0.668 5	1.45	0.080 5	< 0.005	17.3	
SW-N-16	FRM		07-Feb-2020		41.5	0.012 05	0.196	16.55	124.5	97.35	0.117 45	28.2	0.733	1.95	0.138 5	< 0.005	9.635	
SW-N-16	FRM		24-Mar-2020		72.	0.018 5	0.532 5	11.35 a	168.	153.	0.166	526.5	0.568	1.52	0.071 5	< 0.005	12.35	8.4
SW-N-17	SS	N	02-May-2019		83.	0.007	0.253	5.83	147.	41.	0.372	21.3	0.771	0.299	0.147	< 0.005	5.64	
SW-N-17	SS		08-Oct-2019		89.	0.063 2	0.158	1.12	166.	19.8	0.017 6	19.8	0.694	0.292	0.157	< 0.005	4.78	
SW-N-17	SS		04-Dec-2019		107.	0.006 5	0.105	1.32	289.	11.5	< 0.022	7.19	1.06	0.249	0.351	< 0.005	4.75	
SW-N-17	SS		07-Feb-2020		85.	0.005 3	0.068 3	7.98	185.	12.7	0.204	1.36	0.885	0.421	0.322	< 0.005	5.47	
SW-N-18	SS	N	03-May-2019		13.	< 0.005	0.097	5.76	152.	12.3	0.338	0.658	0.426	0.197	0.283	< 0.005	5.53	
SW-N-18	SS		09-Oct-2019		13.	< 0.005	0.11	1.53	241.	30.8	0.043 6	0.66	0.514	0.228	0.458	< 0.005	7.45	
SW-N-18	SS		05-Dec-2019		16.	0.010 3	0.098 4	0.863	357.	34.6	0.020 5	0.472	0.443	0.155	0.633	< 0.005	5.25	
SW-N-19	SS	N	02-May-2019		61.	0.022	0.618	14.5	250.	21.9	0.062	22.7	1.19	3.78	0.139	< 0.005	7.8	
SW-N-19	SS		04-Dec-2019		55.	0.009 6	0.352	13.9	374.	31.	0.042 1	23.1	0.858	2.1	0.125	< 0.005	6.87	
SW-N-19	SS		07-Feb-2020		34.	0.012 2	0.225	25.4	141.	40.9	0.205	5.16	0.879	2.68	0.162	< 0.005	8.63	
SW-N-41S1	FRM	Y	09-Oct-2019		18.	0.008 5	0.228 5	2.355	324.5	154.	0.042 45	196.	0.404 5	0.300 5	0.217 5	< 0.005	3.615	
SW-N-41S1	FRM		06-Feb-2020		15.	< 0.005	0.047 6	4.29	141.5	18.4	0.111 65	20.85	0.254 5	0.152	0.085 5	< 0.005	3.945	
SW-N-41S1	FRM		17-Mar-2020		18.5	< 0.005 6	0.067 15	3.582	206.	30.75	0.101 25	39.85	0.292	0.264	0.104	< 0.005	2.695	1.35
SW-N-45	SS	N	02-May-2019		68.	0.008	0.254	6.44	165.	11.3	0.369	2.73	0.994	0.277	0.252	< 0.005	5.26	
SW-N-45	SS		04-Dec-2019		93.	0.009 5	0.157	1.65	375.	46.9	0.029 9	4.21	0.933	0.313	0.73	< 0.005	4.6	
SW-N-45	SS		07-Feb-2020		51.	0.008 5	0.074 2	5.92	205.	26.3	0.133	0.847	1.06	0.474	0.443	< 0.005	4.27	
SW-N-50	SS	N	08-Oct-2019		11.	< 0.005	0.115	1.48	255.	19.5	0.029 9	0.791	0.602	0.228	0.503	< 0.005	4.51	
SW-N-50	SS		05-Dec-2019		15.	0.010 6	0.108	1.28	352.	56.6	< 0.030 4	1.54	0.46	0.252	0.645	< 0.005	3.92	
SW-N-51	SS	N	07-Feb-2020		10.	< 0.005	0.042 3	5.84	55.3	12.	0.149	0.339	0.305	0.14	0.122	< 0.005	39.3	
SW-N-53	SS		07-Feb-2020		37.	0.008	0.093 7	6.72	247.	7.3	0.159	1.66	0.607	2.76	0.796	< 0.005	24.8	
SW-N-54	SS		05-Dec-2019		49.	0.014 9	0.233	12.9	434.	33.7	0.030 1	68.5	0.87	1.26	0.226	< 0.005	3.76	
SW-S-03	SS		08-Oct-2019		57.	0.012 1	0.156	8.72	208.	27.5	0.021 6	14.5	0.337	1.04	0.146	< 0.005	8.14	
SW-S-03	SS		06-Feb-2020		45.	0.021 6	0.27	10.1	68.4	87.	0.036 6	135.	0.204	1.85	0.077	< 0.005	16.2	
SW-S-04	FRM	Y	08-Oct-2019		73.	0.020 6	0.074 55	1.52	142.5	2.05	0.009 05	0.729	0.128	0.428	0.070 5	< 0.005	4.135	
SW-S-04	FRM		06-Feb-2020		35.5	0.009	0.076 8	3.585	60.65	53.5	0.038 15	8.55	0.137 5	0.568 5	0.059 5	< 0.005	10.45	
SW-S-04	FRM		17-Mar-2020		58.5	0.011 85	0.080 15	1.8 a	96.5	21.15	0.028 65	1.995	0.141	0.345 5	0.053 5	< 0.005	2.895	2.9
SW-S-12	SS	N	03-May-2019		45.	0.02	0.258	16.6	126.	77.7	0.415	67.8	0.226	2.51	0.11	< 0.005	7.22	
SW-S-12	SS		08-Oct-2019		27.	0.038 7	0.236	22.9	266.	81.5	0.019	4.45	0.7	5.86	0.226	< 0.005	5.77	
SW-S-12	SS		05-Dec-2019		40.	0.010 7	0.146	11.6	184.	35.8	0.061 7	6.5	0.239	2.3	0.125	< 0.005	7.15	
SW-S-12	SS		06-Feb-2020		60.	0.025	0.387	15.4	89.3	187.	0.045 5	237.	0.144	2.83	0.118	< 0.005	15.1	
SW-S-20	SS	N	06-Feb-2020		< 10.	0.007	0.054 4	1.83	33.6	32.9	0.039 2	6.61	0.066	0.225	< 0.04	< 0.005	34.8	
SW-S-21	SS		06-Feb-2020		11.	0.008 2	0.107	1.66	33.6	141.	0.058 9	4.04	0.106	0.298	< 0.04	< 0.005	17.6	
SW-S-24	SS		06-Feb-2020		57.	0.019 3	0.122	8.1	81.5	55.	0.046 6	31.9	0.288	1.08	0.07	< 0.005	12.9	
SW-S-27	SS		06-Feb-2020		51.	0.037 5	0.099 6	3.67	72.1	44.5	0.075 9	9.65	0.152	0.382	0.048	< 0.005	8.8	

Notes:

na	*Not applicable.*
a	*Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*
b	*Above 30-day average British Columbia Water Quality Guideline.*
6.31	*pH values were below the applicable range of 6.5-9, but no significant decrease trend was observed.*
(1)	*British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated August 2019. British Columbia Ministry of Environment and A Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment.The guidelines cited are specific to protection of freshwater aquatic life unless otherwise noted.*
(2)	*Maximum acceptable concentration unless otherwise noted.*
(3)	*Metals guidelines are based on total concentrations, not dissolved, with the exception of iron.*
(4)	*The ammonia guideline is pH and temperature dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*
(5)	*The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*
(6)	*This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*
(7)	*The TSS guidelines are flow rate and "change from background" dependent.*
(8)	*Total copper guideline varies with pH, water hardness, temperature and dissolved organic carbon; Total copper results were only compared with guidelines where DOC was analyzed.*

7.2 Assessment of Surface Water Quality Impacts

The primary causes of any surface water quality degradation at the site include leachate, road salt and crushed aggregate production, stockpiling and use. Ammonium lignosulphonate has been used for dust suppression on gravel roads since 2014. Background conductivity in surface water is typically below 200 µS/cm, but has been observed at higher concentrations at some locations during periods of low flow, or after periods of prolonged dry weather. Background ammonia concentrations are typically below 0.01 mg/L, but occasionally reach 0.1 mg/L downgradient of wetland areas. Background chloride concentrations are typically below 10 mg/L. Background sulphate concentrations are typically below 10 mg/L, but often increase in the downstream direction as streams receive groundwater discharge from underlying groundwater aquifers.

Surface water is considered to be impacted by leachate when conductivity concentrations are above 500 µS/cm, ammonia concentrations are above 0.5 mg/L and chloride concentrations are above 20 mg/L. Peak concentrations at surface water monitoring stations are typically observed during the dry summer and early fall months, when flows are low and there is limited dilution by precipitation.

Surface water is considered impacted by aggregate (e.g., production, stockpiling or site construction works) when sulphate is present at concentrations above 75 mg/L and ammonia or nitrate (blasting residuals) are present at concentrations above background levels of 0.1 mg/L. Peak concentrations are typically observed during the first sampling event following the onset of wet weather in the fall months, and in areas of active quarry development or aggregate placement.

Surface water is considered impacted by road salt when both conductivity (>300 µS/cm) and chloride (>20 mg/L) are elevated above background levels, but ammonia and its degradation products (primarily nitrate) are not elevated (<0.1 mg/L) above background levels. Sites that are judged to be impacted by road salt must also be located downstream (or downgradient) of surfaces and roadways where road salt is known to be applied. Concentrations of conductivity and chloride typically exhibit peaks following cold weather periods when de-icing salt is often applied to roadways.

Surface water quality in natural and anthropogenically modified systems can be highly variable due to variations in flow and chemical inputs over time. Professional judgement is also used to determine the nature and degree of any impacts due to leachate, road salt and aggregate stockpiles. The authors are hydrogeologists and geochemists with considerable experience evaluating leachate and water quality at other landfills and mines in coastal regions of British Columbia. If any surface water concentrations exceed BCWQG for the protection of aquatic life at the property boundary, standard CSR protocols for notification of affected property owners should be followed.

7.3 Data

Hartland landfill is located within the Tod Creek watershed on a drainage divide between the Heal Creek drainage basin to the north and the Killarney Creek basin to the south. Surface water from both the Heal Creek drainage basin and Killarney Creek basin flow into Tod Creek and ultimately discharge to Tod Inlet. Surface water sampling stations are shown on Figure 7-1. Surface water sampling stations have been established on the landfill property to monitor compliance at the property boundary and identify changes in surface water quality that could be related to landfill operations. Surface water stations are also located at numerous off-site locations to routinely monitor water quality.

In 2019/20, pre-existing surface water locations continued to be monitored for potential impacts, if any, related to construction of the RTF in the Hartland North Area.

The surface water interpretation was based on water quality data collected at 8 locations south and west of the landfill, 11 locations north of Phase 1 and 2 landfill areas, and 4 locations northwest of the landfill (Hartland North Pad). Surface water quality samples are collected four times per year from property boundary compliance and other key stations, and two times per year from all other stations. When watercourses were dry, samples were not collected. Surface water sampling locations are shown on Figure 7-1. Sampling points utilized for the 2019/20 monitoring program are shown below:

South and West of the Landfill

- Sw-S-03
- Sw-S-04 - compliance
- Sw-S-12
- Sw-S-20
- Sw-S-21
- Sw-S-24
- Sw-S-27
- Sw-S-52

North of the Hartland North pad

- Sw-N-41s1 - compliance
- Sw-N-41s3
- Sw-N-42s1 - compliance
- Sw-N-CS2

North of Phases 1 and 2

- Sw-N-05 - compliance
- Sw-N-14
- Sw-N-16 - compliance
- Sw-N-17
- Sw-N-18
- Sw-N-19
- Sw-N-45
- Sw-N-50
- Sw-N-51
- Sw-N-53
- Sw-N-54

7.4 Surface Water Quality North of the Landfill

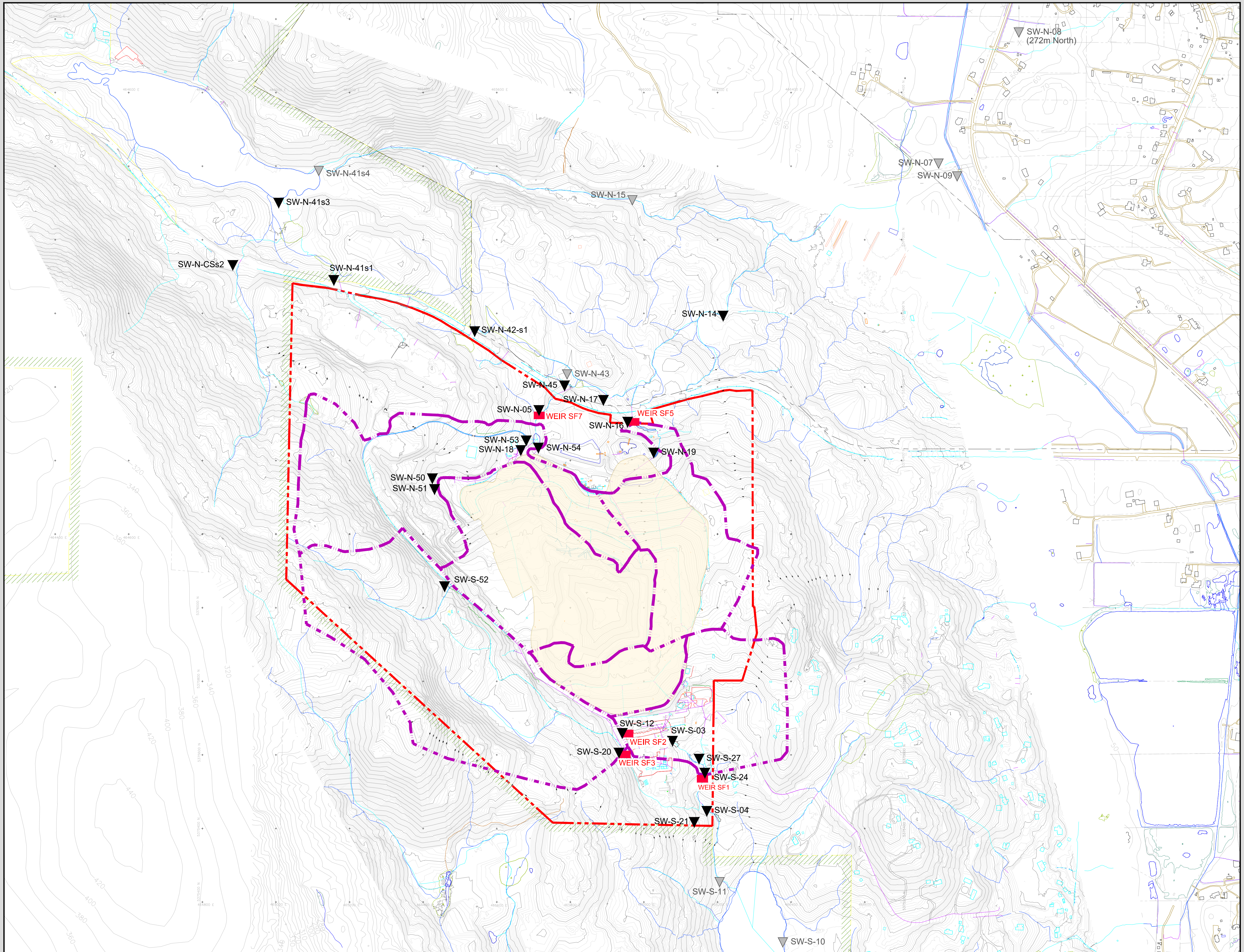
7.4.1 Surface Water Quality North of Phase 1 and Phase 2

Figure 7-2 presents conductivity, ammonia, chloride and sulphate concentrations in Heal Creek downstream of the landfill at stations Sw-N-05, Sw-N-14 and Sw-N-16. The distance of each station from the landfill boundary is shown in brackets in the legend. Sw-N-05 and Sw-N-16 are compliance stations. The plot shows that water quality continued to meet applicable BCWQG at stations downstream of the landfill on all sampling dates in 2019/2020. Similar to previous years, these sampling locations were periodically dry in 2019/20 due to arid summer conditions.

Heal Creek flows north-easterly from the sedimentation pond at the north end of the Phase 2 basin to the confluence with Durrance Creek, as shown in Figure 7-1. Durrance Creek discharges to Tod Creek, which in turn discharges to Tod Inlet, about 3 km north of the landfill. Heal Creek is a small creek with a watershed area of 143 ha. Heal Creek is mainly steep and rocky although the creek passes through a few small wetlands near the upper end. The creek dries up during the summer months except in the lower reaches where groundwater discharge maintains flow year-round. Clean runoff from the Phase 1 closure and the eastern perimeter of the landfill is directed to a lined sedimentation pond and then into the wetland located north of the lower leachate lagoon. The wetland, in turn, discharges northward to Heal Creek. Heal Creek also receives drainage from the area north of Phase 2 (High Level Road ditch), and from a small stream draining a small wetland below the east end of the Hartland North pad. Aggregate and piping was added to select sections of the High Level Road ditch in June 2018 to protect the ditch from nearby construction and mitigate ponding, which may contribute to elevated concentrations of sulphate in surface drainage over time.

On December 23rd, 2019 a leachate condensate pipe along the Northwest Slope Road at Hartland Landfill was damaged by a vehicle which resulted in a minor leachate release along the Northwest Slope Road. The total release volume was determined to be minor, and flows would have been discharged to the north sedimentation pond through the NW freshwater retention pond (via SW-N-54), or directly to the north sedimentation pond via SW-N-18.The north sedimentation pond discharges through a creek (SW-N-05 compliance station) into a roadside ditch on Willis Point Road, which flows east into Tod Creek.

Surface water samples at source of spill, upstream and downstream of sedimentation pond, SW-N-05 and SW-N-54 were immediately collected by CRD staff following the release and submitted to laboratory on the same day for ammonia and chloride analysis. The analytical results indicated that the leachate release was contained within the landfill footprint and did extend just beyond the NW freshwater retention pond (SW-N-54), where surface water was impacted to a minor degree. No impacts were observed downstream of the sedimentation pond and at compliance station SW-N-05 and water quality was consistent with historical concentrations.



Legend

- BUILDING / STRUCTURE
- ROAD
- FENCE
- LEGAL LOT BOUNDARY
- INDEX CONTOUR (5m)
- INTERMEDIATE CONTOUR (1m)
- TREES/SHRUB/VEGETATION
- DITCH
- DRAINAGE
- PIPE
- EXISTING WASTE
- HARTLAND LANDFILL OPERATING AREA BOUNDARY
- SW-S-52 ACTIVE SURFACE WATER SAMPLING LOCATION
- SW-N-15 INACTIVE SURFACE WATER SAMPLING LOCATION
- SURFACE WATER DIVIDE
- WEIR SF1 WEIR LOCATION

Map Sources / Notes:
- Contour interval 1.0 m
- Groundwater elevation data collected by CRD, September 2019.
- Contours based on 24-W542_2018-2019 BASE.dwg PROVIDED BY CINDY WANG OF CAPITAL REGIONAL DISTRICT April 2020.
- Drainage information for years 2018-2019 obtained from Parks & Env. Services GIS technicians and have layers with the prefix "CRD19_GIS DRAINAGE" & "CRD19_GIS streams_Ditches".
- GPS pickup has been conducted by CRD Staff of creeks, wetlands, culverts located under tree canopied areas. This information (considered more accurate) has been added to the base (superceding some planimetric information) and is placed on layers indicating GPS pickup. An example of that layering system would be 'CRD19-wat-culvert_GPS pickup'.
- Surveyed points for monitoring sites (groundwater, gas wells, leachate, purge wells) were updated for 2019.
- The map is to NAD83 UTM coordinates. Vertical datum is to CGVD28.

N E S W

0 50 100 200 300 400 m

1 : 10,000

UTM Zone 10N, NAD83

File Name: FIG7.1-SURFACE WATER BODIES AND SAMPLING-60631284-430-20200622.DWG

Reviewed by:	KJ	Prepared by:	NT
Date Issued:	JUNE 2020	Project Number:	60631284

CRD
Making a difference...together

Project: Hartland Landfill Monitoring
Location: Saanich, BC

Surface Water Bodies and Sampling Locations

AECOM

Figure 7-1
Version 1

7.4.1.1 Monitoring Site SW-N-16

A small wetland is located just north of the lower leachate lagoon. Water flows from this wetland northwards through a weir (Sw-N-16 - compliance location) before discharging to a culvert under Willis Point Road and then to Heal Creek. Site Sw-N-16 is located on the landfill property and is the compliance point used to monitor the quality of the surface water leaving the landfill through this route.

In 2019/20, all parameters were measured at concentrations below BCWQG-MAC guidelines at Sw-N-16 except for pH, TSS, dissolved copper, dissolved iron and total iron during one or more sampling events. Nitrate concentrations were above the BCWQG 30-Day average guideline of 3 mg/L during two out of five sampling events. Nitrate and sulphate concentrations were elevated during October and December 2019 sampling events and reached 6.26 mg/L and 135 mg/L, respectively. However, ammonia concentrations remained relatively low, and only elevated to 1.515 mg/L in May 2019 sampling event. Given the low ammonia and chloride concentrations, it is unlikely the surface water was impacted by leachate. The elevated nitrate and sulphate concentrations during the winter season suggested that surface water may be impacted by the prolonged dry winter season (i.e., less dilution), as well as nearby construction activities involving blasting, aggregate placement, or excavation of organic soils.

The iron exceedances are likely due to the disturbance of sediment during sampling, as indicated by high TSS concentrations. Moreover, the elevated iron concentrations may be derived from the wetland located upgradient of Sw-N-16 or related to sediment accumulation at sampling locations. Dissolved copper concentrations in February 2020 reached 11.35 µg/L, which was above the BCWQG-MAC and higher than previously observed. However, the copper exceedance may be related to contamination from in-line filters used during sampling as discussed in section 3.2.1. The comparison between the total and dissolved copper concentrations also confirms that results were not accurate, as concentrations in dissolved phase are approximately two times higher than observed in the total phase. In June 2020, CRD staff removed sediment accumulations adjacent to sampling locations and cleaned catch basins in an effort to reduce sediment interference at select sampling locations.

The north purge well system has been expanded since 2016 to enhance leachate collection between the upper and lower leachate lagoons, which may result in slight improvements in water quality. Fall 2017 dredging of the lower leachate lagoon is expected to improve groundwater quality downgradient of the lagoon over time.

7.4.1.2 Monitoring Site SW-N-05

The other route for surface water to leave the property to the north is through the main channel of Heal Creek located just north of Phase 2. In 2019/20, water quality samples were collected on all five sampling dates at compliance point Sw-N-05, which is located within the landfill property.

Surface water quality measured at Sw-N-05 met BCWQG-MAC for all parameters on all dates sampled. Nitrate concentrations exceeded BCWQG 30-Day average guidelines on four out of five sampling dates. Conductivity, nitrate and sulphate concentrations were higher than those in 2018/19, indicating that surface water may be impacted by runoff from blasting, quarrying and aggregate stockpiling areas. No impacts were observed related to the damaged leachate collector pipe on December 23, 2019. Statistical analysis revealed an increasing trend in sulphate and nitrate concentrations over the past five years, indicating the slight degradation of water quality due to aggregate production and usage.

7.4.1.3 Monitoring Site SW-N-19

Sw-N-19 is located within the landfill property below the northeast freshwater retention pond, and approximately 80 m east of the lower leachate lagoon. It is not a compliance monitoring location. It receives runoff primarily from the bedrock/refuse interface adjacent to Phase 1 and discharges to the wetland upstream of Sw-N-16. In 2019/20, water quality samples were collected on all four sampling dates.

In 2019/20, all parameters were below BCWQG-MAC guidelines on all sampling dates. Similar to Sw-N-16, nitrate concentrations were elevated (i.e., 4.32 - 12.95 mg/L) during winter months and were above BCWQG 30-day average on three sampling dates. There is no statistically significant trend observed in 2019/20, indicating water quality at this station remained stable over the last five years.

7.4.1.4 Monitoring Sites SW-N-45 and SW-N-17

Sw-N-45 is located north of Phase 2, and outside the landfill property boundary on the north side of Willis Point Road. During 2019/2020, samples were collected on three out of four attempted sampling dates. Concentrations of all analytes were measured at concentrations below BCWQG-MAC and 30-Day Average throughout the monitoring year, except for nitrate and TSS. Nitrate concentrations in Sw-N-45 were marginally above BCWQG 30-Day average during all sampling events. In 2019/20, conductivity, nitrate and sulphate concentrations were elevated compared to those in 2018/19, indicating that surface water may be impacted by construction activities/aggregate stockpiling or nearby road works.

Further downstream on the north side of Willis Point Road at station Sw-N-17, concentrations of all analytes were measured below BCWQG criteria on all sampling dates in 2019/20 except for TSS and nitrate. Similar to Sw-N-45, conductivity, nitrate and sulphate concentrations were elevated compared to those in 2018/19, especially during the winter months. Given the low ammonia and chloride concentrations, surface water is not likely impacted by leachate or road salt.

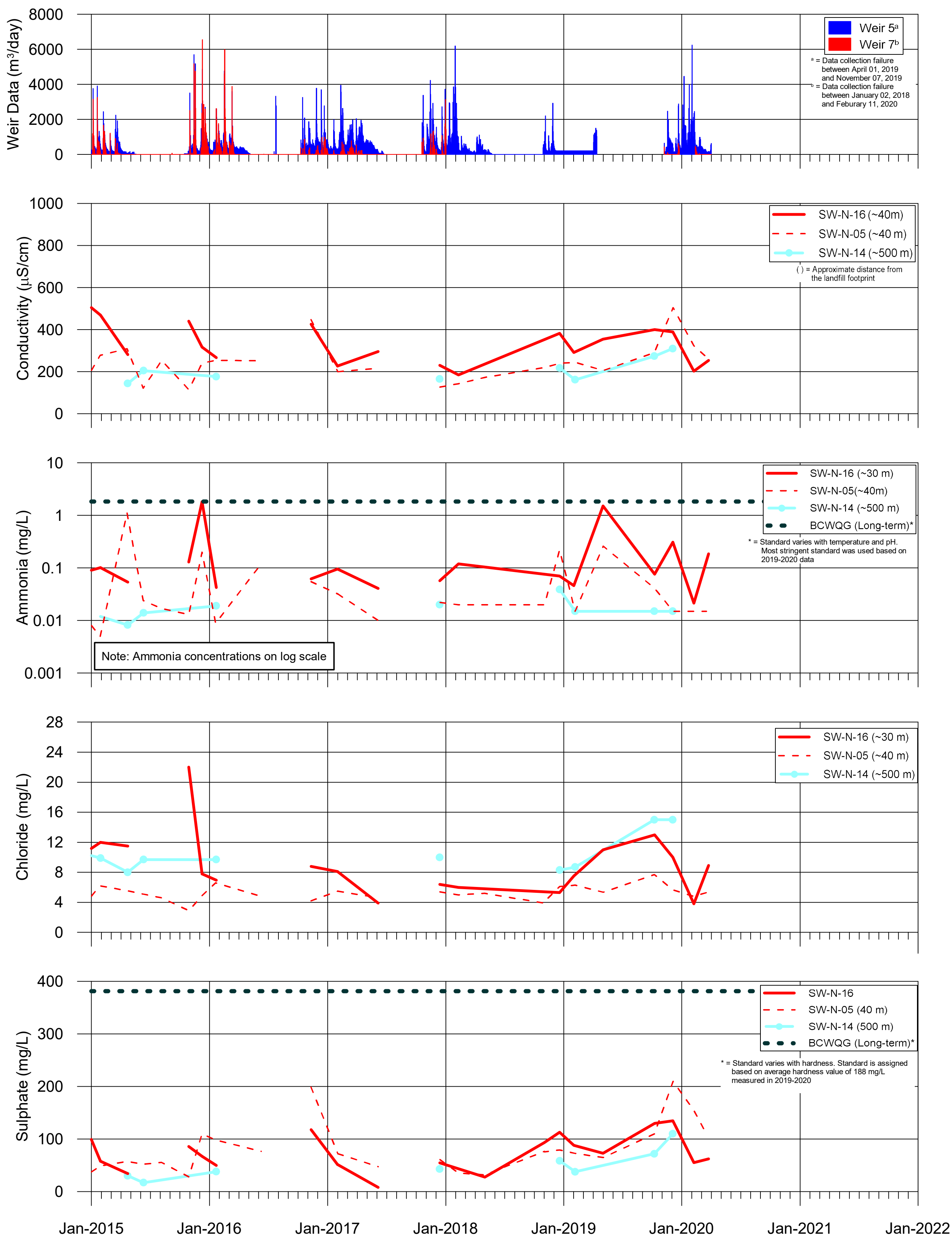


Figure 7-2. Surface Water Quality North of Phase 1

AECOM

7.4.1.5 Monitoring Sites SW-N-14

This sampling location is off site along Heal Creek north of Willis Point Road, and within the Heals Rifle Range. Sw-N-14 is located on Heal Creek upstream of the confluence with Durrance Creek and surface water was sampled on four sampling dates in 2019/20. In 2019/20, conductivity, ammonia and chloride concentrations remained within the range of background concentrations. Sulphate and nitrate concentrations were slightly elevated during the wet season, which may be related to aggregate stockpiling and the drier winter weather (i.e., less dilution). All parameters met the BCWQG criteria, except for nitrate that marginally exceeded BCWQG 30-day average on three out of four sampling events. Given the low ammonia concentrations, Sw-N-14 is not impacted by leachate. A statistically significant increasing trend was observed for sulphate concentrations over the past five years.

7.4.1.6 Monitoring Sites SW-N-51 and SW-N-50

Stations Sw-N-50 and Sw-N-51 are located near the northern boundary of the newly constructed Phase 2 Cell 3 and near the northwest diversion ditch near the Toutle Valley rock quarry and aggregate processing area. They are not compliance stations.

Figure 7-3 presents conductivity, chloride, sulphate, and ammonia concentrations at stations Sw-N-50, Sw-N-05, Sw-N-54 and Sw-N-18. In 2019/20, flow was observed at station Sw-N-51 only during the February 2020 sampling event and was followed by prolonged dry condition. All parameters at Sw-N-51 met the BCWQG criteria except for total zinc, which exceeded the BCWQG MAC and 30-Day average for total zinc on one sampling date. Sw-N-50 is located immediately north of Sw-N-51, and water samples were collected during all four sampling events. In 2019/20, water quality at Sw-N-50 met BCWQG-MAC. Concentrations of leachate parameters remained stable and low throughout 2019/20 indicating water was not impacted by leachate. Nitrate concentrations marginally exceeded BCWQG 30-Day average on two of four sampling dates. In 2019/20, conductivity and sulphate concentrations at Sw-N-50 were slightly elevated during the November and December 2019 sampling events and returned to normal values on February 2020 sampling date. A statistically significant trend was not observed for the past five years, indicating relatively stable water quality at this location.

7.4.1.7 Monitoring Sites SW-N-54 and SW-N-18

Sw-N-18 and Sw-N-54 are located adjacent to the upper leachate lagoon. Station Sw-N-18 is located near the headwaters of Heal Creek and monitors the combined discharge from the Sw-N-50 and Sw-N-51 catchment areas. Sw-N-54 monitors discharge from the NW freshwater retention pond to Phase 2 Cell 1 sedimentation pond. They are not compliance stations.

In 2019/20, water quality in Sw-N-54 was slightly degraded, with elevated conductivity, sulphate and nitrate concentrations. In December 2019, nitrate and sulphate concentrations dramatically increased to 38.20 mg/L and 170 mg/L, respectively and declined back to normal ranges during the following sampling event. Given the low ammonia concentrations, surface water was not impacted by leachate. In 2019/20, all parameters in Sw-N-54 met BCWQG-MAC, except for nitrate on the December 2019 sampling date. Similar to Sw-N-54, nitrate concentrations at Sw-N-18 were elevated during December 2019 sampling event, and above BCWQG 30-day average criteria. Ammonia concentrations at Sw-N-18 also increased to 2.4 mg/L on May 2019 sampling date and exceeded BCWQG 30-day average criteria. The elevated nitrate and sulphate concentrations at Sw-N-54 and Sw-N-18 indicated surface water quality was impacted by quarrying or aggregate stockpiling. Statistical analysis indicated significant decreasing trends in ammonia at Sw-N-18 station for the last five years, while Sw-N-54 did not exhibit any significant trends. Water quality at locations 18 and 54 should continue to be closely monitored for impacts from the aggregate stockpiling and blasting activities. Water quality data collected immediately following the leachate pipeline breach in December 2019 and following sampling in February 2020 indicated that Sw-N-54 was not impacted by the leachate release.

Historically, conductivity, sulphate, and nitrate concentrations fluctuated at locations SW-N-18, SW-N-50 and SW-N-05 due to varying stream discharge, dilute leachate and ongoing quarrying activities. Mitigation measures have been implemented to manage water quality in the Toutle Valley. Temporary tarps were installed on a large portion of the Phase 2 landfill, and aggregate storage in the Toutle Valley is carefully managed. Given the sensitivity of surface water quality to quarrying and runoff from aggregate stockpiles at these locations, water quality at these locations should continue to be monitored closely. Careful surface water management planning is required for this area as the landfill develops. Additional sediment control measures and efforts to reduce the quantity of blasting products may help reduce impairment to water quality as quarry development becomes increasingly close to the northern boundary of the landfill and these water quality monitoring stations.

7.4.2 Surface Water Quality near the Hartland North Pad

The Hartland North pad is located northwest of the landfill as shown on Figure 7-1. This area is undergoing significant changes with the construction of a residuals treatment facility (RTF) associated with the CRD Wastewater Treatment Project. A new aggregate stockpile area is being constructed on the ridge above the Hartland North Pad. Clearing occurred in December 2016 and January 2017 and removal of overburden soils occurred in late spring 2017. Recent geologic mapping (AECOM, 2018) revealed an undulating bedrock surface with extensive deformation, fracturing and mineralization. Development of the RTF is well underway and is slated for completion late in 2020.

The west side of the Hartland North pad drains northward through an ephemeral channel that originates at the northwest corner of the Hartland North pad. The water is carried through a culvert under Willis Point Road and into a drainage channel that eventually discharges into Durrance Lake approximately 450 m to the north. Flow through the channel only occurs during wet weather periods. During dry periods, several wetlands persist along the drainage course, but they are not connected by surface flows. In the downstream portions of the creek, flows increase due to groundwater discharge to the stream. Further downstream, a second creek of similar size joins the original creek. The "combined" creek has a well-defined channel in the area where it discharges to Durrance Lake.

7.4.2.1 Monitoring Sites SW-N-41, SW-N-42, and SW-N-CSs2

Figure 7-4 presents conductivity, ammonia, chloride and sulphate concentrations at sampling locations located along the ephemeral channel at the northwest corner of the Hartland North pad to the drainage channel discharging into Durrance Lake at stations Sw-N-41s1, Sw-N-41s3, Sw-N-42s1, and Sw-N-CSs2, which are off the landfill property. The sampling location Sw-N-CSs2 was periodically dry during periods of prolonged dry weather in 2019/20.

At surface water quality station Sw-N-41s1, located off the landfill property northwest of the Hartland North pad, all parameters met the BCWQG, except for TSS. Water quality exceeded BCWQG 30-Day average for TSS on October 2019 and February 2020 sampling dates. As shown on Figure 7-4, conductivity and sulphate were elevated during the December 2019 sampling event. This implies the temporary impact of runoff from aggregate stockpiles and construction of the RTF. Concentrations of these leachate indicator parameters returned to normal ranges during the following sampling events. Statistical analysis did not indicate any trend over the last five years, indicating the overall stability of water quality since the application of the temporary tarps over the aggregate stockpiles in 2012, and removal of the Hartland North aggregate stockpiles in 2017. However, recent monitoring highlights water quality at this location is sensitive to site construction activities and should continue to be closely monitored.

Station Sw-N-41s3 is located downstream of Sw-N-41s1, where the drainage from the northwest portion of the Hartland North pad flows into Durrance Lake. In 2019/20, all parameters met BCWQG. In 2019/20, concentrations of leachate parameters remained low. Conductivity and sulphate concentrations at Sw-N-41s3 remained lower than those observed upstream at Sw-N-41s1, which may be the result of dilution from other tributaries. Conductivity, chloride and sulphate concentrations did not exhibit statistical trends following the decreasing trends observed in 2018/19, indicating stable water quality since the installation of the tarp on aggregate stockpiles in 2013 and removal of the aggregate stockpiles from the Hartland North pad in 2017.

Water quality at Sw-N-42s1, located northeast of the Hartland North pad along Willis Point Road, reported concentrations of all parameters below applicable BCWQG in 2019/20. Similar to previous years, this site continued to report higher conductivity, ammonia and sulphate values than all other nearby stations except Sw-N-41s1. Chloride concentrations were higher than all other stations near the Hartland North pad but remained below 15 mg/L. Chloride concentrations were highest at Sw-N-41s1 and Sw-N-41s3 during winter months and may indicate impacts from road salt applied to Willis Point Road. The Mann-Kendall analysis revealed a statistically significant increasing trend in sulphate at Sw-N-42s1, indicating that water quality at this location has slightly been impacted by aggregate stockpiling or RTF construction activities over the past five years.

Water quality at background station Sw-N-CSs2 was relatively stable and concentrations were less than the applicable BCWQG. This sampling location was periodically dry during periods of prolonged dry weather in 2019/20 and was sampled one timeout of three attempted sampling events. Water quality at this station remained similar to previous years. The Mann-Kendall statistical trend analysis revealed statistically significant decreasing trends in conductivity and sulphate concentrations and increasing trends in ammonia over the past five years. The increasing trend in ammonia indicates impacts from stockpiling upstream of the sampling location.

7.5 Surface Water Quality South of the Landfill

An ephemeral stream drains the area to the south of the landfill and flows southward towards Killarney Lake, which subsequently drains towards Prospect Lake. Surface water flow south of the landfill occurs mainly during periods of wet weather and groundwater seepage has been observed in the Killarney Creek channel during dry periods. Clean surface water runoff from the south slope of Phase 1 runs westward in a ditch to a culvert that discharges into a small wetland at Sw-S-03 and then into the ephemeral stream that flows south to Killarney Lake.

There are a number of surface water sampling stations located south of the landfill, listed from upstream to downstream, as follows:

- Sw-S-52 diversion ditch rerouted from north of the landfill, upstream of wheel wash facility
- Sw-S-20 flow monitoring weir along diversion ditch at south end of Phase 1
- Sw-S-12 flow monitoring weir upstream of the public weigh scale
- Sw-S-03 culvert emerging from southeast corner of recycling area immediately upstream of a small natural wetland
- Sw-S-27 Killarney Creek, north tributary
- Sw-S-24 Killarney Creek, downstream of confluence of north and west tributaries
- Sw-S-21 drainage ditch along road south of diversion ditch at south end of Phase 1
- Sw-S-04 Killarney Creek, on property boundary, 270 m south of the landfill

7.5.1 Upgradient Surface Water Quality

7.5.1.1 Monitoring Site SW-S-52

S-52 is a background monitoring station. During 2019/20, two surface water samples were collected at station Sw-S-52 out of the three attempted sampling events. Concentrations of all parameters were below the BCWQG. Concentrations of leachate indicator parameters were consistent with previously reported background concentrations, indicating that seasonal fluctuations in precipitation did not likely influence surface water quality at Hartland landfill in 2019/2020. Similar to previous years, sulphate concentrations at Sw-S-52 were relatively stable and below 10 mg/L throughout the monitoring year. No statistically significant trends were observed at this sampling location over the past five years.

7.5.1.2 Monitoring Site SW-S-20

At station Sw-S-20, samples were collected on only one out of three attempted sampling dates. Concentrations of leachate indicator parameters were below applicable BCWQG-MAC values in 2019/20. Concentration of TSS exceeded BCWQG-MAC in one sampling date. Water quality exceeded BCWQG 30-day average for total zinc and TSS concentrations on one sampling date. The slightly elevated metal concentrations during the wet season may be partially due to the elevated TSS. A statistically significant decreasing trend in conductivity, chloride and sulphate was observed over the last five years indicating improvement of water quality at this sampling location.

7.5.2 Surface Water Quality Near and South of the Recycling Area

Figure 7-5 graphically presents water quality data for stations located south of the landfill, including Sw-S-03, Sw-S-04, and Sw-S-12. The distance of each station from the landfill boundary is shown in brackets in the legend. Water quality at each station is colour coded according to its distance from the landfill footprint. CRD's recycling area went into operation in January 2001 and is located near Sw-S-12. In early January 2020, a manhole that receives water from south purge wells (P1, P2, P3, P4 and P10) overflowed onto the gravel road due to blockage of pipe caused by iron precipitate. This manhole is upgradient of the wet well that pumps to the lower lagoon. The manhole and pipe were cleared of the blockage immediately. Leachate discharge was confined to the vicinity of the manhole and was not observed on the downgradient slope and near Hartland office.

7.5.2.1 Monitoring Site SW-S-12

In 2019/20, surface water samples were collected at station Sw-S-12 during four planned sampling events. All parameters met BCWQG-MAC during all sampling events, except for total iron and TSS. Total iron and TSS exceeded BCWQG-MAC on February 2020 sampling event, which may be related to intensive precipitation and high flow conditions. pH, TSS, aluminum, ammonia, nitrate, total cobalt and zinc also exceeded BCWQG 30-Day average on one or more sampling dates in 2019/20. Most of the exceedances were observed in February 2020, which coincided with high TSS. Conductivity, sulphate and nitrate concentrations were all elevated during the September and December sampling events, and they gradually returned to their normal ranges in February 2020. Similar to previous years, ammonia concentrations generally remained low during the summer and fall but increased to 1.9 mg/L in February 2020. Chloride concentrations remained low during all sampling events. Overall, the concurrent increase in conductivity, nitrate and sulphate concentrations in October and December 2019 may be due to runoff from paved areas surrounding the bin facility or dilute leachate. Given the low ammonia concentrations, it is unlikely that surface water was impacted by leachate. Surface water at this location should be closely monitored because ammonia is often the first parameter detected at the leading edge of an advancing leachate plume. High flows and a slightly orange/yellow color were previously reported/observed. The source of the elevated concentrations of ammonia and nutrients should be investigated.

7.5.2.2 Monitoring Site SW-S-03

Sw-S-03 is located on the landfill property in the main channel of Killarney Creek where the culvert discharges into a small wetland area. Sw-S-03 is not a compliance location. Historically, water quality at Sw-S-03 was affected by contaminated runoff from the south face of the landfill and the former truck wash area until the truck wash facility was relocated in the fall of 1997. Due to the close proximity to the public drop-off and storage area, water quality in Sw-S-03 may be affected by runoff from the bin facility, heavy traffic and industrial actives.

Water quality at Sw-S-03 was degraded during October 2019 sampling event, with elevated conductivity, sulphate, and nitrate concentrations. Chloride concentrations remained low during all sampling events. Similar to Sw-S-12, ammonia concentrations remained low in 2019 and reached a peak value of 0.73 mg/L in February 2020. In 2019/2020, total iron, total zinc and TSS exceeded BCWQG-MAC during one sampling event in February 2020. Nitrate, TSS and total zinc were above BCWQG 30-Day average during one or more sampling events. The elevated conductivity, sulphate and nitrate concentrations were likely due to upstream runoff from the area surrounding Sw-S-12 as discussed above. Although conductivity and chloride exhibited decreasing trends in 2018/19, they appeared to have stabilized in 2019/20 and no trends were observed over the past five years. The degradation in water quality at this location in February 2020 could be associated with overflow in the manhole that receives water from south purge wells (P1, P2, P3, P4 and P10) in early January 2020. Water quality should continue to be closely monitored for quarry and leachate impacts in the area downgradient of the bin facility and the south purge wells.

7.5.2.3 Monitoring Site SW-S-04

Water quality at the property boundary compliance point (Sw-S-04) met the BCWQG-MAC values for all analytes in all samples collected during 2019/20. The pH, TSS, total copper and total zinc concentrations were marginally above the 30-day average guidelines in one or more sampling events.

Similar to upstream stations, conductivity, nitrate and sulphate concentrations were slightly elevated in October 2019. Ammonia concentrations remained low during all sampling events. Chloride concentrations increased to peak of 33 mg/L in October 2019 sampling event and decreased to background levels in February and March 2020 sampling events. A statistically significant decreasing trend for chloride was observed at this location over the past five years. Sw-S-04 should continue to be monitored closely for indicators of impacts from leachate and aggregate placement.

7.5.2.4 Monitoring Sites SW-S-24 and SW-S-27

Stations Sw-S-24 and Sw-S-27 are located on the landfill property downgradient of Phase 1 of the landfill, the landfill administration area, and mountain biking trails. These stations are not compliance locations.

Water quality at Sw-S-24 remained below the BCWQG-MAC values in 2019/20 except for total iron that increased to peak of 1,040 µg/L in February 2020 sampling event. At Sw-S-24, conductivity, nitrate and sulphate concentrations were slightly elevated during the November and December 2019 sampling dates but other leachate parameters remained low. The total zinc concentration was above the 30-day average guidelines in February 2020, which may be related to high TSS and high flow condition. At station Sw-S-27, samples were collected on only one out of four attempted sampling dates. Water quality remained below the BCWQG-MAC values in 2019/20 in all sampling events. Concentrations of leachate indicator parameters are very low at this location, and water quality is not impacted by leachate.

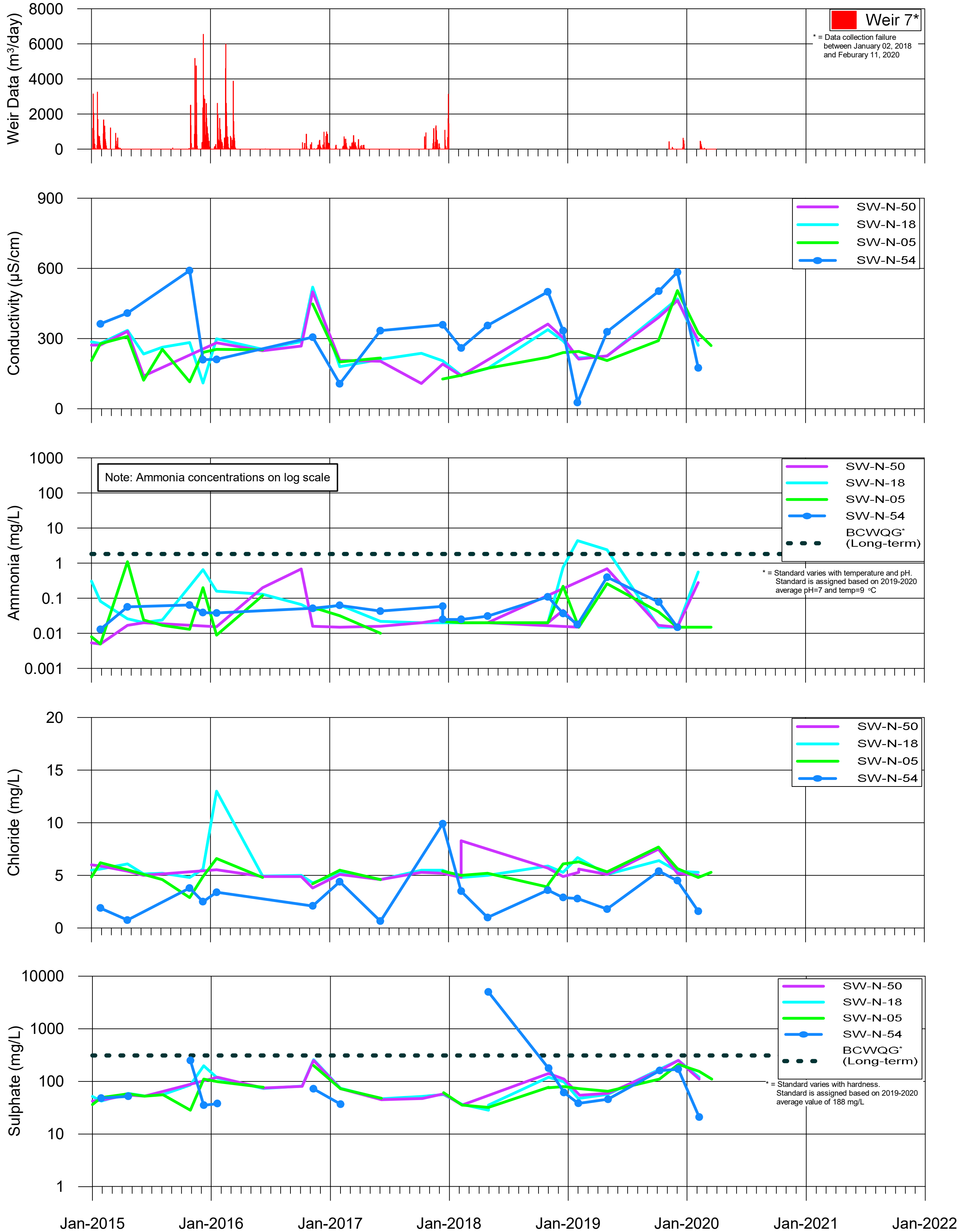


Figure 7-3. Surface Water Quality North of Phase 2

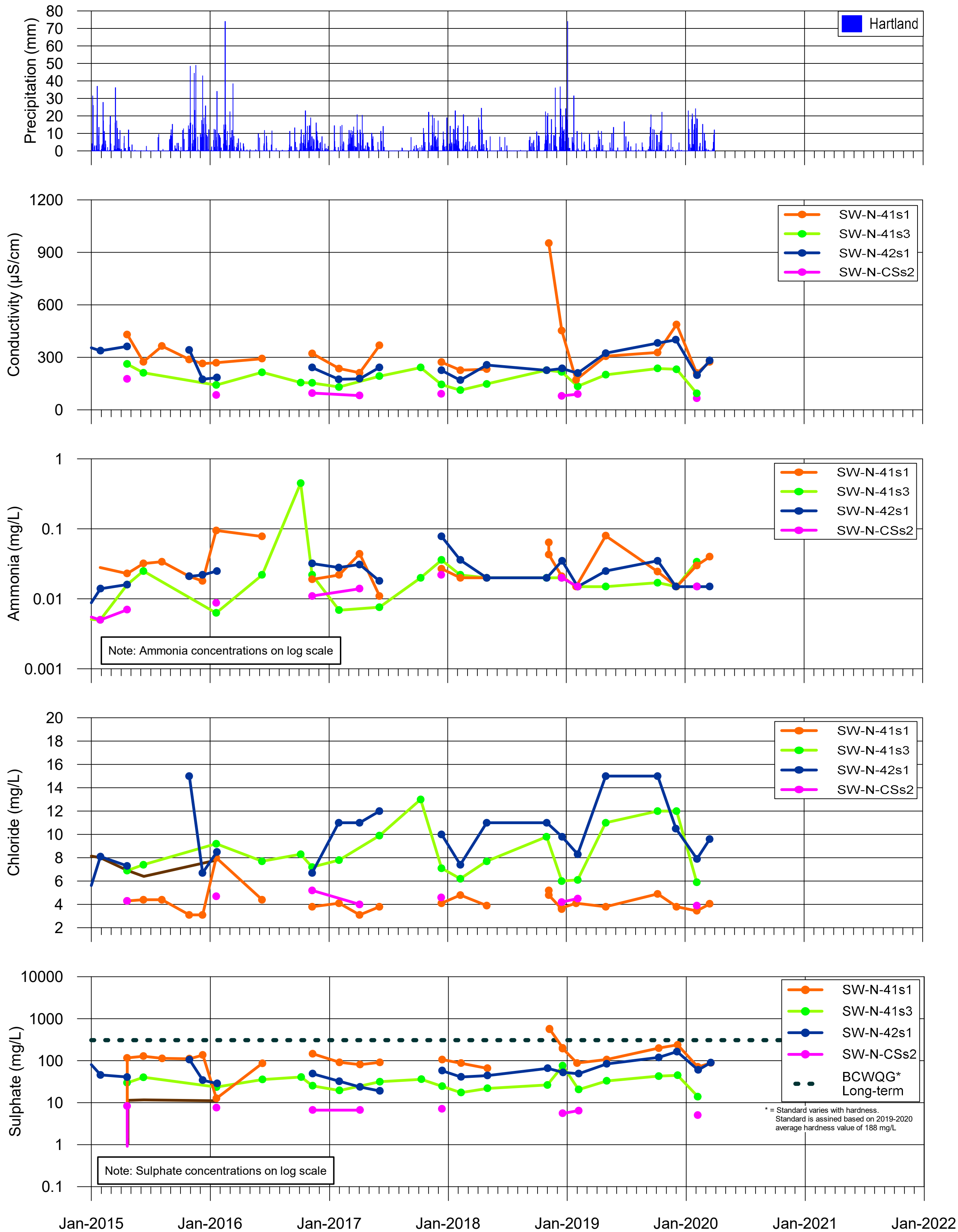


Figure 7- 4. Surface Water Quality Downstream of the Hartland North Pad

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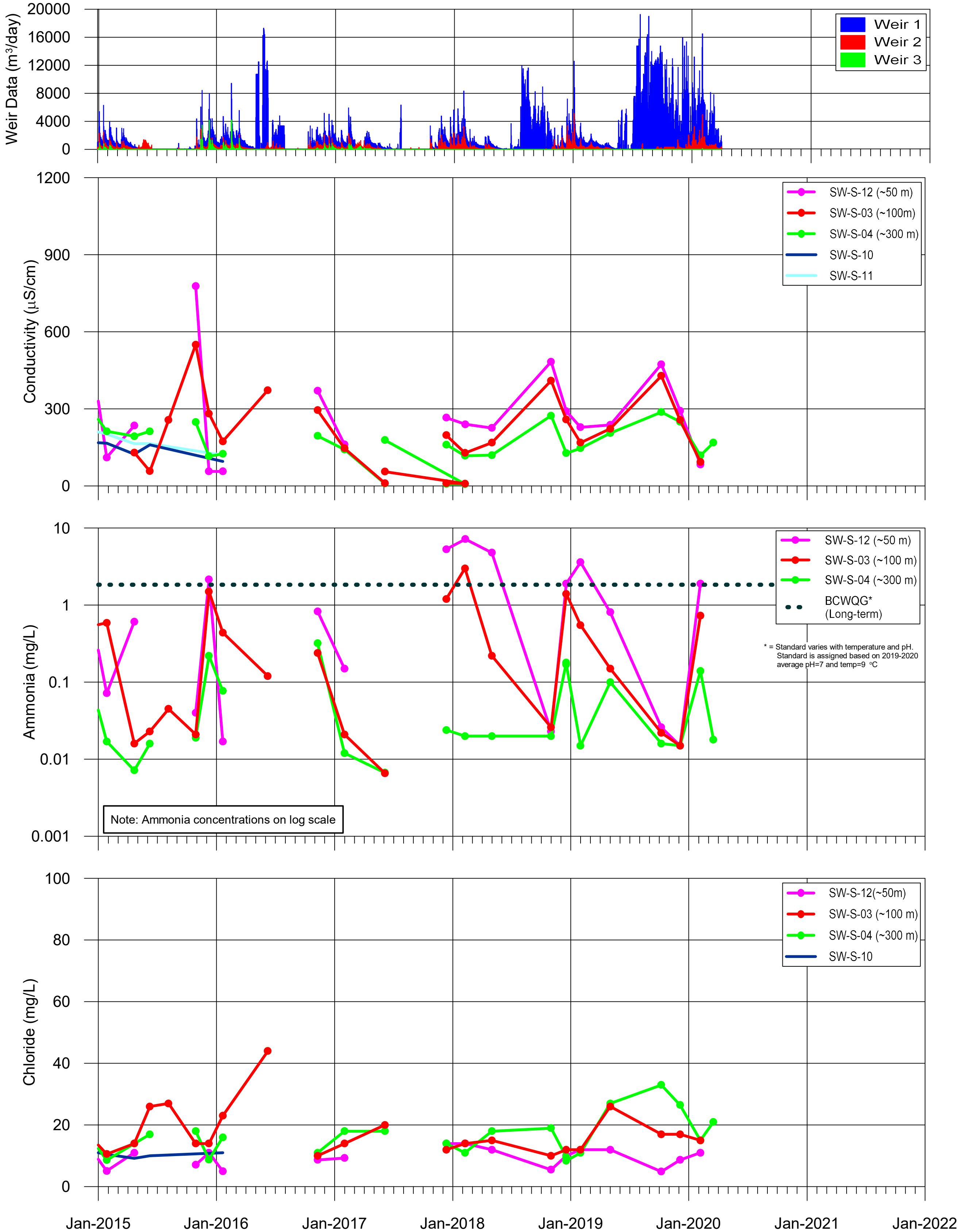

Figure 7-5. Surface Water Quality South of Landfill

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7.6 Summary

The surface water quality data collected in 2019/20 revealed that nearby surface water bodies, Tod Creek, Durrance Lake, Durrance Creek, and Killarney Lake are not impacted by leachate or other landfill activities.

- The leachate release from condensate pipe breach occurred on December 23, 2019 was contained within the landfill footprint. No impacts were observed outside of the landfill footprint at compliance station SW-N-05.
- Dissolved copper concentrations at compliance stations Sw-N-16 and Sw-S-04 exceeded the BCWQG-MAC during the February 2020 sampling event. Dissolved copper criteria are dependent on temperature, pH, hardness and DOC, and determined using the BLM. However, the dissolved metal concentrations, especially for dissolved copper and zinc should be interpreted with caution, due to the noticeable discrepancies between parent and duplicate samples (discussion in section 3.2.1).
- Surface water quality at boundary compliance station (Sw-N-16) along the northern property boundary met BCWQG-MAC in 2019/20, except for pH, TSS, dissolved copper, dissolved iron and total iron during one or more sampling events. The low ammonia and chloride concentrations indicate that surface water was not impacted by leachate. Conductivity, sulphate and nitrate concentrations increased slightly during the wet season, indicating that surface water may be influenced by the prolonged dry winter season (i.e., less dilution), as well as nearby construction activities involving blasting, aggregate placement, or excavation of organic soils. The iron exceedances are likely due to the disturbance of sediment during the sampling, as indicated by high TSS concentrations.
- Surface water quality at boundary compliance station (Sw-N-05) along the northern boundary met BCWQG-MAC for all parameters on all sampling dates. Nitrate concentrations exceeded BCWQG 30-day average concentrations during four out of five sampling events, which may be related to nearby construction activities. Concentrations of sulphate and nitrate showed increase in a statistically significant manner at this location over the last five years, indicating that surface water was impacted by quarrying and aggregate stockpiling areas.
- Surface water quality at station Sw-N-19 (not a compliance location) met BCWQG-MAC values on all sampling dates in 2019/20. The increased nitrate concentrations during the wet season indicated that surface water may be impacted by aggregate runoff. Surface water quality at this station should continue to be closely monitored.
- Surface water quality at station Sw-N-18 and Sw-N-54 (not compliance locations) met BCWQG-MAC values on all sampling dates in 2019/20, except for nitrate at Sw-N-54 during one sampling event. Conductivity, nitrate and sulphate concentrations at these stations increased during the wet season, indicating that surface water may be impacted by blasting residues and runoff from quarrying and aggregate stockpiling areas. An elevated ammonia concentration (2.4 mg/L) was observed at Sw-N-18 in May 2019, while other leachate indicator parameters were within normal ranges. Statistical analysis indicated significant decreasing trends in ammonia at Sw-N-18. Surface water quality at these two stations should continue to be closely monitored.
- Surface water quality at station Sw-N-50 (not a compliance location) met BCWQG-MAC values on all sampling dates in 2019/20. All leachate parameter indicators remained within normal ranges, with slightly elevated conductivity, sulphate and nitrate concentrations during the wet season. Surface water at this station should be closely monitored.
- Surface water at station Sw-N-51 (not compliance location) is typically dry, but samples were collected once in 2019/20 during flowing conditions. Surface water quality at this station met BCWQG-MAC values except for total zinc. As recommended in 2018/19, sampling of this station should be discontinued due to the frequent dry conditions.
- Surface water quality at boundary compliance stations north of the Hartland North pad (Sw-N-41s1 and Sw-N-42s1) met BCWQG-MAC in 2019/20. Conductivity and sulphate concentrations at station Sw-N-41s1 were elevated during the December 2019 sampling event, implying the temporary impact of runoff from a construction activity of the residual treatment facility. Leachate indicator parameters at Sw-N-42s1 remained low in 2019/20, indicating surface water was not impacted by construction activities. The statistically significant increasing trend in sulphate at Sw-N-42s1 station indicates slight impacts of construction activities at the RTF.
- Station Sw-N-41s3 (not a compliance location) is located downstream of Sw-N-41s1 where the drainage from the northwest portion of the Hartland North pad flows into Durrance Lake. In 2019/20, all parameters met BCWQG guidelines. Ammonia concentrations were occasionally elevated but are likely the result of natural drainage from the nearby wetland in the absence of otherwise dilute surface runoff.

- Water quality at station Sw-S-52 (not a compliance location) is representative of background water quality. In 2019/20, concentrations of all parameters were below the BCWQG-MAC. Concentrations of leachate indicator parameters were consistent with previously reported values.
- Surface water quality at Sw-S-12 (not a compliance location) met BCWQG-MAC values, except for total iron and TSS on February 2020 sampling event. The concurrent increase in conductivity, nitrate and sulphate concentrations in October and December 2019 may be due to the runoff from paved areas surrounding the bin facility or dilute leachate. Surface water quality at this station should be closely monitored and investigated to determine the source of elevated ammonia concentrations during the February 2020 sampling event.
- Surface water quality immediately south of the landfill at Sw-S-03 (not a compliance location) exceeded BCWQG-MAC values for total iron, total zinc and TSS in February 2020. The elevated conductivity, sulphate and nitrate concentrations during the wet season were likely due to upstream runoff from the area surrounding Sw-S-12. Water quality should continue to be closely monitored for quarry and leachate impacts in the area downgradient of the bin facility and south purge wells. The degradation in water quality at this location in February 2020 could be associated with overflow in the manhole that receives water from south purge wells (P1, P2, P3, P4 and P10) in early January 2020.
- Water quality at the property boundary compliance point (Sw-S-04) met the BCWQG-MAC values for all analytes in all samples collected during 2019/20, except for dissolved copper in February 2020. Total zinc, pH and TSS concentrations exceeded BCWQG 30-day average guidelines in one or more sampling events. Conductivity, chloride, nitrate and sulphate concentrations were slightly elevated in October 2019. A statistically significant decreasing trend for chloride was observed at this location over the past five years. Sw-S-04 should continue to be monitored closely for indicators of impacts from leachate and aggregate placement.
- Water quality at Sw-S-27 (not a compliance location) met BCWQG-MAC at all sampling events. TSS and total zinc exceeded the BCWQG 30-day average guideline in February 2020. Concentrations of leachate indicator parameters are very low at this location, and water quality is not impacted by leachate. Surface water quality at this location should continue to be closely monitored.

8. Leachate

8.1 Compliance Monitoring Locations

Discharges from the leachate pipeline are subject to the CRD Regional Source Control Program (RSCP) Waste Discharge Permit (Waste Discharge Permit Number SC97.001) authorizing the discharge of leachate to the sanitary sewer in accordance with the CRD's Sewer Use Bylaw 2922. The compliance monitoring location for leachate at Hartland landfill is the Hartland valve chamber (flow detection chamber) at the start of the leachate pipeline. Leachate compliance data is reported to the CRD RSCP on a quarterly basis.

To mitigate previous leachate sulphide concentrations that exceeded the RSCP limit of 1 mg/L, the CRD aerated the leachate lagoons between 2014 and spring 2018. Although Bioxide® amendment is an option to reduce sulphide concentrations, this treatment method has not been needed since 2014. Aeration was identified as a potential cause of biofouling in the lagoons and other leachate infrastructure and so it was stopped in spring 2018.

8.2 Data

Our interpretation of the leachate chemistry data was based on samples collected at the following locations by CRD staff:

- Hartland valve chamber (leachate pipeline flow detection chamber and compliance point)
- Markham valve chamber
- Phase 1 North purge well system (combined discharge from 52-4-0-P7, 80-1-0-P8 and 81-1-0-P9)
- Phase 2 landfill leachate cleanout
- Controlled Waste drainage
- West Face drainage
- Cell 3 Pipe Outlet drainage

These locations were sampled and analyzed for conventional parameters, organic compounds and metals on a monthly basis in 2019/20. In addition, the Hartland valve chamber samples were analyzed quarterly for trace organic compounds including polycyclic aromatic hydrocarbons, phthalate esters, ketones, aromatics, phenols, ethers, nitrosamines, alkanes, alkenes and other select organic compounds.

Due to the lack of flow, only ten (10) leachate samples were collected from the West Face Drainage in 2019/20. Samples in August and September could not be collected. Discharge from this toe drain has been intermittent since it was installed. Drainage patterns from the West Face Closure toe drain are attributed to precipitation, refuse settlement, and the increasing depth of waste cover over the toe drain. Similar to 2018/19, only ten (10) leachate samples were collected at Cell 3 Pipe Outlet in 2019/20 due to a lack of drainage. Ten (10) leachate samples were collected from the Hartland Valve Chamber on 2019/20 as samples from July and August could not be collected due to the construction activities related to the new leachate/centrate return line. A total of nine (9) leachate samples were taking at the Markham Valve Chamber throughout 2019/20. A sample from the Phase 1 North purge well system, Phase 2 Cleanout and the Controlled Waste Ditch could not be collected in September 2019 and so eleven (11) in total were collected at all three locations throughout 2019/20.

8.3 Leachate Generation and Discharge

Leachate collected from the Phase 1 and Phase 2 landfill is discharged to the lower leachate lagoon. During wet winter months, leachate is pumped into a second, lined upper lagoon to minimize head build-up in the unlined lower lagoon. Leachate from the lagoons is discharged from the site through an 8.6 km long pipeline that discharges to the Saanich sanitary sewer and ultimately to the Macaulay Point deep water outfall. The leachate will eventually discharge through the new centrate return line that is shared with the RTF, and will be treated by the McLoughlin Point Wastewater Treatment Plant that is currently under construction.

Total monthly leachate flows discharged to sewer are provided in Appendix D. Average daily leachate flow in 2019/20 was 11.75 L/s, which is in line with the 2018/19 average of 11.55 L/s. The highest monthly leachate flow recorded in 2019/20 was 86,573m^3 (average monthly flow rate of 32.94L/s) in January 2020, which is due to the intense precipitation events and higher operational levels in the upper leachate lagoon. Changes in leachate discharge rates throughout the year may be related to variability in precipitation, biofouling within the line, or operational improvements aimed at minimizing leachate generation.

8.4 Leachate Quality

Sampling and testing of leachate quality has been carried out since the early 1970s. Since 2000, leachate samples have primarily been collected from the Hartland valve chamber which represents the point of discharge for compliance with the RCSP Waste Discharge Permit. The RSCP Waste Discharge Permit limits only apply to the Hartland valve chamber, however, these limits are compared to the other leachate sampling points in support of operational decisions.

The analytical results of the routine monthly leachate discharge samples are provided in Appendix B.4. Analysis of trace organics in the leachate discharge was conducted quarterly and is provided in Appendix B.5. The analytical results for samples collected from the leachate collection and conveyance network are presented in Appendices B-6, B-7, B-8, B-9, B-10 and B-11. In addition to the Sewer Use Bylaw Criteria, leachate quality results for trace organic compounds were screened against BC CSR standards for the protection of drinking water and aquatic life to support operational decisions regarding leachate containment.

8.4.1 Routine Monthly Leachate Analyses and Sewer Use Bylaw Comparison

The Hartland valve chamber is the compliance point for the Waste Discharge Permit. During 2019/20, all leachate quality samples from the compliance point met RSCP Waste Discharge Permit criteria.

Although the Waste Discharge Permit criteria only apply to the combined discharge at the Hartland Valve Chamber, comparison of other leachate monitoring station results to these criteria allows for evaluation of individual leachate contributions to the combined leachate discharge. Concentrations above RSCP criteria at locations other than the Hartland Valve Chamber are not considered to be non-compliant, and the criteria are used for reference purposes only.

Figure 8-1 and Figure 8-2 present time series plots for selected parameters in leachate at the compliance point (Hartland valve chamber) and in Phases 1 and 2 for the past five years. Evaluation of these data allows for comparison of leachate from each of the landfill areas. At all sampling locations, concentrations of inorganic parameters such as conductivity and chloride show the seasonal dilution effect whereby greater precipitation in the fall and winter months results in lower concentrations during the wet winter months. Higher concentrations occur during drier periods from May to October. Leachate discharge from the Phase 2 basin is significantly stronger than leachate generated in Phase 1, which was closed in 1996. The mixing of leachate from Phases 1 and 2 in the Hartland valve chamber results in a leachate that exhibits chemistry which is intermediate between the two primary sources.

Similar to previous years, leachate concentrations at the Hartland Valve Chamber throughout 2019/20 were well above background concentrations observed in surface water and groundwater, with conductivity concentrations ranging from 2,540 µS/cm to 5,726 µS/cm, ammonia concentrations ranging from 230 mg/L to 350 mg/L, and chloride concentrations ranging from 270 mg/L to 560 mg/L. Overall, annual average leachate concentrations in 2019/20 were slightly less concentrated, with average conductivity values at the Hartland Valve Chamber just lower than those measured in 2018/19.

The highest concentrations of leachate indicator parameters were observed in September 2019, when precipitation was near the annual minimum. As shown in Figure 8-2, BOD concentrations at the Hartland valve chamber exhibited a pattern that was consistent with conductivity, ammonia and chloride values. BOD concentrations at Hartland remain relatively low for a large landfill, and were typically below 100 mg/L. In August 2018, BOD concentration reached to peak value of 160 mg/L, which was consistent of elevated sulphide value (0.912 mg/L). The changes in quantity of biological organisms may be related to the elevated temperatures observed during summer months, or changes in leachate storage and management prior to sample collection. Since August 2018, BOD concentrations have fallen back below 100 mg/L and during 2019/20 sampling events, all concentrations were below 100 mg/L.

Total and dissolved sulphide concentrations, as well as total PAHs at Hartland Valve Chamber did not exceed the Waste Discharge Permit criteria during any of the 2019/20 sampling events. Total and dissolved sulphide concentrations exceeded the Waste Discharge Permit criteria in January 2019 and remained well below standard of 1 mg/L since then. Infiltration through aggregate placed in the Phase 2 landfill during winter months is known to be an important source of sulphate to the Phase 2 Cleanout. Sulphate can be reduced to sulphide by bacteria under reducing conditions in the absence of other reducing agents such as oxygen and nitrate.

Average conductivity concentrations were lower in 2019/20 than in 2018/19. Waste Discharge Permit criteria were not exceeded during any of the sampling events during 2019/20 and the long-term conductivity and chloride concentrations at the Hartland Valve Chamber revealed a decreasing trend in monthly data and an increasing trend in nitrate over the past five years. This indicates that leachate quality is relatively stable and slightly improving at this location. Concentrations of many parameters were several orders of magnitude below Waste Discharge Permit criteria.

8.4.1.1 Phase 2 Cleanout

In 2019/20, the elevated sulphide concentrations within the Phase 2 landfill indicate reducing conditions in leachate. Total sulphide concentrations were higher than the Waste Discharge Permit criteria during all sampling events, except for three samples collected in April 2019, November 2019 and February 2020. Total sulphide concentrations peaked at 5.1 mg/L in July 2019, which was lower than the peak concentrations of 7.58 mg/L in 2018/19, 8.88 mg/L in 2017/18 and 11.6 mg/L in 2016/17. The average total sulphide concentration in 2019/20 was 2.06 mg/L, which was lower than the average value of 4.67 mg/L in 2018/19.

As waste deposition continues and the refuse matures, elevated sulphide concentrations may persist in Phase 2. There is significantly higher sulphur content in Phase 2 leachate relative to the Phase 1 landfill, which may be due to the use of locally sourced aggregate containing sulphur as landfill cover. Naturally occurring sulphide minerals appear to be oxidizing to sulphate, which subsequently infiltrates to the Phase 2 basin, and is converted to sulphate via oxidation-reduction reactions. Sulphate concentrations in the Phase 2 cleanout were generally lower than those measured in Phase 1 and the Controlled Waste drainage where leachate is anticipated to be more oxidized.

Similar to previous years, BOD and COD concentrations within Phase 2 were generally higher than concentrations observed in the Hartland Valve Chamber and Phase 1. In 2019/20, all BOD values met the Waste Discharge Permit criteria of 500mg/L. COD exceeded the Waste Discharge Permit criteria of 1,000 mg/L in Phase 2 on total of six (6) of eleven (11) sampling dates in 2019/20, with a peak of 2,240 mg/L in November 2019. Chloride concentrations measured in November 2019 exceeded the Waste Discharge Permit criteria of 1,500 mg/L. Total phenols also exceeded Waste Discharge Permit criteria of 1 mg/L on two (2) sampling dates. All metal concentrations at the Phase 2 clean out met Waste Discharge Permit criteria.

8.4.1.2 North Purge Wells

In 2019/20, data collected from the Phase 1 north purge wells (52-4-0-P7, 80-1-0-P8 and 81-1-0-P9) indicates that all parameters met the Waste Discharge Permit criteria. Total sulphide concentrations in the Phase 1 leachate are quite low (≤ 0.051 mg/L). In 2019/20, sulphate concentrations in Phase 1 were stable, with a mean value of 28.5 mg/L, indicating that sulphate is the most stable form of sulphur in the Phase 1 landfill. Similar to previous years, the average BOD, COD and sulphide concentrations were lowest in Phase 1 when compared to other leachate sampling locations. In 2019/20, all metal concentrations in North Purge wells met Waste Discharge Permit criteria.

8.4.1.3 South Purge Wells

Data collected from the Phase 1 south purge wells (P1, P2, P3, P4 and P10) is presented in Appendix B.1. BOD, COD and other leachate related parameters were not routinely analyzed. Results indicate that all parameters that were analyzed met the Waste Discharge Permit criteria. Samples collected in 2017/18 indicate that leachate in the south purge wells is quite dilute, with moderate concentrations of ammonia (34 - 190 mg/L), low concentrations of nitrate and nitrite, low concentrations of sulphate (<6 mg/L), and moderate to high concentrations of iron and manganese. Additional sampling at these wells would allow for comparison to the Waste Discharge Permit and leachate quality in other areas of the landfill.

8.4.1.4 Controlled Waste Drainage

Leachate collected by the Controlled Waste drainage is not as concentrated as leachate collected from Phase 2 and the West Face Toe Drain. In 2019/20, all leachate parameters in the Controlled Waste drainage leachate met the Waste Discharge Permit criteria. All metal concentrations at Controlled Waste Drainage met Waste Discharge Permit criteria.

8.4.1.5 Markham Valve Chamber

Leachate samples from the Markham Valve Chamber met Waste Discharge Permit criteria on all sampling dates in 2019/20. In 2019/20, total sulphide concentrations at the Markham valve chamber ranged from 0.0018 mg/L to 0.1100 mg/L,and were well below the Waste Discharge Permit criteria. Similar to previous years, BOD and COD concentrations were similar at both the Markham valve chamber and the Hartland valve chamber. In 2019/20, all metal concentrations at Markham Valve Chamber met Waste Discharge Permit criteria.

8.4.1.6 West Face Closure Toe Drain

In 2019/20, leachate discharging from the West Face closure toe drain was flowing and sampled in ten (10) of twelve months. The drainage was dry during the August 2019 and September 2019 sampling dates. Similar to previous years, the West Face Drainage generally has the most concentrated leachate, with the highest BOD, COD, ammonia, conductivity and chloride concentrations.

In 2019/20, the average concentrations of conductivity, chloride, BOD and COD were lower than those measured in 2018/19. In 2019/20, sulphide concentrations remained low, and met Waste Discharge Permit criteria on all sampling dates. COD exceeded the Waste Discharge Permit criteria on all sampling dates. BOD exceeded the Waste Discharge Permit criteria on one sampling date and total phenols exceeded the Waste Discharge Permit criteria on nine (9) of the ten (10) 2019/20 sampling events.

The leachate from the West Face Toe Drain is strongly reduced with a high organic content. However, it only flows episodically and does not convey a large volume of leachate to the leachate collection system on an annual basis. Recent observations indicate flow has been increasing over time. A weir and flow monitor has been installed at the location to evaluate trends over time. Leachate monitoring indicates that it does not appear to materially affect the quality of leachate at the Hartland Valve Chamber.

8.4.1.7 Cell 3 Pipe Outlet (Toutle Valley Leachate Drain)

The Phase 2 Cell 3 Pipe outlet discharges leachate from Phase 2 Cell 3 which commenced in 2016 and is considered to be representative of newly deposited refuse. In 2019/20, samples were collected on ten (10) out of twelve attempted sampling dates. Sampling from this station is challenging due to the intermittent flows observed at this location. In 2019/20, all parameters met Waste Discharge Permit criteria, except for COD on nine (9) of ten sampling dates. In 2019/20, total sulphide exceeded Waste Discharge Permit criteria on one sampling date and chloride also exceed the he Waste Discharge Permit on two (2) of the ten sampling dates.

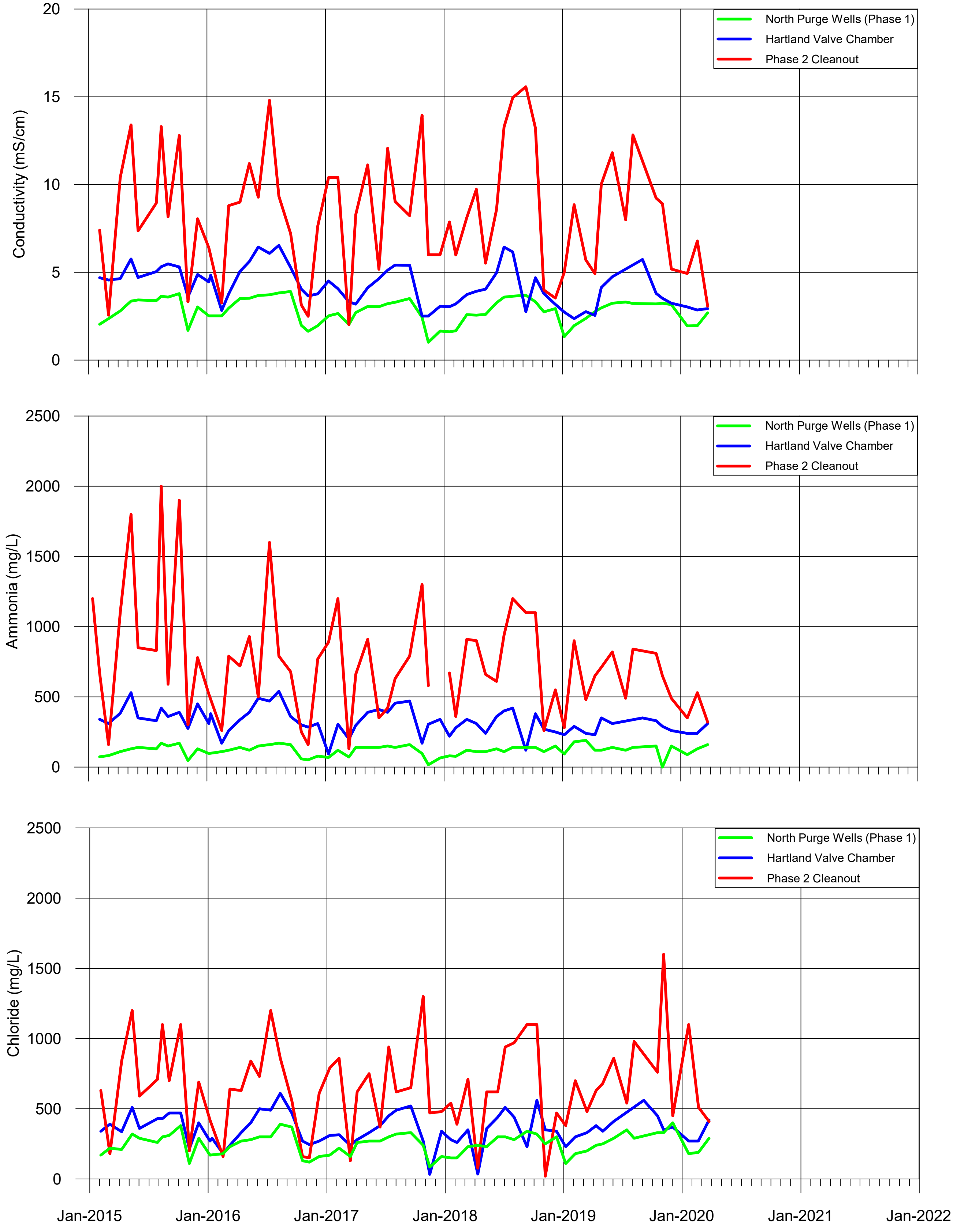

Figure 8-1. Hartland Valve Chamber Leachate Chemistry (Conductivity, Ammonia and Chloride)

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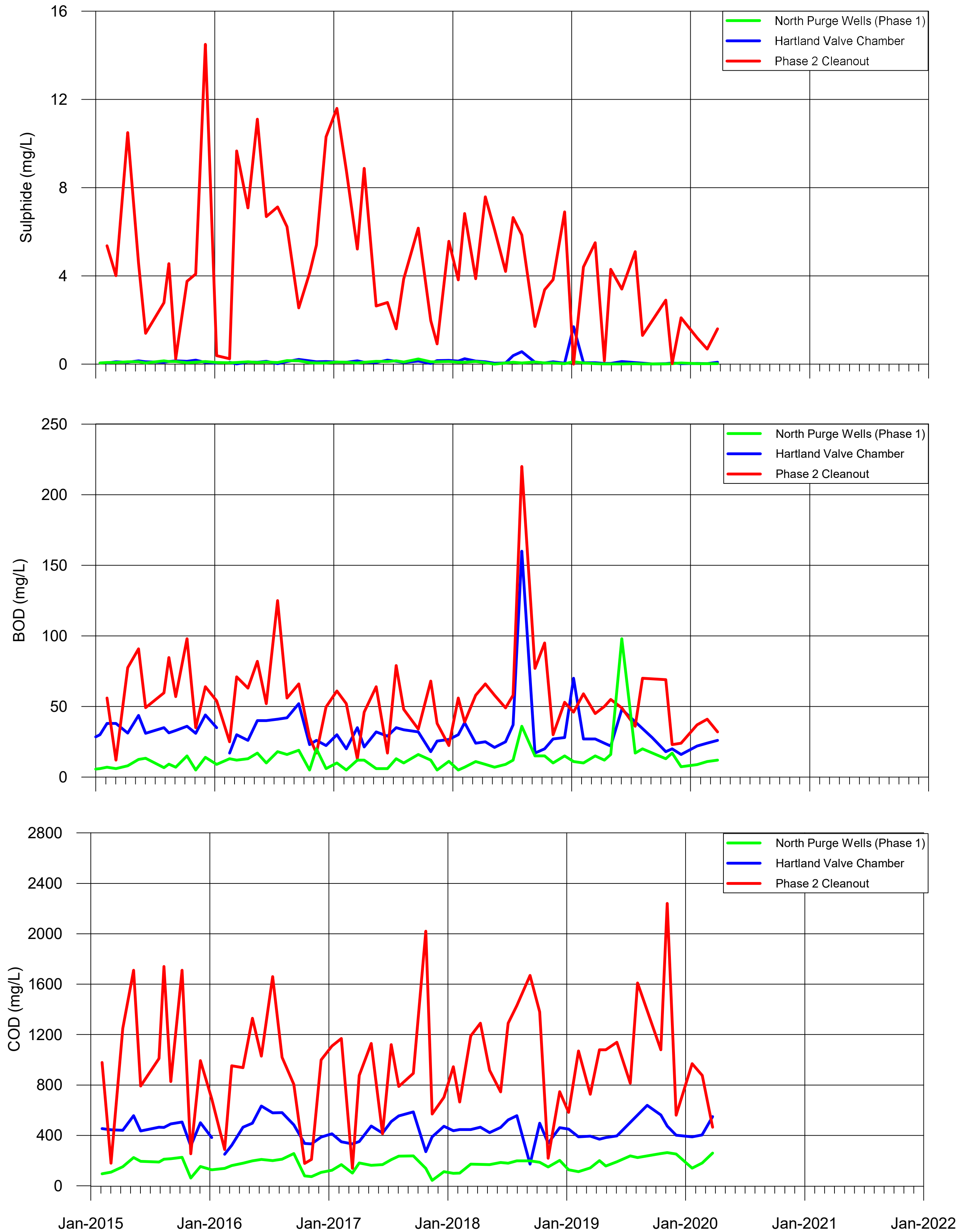

Figure 8-2. Hartland Valve Chamber Leachate Chemistry (Sulphide, BOD and COD)

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8.4.2 Quarterly Trace Organic Analysis at Hartland Valve Chamber

Trace volatile and semi-volatile organic analysis has been carried out quarterly since 1998 on leachate samples collected from the Hartland valve chamber. Trace organic compound analytical results for combined leachate in 2019/20 are presented in Appendix B.5.

A total of two (2) volatile and semi-volatile organic compounds were reported at detectable concentrations across all sampling dates. The detected compounds were found at concentrations that are low compared to those commonly found in leachate at municipal solid waste landfills of similar size. Of the trace organic compounds analyzed, none exceeded Waste Discharge Permit criteria. Similar to previous years, concentrations of volatile organic compounds in Phase 2 leachate (i.e. West Face Drainage and Phase 2 cleanout) are exceedingly low and typically at concentrations on the order of 1% to 20% of Waste Discharge Permit criteria. Regular sampling and analysis for VOC concentrations in leachate sources should continue, but it is not warranted in groundwater at compliance monitoring locations at this time.

In 2019/20, all trace organic parameters were present at concentrations below 0.5 µg/Elevated concentrations (up to 100 µg/L) of methyl ethyl ketone and dimethyl ketone were reported in 2014/15, but concentrations were below detection limits between 2015 and 2017 and also during 2019/2020. The elevated methyl ethyl ketone concentrations in 2018/19 may have been due to the installation of new liner and HDPE pipe infrastructure in the Hartland landfill.

Phthalate esters were detected during the October 2016, April 2017 and October 2018 sampling events, but were not detected in 2019/20. Dimethyl phthalate concentrations were slightly above the detection limit in 2017/18 but have been below detection limits since 2018/19.

In 2019/20, all phenolic compounds were present at or below detection limits. During 2017/18, two phenolic compounds (2,4-dimethylphenol, and 2,4 + 2,5 dichlorophenol) reported concentrations above detection limits. Phenol concentrations in Hartland landfill leachate are lower than, or similar to those found at other large landfills. Phenol is commonly used in a number of manufacturing processes and is present in many consumer products. It also occurs naturally at low concentrations due to sources in wood and other natural organic matter.

In 2019/20, all low weight polycyclic aromatic hydrocarbons (PAH's) were detected in Hartland landfill leachate, with the exception of 2-chloronaphthalene and 2-Methylnaphthalene (Appendix B.4). Total concentration of low weight polycyclic aromatic hydrocarbons (PAH's) ranged from 0.79 to 15.27 µg/L, which was consistent with historical concentrations. Acenaphthene exhibited a maximum concentration of 5.4 µg/L in November 2019, which was lower than the maximum value of 7.0 µg/L in 2018/19 but higher than the maximum value of 3.1 µg/L in 2017/18 and 5.1µg/L in 2016/2017. In 2019/20, high molecular weight polycyclic aromatic hydrocarbons including benzo(a)anthracene, fluoranthene and pyrene continued to be detected in leachate, with maximum concentrations of 0.74 µg/L, 4.6 µg/L and 2.8 µg/L, respectively. These high molecular weight polycyclic aromatic hydrocarbons generally had higher concentrations than those measured in 2018/19. Chrysene and benzo(a)pyrene have been marginally above detection limits since 2016. Total concentrations of high molecular weight polycyclic aromatic hydrocarbons ranged from 0.48 to 11.90 µg/L, which were lower than those measured in 2018/19.

All volatile organic compounds were detected in 2019/20, except for methyl tertiary butyl ether, M & P xylenes, O-xylenes and styrene. The highest concentrations were generally observed in February 2019 and coincided with low ORP values.

The CRD's Environmental Protection division conducted high-resolution analyses of leachate between 2004 and 2007. The high-resolution analytes included polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), nonylphenols, and chlorobenzenes. Data collected (Golder 2008) revealed that nonylphenols and PBDEs are not present at levels of environmental concern, even in full strength leachate. The aquatic risks of PCBs observed in leachate samples were also found to be negligible. In addition, concentrations of nonylphenols, PCBs, DDT and select PDBEs varied in comparison to CRD wastewater. Hartland leachate contributes only 2% of the total wastewater discharge from the Macaulay Point outfall. The evaluation concluded that despite differences in the chemical profile of leachate and Macaulay Point wastewater, leachate had no observable impact on the chemical profile at Macaulay Point. Based on these findings, the high-resolution analyses were discontinued, although co-ordination between the CRD's Marine Monitoring and Environmental programs is on-going.

8.5 Summary

The leachate flow and quality data collected in 2019/20 indicates that:

- Average leachate flow in 2019/20 was 11.75 L/s, with a maximum monthly flow of 86,573 m^3 (32.94 L/s) in January 2020. This was lower than the extreme flows of 39.64 L/s observed during 2006/07, and slightly slower than the long-term (1997 to 2019) average of 11.96 L/s.
- Leachate discharge remained in compliance with the requirements of the Waste Discharge Permit at the Hartland Valve Chamber in 2019/20.Concentrations of trace organics at the Hartland Valve Chamber produced results for the September 2019 sampling event. Of the all 14 analyzed parameters, 2 were reported at detectable concentrations in 2019/20. Statistical trend analysis indicates that leachate quality has been relatively stable to slightly improving at the Hartland Valve Chamber over the past five years.
- The highest concentrations of leachate parameters at Hartland Valve Chamber were observed in September 2019, when precipitation was near the annual minimum.
- Phase 1 leachate exhibited the lowest average values of BOD, COD and sulphide concentrations, compared to other leachate sampling locations.
- Phase 2 leachate exhibited the most reducing conditions, with a peak sulphide concentration of 5.1 mg/L in July 2019. The average total sulphide concentration (2.06 mg/L) in 2019/20 was between those observed in 2018/19 (4.67 mg/L), 2017/18 (4.08 mg/L) and 2016/17(7.19 mg/L).
- The West Face Drainage leachate exhibits the most concentrated leachate, with the highest BOD, COD, conductivity and chloride concentrations. COD exceeded the Waste Discharge Permit criteria on all sampling dates. BOD exceeded the Waste Discharge Permit criteria on one sampling date during 2019/20. Total phenols exceeded the Waste Discharge Permit criteria on nine (9) out of ten sampling dates. However, total sulphide concentrations continued to be low (<0.2 mg/L).

9. Conclusions

Based on our review of historical data and interpretation of groundwater, surface water and leachate quality data collected between April 2019 and March 2020, the annual monitoring program provides an effective assessment of landfill performance and compliance related to groundwater, surface water and leachate flow and quality. The following conclusions are drawn based on our interpretation of the 2019/20 data.

9.1 Groundwater Flow

Groundwater flow in 2019/2020 was consistent with previous years, and the majority flow is northward. A small amount of groundwater flows southeastward from the south end of Phase 1 in the direction of Killarney Lake. Hydraulic gradients were maintained to preserve the hydraulic trap leachate contaminant system, and leachate was effectively contained and controlled on the landfill property.

9.2 Leachate Mound Assessment

The leachate level information collected in 2019/20 revealed that leachate mounding continues to be present in Phase 1 of the landfill. Leachate elevations in Phase 1 were generally stable and exhibited minor seasonal variations. The leachate mound in the upper portion of the refuse is interpreted as being ‘perched’ above the regional bedrock groundwater flow system, with relatively high water levels and strong downward hydraulic gradients. Leachate elevations in Phase 2 (Phase 2 Basin) are generally stable and typically around 113 m ASL. Well 90-2-1 was either dry or contained only few centimeters of leachate above the well screen, with elevations ranging from <133.79 to 133.90 m ASL. Overall, leachate elevations in Phase 2 are typically 1-2 m below the elevation of the unlined lower leachate lagoon, indicating that a significant leachate mound is not present in Phase 2.

9.3 Groundwater Quality

The groundwater quality results for 2019/20 were similar to those measured over recent years and leachate-impacted groundwater is contained within the landfill property. At the north end of the landfill, leachate-affected groundwater extends just north of the unlined lower leachate lagoon and through the middle of the lined upper leachate lagoon but does not extend off-site. South of the landfill, leachate-affected groundwater does not extend off-site. Leachate related exceedances are confined to the landfill footprint on the east side of Phase 1 and are inferred to extend to the west side of the Phase 2 landfill. Overall, this indicates the leachate collection and containment system continued to function as intended and minimized impacts to groundwater and surface water.

Compliance monitoring wells and off site monitoring wells met CSR AW and DW standards. All other CSR exceedances in groundwater were observed in on-site monitoring wells in close proximity to the waste footprint, known leachate sources and leachate purge wells. Groundwater quality in new well 92-1-1 (Hartland North Pad) marginally exceeded CSR DW standards for aluminum, lithium, lead and vanadium during one sampling event. However, lithium concentrations were well below the regional background concentration of 33 µg/L, and is not considered to be a contaminant concern. Water quality at this location should improve with continued well development efforts.

9.4 Domestic Well Water Quality

As part of the CRD’s groundwater quality monitoring program, nineteen (19) domestic wells were sampled in 2019, including 14 routine locations located within a 2 km radius of the landfill and 5 new wells located north of the Hartland north pad. The water quality monitoring program indicated that groundwater quality in the domestic wells sampled in 2019 was consistent with previous results, and landfill leachate did not impact the water quality in the sampled wells. Water quality in all five new domestic wells located northwest of the landfill near the end of Willis Point Road met CDWQ and SDWQG guidelines, indicating these domestic wells were not impacted by leachate from Hartland landfill.

9.5 Surface Water Quality

The surface water quality data collected in 2019/20 revealed that nearby surface water bodies, Tod Creek, Durrance Lake and Durrance Creek and Killarney Lake are not impacted by leachate.

Surface water in the vicinity of the landfill met the BCWQG MAC values except for occasional exceedances for pH, nitrate, iron, copper, zinc and TSS. Elevated concentrations were largely related to seasonal flow variability (high and turbid flow) or construction activities. Of 23 stations, total TSS and iron exceeded BCWQG MAC at five (5) stations, dissolved copper and total zinc concentrations exceeded BCWQG MAC values at two (2) stations and nitrate exceeded BCWQG MAC at one (1) station. Moreover, pH at three (3) stations was slightly lower than 6.5 but remained above 6.0. Most exceedances were observed during February 2020 and were related to the prolonged dry winter. The elevated metal concentrations were generally concurrent with high TSS, which may be related to construction and stockpiling activities involving aggregate. Water quality at background locations (SW-S-52 and CSs2) met BCWQG-MAC guidelines. Concentrations of leachate indicator parameters were consistent with previously reported background values.

9.6 Leachate

The leachate flow and quality data collected in 2019/20 indicates that average leachate flow in 2019/20 was 11.75 L/s, and slightly slower than the long-term (1997 to 2019) average of 11.96 L/s. Leachate discharge remained in compliance with the requirements of the Waste Discharge Permit at the Hartland Valve Chamber in 2019/20. Statistical trend analysis indicated that leachate quality at the Hartland Valve Chamber has remained relatively stable or slightly improved over the past five years.

9.7 Quality Assurance and Quality Control

Upon review of the quality assurance and quality control data collected in 2019/20, groundwater, surface water and leachate sampling and laboratory analysis have produced reliable results that are acceptable for the purposes of this monitoring report. Duplicate sampling frequencies were generally acceptable but additional duplicates are warranted for individual leachate sources to allow for an assessment of the precision of analytical results. However, dissolved metals, especially dissolved copper and zinc concentrations should be interpreted with caution. Over 25-50% of duplicate water samples had dissolved copper and zinc concentrations above RPD thresholds where all parameter concentrations were above the limit of quantification, indicating potential contamination during the sample handling or filtration process.

9.8 Compliance with Operating Certificate and Waste Discharge Permit

Groundwater quality, surface water quality and leachate quality data were used to assess compliance with the Amended Operational Certificate and Waste Discharge Permit and are discussed individually below.

9.8.1 Groundwater

A total of 36 groundwater monitoring wells were identified as Boundary Compliance monitoring locations including wells at locations 4, 18, 20, 21, 28, 29, 30, 31, 39, 41, 42, 50, 53, 55, 56, 57, 71, 72 and 73. Water quality information collected from these wells is compared to the BC CSR Standards for the protection of aquatic life and drinking water to assess compliance with the landfill operating certificate and to protect both current and future uses of the groundwater resource.

With respect to groundwater, the Hartland landfill was in compliance with its Operational Certificate.

9.8.2 Surface Water

A total of five surface water monitoring stations have been identified as Boundary Compliance Monitoring Locations surrounding Hartland landfill including Sw-S-04, Sw-N-05, Sw-N-16, SN-N-41s1 and Sw-N-42s1. These stations are concentrated along the southern and northern property boundaries and are located downgradient of areas that have the potential to be impacted by leachate or runoff from the site, but these impacts are likely unrelated to landfill operations. Water quality data collected from these sites was compared to the BCWQG-MAC values and used to assess compliance with the landfill Operational Certificate.

With respect to surface water, the landfill was in compliance with the Operational Certificate with the exception of the exceedances related to low-flow conditions noted in Table 9-1.

Table 9-1. Surface Water Quality Compliance at Property Boundary Stations

Station	General Parameters	Metals	Recommended Corrective Action
North of the Landfill			
Sw-N-16	TSS (1), Lab pH (1)	Total iron (2), Dissolved iron (1), Dissolved Copper (1)	• Exceedances are anticipated to be related to turbid flow conditions following a prolonged dry period. Continued monitoring to assess these anomalous results. Refinement of the Standard Operating Procedure for surface water sampling to minimize the potential for artificially elevated concentrations of metals associated with suspended sediments. • Dissolved copper exceedance may be related to the sample handling/filtration process. Incorporate filter blanks in sampling program and closely monitor laboratory results for elevated concentrations of trace metals. • Lab pH often exceeds the hold time. Field pH should also be measured for QAQC purposes.
South of the Landfill			
Sw-S-04	Field pH (2)	Dissolved Copper (1)	• Dissolved Copper exceedance may be related to the sampling handling/filtration process. Incorporate filter blanks in sampling program and closely monitor laboratory results for elevated concentrations of trace metals.

9.8.3 Leachate

The Hartland valve chamber is the compliance point for the Waste Discharge Permit. During the monitoring period, leachate discharges at the Hartland valve chamber were in compliance with the Waste Discharge Permit requirements.

10. Recommendations

Based on the findings of this report, our recommendations are summarized in Table 10-1:

Table 10-1. Summary of Recommendations

	Leachate Collection System
1	Leachate purge wells should continue to be operated on a continuous basis except for periods when the leachate conveyance and storage facilities are at capacity. Regular maintenance and replacement of pumps and wells as a result of ongoing biofouling and encrustation will help ensure that target pumping elevations in purge wells are achieved. Options for maintaining lower leachate levels in P9 should be further investigated to continue improving groundwater quality west of the lower leachate lagoon.
2	Pumping levels and the extent of the drawdown cones surrounding the north and south purge well systems should continue to be validated periodically (next assessment in 2024) to confirm the proper functioning of the wells. All procedures should follow the Standard Operating Procedure (SOP) – North Purge Well Drawdown Cone Verification (AECOM, 2016), with interpretation of results by a qualified professional.
3	Consideration should be given to testing and/or replacement of the pump installed in P7 to improve leachate collection. The lower pumping rate observed in P7 since late 2018 continued through 2019/20. The 2019/20 monitoring data indicated several performance interruptions that may impact leachate collection and downgradient water quality over time. Water levels and quality in the north purge wells should continue to be closely monitored to verify the effectiveness of leachate collection system.
4	Pumping elevations in the south purge wells (P2, P3, P4 and P10) should be maintained at elevations below 140 m ASL. Pumping elevations in P1 should be maintained near the bottom of the screened interval around 146 m ASL. Water level monitoring data indicates the pump installed in P1 and the associated SCADA set points may need to be lowered. Pumps and conveyance piping should be regularly maintained to ensure performance targets are achieved. Consideration should be given to installing a flow meter to monitor the volume of leachate discharge from the south purge wells.
5	Consideration should be given to servicing and/or replacing the pump in south purge well P3 due to the increased frequency of performance interruptions.
6	Quarrying and blasting should continue to be conducted under the direction of a qualified blasting professional to minimize the potential for blast-enhanced fracturing, with possible negative impacts on hydraulic properties, groundwater elevations, groundwater flow rates and leachate containment north of the Phase 2 landfill. There are risks to the performance of the hydraulic trap if blasting is not properly designed and implemented.
7	Future quarry development plans (i.e., quarrying, blasting, etc.) for the north bedrock ridge should be evaluated from a hydrogeological perspective to ensure that the proposed development will not affect groundwater recharge or compromise leachate containment. Future development proposes to expand westward across a mapped regional scale geologic fault that is a known barrier to eastward groundwater flow. Furthermore, the location of aggregate stockpiles and associated surface water management plans should be reviewed from the perspective of potential for impacts to surface and groundwater quality.
8	A detailed assessment of the effectiveness of the hydraulic trap and leachate collection systems including the north purge wells and south purge wells is required to evaluate effectiveness as the landfill extends further north and west, and as additional lifts are constructed. Additional leachate containment or groundwater management measures may need to be implemented at the north end of the Phase 2 landfill to mitigate the potential for off-site leachate migration during future landfill development.
9	An assessment of cumulative contaminant load removal per purge well is recommended for both the north and south purge well systems. There may be opportunities for refinement of the north and south purge well systems to minimize collection and treatment of relatively dilute groundwater (e.g. 81-1-0-P9, P4, etc.) for at least part of the year. The relative benefits of each well should be considered in the context of the elevation of the lower leachate lagoon over the period of the assessment.
	Runoff and Infiltration Associated with Aggregate Stockpiles
10	The location and volume of aggregate stockpiles should continue to be minimized outside of the leachate collection system. Stockpiles should be covered where present to minimize sulphate, ammonia, nitrate and TSS impacts on surface water bodies and downgradient groundwater. Direct runoff from aggregate stockpiles should be diverted away from natural water courses as it is known to exceed BCWQ guidelines for sulphate.
11	Within the footprint of the leachate collection system, progressive closure and temporary tarps should continue to be implemented to minimize infiltration to the underlying leachate collection system. The aggregate is a known source of sulphate, which may be contributing to elevated sulphide concentrations in the Phase 2 basin relative to other areas of the landfill, where aggregate is not produced, stored or used as cover material. Aggregate provides a large source of sulphur that may require further sulphide management prior to discharge to the leachate pipeline at the Hartland Valve Chamber.

Groundwater Monitoring Program	
12	Groundwater and surface water sampling programs should continue to be scheduled at times of year that are optimal for collection of samples, and when wells and streams are likely to contain sufficient water for sampling. The current timing of sampling events has precluded collection of a number of groundwater and surface water samples. If streams are not flowing at the time of sampling, the sampling schedule should be modified with the goal of collecting samples reflective of wet and dry season conditions at a minimum. Efforts should be focused on obtaining a complete record of groundwater levels, groundwater quality and surface water quality data for the month of September each year because fall data is relied upon heavily when interpreting groundwater flow, groundwater quality and surface water quality at the landfill.
13	Groundwater levels should continue to be closely monitored at locations east of the landfill (i.e., 18, 76, 17 and 54) to confirm groundwater flow is toward the landfill, although pressure transducers installed in wells 18-1-1, 76-1-1, 17-1-1 and 54-1-1 indicated that the westward groundwater gradients are restored in 2019/20.
14	The elevation of the leachate mound in Phase 1 and 2 should be determined at least once every five years (i.e., next assessment in 2025). The existing protocols should be refined to ensure successive triplicate water level measurements produce the same result. Several inconsistencies have been recently identified, which are interpreted to be the result of highly conductive condensate in landfill gas wells.
15	Groundwater quality data at compliance wells 4-2-1 and 72-2-1 has not been collected since 2016 due to very slow recharge. These wells should be decommissioned to satisfy the requirements of the *Water Sustainability Act*. The need for replacement wells should be evaluated in the context of the overall monitoring plan.
16	Groundwater quality at locations 40, 20, and 21 should continue to be closely monitored due to elevated concentrations of conductivity, chloride, and ammonia in monitoring wells located close to the property boundary, and to monitor the performance of the north purge well system.
17	Groundwater quality at locations 85, 60, 72, 7 and 73 should continue to be closely monitored to confirm the south leachate collection system is performing adequately. This will help determine the net effect of modifications made to P1 in 2018 and confirm whether elevated conductivity and chloride concentrations are related to the use of road salt at the bin facility.
18	Monitoring wells on the north ridge and at Hartland North should continue to be monitored to characterize daily groundwater level fluctuations, further define the groundwater divergence and monitor groundwater flow behavior over time after construction of the Residuals Treatment Facility is complete. These wells should be protected from site development activities and damage by heavy equipment. Monitoring of these wells will also be important as the extents of the quarry within Phase 2 migrate northward. Furthermore, any westward expansion of the quarry may be accompanied by an increase in groundwater flow reporting to the leachate collection system as the Highland Fault is inferred to behave as a barrier to eastward groundwater flow.
19	There should be a routine review of the landfill development plan and filling plan every two years to ensure the existing monitoring network and monitoring program remain sufficient.
20	As required by the Amended Operational Certificate, the results of the annual monitoring program should continue to be reviewed and interpreted by a Qualified Professional experienced in assessing the impacts of landfill leachate at large municipal landfills similar to Hartland.
Surface and Leachate Monitoring Program	
21	The source of ammonia and nitrate observed at Sw-S-12 and Sw-S-03 should be investigated further. Additional waste has been placed on the western and southern portions of Phase 2 over recent years and occasional leachate seeps and runoff from the truck wash have been noted in the past. A multilevel monitoring well cluster should be established west of the bin facility and well 85-1-1 to resolve whether the source of impacts to surface water are due to runoff or discharge of leachate impacted groundwater.
22	The recent update to the BCWQG in August 2019 modified guidelines for the protection of aquatic life for dissolved copper and should be considered in 2020/21.Dissolved organic carbon (DOC) should be collected at all surface water stations on all sampling dates to assess dissolved copper criteria using BLM.
23	In addition to the Sewer Use Criteria, leachate quality results for trace organic compounds should be compared to BC CSR standards for the protection of drinking water and aquatic life to allow for screening of data to identify parameters in leachate that exceed CSR standards, and guide any refinements to the monitoring program in future years.
24	Sampling at surface water at station Sw-N-51 (not compliance location) should be discontinued due to the frequent dry conditions.
Construction Management	
25	Appropriate erosion control measures should continue to be implemented to minimize runoff from construction areas for all projects involving excavation, aggregate placement or soil relocation.
26	The placement of aggregate, road salt, dust suppressant and herbicides should be carefully considered and documented to help understand the causes of potential future concentrations of conductivity, ammonia, chloride, nitrate, sulphate and select metals at groundwater and surface water monitoring locations.

Quality Assurance and Quality Control	
27	Quality assurance for laboratory analyses should continue to be evaluated quarterly, and any discrepancies should be resolved with the laboratory and CRD sampling personnel within one month of receiving the laboratory results. The appropriate notation should be added to the data files to explain the reason for the low precision and the steps taken, if any, to improve the sampling or laboratory procedures.
28	Consider utilizing a different brand of in-line filters to eliminate trace metal concentrations observed in dissolved metals samples. Although the detection limits of these trace metals were generally low, it may interfere the analytical results and subsequent interpretation, especially for metals have stringent water quality guidelines. Filter blanks should be added to the analytical program and in-line filters should be flushed with sample water for at least 30 seconds (e.g. 500 ml) in advance of sampling to remove residual trace metals.
29	Field measurement probes should be calibrated daily in advance of monitoring activities. The calibration should be validated at least once in the middle of the day to confirm the readings are accurate. Lab pH should also be analyzed and recorded for QAQC purposes.

11. Qualifications of the Authors

Kun Jia, M.Sc., P.Geo is a Hydrogeologist / Geochemist with over eight years of experience collecting, analyzing and interpreting hydrogeological and geochemistry data for waste management, mining and contaminated sites projects. Kun has contributed to and authored several monitoring reports at Hartland landfill since 2015 and has been the primary author of the annual monitoring report since 2015.

Rebecca McGovern, M.Sc, has two years of experience collecting, analyzing and interpreting hydrogeological data for contaminated sites, landfills, mines, pharmaceutical sites and industrial facilities. Rebecca assisted with data compilation, preparation of graphical figures, data interpretation and report writing and co-authored this 2019/20 annual monitoring report.

Mehrnoush Javadi., M.Sc., Ph.D. has over eight years of experience collecting, analyzing and interpreting hydrogeological and geochemistry data at landfills and mines. Mehrnoush assisted with data compilation, preparation of graphical figures, data interpretation and report writing, and has been a co-author of this report since 2018.

Ryan Mills, M.Sc., P.Geo. is a Senior Hydrogeologist with over 19 years of experience interpreting and analyzing hydrogeological and water chemistry data for waste management, water resources and mining related projects. Ryan has authored several groundwater monitoring reports and conducted numerous site investigations involving drilling and hydrogeologic testing at Hartland Landfill since 2004. He has also undertaken site investigations at numerous other municipal, industrial and small rural landfills throughout British Columbia. Ryan oversaw and reviewed all aspects of the report.

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Appendix A

Monitoring Station and Groundwater Level Data

- A1. Monitoring Well Co-ordinates
- A2. Monitoring Well Details
- A3. Groundwater Elevations
- A4. Surface Water Station Details

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A1. Monitoring Well Co-ordinates

Appendix A-1. Monitoring Well Co-ordinates 2019-2020

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Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground	Depth to Top of Screen Below Ground	Depth to Bottom of Screen Below Ground		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGL	m BGL	m BGL				
GW-04-3-1	Active	5375469.0	466167.8	127.11	128.20	128.09	114.26	111.21	1.05	15.90	12.85	15.90	2005 Mar	I	SP1	
GW-04-4-1	Active	5375466.8	466166.1	127.13	128.08	128.01	122.98	119.93	0.88	7.20	4.15	7.20	2005 Mar	S	SP1	
GW-07-1-0	Active	5375613.3	466177.0	140.60	142.69	142.29	N/A	N/A	1.69	36.58	No monitor	No monitor	2005 Mar	D	SP1	
GW-09-1-0	Active	5375774.0	466187.0	148.96	150.14	150.14	N/A	N/A	1.18	98.37	No monitor	No monitor	Historic	D	EP1	
GW-16-1-1	Active	5376345.6	466130.2	143.48	144.28	144.06	101.98	100.48	0.58	45.35	41.50	43.00	2005 Mar	D	EP1	
GW-16-1-2	Active	5376345.6	466130.1	143.48	144.28	144.00	110.98	109.48	0.52	45.35	32.50	34.00	2005 Mar	D	EP1	
GW-16-2-1	Active	5376347.1	466133.7	143.31	144.09	143.67	119.81	118.81	0.36	25.55	23.50	24.50	2005 Mar	I	EP1	
GW-16-2-2	Active	5376347.0	466133.7	143.31	144.09	143.72	129.81	126.81	0.41	25.55	13.50	16.50	2005 Mar	I	EP1	
GW-17-1-1	Active	5376186.4	466198.0	150.99	152.17	152.08	100.49	98.99	1.09	57.86	50.50	52.00	2005 Mar	D	EP1	
GW-17-1-2	Active	5376186.5	466198.0	150.99	152.17	152.11	110.99	109.49	1.12	57.86	40.00	41.50	2005 Mar	D	EP1	
GW-17-1-3	Active	5376186.5	466198.0	150.99	152.17	152.04	136.49	133.29	1.05	57.86	14.50	17.70	2005 Mar	I	EP1	
GW-18-1-1	Active	5375976.5	466194.8	168.81	169.48	168.82	110.64	109.14	0.19	59.67	58.17	59.67	2005 Mar	D	EP1	
GW-18-1-2	Active	5375976.5	466194.7	168.81	169.48	169.33	122.61	121.11	0.52	59.67	46.20	47.70	2005 Mar	D	EP1	
GW-18-2-1	Active	5375973.0	466193.8	168.92	169.68	169.16	138.42	136.92	0.24	33.35	30.50	32.00	2005 Mar	D	EP1	
GW-18-2-2	Active	5375973.0	466193.7	168.92	169.68	169.12	155.92	152.92	0.20	33.35	13.00	16.00	2005 Mar	I	EP1	
GW-19-1-1	Active	5375503.2	466125.3	132.89	133.86	133.85	96.89	95.39	0.96	41.76	36.00	37.50	2005 Mar	D	SP1	
GW-19-1-2	Active	5375503.2	466125.3	132.89	133.86	133.87	106.39	104.89	0.98	41.76	26.50	28.00	2005 Mar	I	SP1	
GW-19-2-1	Active	5375507.6	466124.1	132.60	133.37	133.26	117.10	115.60	0.66	18.90	15.50	17.00	2005 Mar	I	SP1	
GW-19-2-2	Active	5375507.6	466124.1	132.60	133.37	133.32	126.60	123.60	0.72	18.90	6.00	9.00	2005 Mar	S	SP1	
GW-20-1-1	Active	5376498.3	465971.1	110.46	111.32	111.17	80.46	77.46	1.20	36.60	30.00	33.00	2005 Mar	D	NP1	Deactivated in 2010.
GW-20-1-2	Active	5376498.4	465971.0	110.46	111.32	111.19	92.66	89.66	1.21	36.60	17.80	20.80	2005 Mar	I	NP1	
GW-21-1-1	Active	5376483.9	465970.8	110.92	111.79	111.69	98.02	94.92	1.25	16.80	12.90	16.00	2005 Mar	I	NP1	
GW-21-1-2	Active	5376483.9	465970.9	110.92	111.79	111.68	105.42	102.32	1.24	16.80	5.50	8.60	2005 Mar	S	NP1	
GW-21-2-1	Active	5376482.3	465970.0	111.10	111.87	111.80	No log	No log	0.70	4.95	No log	No log	2005 Mar	S	NP1	
GW-25-1-1	Active	5376491.7	465713.9	129.91	130.89	130.77	106.91	105.41	0.86	25.20	23.00	24.50	2005 Mar	I	NP2	
GW-25-1-2	Active	5376491.7	465714.0	129.91	130.89	130.78	125.61	123.41	0.87	25.20	4.30	6.50	2005 Mar	S	NP2	
GW-27-1-1	Active	5376358.2	465455.8	141.09	141.91	141.57	118.09	116.59	0.48	25.60	23.00	24.50	2005 Mar	I	BKGND - WP2	
GW-27-1-2	Active	5376358.2	465455.7	141.09	141.91	141.56	140.59	137.59	0.47	25.60	0.50	3.50	2005 Mar	S	BKGND - WP2	
GW-28-1-0	Active	5376503.6	465825.1	136.25	137.07	136.52	N/A	N/A	0.27	32.80	No monitor	No monitor	2005 Mar	D	NP1	

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2019-2020

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground	Depth to Top of Screen Below Ground	Depth to Bottom of Screen Below Ground		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGL	m BGL	m BGL				
GW-29-1-1	Active	5376563.3	465898.2	113.39	114.41	114.38	100.28	98.87	0.99	15.00	13.11	14.52	2005 Mar	S	NP1	
GW-29-1-2	Active	5376563.3	465898.3	113.39	114.41	114.39	110.39	105.96	1.00	15.00	3.00	7.43	2005 Mar	S	NP1	
GW-30-1-1	Active	5376562.2	465978.4	109.84	110.89	110.79	95.51	94.10	0.95	16.37	14.33	15.74	2005 Mar	I	NP1	
GW-30-1-2	Active	5376562.3	465978.5	109.84	110.89	110.79	108.56	104.07	0.95	16.37	1.28	5.77	2005 Mar	S	NP1	
GW-31-1-1	Active	5376555.2	466080.9	105.28	106.34	106.26	90.92	89.50	0.98	17.40	14.36	15.78	2005 Mar	I	NP1	
GW-31-1-2	Active	5376555.2	466080.9	105.28	106.34	106.26	103.84	99.41	0.98	17.40	1.44	5.87	2005 Mar	S	NP1	
GW-36-1-1	Active	5376398.9	465778.3	130.21	130.21	131.51	117.87	114.87	1.30	15.34	12.34	15.34	2005 Mar	I	NP2	
GW-36-2-1	Active	5376400.6	465776.5	130.00	131.11	131.07	90.68	87.63	1.07	42.40	39.32	42.37	2005 Mar	D	NP2	
GW-36-3-1	Active	5376401.7	465773.6	130.01	131.01	130.96	115.01	112.01	0.95	18.00	15.00	18.00	2005 Mar	I	NP2	
GW-37-1-1	Active	5376432.6	465725.6	129.59	130.12	129.98	117.35	114.35	0.39	15.24	12.24	15.24	2005 Mar	I	NP2	
GW-37-2-1	Active	5376432.5	465727.8	129.92	130.64	130.60	89.47	86.42	0.68	43.60	40.45	43.50	2005 Mar	D	NP2	
GW-37-3-1	Active	5376435.6	465726.8	129.95	130.75	130.63	119.72	115.15	0.68	14.80	10.23	14.80	2005 Mar	S	NP2	
GW-38-1-1	Active	5376464.6	465797.2	131.90	132.46	132.31	N/A	N/A	0.41	18.29	No monitor	No monitor	2005 Mar	I	NP2	
GW-39-1-1	Active	5376467.2	465876.1	129.54	130.24	130.11	111.10	108.10	0.57	21.44	18.44	21.44	2005 Mar	I	NP2	
GW-39-2-1	Active	5376466.3	465874.7	129.75	130.72	130.58	95.56	92.56	0.83	37.19	34.19	37.19	2005 Mar	D	NP2	
GW-40-1-1	Active	5376432.1	465915.2	122.00	122.78	122.68	109.76	106.76	0.68	17.07	12.24	15.24	2005 Mar	I	NP1	
GW-41-1-1	Active	5376852.1	465190.4	149.48	150.30	150.16	143.41	140.41	0.68	9.07	6.07	9.07	2005 Mar	S	HNP	
GW-42-1-1	Active	5376717.6	465534.9	138.81	139.45	139.33	133.02	129.97	0.52	8.84	5.79	8.84	2005 Mar	S	HNP	
GW-43-1-1	Active	5376683.8	465448.7	162.60	163.05	163.10	144.31	141.26	0.50	21.34	18.29	21.34	2007 Apr	I	HNP	
GW-44-1-1	Active	5376671.5	465322.3	161.46	162.02	161.89	153.84	150.79	0.43	18.29	7.62	10.67	2005 Mar	S	HNP	
GW-46-2-1	Active	5376075.5	466029.9	169.97	171.25	171.70	161.69	158.69	1.73	11.28	8.28	11.28	2006 Apr	S	P1	
GW-46-3-1	Active	5376085.7	466035.7	169.83	172.46	172.38	137.83	134.78	2.55	35.10	32.00	35.05	2006 Apr	D	P1	Installed during 2005
GW-46-4-1	Active	5376078.5	466035.9	169.71	172.10	172.03	151.12	148.07	2.32	21.64	18.59	21.64	2006 Apr	I	P1	Installed during 2005
GW-47-2-1	Active	5375888.1	465996.7	171.84	174.46	174.40	154.78	151.73	2.55	20.11	17.06	20.11	2006 Apr	I	P1	Installed during 2005
GW-48-1-1	Active	5375840.5	466031.3	169.78	171.34	171.63	160.14	157.14	1.85	14.02	9.64	12.64	2006 Apr	S	P1	
GW-48-2-1	Active	537815.8	466031.6	168.87	171.28	171.22	149.97	146.92	2.35	21.95	18.90	21.95	2006 Apr	I	P1	Installed during 2005
GW-51-1-1	Active	5376475.1	466048.2	110.90	111.68	111.76	106.13	103.13	0.86	7.77	4.77	7.77	2005 Mar	S	NP1	
GW-51-2-1	Active	5376474.1	466045.6	110.90	111.83	111.89	100.49	97.49	0.99	13.41	10.41	13.41	2005 Mar	S	NP1	
GW-51-3-1	Active	5376473.3	466042.7	110.97	111.84	111.89	93.85	90.85	0.92	20.12	17.12	20.12	2005 Mar	I	NP1	
GW-52-1-1	Active	5376406.0	465979.1	119.91	120.94	120.90	93.19	90.19	0.99	29.72	26.72	29.72	Historic	I	NP1	
GW-52-2-0	Active	5376391.0	465959.0	119.99	120.65	120.65	N/A	N/A	0.66	15.57	No monitor	No monitor	Historic	I	NP1	

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2019-2020

AECOM

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground	Depth to Top of Screen Below Ground	Depth to Bottom of Screen Below Ground		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGL	m BGL	m BGL				
GW-52-3-0	Active	5376389.9	465948.8	119.78	120.35	120.35	N/A	N/A	0.57	15.53	No monitor	No monitor	Historic	I	NP1	
GW-52-4-0-P7	Active	5376388.0	465947.0	119.80	120.60	120.60	N/A	N/A	0.80	22.25	No monitor	No monitor	Historic	I	NP1	Purge well
GW-53-1-1	Active	5376506.2	465761.3	130.84	131.81	131.92	114.15	110.88	1.08	19.96	16.69	19.96	2005 Mar	I	NP2	
GW-54-1-1	Active	5376187.7	466226.9	154.63	155.58	155.65	107.91	104.91	1.02	49.72	46.72	49.72	2005 Mar	D	EP1	
GW-54-2-1	Active	5376185.6	466225.5	154.69	155.62	155.66	118.55	115.55	0.97	39.14	36.14	39.14	2005 Mar	D	EP1	
GW-54-3-1	Active	5376183.4	466224.7	154.66	155.50	155.53	138.05	135.05	0.87	19.61	16.61	19.61	2005 Mar	I	EP1	
GW-55-1-1	Active	5376910.6	465136.1	147.67	147.68	148.52	139.06	134.56	0.85	13.11	8.61	13.11	2005 Mar	S	HNP	
GW-56-1-1	Active	5376838.5	465287.8	148.67	149.69	149.61	139.92	131.29	0.94	17.38	8.75	17.38	2005 Mar	I	HNP	
GW-57-1-1	Active	5376873.9	465528.4	132.37	132.99	132.90	122.77	118.81	0.53	13.56	9.60	13.56	2005 Mar	S	HNP	
GW-58-1-0	Active	5376324.8	465822.9	137.17	138.30	138.23	N/A	N/A	1.06	19.20	No monitor	No monitor	2009 May	I	NP2	
GW-60-1-1	Active	5375636.9	466137.2	141.63	142.40	142.32	122.23	119.23	0.69	22.40	19.40	22.40	2005 Mar	I	SP1	
GW-60-2-1	Active	5375638.4	466137.4	141.61	142.46	142.40	129.51	126.51	0.79	15.10	12.10	15.10	2005 Mar	I	SP1	
GW-60-3-1	Active	5375640.0	466137.5	141.74	142.60	142.49	137.84	134.84	0.75	6.90	3.90	6.90	2005 Mar	S	SP1	
GW-61-1-1	Active	5375980.6	465523.1	212.00	213.06	212.95	146.40	143.40	0.95	68.60	65.60	68.60	2005 Mar	D	BKGND - WP2	
GW-62-1-1	Active	5376609.3	465265.5	183.44	184.25	184.25	161.32	159.82	N/A	23.70	22.12	23.62	2008 May	I	HNP	Survey elevations suspect.
GW-62-2-1	Active	5376610.5	465267.3	183.06	183.96	183.96	168.70	165.70	N/A	18.90	14.36	17.36	2008 May	I	HNP	Survey elevations suspect.
GW-63-1-1	Active	5375812.3	465609.5	197.24	198.18	198.09	168.44	165.44	0.85	31.80	28.80	31.80	2005 Mar	I	BKGND - WP2	
GW-63-2-1	Active	5375809.7	465610.5	197.21	198.11	198.03	186.71	183.71	0.82	13.50	10.50	13.50	2005 Mar	S	BKGND - WP2	
GW-71-1-1	Active	5375643.3	466260.6	144.04	144.93	144.82	116.61	113.56	0.81	31.24	27.43	30.48	2005 Mar	D	SP1	
GW-71-2-1	Active	5375644.1	466259.9	144.04	144.92	144.81	127.04	123.98	0.80	20.10	17.00	20.06	2005 Mar	I	SP1	
GW-71-3-1	Active	5375645.3	466259.1	144.05	144.95	144.90	137.04	134.00	0.85	10.10	7.01	10.05	2005 Mar	S	SP1	
GW-72-1-1	Active	5375670.6	466186.6	143.29	144.13	144.03	115.86	112.81	0.79	30.48	27.43	30.48	2005 Mar	D	SP1	
GW-72-2-1	Active	5375671.7	466186.7	143.32	144.09	144.04	126.56	123.20	0.72	20.12	16.76	20.12	2005 Mar	I	SP1	
GW-72-3-1	Active	5375672.7	466186.8	143.38	144.17	144.12	136.06	133.02	0.74	10.36	7.32	10.36	2005 Mar	S	SP1	
GW-73-1-1	Active	5375532.1	466184.1	134.52	135.47	135.31	106.91	103.86	0.86	30.66	27.61	30.66	2005 Mar	D	SP1	
GW-73-2-1	Active	5375533.2	466184.1	134.50	135.40	135.36	117.40	114.38	0.86	20.12	17.10	20.12	2005 Mar	I	SP1	
GW-73-3-1	Active	5375534.3	466184.1	134.48	135.37	135.31	127.46	124.42	0.83	10.06	7.02	10.06	2005 Mar	S	SP1	
GW-75-1-1	Active	5376207.5	466035.3	154.82	155.62	155.97	127.72	121.72	1.15	33.10	27.10	33.10	2007 Apr	D	P1	
GW-76-1-1	Active	5375966.0	466228.4	171.08	171.79	171.69	123.23	117.13	0.61	61.90	47.85	53.95	2005 Mar	D	EP1	
GW-76-2-1	Active	5375967.5	466227.1	171.00	171.77	171.66	133.81	127.72	0.66	43.60	37.19	43.28	2005 Mar	D	EP1	

Notes:

Datum Description

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m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

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I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2019-2020

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground	Depth to Top of Screen Below Ground	Depth to Bottom of Screen Below Ground		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGL	m BGL	m BGL				
GW-76-3-1	Active	5375968.8	466226.0	170.99	171.75	171.71	145.08	142.03	0.72	29.00	25.91	28.96	2005 Mar	I	EP1	
GW-77-1-1	Active	5376487.8	465536.8	155.04	155.66	155.63	120.60	117.55	0.59	40.26	34.44	37.49	2006 Apr	D	NP2	Installed in 2006
GW-77-2-1	Active	5376485.8	465536.2	154.90	155.51	155.45	139.16	135.87	0.55	20.67	15.74	19.03	2006 Apr	I	NP2	Installed in 2006
GW-78-1-1	Active	5376498.8	465648.8	142.66	143.46	143.38	113.46	110.18	0.72	33.79	29.20	32.48	2006 Apr	D	NP2	Installed in 2006
GW-78-2-1	Active	5376500.3	465646.7	142.59	143.40	143.36	132.42	129.14	0.77	14.11	10.17	13.45	2006 Apr	S	NP2	Installed in 2006
GW-80-1-0-P8	Active	5376397.4	465931.0	119.61	120.29	N/A	N/A	N/A	N/A	20.42	No monitor	No monitor	2008 May	I	NP1	Purge well
GW-81-1-0-P9	Active	5376409.0	465910.8	122.17	122.85	N/A	N/A	N/A	N/A	26.82	No monitor	No monitor	2008 May	I	NP1	Installed in 2007
GW-82-1-1	Active	5376257.5	465772.7	154.67	155.89	155.86	135.17	131.50	1.18	23.77	19.50	23.17	2009 May	I	P2	Installed in 2007
GW-83-1-1	Active	5376353.3	465723.8	140.09	141.40	141.44	124.97	121.92	1.35	18.90	15.12	18.17	2009 May	I	P2	Installed in 2007
GW-85-1-1	Active	5375688.3	466068.7	149.09	150.09	150.07	142.99	139.95	0.98	9.14	6.1	9.14	2009 May	S	SP1	Installed in March 2009
GW-87-1-1	Active	5376451.7	465243.4	182.32	183.22	183.16	147.62	144.52	0.84	37.80	34.70	37.80	2015 Feb	D	NP2	Installed in 2014
GW-87-2-1	Active	5376453.8	465242.8	182.36	183.26	183.24	165.56	162.56	0.88	21.90	16.80	19.80	2015 Feb	I	NP2	Installed in 2014
GW-88-1-1	Active	5376467.2	465271.7	181.47	182.24	182.16	138.77	135.77	0.69	45.70	42.70	45.70	2015 Feb	D	NP2	Installed in 2014
GW-88-2-1	Active	5376470.1	465271.9	181.29	182.16	182.10	168.49	165.49	0.81	16.80	12.80	15.80	2015 Feb	I	NP2	Installed in 2014
GW-89-1-1	Active	5376028.4	466043.4	169.25	169.45	169.45	138.62	135.57	0.19	30.18	30.63	33.68	2018 Dec	D	P1	Installed in 208
GW-89-2-1	Active	5376026.8	466048.7	169.141	169.34	169.34	149.48	146.43	0.20	19.05	19.66	22.71	2018 Dec	I	P1	Installed in 2018
GW-90-1-1	Active	5376286.6	465651.3	151.876	152.69	152.69	118.34	115.30	0.81	38.40	33.54	36.58	2019 Oct	D	P2	leachate mound monitoring well
GW-90-2-1	Active	5376286.8	465652.3	152.00	152.75	152.75	136.84	133.79	0.75	14.94	15.16	18.21	2018 Dec	I	P2	leachate mound monitoring well
GW-91-1-1	Active	5376604.9	465473.7	164.61	165.33	165.33	149.01	145.97	0.72	18.64	15.60	18.64	2019 Nov	I	HNP	Installed in 2019
GW-92-1-1	Active	5376535.4	465501.9	167.68	168.57	168.57	147.76	144.72	0.88	22.96	19.92	22.96	2019 Nov	I	HNP	Installed in 2019
GW-93-1-1	Active	5376556.5	465260.0	183.42	184.24	184.24	159.34	156.29	0.83	28.04	24.08	27.13	2019 Nov	D	HNP	Installed in 2019
GW-94-1-1	Active	5376508.8	465129.5	203.65	204.32	204.32	163.87	160.83	0.67	42.82	39.78	42.82	2019 Dec	D	HNP	Installed in 2019
VLGW-02-D	Active	5375782.7	465984.2	168.58	168.93	168.79	155.58	151.58	0.21	22.00	13.00	17.00	2008 May	I	P1	Landfill gas well
VLGW-03-D	Active	5375776.6	465933.6	170.04	170.30	170.30	156.29	153.29	0.26	17.00	13.75	16.75	2014 Feb	I	P1	Landfill gas well
VLGW-04-D	Active	5375858.1	466056.5	169.24	169.95	169.90	156.24	152.24	0.65	19.00	13.00	17.00	2008 May	I	P1	Landfill gas well
VLGW-08-D	Active	5376088.1	466113.6	164.42	165.28	165.14	147.41	137.38	0.72	28.04	17.01	27.04	2008 May	I	P1	Landfill gas well
VLGW-11-S	Active	5375996.8	466122.6	166.06	166.53	166.48	160.42	155.78	0.42	11.28	5.64	10.28	2008 May	I	P1	Landfill gas well
VLGW-15-D	Active	5375842.9	465997.0	170.61	171.13	171.07	156.41	148.21	0.46	23.31	14.2	22.4	2008 May	D	P1	Landfill gas well
VLGW-16-D	Active	5375901.0	466011.3	172.47	173.38	173.31	157.02	147.48	0.84	25.90	15.45	24.99	2008 May	I	P1	Landfill gas well
VLGW-17-D	Active	5375959.1	466025.5	171.40	171.81	171.77	157.20	144.28	0.37	28.04	14.2	27.12	2008 May	D	P1	Landfill gas well

Notes:

Datum Description

m BGL	*metres below ground level*
m AGL	*metres above ground level*
m ASL	*metres above mean sea level*

Monitor Class

S	*Shallow well <15 m deep*
I	*Intermediate well between 15 and 30 m deep*
D	*Deep well >30 m deep*

Area of Landfill

SP1	*South of Phase 1 Landfill*
EP1	*East of Phase 1 Landfill*
NP1	*North of Phase 1 Landfill*
NP2	*North of Phase 2 Landfill*
BKGND - WP2	*Background Water Quality West of Phase 2*
HNP	*Hartland North Pad*
P1	*Phase 1*
P2	*Phase 2*

AECOM

Appendix A-1. Monitoring Well Co-ordinates 2019-2020

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground	Depth to Top of Screen Below Ground	Depth to Bottom of Screen Below Ground		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGL	m BGL	m BGL				
VLGW-18-D	Active	5376017.5	466039.7	170.14	170.78	170.61	152.94	141.80	0.47	29.25	17.2	28.34	2008 May	D	P1	Landfill gas well
VLGW-19-D	Active	5376076.2	466054.1	168.80	169.53	169.21	151.60	141.37	0.42	28.34	17.2	27.43	2008 May	I	P1	Landfill gas well
VLGW-20-D	Active	5376131.2	466062.8	167.88	169.05	168.93	148.03	140.76	1.05	28.04	19.85	27.12	2008 May	I	P1	Landfill gas well
VLGW-21-D	Active	5376177.2	466082.0	164.81	165.40	165.30	147.89	140.43	0.49	25.93	16.92	24.38	2008 May	I	P1	Landfill gas well
VLGW-26-D	Active	5376165.6	466022.9	163.94	164.57	164.45	145.50	136.82	0.51	28.04	18.44	27.12	2008 May	D	P1	Landfill gas well
P1	Active	5375732.0	466026.0	157.60	158.17	158.17	151.50	145.41	0.57	12.50	6.10	12.19	2018 Dec	S	P1	Purge well, to replace the old well installed in 2005
P2	Active	5375733.3	466030.9	157.37	158.72	158.62	146.87	132.37	1.25	25.00	10.5	25	2005 Mar	I	P1	Purge well
P3	Active	5375739.0	466056.7	157.25	158.51	158.41	143.18	132.25	1.16	25.00	14.07	25	2005 Mar	I	P1	Purge well
P4	Active	5375751.7	466064.7	157.73	158.88	158.78	146.21	132.73	1.05	25.00	11.52	25	2005 Mar	I	P1	Purge well
P10	Active	5375731.5	466023.5	157.89	N/A	158.01	144.79	129.89	0.12	28.00	13.1	28	2010 October	I	P1	Purge well
VLGW-01-D	Inactive	5375802.0	466040.8	168.25	168.86	168.79	163.25	156.25	0.54	14.00	5.00	12.00	2008 May	I	P1	Landfill gas well
GW-01-1-1	Inactive	5375781.9	465852.0			168.56	-42.00	-44.50	168.56	55.54	42	44.5				
GW-01-1-2	Inactive	5375781.9	465852.0			168.53	-24.40	-24.80	168.53	40.10	24.4	24.8				
GW-01-1-3	Inactive	5375781.9	465852.0			168.53	-13.00	-14.75	168.53	29.53	13	14.75				
GW-01-2-1	Inactive	5375787.9	465859.0			168.25	-4.70	-5.10	168.25	20.50	4.7	5.1				
GW-01-3-1	Inactive	5375791.9	465851.0			167.81	-5.11	-5.91	167.81	21.02	5.11	5.91				
GW-02-1-1	Inactive	5375813.9	465996.0			166.90	-33.00	-33.50	166.90	48.58	33	33.5				
GW-02-1-2	Inactive	5375813.9	465996.0			166.90	-23.00	-24.60	166.90	39.29	23	24.6				
GW-02-1-3	Inactive	5375813.9	465996.0			166.90	-12.20	-13.80	166.90	28.79	12.2	13.8				
GW-02-2-1	Inactive	5375812.9	465990.0			167.14	-6.25	-7.50	167.14	22.53	6.25	7.5				
GW-03-1-1	Inactive	5375684.9	466042.0	147.41	148.21	148.05	122.91	122.21	0.64	26.03	24.5	25.2				
GW-03-1-2	Inactive	5375684.9	466042.0	147.41	148.21	148.05	134.11	133.61	0.64	16.33	13.3	13.8				
GW-03-1-3	Inactive	5375684.9	466042.0	147.41	148.21	148.05	143.41	141.61	0.64	7.03	4	5.8				
GW-03-2-1	Inactive	5375685.5	466037.7	149.20	150.01	149.28	145.15	142.10	0.08	7.10	4.05	7.1	2005 Mar	S	SP1	
GW-04-1-1	Inactive	5375464.0	466171.0	126.67	128.12	128.07	96.47	95.77	1.40	32.00	30.2	30.9				
GW-04-1-2	Inactive	5375464.0	466171.0	126.67	128.12	128.07	104.27	103.67	1.40	24.10	22.4	23				
GW-04-1-3	Inactive	5375464.0	466171.0	126.67	128.12	128.07	116.67	115.07	1.40	11.60	10	11.6				
GW-04-1-4	Inactive	5375464.0	466171.0	126.67	128.12	128.07	122.97	121.27	1.40	6.10	3.7	5.4				
GW-04-2-1	Inactive	5375468.5	466169.3	127.14	127.95	127.86	107.49	104.44	0.75	22.70	19.65	22.70	2005 Mar	I	SP1	Deactivated in 2016.
GW-05-1-1	Inactive	5376444.9	465813.9	126.29	127.49	127.49	112.59	110.59	1.20	16.90	13.7	15.7				
GW-05-1-2	Inactive	5376444.9	465813.9	126.29	127.49	127.49	118.69	116.69	1.20	10.80	7.6	9.6				

Notes:

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Monitor Class
- *S* — *Shallow well <15 m deep*
- *I* — *Intermediate well between 15 and 30 m deep*
- *D* — *Deep well >30 m deep*

Area of Landfill
- *SP1* — *South of Phase 1 Landfill*
- *EP1* — *East of Phase 1 Landfill*
- *NP1* — *North of Phase 1 Landfill*
- *NP2* — *North of Phase 2 Landfill*
- *BKGND - WP2* — *Background Water Quality West of Phase 2*
- *HNP* — *Hartland North Pad*
- *P1* — *Phase 1*
- *P2* — *Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2019-2020

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground	Depth to Top of Screen Below Ground	Depth to Bottom of Screen Below Ground		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGL	m BGL	m BGL				
GW-05-1-3	Inactive	5376444.9	465813.9	126.29	127.49	127.49	122.89	121.89	1.20	5.60	3.4	4.4				
GW-05-2-1	Inactive	5376426.9	465774.9	126.00	126.80	126.80	125.20	124.20	0.80	2.60	0.8	1.8				
GW-06-1-1	Inactive	5376148.9	465661.9	127.70	128.41	128.40	107.00	104.90	0.70	23.50	20.7	22.8				
GW-06-1-2	Inactive	5376148.9	465661.9	127.70	128.41	128.40	115.20	113.20	0.70	15.20	12.5	14.5				
GW-06-1-3	Inactive	5376148.9	465661.9	127.70	128.41	128.40	120.80	118.80	0.70	9.60	6.9	8.9				
GW-06-2-1	Inactive	5376151.9	465669.9	127.46	127.76	127.76	125.86	124.86	0.30	2.90	1.6	2.6				
GW-08-1-1	Inactive	5375867.9	465738.0	159.26	160.28	160.26	145.86	143.76	1.00	16.50	13.4	15.5				
GW-08-1-2	Inactive	5375867.9	465738.0	159.26	160.28	160.26	152.11	150.11	1.00	10.15	7.15	9.15				
GW-08-1-3	Inactive	5375867.9	465738.0	159.26	160.28	160.26	156.76	155.76	1.00	4.50	2.5	3.5				
GW-10-1-1	Inactive	5376108.9	465701.9	135.11	135.41	135.41	133.61	132.61	0.30	2.80	1.5	2.5				
GW-11-1-1	Inactive	5376254.9	465770.9	134.13	135.13	135.13	131.23	130.23	1.00	4.90	2.9	3.9				
GW-12-1-0	Inactive	5375701.0	466189.0	143.02	143.82	143.82	N/A	N/A	0.80	3.40	No monitor	No monitor	Historic	S	SP1	Dug well, deactivated in 2010
GW-13-1-1	Inactive	5376166.9	466031.9	150.43	152.73	152.73	121.93	118.93	2.30	33.80	28.5	31.5				
GW-13-1-2	Inactive	5376166.9	466031.9	150.43	152.73	152.73	126.83	125.33	2.30	27.40	23.6	25.1				
GW-14-1-1	Inactive	5375968.9	465969.9	158.73	160.22	160.22	138.53	135.53	1.49	24.69	20.2	23.2				
GW-15-1-1	Inactive	5375754.9	466007.0	159.78	160.82	160.82	145.68	143.38	1.04	17.44	14.1	16.4				
GW-22-1-1	Inactive	5376290.1	465751.7	138.54	138.81	139.86	111.22	109.69	1.32	28.09	27.32	28.85				
GW-23-1-1	Inactive	5376260.7	465718.7	128.37	129.52	129.50	111.51	110.09	1.13	17.57	16.86	18.28				
GW-23-1-2	Inactive	5376260.7	465718.7	128.37	129.52	129.49	124.67	121.80	1.12	5.14	3.7	6.57				
GW-24-1-1	Inactive	5376421.9	465753.0	127.77	128.88	128.88	109.91	108.51	1.11	18.56	17.86	19.26				
GW-24-1-2	Inactive	5376421.9	465753.0	127.77	128.88	128.87	124.10	121.26	1.10	5.09	3.67	6.51				
GW-26-1-1	Inactive	5376319.8	465596.6	128.22	129.16	129.12	109.79	111.20	0.90	17.73	18.43	17.02				
GW-26-1-2	Inactive	5376319.8	465596.6	128.22	129.16	129.12	124.36	121.52	0.90	5.28	3.86	6.7				
GW-32-1-1	Inactive	5376129.7	465569.9	165.41	166.44	166.34	123.85	122.44	0.93	42.27	41.56	42.97				
GW-32-1-2	Inactive	5376129.7	465569.9	165.41	166.44	166.37	157.93	152.04	0.96	10.43	7.48	13.37				
GW-33-1-1	Inactive	5376296.5	465627.4	124.55	123.43	124.54	111.11	109.69	-0.01	14.15	13.44	14.86				
GW-33-1-2	Inactive	5376296.5	465627.4	124.55	123.43		N/A	N/A	-124.55		no monitor	no monitor				
GW-34-1-1	Inactive	5376216.8	465668.4	119.47			104.64	101.64	-119.47		14.83	17.83				
GW-34-2-1	Inactive	5376214.9	465668.9	119.67			115.97	112.97	-119.67		3.7	6.7				
GW-35-1-1	Inactive	5376207.9	465677.3	120.19			108.29	105.29	-120.19		11.9	14.9				
GW-35-1-2	Inactive	5376207.0	465675.9	120.33			117.13	114.13	-120.33		3.2	6.2				

Notes:

Datum Description

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Monitor Class

S — *Shallow well <15 m deep*
I — *Intermediate well between 15 and 30 m deep*
D — *Deep well >30 m deep*

Area of Landfill

SP1 — *South of Phase 1 Landfill*
EP1 — *East of Phase 1 Landfill*
NP1 — *North of Phase 1 Landfill*
NP2 — *North of Phase 2 Landfill*
BKGND - WP2 — *Background Water Quality West of Phase 2*
HNP — *Hartland North Pad*
P1 — *Phase 1*
P2 — *Phase 2*

Appendix A-1. Monitoring Well Co-ordinates 2019-2020

AECOM

Station Name	Status	Location		Elevations					Depths				Survey Date	Monitor Class	Area of Landfill	Comments
		Northing (NAD 83)	Easting (NAD 83)	Ground Surface Elevation	Top of Casing Elevation	Top of Piezometer Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Stickup	Borehole Depth Below Ground	Depth to Top of Screen Below Ground	Depth to Bottom of Screen Below Ground		Shallow (S), Intermediate (I), Deep (D)		
		m	m	m ASL	m ASL	m ASL	m ASL	m ASL	m AGL	m BGL	m BGL	m BGL				
GW-45-1-1	Inactive	5376163.1	466106.3	162.37			143.71	140.71	-162.37		18.66	21.66				
GW-46-1-1	Inactive	5376078.3	466029.2	170.48	171.65	171.96	140.68	134.68	1.48		29.8	35.8				
GW-47-1-1	Inactive	5375918.3	465992.6	174.85	177.24	177.37	155.09	152.09	2.52	22.55	19.76	22.758	2008 May	I	P1	
GW-49-1-0	Inactive	5376759.5	465218.7	160.00	159.81	159.81	N/A	N/A	-0.19	62.20						
GW-50-1-1	Inactive	5376480.9	466193.4	119.37	120.41	120.43	105.47	102.47	1.06	16.90	13.9	16.9	2005 Mar	I	EP1	
GW-59-1-1	Inactive	5376254.5	465636.2	125.62	126.40	126.40	113.72	112.22	0.78	13.40	11.9	13.4				
GW-64-1-1	Inactive	5375855.0	465849.0	172.00		172.78	156.20	154.50	0.78	17.50	15.8	17.5				
GW-65-1-1	Inactive	5375831.0	465820.0	172.09		172.79	159.79	153.69	0.70	18.40	12.3	18.4				
GW-66-1-1	Inactive	5376088.0	465902.0	164.23		165.08	157.03	150.93	0.85	13.30	7.2	13.3				
GW-67-1-1	Inactive	5376256.2	465774.0	155.85	N/A	157.55	133.95	127.85	1.70	28.00	21.90	28.00	2005 Mar	I	P2	Destroyed. Replaced by GW-82-1-1
GW-67-2-1	Inactive	5376256.2	465774.0	155.85		157.55	133.95	127.85	1.70	28.00	21.9	28	2005 Mar	I	P2	
GW-68-1-1	Inactive	5376353.0	465718.0	141.56		142.74	130.36	124.26	1.18	17.30	11.2	17.3				
GW-68-2-1	Inactive	5376353.0	465718.0	141.56	N/A	142.29	123.76	120.76	0.73	20.80	17.80	20.80	Historic	I	P2	Destroyed. Replaced by GW-83-1-1
GW-69-1-1	Inactive	5376267.6	465665.8	140.64		142.50	127.64	121.54	1.86	19.10	13	19.1	2005 Mar	I	P2	
GW-69-2-1	Inactive	5376269.9	465667.0	140.67		142.11	121.67	115.67	1.44	25.20	19	25	2005 Mar	I	P2	
GW-70-1-1	Inactive	5376019.0	465891.0	167.00		167.59	149.50	143.40	0.59	23.60	17.5	23.6				
GW-74-1-1	Inactive	5376013.4	466018.4	170.94	171.56	171.60	138.04	132.04	0.66	38.90	32.90	38.90	2007 Apr	D	P1	
GW-74-2-1	Inactive	5 376 021.6	466 032.5	170.29	172.25	172.40	153.19	150.19	2.11	20.10	17.10	20.10	2006 Apr	I	P1	Installed during 2005
GW-79-1-1	Inactive	5376522.5	465404.3	182.87	183.63	183.59	147.82	144.77	0.72	39.62	35.05	38.10	2007 Apr	D	NP2	Installed during 2007, decommissioned in May 2018
GW-79-2-1	Inactive	5376521.9	465403.1	182.96	183.69	183.59	157.05	154.00	0.64	30.48	25.91	28.96	2007 Apr	I	NP2	Installed during 2007, decommissioned in May 2018
GW-84-1-1	Inactive	5376225.9	465646.9	158.20	158.86	158.79	120.63	117.58	0.59	27.74	37.565889	40.615889	2009 Feb	I	P2	Installed during 2007
GW-84-2-1	Inactive	5376224.8	465648.5	158.43	159.06	161.36	133.14	130.09	2.93	15.24	25.289839	28.339839	2009 Feb	S	P2	Installed during 2007
GW-86-1-1	Inactive	5376228.4	465651.4	160.55	N/A	N/A	N/A	N/A	N/A	42.98	N/A	N/A	2010 October	D	P2	SG piezo - 42.42 mBGS
GW-86-1-2	Inactive	5376228.4	465651.4	160.55	N/A	N/A	N/A	N/A	N/A	42.98	N/A	N/A	2010 October	I	P2	SG piezo - 20.85 mBGS
GW-86-2-1	Inactive	5376224.8	465651.8	160.55	N/A	N/A	N/A	N/A	N/A	30.78	N/A	N/A	2010 October	D	P2	SG piezo - 29.69 mBGS
GW-86-2-2	Inactive	5376224.8	465651.8	160.55	N/A	N/A	N/A	N/A	N/A	30.78	N/A	N/A	2010 October	I	P2	SG piezo - 8.67 mBGS
P5	Inactive	5375775.2	466079.9	158.35	159.46	159.36	144.43	133.35	1.01	25.00	13.92	25	2005 Mar	I	P1	Purge well
P6	Inactive	5375803.6	466098.0	159.88	161.65	161.55	147.74	134.88	1.67	25.00	12.14	25	2005 Mar	I	P1	Purge well

Notes:

Datum Description

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Monitor Class

- *S* — *Shallow well <15 m deep*
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Area of Landfill

- *SP1* — *South of Phase 1 Landfill*
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- *BKGND - WP2* — *Background Water Quality West of Phase 2*
- *HNP* — *Hartland North Pad*
- *P1* — *Phase 1*
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A2. Monitoring Well Details

Appendix A-2 - Groundwater Monitoring Plan 2019-2020

Station Name	Status	Pipe Diameter (mm)	Sampled in 2019/2020				Development Method	Sampling Method	Comments
			Chemistry		Water levels				
			Quarterly (4/yr)	Bi-annual (2/yr)	4/yr	Continuous			
GW-04-2-1	Active	50			Y		sample pump	footvalve	Dedicated submersible pump installed January 2012. Well recharges very slowly since 2014, so it is no longer sampled.
GW-04-3-1	Active	50	Y		Y		footvalve	footvalve	Submersible pump removed. Sampled using waterra in from May 2019 onwards.
GW-04-4-1	Active	50	Y		Y		footvalve	footvalve	
GW-07-1-0	Active	220	Y		Y		well pump	well pump	
GW-09-1-0	Active	150			Y		NA	NA	Sampling discontinued in 2010 due to outdated pump and redundancy. Water levels only.
GW-16-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-16-1-2	Active	50		Y	Y		footvalve	footvalve	
GW-16-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-16-2-2	Active	50		Y	Y		footvalve	footvalve	16-2-2 often dry; difficult to develop and sample. Sometimes use bailer.
GW-17-1-1	Active	50		Y	Y	Y	footvalve	footvalve	Pressure transducer installed in March 2019.
GW-17-1-2	Active	50		Y	Y		footvalve	footvalve	
GW-17-1-3	Active	50		Y	Y		footvalve	footvalve	
GW-18-1-1	Active	50	Y		Y	Y	sample pump	sample pump / footvalve	Dedicated submersible pump installed May 2009. Pump failed in September and November 2018. Waterra tubing from Feb/Mar 2019 onwards. Pressure transducer installed in March 2019.
GW-18-1-2	Active	50			Y		sample pump	sample pump	Pump damaged and stuck in well since 2004. Not sampled, only water levels.
GW-18-2-1	Active	50	Y		Y		footvalve	footvalve	
GW-18-2-2	Active	50	Y		Y		footvalve	footvalve	
GW-19-1-1	Active	50	Y		Y		footvalve	footvalve	19-1-1 sometimes flows artesian.
GW-19-1-2	Active	50	Y		Y		footvalve	footvalve	19-1-2 sometimes flows artesian.
GW-19-2-1	Active	50	Y		Y		footvalve	footvalve	19-2-1 sometimes flows artesian.
GW-19-2-2	Active	50	Y		Y		footvalve	footvalve	
GW-20-1-1	Active	50	Y		Y		sample pump	footvalve	Dedicated submersible pump installed January 2012. Pump ceased functioning in Nov 2019, was removed for repair and is currently sampled using waterra.
GW-20-1-2	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-21-1-1	Active	50	Y		Y		sample pump	footvalve	Dedicated submersible pump installed January 2012. Pump replaced with waterra.
GW-21-1-2	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-21-2-1	Active	50	Y		Y		footvalve	footvalve	
GW-25-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-25-1-2	Active	50	Y		Y		footvalve	footvalve	
GW-27-1-1	Active	50	Y		Y		not developed	footvalve	Artesian
GW-27-1-2	Active	50	Y		Y		footvalve	footvalve	27-1-2 almost dry in summer, bailer used occasionally.
GW-28-1-0	Active	150	Y		Y		sample pump	sample pump	Open borehole. Dedicated submersible pump installed January 2011.
GW-29-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-29-1-2	Active	50	Y		Y		footvalve	footvalve	
GW-30-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-30-1-2	Active	50	Y		Y		footvalve	footvalve	30-1-2 almost dry in summer, bailer used occasionally.
GW-31-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-31-1-2	Active	50		Y	Y		footvalve	footvalve	
GW-36-1-1	Active	50			Y	Y	NA	NA	Pressure transducer installed June 1997 records water levels continuously.
GW-36-2-1	Active	50			Y		footvalve	footvalve	
GW-36-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-37-1-1	Active	50			Y	Y	NA	NA	Pressure transducer installed June 1997 records water levels continuously.
GW-37-2-1	Active	50			Y		footvalve	footvalve	
GW-37-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-38-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-39-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-39-2-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2011.
GW-40-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in September 2008 records water levels continuously. Can be removed as required for sampling.
GW-41-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in May 2018.
GW-42-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-43-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in May 2018.
GW-44-1-1	Active	50	Y		Y	Y	footvalve	footvalve	Pressure transducer installed in May 2018.
GW-46-2-1	Active	50			Y		NA	NA	
GW-46-3-1	Active	50			Y		NA	NA	
GW-46-4-1	Active	50			Y		NA	NA	
GW-47-2-1	Active	50			Y		NA	NA	
GW-48-1-1	Active	50			Y		NA	NA	
GW-48-2-1	Active	50			Y		NA	NA	
GW-50-1-1	Active	50			Y		footvalve	NA	Deactivated in from sampling program September 2012 due to poor recharge. Now only monitored for water level.
GW-51-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-51-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-51-3-1	Active	50		Y	Y		footvalve	footvalve	
GW-52-1-1	Active	50	Y		Y		footvalve	footvalve	Pressure transducer installed in 2018
GW-52-2-0	Active	150			Y		NA	NA	
GW-52-3-0 (P52)	Active	150			Y	Y	NA	NA	Pressure transducer records water levels continuously.
GW-52-4-0 (P7)	Active	250	Y		Y	Y	NA	spigot	Pressure transducer installed. Purge well in conjunction with 80-1-0-P8. Pressure transducer records water levels continuously. Sampling spigot installed in 2016.
GW-53-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-54-1-1	Active	50			Y		sample pump	sample pump	Dedicated submersible pump installed January 2012. Sampling discontinued in 2016. Water levels only. Pressure transducer installed in March 2019.
GW-54-2-1	Active	50			Y		footvalve	footvalve	Water levels only.
GW-54-3-1	Active	50			Y		footvalve	footvalve	Water levels only.
GW-55-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-56-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-57-1-1	Active	50		Y	Y		footvalve	footvalve	
GW-58-1-0	Active	150	Y		Y		sample pump	sample pump	Dedicated submersible pump reinstalled after Phase 2 Cell one closure in October 2012. This well is an 8" diameter borehole.
GW-60-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-60-2-1	Active	50	Y		Y		footvalve	footvalve	
GW-60-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-61-1-1	Active	150			Y		NA	NA	Borehole
GW-62-1-1	Active	50		Y	Y	Y	sample pump	sample pump	Portable pressure transducer installed January 2012 - records water levels every three hours. Dedicated submersible pump installed January 2012.
GW-62-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-63-1-1	Active	50		Y	Y		sample pump	sample pump	Dedicated submersible pump installed January 2011.
GW-63-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-71-1-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012 has malfunctioned.
GW-71-2-1	Active	50	Y		Y		sample pump	footvalve	Dedicated submersible pump installed January 2012.
GW-71-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-72-1-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-72-2-1	Active	50			Y		footvalve	footvalve	Well has been recharging very slowly since 2014, so it is no longer sampled. Water levels only.
GW-72-3-1	Active	50	Y		Y		footvalve	footvalve	

Footvalves are 16 mm (5/8") unless otherwise noted.

NA - Not Available or Not Applicable.

Appendix A-2 - Groundwater Monitoring Plan 2019-2020

Station Name	Status	Pipe Diameter (mm)	Sampled in 2019/2020 – Chemistry – Quarterly (4/yr)	Sampled in 2019/2020 – Chemistry – Bi-annual (2/yr)	Sampled in 2019/2020 – Water levels – 4/yr	Sampled in 2019/2020 – Water levels – Continuous	Development Method	Sampling Method	Comments
GW-72-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-73-1-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-73-2-1	Active	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012.
GW-73-3-1	Active	50	Y		Y		footvalve	footvalve	
GW-74-2-1	Active	50			Y		NA	NA	
GW-75-1-1	Active	50			Y		NA	NA	
GW-76-1-1	Active	50			Y	Y	sample pump	sample pump	Dedicated submersible pump installed January 2010. Sampling discontinued in 2016. Water levels only. Pressure transducer installed in March 2019.
GW-76-2-1	Active	50			Y		sample pump	sample pump	Sampling discontinued in 2016. Water levels only. Dedicated submersible pump installed January 2012.
GW-76-3-1	Active	50			Y		footvalve	footvalve	Sampling discontinued in 2016. Water levels only.
GW-77-1-1	Active	50		Y	Y	Y	footvalve	sample pump	Portable pressure transducer installed January 2012 - records water levels every three hours. Dedicated submersible pump installed.
GW-77-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-78-1-1	Active	50		Y	Y	Y	footvalve	footvalve	Portable pressure transducer installed January 2012 - records water levels every three hours.
GW-78-2-1	Active	50		Y	Y		footvalve	footvalve	
GW-80-1-0-P8	Active	NA	Y		Y	Y	sample pump	spigot	Pressure transducer installed. Purge well in conjunction with 52-4-0-P7. Pressure transducer records water levels continuously. Sampling spigot installed in 2016.
GW-81-1-0-P9	Active	NA	Y		Y	Y	NA	bailer	Borehole. Pressure transducer installed in 2018.
GW-82-1-1	Active	50			Y		NA	NA	
GW-83-1-1	Active	50			Y		NA	NA	
GW-85-1-1	Active	50	Y		Y		footvalve	footvalve	
GW-87-1-1	Active	50		Y	Y	Y	footvalve	sample pump	Well drilled in December 2014. Dedicated submersible pump (GeoTech) installed in February 2015. Pressure transducer installed March 2016.
GW-87-2-1	Active	50		Y	Y	Y	footvalve	waterra	Well drilled in December 2014. Pressure transducer installed in March 2016.
GW-88-1-1	Active	50		Y	Y	Y	footvalve	waterra	Well drilled in December 2014. Dedicated submersible pump (GeoTech) installed in February 2015 but replaced with waterra tubing after malfunctioning in 2016. Pressure transducer installed March 2016.
GW-88-2-1	Active	50		Y	Y	Y	footvalve	waterra	Well drilled in December 2014. Pressure transducer installed in March 2016.
GW-89-1-1	Active	50			Y	Y	NA	NA	Well drilled in Dec 2018. Pressure transducer installed in March 2019
GW-89-2-1	Active	50			Y	Y	NA	NA	Well drilled in Dec 2018. Pressure transducer installed in March 2019
GW-90-1-1	Active	50			Y		NA	NA	Well drilled in Oct 2019. No water levels taken in well due to high landfill gas concentrations in area.
GW-90-2-1	Active	50			Y		NA	NA	Well drilled in Dec 2018. No water levels taken in well since Oct 2019 due to high landfill gas concentrations in area.
GW-91-1-1	Active	50		Y	Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
GW-92-1-1	Active	50		Y	Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
GW-93-1-1	Active	50		Y	Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
GW-94-1-1	Active	50		Y	Y	Y	Waterra	Waterra	Well drilled in Dec 2019. Pressure transducer installed in March 2020
P1	Active	NA	Y		Y	Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously. Second bladder pump installed April 2013. Electric submersible pump installed 14-May-2015.
P10	Active	NA	Y		Y	Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
P2	Active	NA	Y		Y	Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
P3	Active	NA	Y		Y	Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
P4	Active	NA	Y		Y	Y	NA	spigot	Pressure transducer installed. QED bladder pumps installed and pressure transducer records water levels continuously.
VLGW002D	Active	NA			Y		NA	NA	
VLGW003D	Active	NA			Y		NA	NA	
VLGW004D	Active	NA			Y		NA	NA	
VLGW008D	Active	NA			Y		NA	NA	
VLGW011S	Active	NA			Y		NA	NA	
VLGW015D	Active	NA			Y		NA	NA	
VLGW016D	Active	NA			Y		NA	NA	
VLGW017D	Active	NA			Y		NA	NA	
VLGW018D	Active	NA			Y		NA	NA	
VLGW019D	Active	NA			Y		NA	NA	
VLGW020D	Active	NA			Y		NA	NA	
VLGW021D	Active	NA			Y		NA	NA	
VLGW026D	Active	NA			Y		NA	NA	
VLGW001D	Inactive	NA					NA	NA	Well is obstructed. No water level measurements were taken in 2018-2019
GW-01-1-1	Inactive	20							Site destroyed.
GW-01-1-2	Inactive	20							
GW-01-1-3	Inactive	20							
GW-01-2-1	Inactive	20							
GW-01-3-1	Inactive	20							
GW-02-1-1	Inactive	20							Site destroyed
GW-02-1-2	Inactive	20							
GW-02-1-3	Inactive	20							
GW-02-2-1	Inactive	20							
GW-03-1-1	Inactive	20							Deactivated at end of 1998, replaced by well 60-1-1.
GW-03-1-2	Inactive	20							Deactivated at end of 1998, replaced by well 60-2-1.
GW-03-1-3	Inactive	20							Deactivated at end of 1998, replaced by well 60-3-1.
GW-03-2-1	Inactive	50							Destroyed and replaced with 85-1-1 in March 2009.
GW-04-1-1	Inactive	20							Deactivated at end of 1998, replaced by new 04-2-1.
GW-04-1-2	Inactive	20							Deactivated at end of 1998, replaced by well 04-3-1.
GW-04-1-3	Inactive	20							Deactivated at end of 1998, replaced by well 04-4-1.
GW-04-1-4	Inactive	40							Deactivated during 1998, failed to recharge after purging.
GW-04-2-1	Inactive	50	Y		Y		sample pump	sample pump	Dedicated submersible pump installed January 2012. Sampling discontinued due to very slow recharge rate.
GW-05-1-1	Inactive	20							Site destroyed during construction of Phase 2 lagoon
GW-05-1-2	Inactive	20							
GW-05-1-3	Inactive	20							
GW-05-2-1	Inactive	20							
GW-06-1-1	Inactive	20							Site destroyed during dike construction in interim filling area.
GW-06-1-2	Inactive	20							
GW-06-1-3	Inactive	20							
GW-06-2-1	Inactive	20							
GW-08-1-1	Inactive	20							Site destroyed
GW-08-1-2	Inactive	20							
GW-08-1-3	Inactive	20							
GW-10-1-1	Inactive	20							Site destroyed
GW-11-1-1	Inactive	20							Site destroyed

Notes:

Footvalves are 16 mm (5/8") unless otherwise noted.

NA - Not Available or Not Applicable.

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Appendix A-2 - Groundwater Monitoring Plan 2019-2020

Station Name	Status	Pipe Diameter (mm)	Sampled in 2019/2020				Development Method	Sampling Method	Comments
			Chemistry		Water levels				
			Quarterly (4/yr)	Bi-annual (2/yr)	4/yr	Continuous			
GW-12-1-0	Inactive	220							Deactivated in 2010.
GW-13-1-1	Inactive	50							Site destroyed
GW-13-1-2	Inactive	50							
GW-14-1-1	Inactive	50							Site destroyed
GW-15-1-1	Inactive	50							Site destroyed
GW-22-1-1	Inactive	50							Destroyed during expansion of interim composting area.
GW-23-1-1	Inactive	50							Site destroyed in November 1994
GW-23-1-2	Inactive	50							
GW-24-1-1	Inactive	50							Site destroyed during construction of Phase 2 lagoon
GW-24-1-2	Inactive	50							
GW-26-1-1	Inactive	50							Site destroyed in August 1994
GW-26-1-2	Inactive	50							
GW-32-1-1	Inactive	50							Site destroyed in October 1997
GW-32-1-2	Inactive	50							Site destroyed in October 1997
GW-33-1-1	Inactive	50							Deactivated in August 1992.
GW-33-1-2	Inactive	50							
GW-34-1-1	Inactive	50							Site destroyed in August 1994
GW-34-2-1	Inactive	50							
GW-35-1-1	Inactive	50							Site destroyed in August 1994
GW-35-1-2	Inactive	50							
GW-45-1-1	Inactive	50							Site destroyed.
GW-46-1-1	Inactive	50							Deactivated in June 1999.
GW-47-1-1	Inactive	50							Deactivated in December 2012.
GW-49-1-0	Inactive	50							Deactivated in June 2005.
GW-50-1-1	Inactive	50							Deactivated in September 2012 due to poor recharge.
GW-59-1-1	Inactive	50							Destroyed Feb 2005 by Phase 2 construction.
GW-64-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-65-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-66-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-67-1-1	Inactive	50							Destroyed. Replaced by GW-82-1-1
GW-67-2-1	Inactive	50							Destroyed. Replaced by GW-82-1-1
GW-68-1-1	Inactive	50							Destroyed. Replaced by GW-83-1-1
GW-68-2-1	Inactive	50							Destroyed. Replaced by GW-83-1-1
GW-69-1-1	Inactive	50							Destroyed July 2006 during construction on active face
GW-69-2-1	Inactive	50							Destroyed July 2006 during construction on active face
GW-70-1-1	Inactive	50							Destroyed by interim fill area construction in 2003.
GW-74-1-1	Inactive	50			Y		NA	NA	Decommissioned
GW-84-1-1	Inactive	50							Destroyed spring 2009. Recorded continuous water levels until April 2012. No longer functioning. Cannot be repaired because it's buried in garbage.
GW-84-2-1	Inactive	50							Destroyed spring 2009. Recorded continuous water levels until April 2012. No longer functioning. Cannot be repaired because it's buried in garbage.
T-86-1-1	Inactive	NA							
T-86-1-2	Inactive	NA			Y	Y	NA	NA	Pressure transducer installed October 2010. Well replaces GW-84-1-1 & GW-84-2-1. Pressure transducer records water levels continuously. No longer functioning.
T-86-2-1	Inactive	NA			Y	Y	NA	NA	Pressure transducer installed October 2010. Well replaces GW-84-1-1 & GW-84-2-1. Pressure transducer records water levels continuously. No longer functioning.
T-86-2-2	Inactive	NA			Y	Y	NA	NA	Pressure transducer installed October 2010. Well replaces GW-84-1-1 & GW-84-2-1. Pressure transducer records water levels continuously. No longer functioning.

Notes:

Footvalves are 16 mm (5/8") unless otherwise noted.

NA - Not Available or Not Applicable.

AECOM

A3. Groundwater Elevations

Appendix A-3 - Groundwater Elevations 2019-2020

Station	Groundwater Elevations (mASL)			
	Q2	Q3	Q4	Q1
	May 7 to May 9, 2019	August 28 to August 30, 2019	October 30 to November 1, 2019	January 28 to January 30, 2020
04-2-1	126.91	125.43	126.84	127.46
04-3-1	124.32	123.03	124.58	125.10
04-4-1	125.11	123.86	125.18	125.55
07-1-0	140.96	140.60	141.11	141.41
09-1-0	146.10	---	---	147.50
16-1-1	129.03	125.63	131.25	135.34
16-1-2	130.03	126.39	131.85	134.75
16-2-1	130.53	127.93	132.27	135.73
16-2-2	130.46	127.91	132.27	135.73
17-1-1	143.97	142.20	144.56	148.71
17-1-2	143.96	142.19	144.54	147.57
17-1-3	145.05	143.16	144.86	148.36
18-1-1	150.47	149.02	150.46	152.72
18-1-2	150.48	---	---	152.71
18-2-1	160.66	159.04	162.14	164.62
18-2-2	160.72	159.24	162.20	164.69
19-1-1	133.85	132.49	133.85	133.85
19-1-2	133.87	131.56	133.17	133.87
19-2-1	133.26	131.88	133.26	133.26
19-2-2	133.12	130.15	132.09	132.71
20-1-1	109.83	109.32	110.49	111.18
20-1-2	109.58	108.83	109.66	110.03
21-1-1	110.25	109.46	110.52	110.76
21-1-2	109.70	108.99	109.88	110.33
21-2-1	109.76	109.01	109.90	110.36
25-1-1	125.14	124.40	125.38	127.10
25-1-2	126.50	126.30	126.56	127.17
27-1-1	141.57	141.57	141.57	141.57
27-1-2	138.91	138.54	140.43	139.72
28-1-0	119.01	118.86	119.24	121.55
29-1-1	111.97	111.39	112.07	112.47
29-1-2	112.09	111.49	112.17	112.51
30-1-1	105.45	104.50	105.79	107.13
30-1-2	106.16	105.86	107.03	108.26
31-1-1	104.19	103.21	104.20	105.11
31-1-2	104.04	103.21	104.15	105.00
36-1-1	126.13	121.53	124.54	126.69
36-2-1	122.26	121.53	123.15	125.07
36-3-1	122.70	121.16	123.79	125.62
37-1-1	124.17	123.82	125.47	128.36
37-2-1	121.86	121.08	123.40	125.14
37-3-1	123.85	123.44	124.79	127.62
38-1-1	119.59	119.43	119.82	122.14
39-1-1	119.94	119.35	120.48	123.72
39-2-1	119.59	119.45	119.82	122.10
40-1-1	117.18	116.93	117.32	118.64
41-1-1	147.69	147.05	147.54	147.85
42-1-1	137.66	137.11	137.70	137.91
43-1-1	157.78	156.74	158.31	159.28
44-1-1	160.13	159.10	160.44	160.78
46-2-1	157.18	156.95	157.13	157.40
46-3-1	151.48	Dry	151.94	150.04
46-4-1	149.66	Dry	Dry	Dry
47-2-1	152.59	152.40	152.22	152.20
48-1-1	---	---	158.90	---
48-2-1	149.32	---	148.79	149.25
50-1-1	115.65	---	---	---
51-1-1	109.56	108.54	109.88	110.32
51-2-1	109.88	108.66	110.17	110.67
51-3-1	109.91	108.68	110.21	110.70

Notes:

Bracketed data on bottom of well.

--- - *Not measured*

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Appendix A-3 - Groundwater Elevations 2019-2020

Station	Groundwater Elevations (mASL)			
	Q2	Q3	Q4	Q1
	May 7 to May 9, 2019	August 28 to August 30, 2019	October 30 to November 1, 2019	January 28 to January 30, 2020
52-1-1	118.16	117.88	117.99	118.44
52-2-0	117.56	117.15	117.42	117.94
52-3-0 (P52)	114.35	113.67	114.65	115.17
52-4-0 (P7)	111.0-113.0	111.0-113.0	111.0-113.0	111.0-113.0
53-1-1	120.56	120.34	121.00	123.00
54-1-1	149.53	147.02	149.24	151.30
54-2-1	149.14	146.71	148.82	150.84
54-3-1	149.13	147.11	148.90	150.75
55-1-1	142.31	140.54	141.72	144.12
56-1-1	143.77	142.77	145.19	146.69
57-1-1	128.85	---	129.41	130.48
58-1-0	127.54	126.17	128.48	129.44
60-1-1	141.47	140.84	141.62	141.87
60-2-1	141.52	140.89	141.67	141.88
60-3-1	141.08	140.35	141.19	141.43
61-1-1	183.95	183.14	184.51	186.76
62-1-1	171.80	168.46	172.16	175.62
62-2-1	171.84	168.51	172.21	175.68
63-1-1	190.65	188.72	191.38	192.67
63-2-1	191.53	190.53	193.18	194.19
71-1-1	141.50	140.48	141.51	142.27
71-2-1	141.61	140.65	141.66	142.38
71-3-1	141.55	140.57	141.59	142.31
72-1-1	141.44	140.74	141.57	141.90
72-2-1	141.60	140.98	141.52	141.90
72-3-1	141.50	140.89	141.64	142.00
73-1-1	133.17	131.25	133.39	135.16
73-2-1	133.19	131.29	133.42	135.17
73-3-1	132.68	130.73	132.67	133.41
74-2-1	153.32	154.84	152.55	152.51
75-1-1	129.32	128.39	128.07	129.10
76-1-1	157.25	155.42	156.71	159.60
76-2-1	160.35	158.51	160.75	163.30
76-3-1	162.50	160.65	163.00	165.75
77-1-1	155.02	153.69	155.63	155.63
77-2-1	153.95	152.66	154.37	155.45
78-1-1	131.02	129.17	132.06	134.32
78-2-1	134.81	133.92	134.93	137.95
80-1-0 (P8)	113.0-114.5	113.0-114.5	113.0-114.5	113.0-114.5
81-1-0 (P9)	118.80	118.59	118.95	120.27
82-1-1	132.82	132.86	132.87	132.87
83-1-1	126.91	125.78	126.88	127.04
85-1-1	145.27	144.99	145.42	145.90
87-1-1	174.86	167.32	169.95	183.16
87-2-1	175.00	167.31	169.97	183.24
88-1-1	171.32	167.87	171.05	174.20
88-2-1	171.56	167.81	171.03	175.29
89-1-1	146.46	147.68	150.63	150.80
89-2-1	151.10	150.92	149.55	150.34
90-1-1	---	---	---	---
90-2-1	133.90	Dry	133.22	---
91-1-1	---	---	---	160.72
92-1-1	---	---	---	162.18
93-1-1	---	---	---	178.05
94-1-1	---	---	---	200.33
LG-02-D	148.79	148.34	148.31	148.84
LG-03-D	150.05	149.99	150.01	150.08
LG-04-D	157.50	157.36	157.16	157.18
LG-08-D	146.03	143.47	143.97	148.17
LG-11-S	155.65	155.66	155.66	155.65
LG-15-D	148.71	148.37	148.36	148.88
LG-16-D	150.39	149.95	149.81	150.16
LG-17-D	151.47	151.02	150.71	151.24
LG-18-D	152.26	151.44	151.04	151.03
LG-19-D	151.77	151.55	151.16	151.04
LG-20-D	148.27	148.24	148.09	148.04
LG-21-D	143.04	142.40	142.20	142.62
LG-26-D	145.02	145.05	144.86	145.07

Notes:

Bracketed data on bottom of well.

--- - Not measured

A4. Surface Water Station Details

Appendix A-4. Surface Water Station Details 2019-2020

AECOM

Station Name	Location		Status	Parameter List		Comments
	Northing	Easting		Routine		
	UTM (NAD83)	UTM (NAD83)		4/yr	2/yr	
Sw-N-05	5 376 534.511	465 729.384	Active	Y		Heal Creek - 40m from perimeter fence line
Sw-N-14	5 376 795.252	466 228.944	Active		Y	Heal Creek 2/3 of the way from the Northeast Diversion Ditch to Durrance Creek.
Sw-N-16	5 376 506.808	465 968.695	Active	Y		North Wetland at discharge of Weir SF5 into North Wetland Creek, just above confluence with Heal Creek.
Sw-N-17	5 376 566.303	465 903.628	Active	Y		Heal Creek below confluence with 42 Creek and above confluence with North Wetland Creek.
Sw-N-18	5 376 429.846	465 679.709	Active	Y		Northwest Diversion Ditch at discharge to Northwest Sedimentation Pond.
Sw-N-19	5 376 423.322	466 040.279	Active	Y		Northeast Diversion Ditch below Northeast Sedimentation Pond, just above discharge into North Wetland.
Sw-N-41s1	5 376 892.202	465 171.078	Active	Y		41 Creek at north side of Willis Point Road, near source.
Sw-N-41s3	5 377 102.438	465 021.226	Active	Y		41 Creek just above discharge to Durrance Lake.
Sw-N-42s1	5 376 753.436	465 553.804	Active	Y		42 Creek at discharge from 42 Wetland below southeast end of Yardwaste Pad. Across Willis Point Road from Well 42.
Sw-N-45	5 376 605.647	465 797.403	Active	Y		Heal Creek just above confluence with 42 Creek.
Sw-N-50	5 376 353.361	465 438.872	Active	Y		Toutle Valley break out.
Sw-N-51	5 376 323.976	465 444.733	Active	Y		NW diversion ditch just above confluence with Toutle Valley break out.
Sw-N-53	5 376 456.000	465 693.000	Active	Y		Drainage from High Level Road North Diversion Ditch to Northwest Sedimentation Pond.
Sw-N-54	5 376 438.000	465 713.000	Active	Y		Runoff from northeast face of Phase 2 and Phase 2 Cell 1 closure into Northwest Sedimentation Pond. Replaced Sw-N-47.
Sw-N-CSs2	5 376 933.072	464 896.583	Active		Y	Control station on south side of Willis Point Rd at ephemeral stream and culvert 300 m west of Yardwaste gate.
Sw-S-03	5 375 637.813	466 077.533	Active	Y		Kilarney Creek at culvert discharging from underneath Recycle Road.
Sw-S-04	5 375 447.329	466 171.246	Active	Y		Kilarney Creek below confluence with Southwest Diversion Ditch.
Sw-S-12	5 375 661.074	465 954.884	Active	Y		At the discharge of Weir SF2, upstream of Killarney Creek.
Sw-S-20	5 375 607.030	465 945.921	Active		Y	At the discharge of Weir SF3, in the Southwest Diversion Ditch where it converges with the South High Level Road.
Sw-S-21	5 375 419.559	466 150.441	Active	Y		Southwest Diversion Ditch just above confluence with Kilarney Creek.
Sw-S-24	5 375 553.049	466 179.487	Active	Y		Kilarney Creek just above confluence with Bike Trail Kiosk Creek and below confluence with Southeast Storm Drain.
Sw-S-27	5 375 591.468	466 163.597	Active	Y		Southeast Storm Drain just above confluence with Kilarney Creek.
Sw-S-52	5 376 059.905	465 472.066	Active		Y	Creek from Mt. Work before entering culvert draining to South Diversion Ditch.
Sw-N-06	5 376 669.740	466 024.406	Inactive	n/a		Heal Creek - East side of access road approximately 600m from entrace of rifle range. Discontinued: same channel morphology and water quality as SW-14 (no additional inputs between the two stations.
Sw-N-07	5 377 209.377	466 814.510	Inactive	n/a		Durrance Creek - on private property approximately 100m due west of Wallace Drive, 1km north of Willis Pt Road intersection. DISCONTINUED IN JUNE 2015 DUE TO SAFETY HAZARD (dilapidated bridge).
Sw-N-07A	5 377 096.940	466 527.760	Inactive	n/a		Intended to replace 07 but water quality differed significantly so station discontinued.
Sw-N-08	5 377 837.095	467 019.461	Inactive	n/a		Todd Creek on west side of road approximately 2km north of Willis Pt Road intersection
Sw-N-09	5 377 174.427	466 865.131	Inactive	n/a		Todd Creek below confluence with Durrance Creek. Just below Durrance Road bridge.
Sw-N-15	5 377 109.531	465 982.354	Inactive	n/a		Durrance Creek well above confluence with Heal Creek.
Sw-N-41s0	5 376 810.000	465 232.000	Inactive	n/a		41 Creek at source where pipe discharges from Yardwaste Pad. Near gate on access road of Willis Point Road.
Sw-N-41s2	5 376 955.866	465 105.992	Inactive	n/a		41 Creek at discharge from wetland located part way down creek.
Sw-N-41s4	5 377 189.115	465 130.141	Inactive	Y		Discharge from Durrance Lake.
Sw-N-41s5	5 377 478.219	464 471.090	Inactive	n/a		West end of Durrance Lake near where stream enters west end of lake.
Sw-N-41s6	5 377 236.090	464 906.330	Inactive	n/a		Creek / culvert entering Durrance Lake from north side 1/3 of the way from the west end (Inlet) to the east end (outlet). Discontinued due to high traffic area and likelihood of contamination from recreational activities.
Sw-N-41s7	5 377 416.510	464 790.110	Inactive	n/a		Creek / culvert entering Durrance Lake from north side near west end entrance of parking lot.
Sw-N-43	5 376 636.303	465 804.994	Inactive	n/a		42 Creek just above confluence with Heal Creek.
Sw-N-46	5 376 500.000	465 700.000	Inactive	n/a		Discharge channel from Northwest Sedimentation Pond.
SW-N-47	5 376 438.000	465 713.000	Inactive	n/a		Runoff from northeast face of Phase 2 into Northwest Sedimentation Pond. Replaced by Sw-N-54.
Sw-N-48	5 376 354.000	466 031.000	Inactive	n/a		Northeast Diversion Ditch at entry into Northeast Sedimentation Pond.
Sw-N-CSs1	5 377 280.000	464 570.000	Inactive	n/a		Control station at pond on north side of Willis Point Rd 800 m west of Yardwaste gate. Drains into southeast side of Durrrance Lake.
Sw-S-10	5 375 090.830	466 377.540	Inactive	n/a		Kilarney Lake, near outlet
Sw-S-11	5 375 258.558	466 213.279	Inactive	n/a		Kilarney Creek just above entrance into northwest end of Kilarney Lake.
Sw-S-13	5 375 660.000	466 060.000	Inactive	n/a		Old wash down area septic tank in current yardwaste drop off area.
Sw-S-22	5 375 307.180	466 327.650	Inactive	n/a		Stream entering northeast end of Kilarney Lake.
Sw-S-23	5 375 469.346	466 151.441	Inactive	n/a		Kilarney Creek just above confluence with Southwest Diversion Ditch. Discontinued due to water quality similarities to SW-S-25 and close proximity to SW-S-03
Sw-S-25	5 375 574.866	466 158.314	Inactive	n/a		Kilarney Creek just above confluence with Southeast Storm Drain. Discontinued due to proximity and similarity to SW-S-23.
Sw-S-26	5 375 554.010	466 181.970	Inactive	n/a		Bike Trail Kiosk Creek just above confluence with Kilarney Creek.
Sw-S-28	5 375 626.640	466 172.100	Inactive	n/a		07 Creek just above confluence with Southeast Storm Drain.
Sw-S-29	5 375 645.480	466 159.040	Inactive	n/a		Southeast Storm Drain above confluence with 07 Creek, where culvert discharges after crossing under East Hydro Road near well site 60.
Sw-S-30	5 375 651.511	465 914.193	Inactive	n/a		Southwest Diversion Ditch just above confluence with High Level Road South Diversion Ditch.
Sw-S-31	5 375 887.490	465 662.951	Inactive	n/a		Base of High Level Road South Diversion Ditch, sampled at the grate.

Appendix B

Water Quality Data

- B1.
- B1a. Quarterly Groundwater Quality
- B1b. Annual Groundwater Quality
- B2. Domestic Well Quality
- B3. Surface Water Quality
- B3a. Quarterly Surface Water Quality – North
  B3b. Quarterly Surface Water Quality – South
  B3C. Annual Surface Water Quality – North and South
- B4. Monthly Leachate Quality Data – Hartland Valve Chamber
- B5. Quarterly Leachate Quality – Trace Organics
- B6. Monthly Leachate Quality – Phase 2 Cleanout
- B7. Monthly Leachate Quality – North Purge Wells
- B8. Monthly Leachate Quality – Controlled Waste Drainage
- B9. Monthly Leachate Quality – Markham Valve Chamber
- B10. Monthly Leachate Quality – West Face Drainage
- B11. Monthly Leachate Quality - Cell 3 Pipe Outlet

AECOM

B1a. Quarterly Groundwater Quality

Appendix B-1. Groundwater Quality Data 2019-2020

Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	PH (Field)	Specific Conductivity - 25°C (Field)	Temperature (Field)	Alkalinity	Hardness as CaCO3	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead
BC CSR				AW Maximum (1)	---	---	---	---		---	90	50	10000	1.5	---	12000	0.5-4 (5)	---	1500	90 (7)	40	20-90 (5)	---	---	40-160 (5)
				DW Maximum (2)	---	---	---	---		9500	6	10	1000	8	---	5000	5	---	250	6000	20 (8)	1500	---	--- (6)	10
				Fraction	TOT	TOT	TOT	TOT	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/L	mg/L	µg/l	µg/l	µg/l	mg/L	µg/l	µg/l
				Method Detection Limit	0.1	1	0.1	1	0.5	0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	1	0.1	0.005	0.05	0.5	1	0.005
Gw - 04-3-1	SS	Y	5/16/2019		6.87	328	10.7	166	191	2.94	0.071	0.304	39.8	< 0.01	< 0.005	79.	0.019	63.9	21.	< 0.1	0.094	0.473	191.	5.6	0.081
	SS		9/11/2019		6.8	342	11.6	170	197	1.64	0.075	0.255	44.8	< 0.01	< 0.005	69.	0.014 9	65.5	24.	< 0.1	0.035 1	0.335	197.	6.5	0.043 8
	SS		11/6/2019		6.85	325	10.5	160	196	2.02	0.073	0.183	44.6	< 0.01	< 0.005	75.	0.014	64.6	22.	< 0.1	0.038 4	0.388	196.	2.5	0.019 3
	SS		2/13/2020	Clear and colourless	6.99	317	8.8	160	197	36.6	0.095	0.249	40.8	< 0.01	< 0.005	80.	0.038 8	65.3	21.	0.2	0.042 6	0.576	197.	17.1	0.085 5
Gw - 04-4-1	SS	Y	5/16/2019		6.28	208	9	77.3	103	8.37	0.072	0.5	8.56	< 0.01	< 0.005	75.	0.038	32.4	29.	< 0.1	0.092	2.15	103.	7.1	0.037
	SS		9/11/2019		6.15	300	11.1	120	155	3.89	0.042	0.139	14.3	< 0.01	< 0.005	69.	0.017 9	50.4	45.	< 0.1	0.054 2	1.13	155.	2.1	< 0.005
	SS		11/6/2019		6.25	296	11.3	64	144	7.92	0.062	0.072	11.2	< 0.01	< 0.005	78.	0.018 7	45.3	34.	0.1	0.081 8	2.19	144.	6.9	< 0.005
	SS		2/13/2020	Clear and colourless	5.85	160	8.5	65	84.6	10.5	0.065	0.105	14.2	< 0.01	< 0.005	56.	0.018 3	26.6	17.	0.11	0.049 2	7.38	84.6	8.9	0.163
Gw - 07-1-0	SS	N	5/16/2019		6.6	580	12.6	255	322	0.82	0.068	0.828	11.7	< 0.01	< 0.005	188.	0.019	110.	67.	< 0.1	2.5	0.477	322.	637.	0.015
	SS		9/9/2019		6.57	599	13.4	250	316	1.49	0.08	0.649	11.3	< 0.01	< 0.005	187.	0.023 7	108.	70.	< 0.1	2.24	0.452	316.	384.	0.012 5
	SS		11/7/2019		7.09	559	10.3	260	344	0.66	< 0.02	1.98	12.3	< 0.01	< 0.005	166.	0.006 5	118.	77.	< 0.1	2.45	0.181	344.	3 220.	< 0.005
	SS		2/13/2020	Clear and colourless	6.85	590	11.6	260	344	0.66	0.124	0.55	11.6	< 0.01	< 0.005	160.	0.075 4	118.	77.	< 0.1	2.27	0.752	344.	199.	0.192
Gw - 16-1-1	SS	N	9/6/2019		6.4	225	13.5	140	154	1.26	0.065	0.301	22.3	< 0.01	< 0.005	27.	0.011 7	51.3	3.5	< 0.1	0.02	1.81	154.	2.3	0.014 8
	SS		11/28/2019		6.69	186	10.1	94	111	123.	0.046	0.084	3.5	0.016	0.009	12.	0.026 3	36.5	3.1	0.27	0.622	2.12	111.	229.	0.381
Gw - 16-1-2	SS	N	9/6/2019		6.31	222	12.6	130	136	7.6	0.079	0.133	25.1	< 0.02	< 0.01	< 20.	0.013	45.6	2.9	< 0.2	0.017	0.37	136.	5.4	0.026
	SS		11/28/2019		6.68	185	10.5	110	123	2.72	0.067	0.146	21.1	< 0.01	< 0.005	15.	0.012 8	40.8	2.9	0.11	0.020 9	0.381	123.	2.7	0.011 3
Gw - 16-2-1	SS	N	9/6/2019		6.67	287	13	160	165	2.81	0.202	0.389	13.1	< 0.01	< 0.005	23.	0.052 3	54.7	3.	< 0.1	0.024 9	0.958	165.	13.	0.021 4
	SS		11/28/2019		6.81	191	10.7	100	120	4.19	0.081	0.17	9.36	< 0.01	< 0.005	13.	0.018 5	39.7	2.7	0.22	0.021 6	1.34	120.	9.5	0.013 5
Gw - 16-2-2	NS	N	9/6/2019		Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
	SS		11/28/2019		6.54	168	10.8	93	112	1.37	0.039	0.055	6.81	< 0.01	< 0.005	12.	0.019	37.1	2.8	0.22	0.025 5	1.01	112.	2.	0.009 1
Gw - 17-1-1	SS	Y	9/6/2019		7.03	345	12.4	180	192	2.01	0.109	0.571	20.4	< 0.01	< 0.005	31.	0.012 3	61.1	6.2	< 0.1	0.037	0.938	192.	1.6	0.007 9
	SS		11/28/2019		7.26	363	10.4	230	259	2.85	0.086	0.439	17.9	< 0.01	< 0.005	26.	0.016 5	81.6	5.6	< 0.1	0.011	1.23	259.	2.2	0.010 6
Gw - 17-1-2	SS	Y	9/6/2019		6.8	309	13.8	170	169	2.6	0.207	1.41	24.8	< 0.02	< 0.01	37.	0.011	49.7	7.	< 0.2	0.022	2.01	169.	6.7	0.027
	SS		11/28/2019		7.35	328	10.8	210	228	1.02	0.164	0.73	37.7	< 0.01	< 0.005	26.	0.012	69.8	5.6	< 0.1	0.008 9	0.763	228.	6.2	0.023
Gw - 17-1-3	SS	Y	9/6/2019		6.79	443	12.6	260	285	1.44	0.046	0.315	14.9	< 0.01	< 0.005	16.	0.010 5	85.3	5.	0.1	0.024 7	0.52	285.	< 1.	0.006
	SS		11/28/2019		7.06	377	10.6	180	215	2.33	0.032	0.175	8.99	< 0.01	< 0.005	13.	0.012 7	66.	5.2	< 0.1	0.042 7	1.25	215.	1.5	0.005 8
Gw - 18-1-1	SS	Y	5/29/2019		6.69	257	11	170	181	1.36	0.55	1.42	10.3	< 0.01	< 0.005	19.	0.036 3	61.1	3.8	< 0.1	0.125	0.185	181.	< 1.	< 0.005
	FRM		9/6/2019	Mean of duplicates	6.92	280	12.5	170	181.5	1.86	0.602 5	1.68	11.	< 0.01	< 0.005	19.	0.027 75	61.3	3.6	< 0.1	0.069 95	0.326	181.5	1.85	0.024
	FRM		11/29/2019	Mean of duplicates	7.06	27	8.7	170	186	2.59	0.592	1.82	11.	< 0.01	< 0.005	20.5	0.011 25	62.4	3.9	< 0.1	0.005 45	0.254 5	186.	2.2	0.006 25
	FRM		2/27/2020	Mean of duplicates	6.87	220	10.1	150	164	13.75	0.798	1.24	13.15	< 0.01	< 0.005	23.	0.074 45	55.25	3.65	0.135	0.181 5	1.005	164.	74.95	0.071 9
Gw - 18-2-1	SS	Y	5/29/2019		6.72	254	10.9	170	178	0.9	0.039	0.086	1.83	< 0.01	< 0.005	10.	0.026 8	60.3	4.3	< 0.1	0.017 1	0.605	178.	< 1.	< 0.005
	SS		9/6/2019		6.69	269	11.7	170	179	5.51	0.038	0.049	1.81	< 0.01	< 0.005	11.	0.025 8	61.2	3.8	< 0.1	0.012 2	0.797	179.	20.7	0.043 2
	SS		11/29/2019		6.98	230	10.1	150	207	1.02	0.032	0.045	2.06	< 0.01	< 0.005	11.	0.027 8	70.9	3.8	< 0.1	0.018	0.845	207.	2.9	0.008 5
	SS		2/27/2020	Slightly silty and slightly grey	7.04	260	10.4	150	181	2.13	0.029	0.037	1.67	< 0.01	< 0.005	13.	0.035 2	62.3	3.6	< 0.1	0.019 3	1.15	181.	15.6	0.012 5
Gw - 18-2-2	SS	Y	5/29/2019		6.86	243	10.9	150	156	1.01	0.03	0.092	5.26	< 0.01	< 0.005	< 10.	0.011 8	53.7	4.	< 0.1	0.020 6	0.738	156.	< 1.	< 0.005
	SS		9/6/2019		6.76	275	12.1	160	179	0.76	0.032	0.074	6.92	< 0.01	< 0.005	11.	0.014 7	61.8	4.3	< 0.1	0.008 8	0.724	179.	< 1.	0.010 3
	SS		11/29/2019		7.03	281	10.1	140	207	1.24	0.026	0.063	8.25	< 0.01	< 0.005	11.	0.016 9	71.5	3.9	< 0.1	0.033 6	1.65	207.	8.	0.009 4
	SS		2/27/2020	Clear and colourless	6.89	264	10.5	150	156	0.8	0.031	0.071	5.02	< 0.01	< 0.005	11.	0.022 4	54.1	3.4	< 0.1	0.019 2	1.15	156.	1.7	0.009 1
Gw - 19-1-1	SS	N	5/15/2019		6.73	324	10.8	183	207	2.22	< 0.02	2.61	4.27	< 0.01	< 0.005	15.	0.005	68.5	18.	< 0.1	1.56	0.098	207.	4 690.	0.016
	SS		9/11/2019		6.68	345	12.1	210	205	121.	0.124	1.96	9.95	0.017	0.005 6	28.	0.012 7	65.5	41.	0.11	0.743	1.02	205.	4 490.	0.265
	SS		11/7/2019		6.99	402	11	220	242	0.8	< 0.02	0.703	11.9	< 0.01	< 0.005	23.	0.006 4	78.6	29.	0.18	0.579	< 0.05	242.	2 180.	< 0.005
	SS		2/12/2020	Slightly silty and slightly orange	6.52	287	9.1	150	185	2.5	0.065	0.582	7.49	< 0.01	< 0.005	41.	0.014 1	55.3	19.	< 0.1	0.424	0.174	185.	213.	0.006 6
Gw - 19-1-2	SS	N	5/15/2019		6.89	349	11.4	189	216	1.14	< 0.02	2.04	5.12	< 0.01	< 0.005	14.	< 0.005	72.2	18.	< 0.1	1.27	< 0.05	216.	4 530.	< 0.005
	SS		9/11/2019		6.59	347	11.6	190	212	1.91	< 0.02	1.46	2.64	< 0.01	< 0.005	16.	< 0.005	70.1	25.	< 0.1	0.376	< 0.05	212.	5 680.	0.005
	SS		11/7/2019	resampled	6.97	389	9.7	190	232	1.42	< 0.02	1.74	2.89	< 0.01	< 0.005	19.	< 0.005	75.3	34.	< 0.1	0.974	< 0.05	232.	5 430.	< 0.005
	SS		2/12/2020	Clear and colourless	7.05	258	9.5	130	172	< 0.5	< 0.02	0.434	5.42	< 0.01	< 0.005	48.	< 0.005	51.2	11.	< 0.1	0.105	0.099	172.	316.	< 0.005
Gw - 19-2-1	SS	N	5/15/2019		7.13	284	11	140	181	1.12	< 0.02	0.368	40.3	< 0.01	< 0.005	59.	< 0.005	56.	13.	< 0.1	0.095	< 0.05	181.	101.	< 0.005
	SS		9/11/2019		7.51	316	12.1	160	194	2.86	< 0.02	0.219	40.2	< 0.01	< 0.005	56.	< 0.005	60.3	12.	< 0.1	0.062 5	< 0.05	194.	35.8	0.005 2
	SS		11/7/2019		7.76	292	10.9	150	195	0.78	< 0.02	0.33	42.3	< 0.01	< 0.005	60.	< 0.005	60.	12.	0.11	0.043 6	< 0.05	195.	169.	< 0.005
	SS		2/12/2020	Clear and colourless	7.25	296	9.9	150	204	0.73	< 0.02	0.344	44.2	< 0.01	< 0.005	67.	< 0.005	62.4	15.	< 0.1	0.058 8	0.089	204.	80.2	0.005 1
Gw - 19-2-2	SS	N	5/15/2019		7.26	283	11	135	176	3.11	0.024	0.69	35.1	< 0.01	0.01	62.	0.01	53.4	12.	< 0.1	0.08	0.659	176.	43.1	0.031
	SS		9/11/2019		6.99	289	12.3	130	169	100.	0.076	0.884	73.1	0.013	0.012 1	51.	0.092 4	52.8	17.	0.21	0.642	1.13	169.	2 600.	0.523
	SS		11/7/2019	resampled	7.93	282	10	150	195	15.3	< 0.02	0.289	42.1	< 0.01	< 0.005	60.	0.012 8	59.3	13.	< 0.1	0.101	0.158	195.	239.	0.029 1
	SS		2/12/2020	Moderately silty and moderately orange	6.98	247	9.2	120	151	2.06	0.027	0.119	36.4	< 0.01	< 0.005	46.	0.005 9	46.2	17.	< 0.1	0.013 5	0.257	151.	21.5	0.009 5
Gw - 20-1-1	SS	Y	5/30/2019		7.15	179	11.6	93	81.3	4.3	< 0.1	< 0.1	2.86	< 0.05	< 0.025	4 130.	< 0.025	25.8	8.2	0.62	0.067	< 0.25	81.3	11.4	< 0.025
	SS		9/26/2019		7.86	171	12.7	91	78	2.7	0.138	< 0.04	2.56	< 0.02	< 0.01	4 160.	< 0.01	24.9	7.2	0.45	0.064	< 0.1	78.	5.1	< 0.01
	SS		11/21/2019		7.96	143	11	76	69.1	8.5	< 0.1	< 0.1	2.21	< 0.05	< 0.025	4 240.	0.04	22.2	8.9	< 0.5	0.048	0.62	69.1	14.8	0.039
	SS		2/20/2020	Clear and colourless, contains some organics	7.3	176	10.3	96	88.2	4.4	< 0.04	0.054	3.44	< 0.02	< 0.01	3 450.	< 0.01	27.4	9.8	< 0.2	0.078	0.37	88.2	12.7	0.018
Gw - 20-1-2	SS	Y	5/30/2019		7.26	199	11.1	150	97.7	3.	< 0.1	< 0.1	3.73	< 0.05	< 0.025	3 730.	< 0.025	30.6	13.	0.54	0.11	< 0.25	97.7	17.1	< 0.025
	SS		9/26/2019		7.63	201	11.6	110	107	2.6	0.066	0.043	3.81	< 0.02	< 0.01	3 890.	< 0.01	33.6	11.	< 0.2	0.122	0.14	107.	14.5	< 0.01
	SS		11/21/2019		7.9	180	11.1	91	90.3	3.2	< 0.04	< 0.04	3.02	< 0.02	< 0.01	3 930.	< 0.01	28.4	9.	< 0.2	0.056	< 0.1	90.3	11.1	< 0.01
	SS		2/20/2020	Clear and colourless	7.25	218	10.5	120	108	4.	< 0.04	0.071	4.12	< 0.02	< 0.01	3 020.	< 0.01	33.3	16.	< 0.2	0.132	< 0.1	108.	19.1	< 0.01

Appendix B-1. Groundwater Quality Data 2019-2020

AECOM

BC CSR				AW Maximum (1)	---	---	---	---		---	90	50	10000	1.5	---	12000	0.5-4 (5)	---	1500	90 (7)	40	20-90 (5)	---	---	40-160 (5)
				DW Maximum (2)	---	---	---	---		9500	6	10	1000	8	---	5000	5	---	250	6000	20 (8)	1500	---	--- (6)	10
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	PH (Field)	Specific Conductivity - 25°C (Field)	Temperature (Field)	Alkalinity	Hardness as CaCO3	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead
				Fraction	TOT	TOT	TOT	TOT	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/L	mg/L	µg/l	µg/l	µg/l	mg/L	µg/l	µg/l
				Method Detection Limit	0.1	1	0.1	1	0.5	0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	1	0.1	0.005	0.05	0.5	1	0.005
Gw - 21-1-1	SS	Y	5/30/2019		7.56	128	13.3	74	72.1	3.5	< 0.1	0.85	2.45	< 0.05	< 0.025	3 930.	< 0.025	22.5	4.4	< 0.5	0.04	< 0.25	72.1	8.8	< 0.025
	FRM		10/2/2019	Mean of duplicates	8.08	138	12.2	71.5	70.15	8.05	< 0.07	2.195	2.135	< 0.035	< 0.017 5	3 980.	< 0.017 5	21.85	3.65	< 0.35	< 0.017 5	< 0.175	70.15	9.3	< 0.017 5
	FRM		11/21/2019	Mean of duplicates	8.22	132	11.6	68	64.85	7.25	< 0.1	2.35	1.49	< 0.05	< 0.025	3 880.	< 0.025	20.15	3.6	< 0.5	< 0.025	< 0.25	64.85	5.25	< 0.025
	FRM		2/20/2020	Mean of duplicates	8.06	125	10.5	71	64.3	1.25	< 0.04	2.13	1.56	< 0.02	< 0.01	3 655.	< 0.01	19.9	3.6	< 0.2	< 0.01	0.08	64.3	2.65	< 0.01
Gw - 21-1-2	FRM	Y	5/30/2019	Mean of duplicates	6.24	367	12.2	175	157.5	1.23	< 0.02	1.47	20.25	< 0.01	< 0.005	878.	0.006	47.35	39.	0.215	0.981	0.212	157.5	1 021.5	0.005 6
	FRM		9/26/2019	Mean of duplicates	6.29	532	12.9	220	223.5	1.615	0.022	1.48	24.45	< 0.01	< 0.005	837.5	0.006 3	67.25	72.5	0.31	1.435	0.379	223.5	1 545.	0.007 3
	FRM		11/21/2019	Mean of duplicates	6.8	454	11.5	200	198	0.845	< 0.02	1.455	23.05	< 0.01	< 0.005	854.5	0.006 85	59.45	59.	0.19	1.415	0.31	198.	1 315.	0.008 05
	FRM		2/20/2020	Mean of duplicates	6.67	318	11.5	170	125	0.69	0.022 5	1.4	15.35	< 0.01	< 0.005	677.	0.005 2	37.05	25.5	0.195	0.992	0.425 5	125.	788.	0.005 5
Gw - 21-2-1	SS	Y	5/30/2019		6.39	385	11.7	190	168	1.47	< 0.02	1.68	18.1	< 0.01	< 0.005	642.	0.005 2	50.5	46.	0.22	1.14	0.432	168.	1 160.	0.013 7
	FRM		9/26/2019	Mean of duplicates	6.57	554	12.7	225	227.5	1.535	0.032 5	2.585	23.25	< 0.01	< 0.005	823.5	0.016 4	68.6	82.	0.255	1.705	1.297	227.5	1 890.	0.027 15
	FRM		11/21/2019	Mean of duplicates	6.84	433	10.5	200	189.5	2.2	< 0.02	1.62	20.45	< 0.01	< 0.005	755.	0.011 05	56.6	58.5	0.23	1.445	0.534 5	189.5	1 265.	0.015 35
	FRM		2/20/2020	Mean of duplicates	6.44	317	10.1	170	152	1.83	0.033	1.835	16.55	< 0.01	< 0.005	635.5	0.011 4	45.25	28.	0.23	1.155	1.074 5	152.	972.5	0.026 8
Gw - 25-1-1	SS	N	6/13/2019		6.38	332	11.6	150	212	3.17	0.082	0.375	4.74	< 0.01	< 0.005	232.	< 0.005	72.5	5.7	< 0.1	0.189	1.59	212.	75.2	0.061 4
	SS		9/30/2019		6.55	360	13	150	224	1.83	0.085	0.189	7.96	< 0.01	< 0.005	238.	< 0.005	76.5	5.6	< 0.1	0.142	0.106	224.	33.8	0.010 1
	SS		11/15/2019		7.07	343	11	150	246	1.36	0.069	0.176	5.96	< 0.01	< 0.005	238.	< 0.005	83.9	6.	< 0.1	0.145	0.204	246.	47.2	< 0.005
	SS		2/24/2020	Clear and colourless	7.01	405	10.4	130	286	2.14	0.076	0.161	6.31	< 0.01	< 0.005	228.	0.007 4	96.8	5.5	< 0.1	0.149	0.17	286.	35.5	0.202
Gw - 25-1-2	FRM	N	6/13/2019	Mean of duplicates	6.29	216	12.1	115	133	1.77	0.032 5	0.215	3.55	< 0.01	< 0.005	54.	< 0.005	47.9	3.95	< 0.1	0.073 65	0.632 5	133.	24.8	< 0.005
	SS		9/30/2019		6.78	357	12.6	150	225	4.08	0.081	0.175	9.08	< 0.01	< 0.005	251.	< 0.005	76.9	5.7	< 0.1	0.145	0.1	225.	43.6	0.017
	SS		11/15/2019		7.26	241	12.9	120	154	6.87	0.053	0.23	4.01	< 0.01	< 0.005	66.	0.005 6	55.4	3.6	0.13	0.086 7	0.496	154.	37.2	0.005 6
	SS		2/24/2020	Clear and colourless	6.75	221	10.6	110	138	1.48	0.031	0.202	4.18	< 0.01	< 0.005	88.	< 0.005	49.5	2.6	< 0.1	0.078 1	0.635	138.	38.1	< 0.005
Gw - 27-1-1	FRM	N	5/22/2019	Mean of duplicates	7.4	128	11.5	71	69.75	2.54	< 0.02	0.242	2.115	< 0.01	< 0.005	240.	< 0.005	18.55	3.4	0.175	0.024 5	1.004 5	69.75	80.6	0.071
	SS		10/1/2019		7.89	124	11	70	66.7	1.08	< 0.02	< 0.02	2.	< 0.01	< 0.005	233.	< 0.005	18.3	3.6	< 0.1	0.014 7	< 0.05	66.7	3.2	0.006 7
	SS		11/13/2019		7.87	121	10.5	74	70.2	1.54	< 0.02	0.069	2.32	< 0.01	< 0.005	231.	< 0.005	19.	3.7	< 0.1	0.012 1	0.235	70.2	31.9	0.012 8
	SS		2/27/2020	Clear and colourless	7.51	123	10	73	69.2	24.	< 0.02	0.07	2.82	< 0.01	< 0.005	245.	0.010 1	18.6	3.4	< 0.1	0.046	1.03	69.2	93.4	0.143
Gw - 27-1-2	SS	N	5/22/2019		6.32	294	12.5	130	221	9.56	0.139	0.3	6.09	< 0.01	< 0.005	84.	0.019	72.	5.4	0.1	0.122	1.47	221.	23.8	0.035 2
	SS		10/1/2019		6.61	294	12.5	110	167	15.2	0.102	0.091	4.94	< 0.01	< 0.005	69.	0.012 2	55.6	4.7	0.18	0.083 6	2.35	167.	5.	< 0.005
	SS		11/13/2019		6.9	347	11	100	172	9.95	0.119	0.191	6.96	< 0.01	< 0.005	128.	0.013 8	56.6	4.3	0.2	0.066 1	2.38	172.	11.8	0.024 9
	SS		2/27/2020	Slightly silty and slightly orange	6.4	442	9	61	274	9.73	0.106	0.147	8.05	< 0.01	< 0.005	49.	0.012 1	90.	4.1	0.19	0.066 5	7.37	274.	21.3	0.038 6
Gw - 28-1-0	SS	Y	5/30/2019		6.23	272	11.5	160	188	0.75	0.021	0.138	1.	< 0.01	< 0.005	1 010.	< 0.005	64.	5.7	0.15	0.041 6	0.157	188.	33.7	< 0.005
	SS		9/30/2019		6.94	295	11.9	160	189	0.94	0.036	0.108	0.995	< 0.01	< 0.005	693.	< 0.005	63.9	6.7	0.1	0.052 4	0.122	189.	28.7	< 0.005
	SS		11/15/2019		6.75	287	11.2	180	205	2.94	0.03	0.115	1.02	< 0.01	< 0.005	970.	< 0.005	69.3	5.6	0.11	0.041 7	0.191	205.	39.1	< 0.005
	SS		2/24/2020	Clear and colourless	6.74	274	11.2	160	178	0.74	0.037	0.113	0.984	< 0.01	< 0.005	973.	< 0.005	58.9	4.5	0.18	0.041 1	0.248	178.	29.9	< 0.005
Gw - 29-1-1	SS	Y	5/23/2019		6.16	278	10.8	98	132	0.9	0.025	0.335	0.739	< 0.01	< 0.005	385.	0.009 6	44.	42.	0.25	0.031 6	0.567	132.	11.6	0.012 1
	SS		10/2/2019		6.69	295	11.4	100	149	< 0.5	0.023	0.256	0.748	< 0.01	< 0.005	384.	0.008 5	50.1	41.	0.24	0.026 1	0.189	149.	1.2	< 0.005
	SS		12/2/2019		6.77	303	10.1	100	153	1.21	< 0.02	0.249	0.768	< 0.01	< 0.005	410.	0.013	51.	49.	0.22	0.023	0.233	153.	16.1	< 0.005
	SS		2/2/2020	Clear and colourless	6.53	251	9.9	100	129	1.51	0.028	0.24	0.666	< 0.01	< 0.005	434.	0.006 3	43.2	29.	0.27	0.011 4	0.434	129.	19.4	0.008 6
Gw - 29-1-2	SS	Y	5/23/2019		5.82	244	11	81	108	3.32	0.041	0.24	2.64	< 0.01	< 0.005	180.	0.008 7	35.6	25.	< 0.1	0.084 6	2.05	108.	33.3	0.027 5
	SS		10/2/2019		6.4	270	11.2	89	126	0.59	0.054	0.039	3.44	< 0.01	< 0.005	250.	0.009 9	42.	27.	< 0.1	0.099	0.617	126.	29.7	< 0.005
	SS		12/2/2019		6.6	310	10.8	83	137	3.99	0.052	0.057	3.71	< 0.01	< 0.005	223.	0.019	45.	45.	< 0.1	0.038 7	1.37	137.	45.6	0.005 8
	SS		2/2/2020	Clear and colourless	6.35	243	9.7	78	99.6	0.68	0.06	0.042	2.36	< 0.01	< 0.005	265.	< 0.005	33.	35.	0.12	0.017 4	1.14	99.6	8.3	< 0.005
Gw - 30-1-1	SS	Y	5/28/2019		6.72	424	10.9	180	244	1.49	0.059	0.749	62.4	< 0.01	< 0.005	397.	0.061 3	83.4	0.	0.11	0.051 1	1.21	244.	74.7	0.032 7
	SS		10/8/2019		7.73	286	11.6	150	227	1.44	0.033	0.452	61.4	< 0.01	< 0.005	341.	0.019 5	77.4	61.	0.12	0.034 8	0.823	227.	10.2	0.032 1
	SS		11/29/2019		7.34	389	10.5	190	238	1.75	0.059	0.392	66.3	< 0.01	< 0.005	360.	0.114	81.4	53.	< 0.1	0.070 8	5.99	238.	12.2	0.445
	SS		2/4/2020	Clear and colourless	7.43	405	10.5	180	230	2.58	0.034	0.367	60.8	< 0.01	< 0.005	345.	0.031	77.2	55.	< 0.1	0.039 7	0.417	230.	3.9	0.02
Gw - 30-1-2	SS	Y	5/28/2019		6.27	418	10.9	150	160	2.22	0.059	0.494	9.86	< 0.01	< 0.005	225.	0.118	54.1	0.	< 0.1	0.067	1.4	160.	10.4	0.034 9
	SS		10/8/2019		7.36	420	11.7	160	200	3.45	0.035	0.546	9.67	< 0.01	< 0.005	292.	0.093 6	69.	67.	8.72	0.693	13.9	200.	342.	0.916
	SS		11/25/2019		6.23	145	10.9	41	60	14.6	0.042	0.273	6.2	< 0.01	< 0.005	45.	0.173	19.5	33.	0.2	0.084 6	2.79	60.	33.2	0.053 2
	SS		2/4/2020	Clear and colourless	6.05	211	9.1	52	43	12.1	0.031	0.155	16.3	< 0.01	< 0.005	33.	0.116	13.8	46.	0.17	0.123	7.21	43.	34.9	0.211
Gw - 31-1-1	SS	Y	10/10/2019		6.38	210	10.1	130	142	4.16	0.029	0.306	1.9	< 0.01	< 0.005	52.	0.012	50.7	5.6	< 0.1	0.108	0.268	142.	19.5	0.011 3
	FRM		12/2/2019	Mean of duplicates	7.13	251	9.8	130	171	0.845	0.056	0.320 5	1.905	< 0.01	< 0.005	45.	0.018 6	60.7	6.5	< 0.1	0.139	0.270 5	171.	10.25	< 0.005
Gw - 31-1-2	SS	Y	10/10/2019		6.44	213	11.2	120	134	1.04	< 0.02	0.096	1.39	< 0.01	< 0.005	55.	0.012 2	47.3	6.5	< 0.1	0.028 8	0.467	134.	15.2	0.007 4
	SS		12/2/2019		6.88	339	10.4	110	281	5.31	0.032	0.177	4.58	< 0.01	< 0.005	43.	0.026 5	97.1	9.3	0.22	0.097 7	2.09	281.	93.8	0.041 1
Gw - 36-3-1	SS	N	5/29/2019		6.59	810	14	340	551	1.15	0.095	0.293	46.7	< 0.01	< 0.005	83.	0.005 3	166.	15.	0.1	0.153	1.33	551.	1.2	< 0.005
	SS		9/25/2019		6.87	808	14.2	350	557	0.93	0.082	0.302	46.6	< 0.01	< 0.005	102.	0.005 8	168.	11.	< 0.1	0.129	1.4	557.	2.5	0.007 6
	SS		11/20/2019		7.01	727	12	340	497	3.45	0.078	0.292	52.4	< 0.01	< 0.005	85.	0.007 8	144.	11.	< 0.1	0.178	1.47	497.	13.	0.011 9
	SS		2/20/2020	Clear and colourless	6.99	797	12.5	310	550	1.06	0.078	0.294	38.9	< 0.01	< 0.005	70.	0.005 8	165.	15.	< 0.1	0.136	2.15	550.	1.6	< 0.005
Gw - 37-3-1	SS	N	5/29/2019		6.48	292	11.3	160	244	1.	0.025	0.335	13.2	< 0.01	< 0.005	307.	0.006 8	83.	5.1	0.12	0.255	0.083	244.	886.	< 0.005
	SS		9/25/2019		6.9	374	11.8	160	245	1.02	< 0.02	0.238	13.4	< 0.01	< 0.005	284.	0.008 8	83.2	5.1	< 0.1	0.204	0.053	245.	1 140.	< 0.005
	SS		11/21/2019		6.75	460	11.5	160	314	1.78	< 0.02	0.222	17.8	< 0.01	< 0.005	280.	0.009 6	107.	4.9	< 0.1	0.429	0.092	314.	1 150.	0.102
	SS		2/20/2020	Clear and colourless	6.83	430	10.9	120	277	0.89	0.034	0.176	14.2	< 0.01	< 0.005	384.	0.008 3	93.5	4.6	< 0.1	0.365	0.495	277.	499.	0.010 9
Gw - 38-1-1	SS	N	5/24/2019		7.05	481	12.6	280	324	1.61	0.289	0.75	8.64	< 0.01	< 0.005	214.	0.034 2	100.	12.	< 0.1	0.048 7	1.42	324.	9.8	0.034 1
	SS		10/1/2019		7.05	499	13.4	250	328	0.9	0.204	0.262	7.	< 0.01	< 0.005	184.	0.042 3	104.	12.	< 0.1	0.050 3	0.402	328.	< 1.	< 0.005
	SS		11/21/2019		7.24	468	12.5	280	329	51.4	0.216	0.38	7.55	< 0.01	< 0.005	203.	0.036 3	103.	13.	< 0.1	0.213	1.02	329.	132.	0.111
	SS		2/21/2020	Clear and colourless	7.72	478	11.1	280	303	1.1	0.29	0.337	7.28	< 0.01	< 0.005	174.	0.023 6	94.5	13.	< 0.1	0.033 9	0.66	303.	5.5	0.022
Gw - 39-1-1	SS	Y	5/24/2019		6.77	191	12.3	99	114	2.84	0.138	0.821	6.82	< 0.01	< 0.005	24.	0.012	39.5	2.3	< 0.1	0.025 6	1.45	114.	17.6	0.031 7
	FRM		9/25/2019	Mean of duplicates	7.45	260	11.7	160	177	1.855	0.157 5	0.553	1.86	< 0.01	< 0.005	1 004.	< 0.005	61.35	4.4	< 0.1	0.011 15	0.212 5	177.	1.3	< 0.005
	FRM		11/20/2019	Mean of duplicates	7.25	177	10.7	105	109	1.875	0.079	0.372 5	6.275	< 0.01	< 0.005	15.5	0.011 2	37.85	2.4	< 0.1	0.017 3	0.177 5	109.	1.35	0.005 85
	FRM		2/20/2020	Mean of duplicates	7.46	184	11.2	100	108	2.135	0.097	0.365 5	5.975	< 0.01	< 0.005	14.5	0.009 75	37.65	2.5	< 0.1	0.018 1	0.370 5	108.	3.	0.012 25
Gw - 39-2-1	FRM	Y	5/24/2019	Mean of duplicates	6.83	1481	11.2	170	182	0.76	0.175 5	0.481	2.02	< 0.01	< 0.005	871.5	< 0.005	62.45	4.25	< 0.1	0.015 15	0.125	182.	7.4	< 0.005
	SS		9/25/2019		8.03	200	12.5	100	121	2.44	0.094	0.335	6.58	< 0.01	< 0.005	19.	0.018 9	42.8	2.4	< 0.1	0.022	0.328	121.	4.2	< 0.005
	SS		11/20/2019		7.26	261	11.1	170	172	0.81	0.178	0.523	2.01	< 0.01	< 0.005	830.	< 0.005	58.6	4.6	< 0.1	0.009 1	0.184	172.	1.3	< 0.005
	SS		2/20/2020	Clear and colourless	7.1	267	11.2	160	175	0.67	0.177	0.502	1.83	< 0.01	< 0.005	706.	< 0.005	60.1	4.3	< 0.1	0.014 5	0.28	175.	1.1	< 0.005
Gw - 40-1-1	SS	N	5/29/2019		6.67	411	14.3	240	230	0.92	0.164	0.13	5.77	< 0.01	< 0.005	160.	0.012 5	78.2	12.	0.17	0.43	3.66	230.	6.7	0.030 6
	SS		9/25/2019		6.84	539	14.2	260	309	1.26	0.158	0.11	9.34	< 0.01	< 0.005	235.	0.021 7	105.	22.	0.16	0.836	5.87	309.	3.9	0.075 1
	SS		11/20/2019		6.95	541	13.8	260	309	1.22	0.128	0.115	9.69	< 0.01	< 0.005	214.	0.024 1	103.	16.	0.2	0.822	5.67	309.	4.7	0.049 2
	SS		2/20/2020	Slightly silty and colourless	7.07	446	12.5	200	219	1.12	0.192	0.105	7.86	< 0.01	< 0.005	169.	0.014 1	72.9	21.	0.19	0.654	3.97	219.	3.2	0.101

Appendix B-1. Groundwater Quality Data 2019-2020

Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	PH (Field)	Specific Conductivity - 25°C (Field)	Temperature (Field)	Alkalinity	Hardness as CaCO3	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead
BC CSR				AW Maximum (1)	---	---	---	---		---	90	50	10000	1.5	---	12000	0.5-4 (5)	---	1500	90 (7)	40	20-90 (5)	---	---	40-160 (5)
				DW Maximum (2)	---	---	---	---		9500	6	10	1000	8	---	5000	5	---	250	6000	20 (8)	1500	---	--- (6)	10
				Fraction	TOT	TOT	TOT	TOT	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/L	mg/L	µg/l	µg/l	µg/l	mg/L	µg/l	µg/l
				Method Detection Limit	0.1	1	0.1	1	0.5	0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	1	0.1	0.005	0.05	0.5	1	0.005
Gw - 41-1-1	SS	Y	5/23/2019		6.43	332	10.1	150	226	1.37	0.057	1.81	2.29	< 0.01	< 0.005	26.	< 0.005	76.8	5.2	< 0.1	0.089 5	0.547	226.	13.	0.013 9
	FRM		9/19/2019	Mean of duplicates	7.09	361	10.3	160	235.5	0.845	0.033	4.425	2.445	< 0.01	< 0.005	28.	0.107 2	80.55	4.65	< 0.1	0.16	0.237 5	235.5	13.4	0.006 7
	FRM		12/2/2019	Mean of duplicates	7.23	363	10.8	155	243	2.47	0.030 5	3.02	3.015	< 0.01	< 0.005	26.5	0.017 2	82.15	4.65	< 0.1	0.13	0.354	243.	8.25	0.008 45
	FRM		3/4/2020	Mean of duplicates	7.25	319	9.7	150	213.5	3.085	0.053 5	3.31	2.285	< 0.01	< 0.005	24.5	0.007 4	71.25	4.7	< 0.1	0.110 5	0.353	213.5	34.1	0.013 2
Gw - 42-1-1	FRM	Y	5/23/2019	Mean of duplicates	6.24	287	9.3	200	245	5.56	< 0.02	0.152 5	11.95	0.010 5	< 0.005	86.5	< 0.005	89.2	10.5	0.14	0.047 8	0.068	245.	705.5	0.006
	SS		9/19/2019		6.9	400	10.8	200	272	44.8	< 0.02	0.211	13.6	0.016	< 0.005	73.	< 0.005	99.6	15.	0.22	0.060 3	0.276	272.	740.	0.147
	FRM		12/2/2019	Mean of duplicates	6.87	394	9.9	195	267.5	4.465	< 0.02	0.225 5	14.8	< 0.01	< 0.005	81.	< 0.005	97.3	13.5	0.205	0.052 65	0.059 5	267.5	687.5	0.005 15
	FRM		3/4/2020	Mean of duplicates	6.67	255	9.1	195	247.5	7.83	< 0.02	0.147	13.5	< 0.01	< 0.005	71.5	0.013 8	88.9	10.5	0.155	0.043 65	0.091	247.5	651.5	0.006 85
Gw - 43-1-1	SS	N	5/24/2019		6.78	492	12.1	280	332	2.32	0.472	0.465	7.65	< 0.01	< 0.005	643.	0.035 6	116.	11.	< 0.1	0.054 4	3.87	332.	7.1	0.024 7
	SS		9/18/2019		7.21	482	12.2	240	310	2.04	0.214	0.242	6.81	< 0.01	< 0.005	575.	0.016 8	108.	9.5	< 0.1	0.052 8	3.64	310.	3.1	< 0.005
	SS		11/15/2019		7.03	456	11.3	260	341	2.49	0.276	0.289	7.67	< 0.01	< 0.005	564.	0.019 7	120.	10.	< 0.1	0.064 9	2.89	341.	2.7	< 0.005
	SS		2/27/2020	Clear and colourless	6.89	460	10.5	260	333	2.25	0.148	0.234	7.44	< 0.01	< 0.005	622.	0.02	116.	12.	< 0.1	0.055	3.67	333.	2.2	< 0.005
Gw - 44-1-1	SS	N	5/24/2019		6.69	322	10.8	200	221	< 0.5	0.153	0.087	11.	< 0.01	< 0.005	94.	0.023 3	80.1	5.5	< 0.1	0.018	0.528	221.	2.	0.008 8
	SS		9/18/2019		7.12	455	11.3	200	221	3.99	0.158	0.069	11.2	< 0.01	< 0.005	82.	0.032 7	80.3	4.7	< 0.1	0.061 1	0.454	221.	6.4	0.006 7
	SS		11/14/2019		7.34	330	10.6	210	215	3.	0.112	0.063	10.9	< 0.01	< 0.005	95.	0.021	77.9	5.3	< 0.1	0.009 6	0.453	215.	3.1	< 0.005
	SS		2/27/2020	Clear and colourless	6.95	319	10.1	200	227	1.66	0.18	0.067	11.5	< 0.01	< 0.005	103.	0.021 3	82.2	4.7	< 0.1	0.019 2	1.25	227.	4.7	0.040 7
Gw - 51-1-1	SS	N	10/2/2019		6.5	275	11.9	100	181	2.34	0.057	0.548	4.65	< 0.01	< 0.005	62.	0.011 8	61.2	8.1	0.12	0.096 8	5.18	181.	< 1.	< 0.005
	SS		11/21/2019		6.64	129	10.8	110	166	3.03	0.048	0.429	5.63	< 0.01	< 0.005	64.	0.011 9	56.	7.	0.11	0.072 3	2.84	166.	1.5	< 0.005
Gw - 51-2-1	SS	N	10/2/2019		7.12	315	11.4	140	194	1.32	0.224	0.965	39.5	< 0.01	< 0.005	178.	0.013 3	55.	27.	< 0.1	0.054 1	0.467	194.	< 1.	0.024 1
	SS		11/21/2019		7.62	309	9.9	150	182	1.64	0.218	0.85	35.1	< 0.01	< 0.005	158.	0.008 9	51.	24.	< 0.1	0.054 6	0.605	182.	5.6	0.031 3
Gw - 51-3-1	SS	N	10/2/2019		7.35	320	10.7	130	213	< 0.5	0.137	0.527	30.9	< 0.01	< 0.005	231.	0.008 6	59.8	40.	< 0.1	0.039 9	0.966	213.	< 1.	0.039 8
	SS		11/21/2019		7.72	317	9.7	140	211	3.62	0.142	0.421	27.2	< 0.01	< 0.005	199.	0.009	57.2	41.	< 0.1	0.054 4	2.41	211.	8.4	0.077 1
Gw - 52-1-1	SS	N	5/29/2019		6.92	1320	14.7	830	480	4.	< 0.1	0.63	108.	< 0.05	< 0.025	2 830.	< 0.025	128.	190.	1.79	1.83	0.91	480.	526.	< 0.025
	SS		9/30/2019		6.9	1805	16.1	910	521	4.3	< 0.04	0.259	114.	< 0.02	< 0.01	2 800.	< 0.01	140.	190.	1.12	2.36	< 0.1	521.	559.	< 0.01
	SS		11/14/2019		7.2	1670	13.8	920	547	3.4	0.043	0.311	118.	< 0.02	< 0.01	2 810.	< 0.01	146.	200.	1.14	2.46	0.15	547.	594.	< 0.01
	SS		2/27/2020	Clear and slightly yellow	6.91	2108	13.8	850	500	4.6	< 0.04	0.265	118.	< 0.02	< 0.01	2 790.	< 0.01	133.	190.	1.09	2.33	3.36	500.	559.	0.175
Gw - 52-4-0 (P7)	SS	N	5/30/2019		6.56	3262	18.9	1400	513	10.2	0.305	5.18	373.	< 0.02	< 0.01	2 580.	0.015	118.	**280.** b	2.59	5.14	1.81	513.	13 400.	0.235
	SS		9/13/2019		6.8	3395	18.3	1500	691	9.4	0.248	7.92	484.	< 0.02	< 0.01	3 560.	< 0.01	154.	**350.** b	2.78	7.98	0.55	691.	14 800.	0.049
	SS		11/18/2019		6.92	3084	17.7	1400	542	9.	0.419	2.09	333.	< 0.02	< 0.01	2 590.	< 0.01	119.	**330.** b	2.42	6.01	3.14	542.	3 080.	0.231
	SS		2/27/2020	Clear and slightly yellow	6.81	2752	16.3	1300	489	13.7	0.39	6.25	304.	< 0.02	< 0.01	2 510.	< 0.01	112.	**280.** b	4.25	5.81	2.47	489.	11 600.	0.091
Gw - 53-1-1	SS	Y	5/30/2019		6.72	340	11	200	233	2.15	< 0.02	0.223	22.5	< 0.01	< 0.005	479.	0.011	81.8	7.9	< 0.1	0.451	0.248	233.	293.	0.011 6
	SS		9/30/2019		7.16	344	11.5	210	234	2.29	< 0.02	0.136	21.2	< 0.01	< 0.005	508.	0.011 1	81.9	7.	< 0.1	0.431	0.059	234.	276.	0.005 2
	SS		11/15/2019		7.07	328	10.3	210	242	2.55	< 0.02	0.124	21.	< 0.01	< 0.005	492.	0.012 8	84.8	7.3	< 0.1	0.428	< 0.05	242.	301.	< 0.005
	SS		2/24/2020	Clear and colourless	7.17	325	10	210	228	1.95	< 0.02	0.13	25.4	< 0.01	< 0.005	473.	0.011	79.	6.7	< 0.1	0.492	0.982	228.	263.	< 0.005
Gw - 55-1-1	SS	Y	9/19/2019		7.01	362	10.7	160	232	0.92	0.107	0.144	4.2	< 0.01	< 0.005	19.	0.012 3	81.	15.	0.12	0.021 5	0.257	232.	3.2	< 0.005
	SS		12/2/2019		7.1	395	9.6	150	265	2.22	0.098	0.224	7.15	< 0.01	< 0.005	22.	0.006 3	91.8	18.	0.17	0.028	1.58	265.	16.1	0.035 6
Gw - 56-1-1	SS	Y	5/23/2019		6.78	292	10.7	150	200	1.61	0.043	0.156	26.9	< 0.01	< 0.005	19.	0.008 4	70.9	9.2	< 0.1	0.005 9	0.059	200.	1.9	< 0.005
	SS		9/20/2019		7.35	281	10.5	140	197	1.63	0.038	0.133	24.3	< 0.01	< 0.005	18.	0.032 3	69.9	6.9	< 0.1	0.009 3	0.098	197.	3.1	< 0.005
	SS		11/29/2019		7.61	278	9.3	150	204	1.4	0.037	0.156	22.4	< 0.01	< 0.005	17.	0.010 4	72.6	10.	< 0.1	0.007 2	1.26	204.	10.1	0.017 2
	SS		3/4/2020	Clear and colourless	7.41	291	9.5	140	189	2.42	0.029	0.145	24.5	< 0.01	< 0.005	16.	0.059 5	65.6	8.	< 0.1	< 0.005	0.613	189.	7.5	0.014 2
Gw - 57-1-1	SS	Y	9/19/2019		7.25	298	10	160	197	2.58	0.026	0.096	11.4	< 0.01	< 0.005	36.	0.021 6	71.	16.	< 0.1	0.034 1	0.159	197.	32.	0.005 4
	SS		11/26/2019		7.37	339	9.1	170	230	0.83	0.025	0.115	10.3	< 0.01	< 0.005	36.	0.006 9	82.7	20.	< 0.1	0.056 3	0.297	230.	16.8	0.021 4
Gw - 58-1-0	FRM	N	5/29/2019	Mean of duplicates	6.63	5664	19.9	1950	1725	13.45	0.45	1.865	36.	< 0.05	< 0.025	3 705.	0.074 5	459.5	**920.** b	10.9	**58.95** a b	5.645	1 725.	3 615.	0.314 5
	SS		9/25/2019		6.63	5685	19.8	1900	1800	13.9	0.471	1.88	37.9	< 0.02	< 0.01	3 790.	0.067	488.	**1 000.** b	10.3	**63.3** a b	6.57	1 800.	1 980.	0.278
	SS		11/20/2019		6.62	5458	19.6	1900	1660	19.6	0.37	1.87	39.7	< 0.05	< 0.025	4 010.	0.058	422.	**1 200.** b	11.	**63.2** a b	4.97	1 660.	5 280.	0.363
	SS		2/20/2020	Clear and moderately yellow brown	6.6	5104	19.5	1700	1400	12.6	0.399	2.03	33.2	< 0.02	< 0.01	3 190.	0.029	361.	**830.** b	9.02	**54.** a b	4.	1 400.	4 920.	0.282
Gw - 60-1-1	SS	N	5/15/2019		7.15	518	11.7	254	324	1.09	0.031	0.751	33.5	< 0.01	< 0.005	158.	0.007	103.	62.	< 0.1	0.149	0.891	324.	52.9	0.028
	SS		9/11/2019		6.83	559	10.9	250	328	1.05	0.026	0.528	27.1	< 0.01	< 0.005	184.	0.006 5	105.	71.	< 0.1	0.052	0.674	328.	57.8	0.014 9
	SS		11/7/2019		7.38	532	10.4	250	340	0.81	< 0.02	0.433	23.7	< 0.01	< 0.005	196.	0.008 1	108.	70.	< 0.1	0.044 4	0.212	340.	140.	< 0.005
	SS		2/13/2020	Clear and slightly orange	6.96	534	9.5	250	349	0.92	0.022	0.381	24.3	< 0.01	< 0.005	216.	0.022 6	110.	70.	< 0.1	0.059 9	0.419	349.	99.4	0.016 8
Gw - 60-2-1	SS	N	5/15/2019		7.19	465	11.5	158	267	1.56	0.072	0.563	45.5	< 0.01	< 0.005	260.	0.014	83.9	74.	< 0.1	0.184	0.546	267.	5.9	0.014
	SS		9/11/2019		6.86	513	11.9	170	282	0.71	0.055	0.337	44.3	< 0.01	< 0.005	269.	0.014 3	90.1	80.	< 0.1	0.286	0.229	282.	23.9	0.011 3
	SS		11/7/2019		7.6	451	10.5	170	279	0.65	0.028	0.382	43.7	< 0.01	< 0.005	243.	0.008 8	87.6	70.	< 0.1	0.133	0.194	279.	14.6	< 0.005
	SS		2/13/2020	Clear and colourless	7.22	456	9.8	160	284	0.67	0.064	0.373	41.7	< 0.01	< 0.005	292.	0.032	88.5	70.	< 0.1	0.133	0.581	284.	11.3	0.015
Gw - 60-3-1	SS	N	5/15/2019		6.86	468	10.9	186	252	0.89	0.046	0.346	12.7	< 0.01	< 0.005	223.	0.266	86.2	55.	< 0.1	0.366	2.14	252.	1.3	< 0.005
	SS		9/11/2019		6.65	564	12.2	220	283	1.37	0.051	0.396	14.8	< 0.01	< 0.005	356.	0.366	96.9	73.	< 0.1	0.48	2.87	283.	8.1	0.016 9
	SS		11/7/2019		7.24	537	11	230	298	0.71	0.025	0.226	15.4	< 0.01	< 0.005	392.	0.404	102.	65.	< 0.1	0.629	2.84	298.	< 1.	< 0.005
	SS		2/13/2020	Clear and slightly grey	6.7	496	9.6	210	298	2.33	0.057	0.185	15.	< 0.01	< 0.005	289.	0.323	102.	63.	< 0.1	0.398	2.86	298.	2.6	0.011 9
Gw - 62-1-1	SS	N	9/19/2019		6.95	205	10.8	120	138	1.64	0.028	0.091	1.47	< 0.01	< 0.005	41.	0.031 3	48.3	3.1	0.15	0.012 9	0.14	138.	3.4	0.008 4
	SS		11/13/2019		6.61	193	9.6	130	143	1.24	0.026	0.094	1.32	< 0.01	< 0.005	30.	0.006 1	49.6	4.	0.13	0.014 3	0.067	143.	4.1	< 0.005
	SS		9/19/2019		6.86	200	10.7	120	137	0.74	0.045	0.104	3.76	< 0.01	< 0.005	342.	0.005 8	47.7	3.1	0.14	0.015 3	0.08	137.	1.	0.014
	SS		11/13/2019		6.67	190	9.6	130	136	2.8	0.035	0.112	3.79	< 0.01	< 0.005	205.	0.006 9	47.2	3.6	0.15	0.016 2	0.169	136.	5.1	0.006 8
Gw - 63-1-1	SS	N	9/9/2019		6.75	113	11.4	150	147	13.2	0.125	0.081	11.6	< 0.01	< 0.005	13.	0.012 4	46.7	5.	< 0.1	0.080 9	0.115	147.	27.3	0.010 2
	SS		11/7/2019		7.89	231	10.8	150	151	1.21	< 0.02	0.079	8.14	< 0.01	< 0.005	< 10.	< 0.005	47.9	5.6	< 0.1	0.059 3	0.059	151.	25.3	< 0.005
Gw - 63-2-1	SS	N	9/9/2019		6.65	231	10.4	160	154	4.66	0.071	0.178	14.7	< 0.01	< 0.005	10.	0.006 9	53.5	5.4	< 0.1	0.009 5	0.216	154.	5.5	< 0.005
	SS		11/7/2019		7.69	231	10.1	150	160	2.13	< 0.02	0.215	16.4	< 0.01	< 0.005	< 10.	0.011 6	55.6	5.2	< 0.1	0.013 2	0.998	160.	5.8	0.017
Gw - 71-1-1	FRM	Y	5/16/2019	Mean of duplicates	6.84	230	10.3	138	142	2.505	0.031	0.424 5	5.705	< 0.01	< 0.005	601.	0.007	46.15	7.95	< 0.1	0.089 5	0.142	142.	6.55	0.006
	FRM		9/12/2019	Mean of duplicates	7.02	231	10.6	170	168	1.085	0.043 5	0.284 5	5.89	< 0.01	< 0.005	400.	0.006 65	55.65	8.85	< 0.1	0.061	0.078	168.	7.05	< 0.005
	FRM		11/6/2019	Mean of duplicates	7.52	263	10.2	160	170.5	3.345	0.056	0.265 5	6.245	< 0.01	< 0.005	449.	0.072 5	55.7	8.9	< 0.1	0.109 5	0.156 5	170.5	19.75	0.007 75
	FRM		2/13/2020	Mean of duplicates	7.45	245	9.7	140	154.5	1.175	0.086	0.398	7.93	< 0.01	< 0.005	542.5	0.005 65	50.2	7.65	< 0.1	0.133 5	0.776	154.5	6.65	0.023
Gw - 71-2-1	SS	Y	5/16/2019		6.97	330	10.4	212	220	1.28	0.023	0.446	16.	< 0.01	< 0.005	278.	0.01	75.2	8.7	< 0.1	0.197	0.134	220.	217.	0.029
	SS		9/12/2019		7.08	331	10.4	210	219	1.73	0.026	0.34	16.4	< 0.01	< 0.005	260.	0.022 7	75.1	9.1	< 0.1	0.122	0.246	219.	259.	0.034 6
	SS		11/6/2019		7.45	330	10.2	210	220	31.1	0.041	0.315	28.4	< 0.01	< 0.005	294.	0.029 8	74.5	24.	< 0.1	0.133	0.201	220.	253.	0.058 5
	SS		2/13/2020	Clear and colourless	7.19	338	9.8	220	241	4.48	0.036	0.329	20.2	< 0.01	< 0.005	323.	0.022 7	82.6	8.7	< 0.1	0.148	2.63	241.	258.	0.154
Gw - 71-3-1	SS	Y	5/16/2019		6.23	251	10.4	146	159	1.1	0.021	0.162	6.9	< 0.01	< 0.005	240.	0.025	56.5	8.8	< 0.1	0.084	0.621	159.	6.3	0.009
	SS		9/12/2019		6.54	303	10.8	180	198	1.89	< 0.02	0.111	9.89	< 0.01	< 0.005	345.	0.018 6	71.	9.6	< 0.1	0.047	0.553	198.	3.5	< 0.005
	SS		11/6/2019		6.85	314	10.7	180	200	5.32	0.031	0.033	6.72	< 0.01	< 0.005	486.	0.064 7	70.9	11.	< 0.1	0.040 9	0.696	200.	10.8	0.009 2
	SS		2/13/2020	Clear and colourless	6.62	250	10.2	130	153	0.94	0.022	0.092	8.52	< 0.01	< 0.005	237.	0.019 9	54.2	14.	< 0.1	0.055 8	3.05	153.	3.3	0.083 1

Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	PH (Field)	Specific Conductivity - 25°C (Field)	Temperature (Field)	Alkalinity	Hardness as CaCO3	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chloride	Chromium	Cobalt	Copper	Hardness (As Caco3)	Iron	Lead
BC CSR				AW Maximum (1)	---	---	---	---		---	90	50	10000	1.5	---	12000	0.5-4 (5)	---	1500	90 (7)	40	20-90 (5)	---	---	40-160 (5)
				DW Maximum (2)	---	---	---	---		9500	6	10	1000	8	---	5000	5	---	250	6000	20 (8)	1500	---	--- (6)	10
				Fraction	TOT	TOT	TOT	TOT	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	pH	µS/cm	°C	mg/L	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/L	mg/L	µg/l	µg/l	µg/l	mg/L	µg/l	µg/l
				Method Detection Limit	0.1	1	0.1	1	0.5	0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	1	0.1	0.005	0.05	0.5	1	0.005
Gw - 72-1-1	FRM	Y	5/16/2019	Mean of duplicates	7.05	450	10.8	160.5	275.5	1.18	< 0.02	0.277	13.5	< 0.01	< 0.005	1 640.	0.005	87.3	72.5	< 0.1	0.158	0.067	275.5	392.5	0.007 5
	FRM		9/11/2019	Mean of duplicates	7.27	494	10.6	160	265	0.93	< 0.02	0.215	12.95	< 0.01	< 0.005	1 440.	< 0.005	85.	82.5	0.1	0.050 6	< 0.05	265.	376.5	< 0.005
	FRM		11/6/2019	Mean of duplicates	7.63	428	10.9	150	264	4.05	< 0.04	0.048 5	12.6	< 0.02	< 0.01	1 605.	0.034 5	83.25	70.	< 0.2	0.095	0.18	264.	384.	< 0.01
	FRM		2/12/2020	Mean of duplicates	7.56	438	10.2	160	278.5	0.85	< 0.02	0.177	12.85	< 0.01	< 0.005	1 650.	0.012 75	88.2	69.5	0.1	0.076 3	0.097	278.5	398.5	< 0.005
Gw - 72-3-1	SS	Y	5/15/2019		7.07	485	11.2	217	259	1.54	0.029	0.449	16.9	< 0.01	< 0.005	503.	0.028	90.7	56.	< 0.1	0.181	0.368	259.	11.4	0.007
	SS		9/11/2019		6.87	525	11.6	210	268	1.01	0.03	0.286	19.8	< 0.01	< 0.005	545.	0.015 1	94.4	62.	< 0.1	0.102	0.303	268.	3.9	0.005 6
	SS		11/6/2019		7.4	497	11.2	210	277	17.2	0.043	0.239	30.5	< 0.01	< 0.005	648.	0.025 8	96.9	54.	0.1	0.153	0.763	277.	48.5	0.023
	SS		2/12/2020	Clear and colourless	7.15	478	10.2	210	271	0.79	0.026	0.32	16.4	< 0.01	< 0.005	568.	0.044 4	94.9	49.	< 0.1	0.107	0.505	271.	4.6	0.012 4
Gw - 73-1-1	SS	Y	5/15/2019		6.82	321	10.6	164	200	0.52	0.021	0.329	13.4	< 0.01	< 0.005	108.	0.018	62.3	21.	< 0.1	0.193	0.252	200.	< 1.	0.016
	FRM		9/12/2019	Mean of duplicates	7.02	332	10.9	160	205	0.905	0.022 5	0.238	12.85	< 0.01	< 0.005	114.	0.013 3	64.4	24.	< 0.1	0.168 5	0.238	205.	2.65	0.017 65
	SS		11/6/2019		7.2	324	10.4	160	206	46.8	0.025	0.168	13.3	0.011	< 0.005	123.	0.023 9	63.2	22.	< 0.1	0.188	0.44	206.	24.7	0.083 5
	SS		2/12/2020	Clear and colourless	7.01	320	9.4	170	211	< 0.5	0.023	0.287	12.7	< 0.01	< 0.005	125.	0.025 9	65.4	20.	< 0.1	0.236	0.462	211.	< 1.	0.018 1
Gw - 73-2-1	SS	Y	5/15/2019		6.38	301	10.7	154	192	1.02	< 0.02	0.336	11.7	< 0.01	< 0.005	81.	0.006	60.6	22.	< 0.1	0.173	0.65	192.	32.6	0.012
	SS		9/12/2019		6.5	347	10.4	160	214	0.83	< 0.02	0.123	10.6	< 0.01	< 0.005	98.	< 0.005	67.3	40.	< 0.1	0.082 3	0.441	214.	25.7	< 0.005
	SS		11/6/2019		6.84	334	10.2	150	212	4.15	< 0.02	0.085	10.7	< 0.01	< 0.005	99.	0.006 9	65.9	26.	< 0.1	0.086	0.438	212.	19.	< 0.005
	SS		2/12/2020	Clear and colourless	6.77	293	9.9	160	200	0.53	< 0.02	0.051	8.9	< 0.01	< 0.005	73.	0.006 9	62.4	18.	< 0.1	0.062 4	0.393	200.	13.4	< 0.005
Gw - 73-3-1	SS	Y	5/15/2019		5.85	232	10.8	65.7	77	3.19	0.039	0.253	15.2	< 0.01	< 0.005	54.	0.027	24.	27.	< 0.1	0.046	0.413	77.	16.4	0.01
	SS		9/12/2019		6.64	313	11	120	138	3.25	0.039	0.205	23.2	< 0.01	< 0.005	94.	0.026 6	43.9	45.	< 0.1	0.041 3	0.367	138.	2.5	0.008 3
	FRM		11/6/2019	Mean of duplicates	6.51	248	10.6	85.5	94.9	2.335	0.031 5	0.104	17.5	< 0.01	< 0.005	71.	0.042 85	29.4	27.	< 0.1	0.033 35	0.369 5	94.9	2.55	0.005 9
	SS		2/12/2020	Clear and colourless	6.19	193	9.8	74	86.6	3.47	0.034	0.14	14.4	< 0.01	< 0.005	41.	0.043 8	27.	24.	< 0.1	0.022 3	0.511	86.6	48.4	0.012 7
Gw - 77-1-1	SS	N	9/20/2019		7.56	268	12.2	160	175	1.42	< 0.02	0.068	4.24	< 0.01	< 0.005	214.	< 0.005	53.6	5.4	< 0.1	0.054 5	< 0.05	175.	80.9	0.008 3
	SS		11/14/2019		7.8	350	11	170	181	2.13	< 0.02	0.084	4.33	< 0.01	< 0.005	207.	< 0.005	55.3	5.4	< 0.1	0.122	0.162	181.	113.	0.031 2
Gw - 77-2-1	SS	N	9/20/2019		7.44	378	12.3	170	184	1.7	0.035	0.746	19.2	< 0.01	< 0.005	162.	0.007 8	50.7	5.6	< 0.1	0.008 4	0.094	184.	6.1	< 0.005
	SS		11/14/2019		7.06	277	11.7	180	190	14.5	0.022	0.694	18.8	< 0.01	< 0.005	177.	0.007 1	52.2	6.2	< 0.1	0.163	0.153	190.	74.7	0.021 8
Gw - 78-1-1	SS	N	9/18/2019		6.7	377	0	200	229	8.11	0.429	0.536	36.1	< 0.01	< 0.005	303.	0.032 8	65.8	3.	0.12	0.020 5	0.287	229.	14.2	0.006 3
	SS		11/14/2019		7.4	362	10.9	210	213	45.4	0.408	0.561	30.8	< 0.01	< 0.005	319.	0.041 9	59.9	3.5	0.11	0.226	0.599	213.	181.	0.122
Gw - 78-2-1	FRM	N	9/18/2019	Mean of duplicates	6.42	303	7.6	110	198	1.125	0.094 5	0.223 5	12.9	< 0.01	< 0.005	238.	0.536 5	63.6	4.1	0.255	0.079 55	0.447	198.	< 1.	< 0.005
	SS		11/14/2019		7.23	267	10.7	150	268	1.85	0.203	0.433	23.3	< 0.01	< 0.005	243.	0.465	87.	4.7	0.1	0.102	0.626	268.	4.2	0.034 7
Gw - 80-1-0 (P8)	SS	N	5/30/2019		6.41	1130	14.6	490	436	3.42	0.306	0.954	58.4	< 0.01	< 0.005	730.	0.024 5	134.	97.	1.07	3.91	9.65	436.	1 180.	0.121
	SS		9/13/2019		6.76	1840	16.4	710	533	6.06	1.96	0.875	103.	< 0.01	< 0.005	1 310.	0.055 5	155.	200.	1.75	6.77	40.2	533.	915.	3.23
	SS		11/18/2019		6.87	1590	15.7	520	358	6.21	2.87	0.593	86.9	< 0.01	< 0.005	1 380.	0.054 4	103.	130.	3.49	7.06	34.2	358.	199.	0.095 3
	SS		2/14/2020	Clear and moderately yellow, contains some organics	6.85	1705	13.1	570	335	10.7	0.966	1.72	57.6	< 0.01	< 0.005	1 070.	0.068 7	99.3	130.	6.66	5.85	15.9	335.	616.	0.128
Gw - 81-1-0 (P9)	SS	N	5/30/2019		6.85	966	15.4	330	453	5.9	< 0.04	0.19	63.8	< 0.02	< 0.01	1 050.	< 0.01	113.	100.	0.82	1.06	0.59	453.	469.	0.025
	SS		9/13/2019		7.68	945	17.5	300	438	3.7	0.101	0.159	59.9	< 0.02	< 0.01	1 080.	< 0.01	106.	120.	0.7	1.29	0.59	438.	2 160.	0.016
	SS		11/15/2019		7.57	916	15.7	330	467	4.	0.097	0.136	57.5	< 0.02	< 0.01	1 020.	< 0.01	111.	110.	0.69	1.32	0.63	467.	740.	0.012
	SS		2/14/2020	Clear and slightly yellow	7.02	1077	13.2	310	434	1.32	0.126	0.148	57.6	< 0.01	< 0.005	972.	0.006	104.	120.	0.69	1.33	2.02	434.	46.3	0.024 7
Gw - 85-1-1	SS	N	5/17/2019		6.23	607	13.8	84.4	195	1.77	0.062	0.266	4.87	< 0.01	< 0.005	205.	0.061	56.6	150.	< 0.1	0.818	5.87	195.	2.7	0.019
	SS		9/9/2019		6.46	693	15.2	110	218	10.1	0.085	0.215	5.11	< 0.01	< 0.005	236.	0.078	64.3	150.	0.13	1.16	6.14	218.	2.9	0.018 4
	SS		11/7/2019		6.99	448	15.6	75	133	1.21	0.075	0.195	2.94	< 0.01	< 0.005	195.	0.027	39.3	82.	< 0.1	0.6	4.77	133.	2.	0.008 5
	SS		2/13/2020	Slightly silty and slightly yellow	6.94	298	14.2	74	99	1.26	0.078	0.22	3.02	< 0.01	< 0.005	125.	0.017	29.5	65.	< 0.1	0.208	5.37	99.	1.3	0.024 8
Gw - 87-1-1	SS	N	9/18/2019		7.66	252	10.8	150	165	3.86	0.167	0.423	17.6	< 0.01	< 0.005	15.	0.050 2	51.5	4.6	< 0.1	0.153	0.139	165.	4.3	0.008 6
	SS		11/10/2019		7.55	231	9.4	160	177	2.95	0.099	0.313	29.5	< 0.01	< 0.005	18.	0.019 4	55.3	5.	< 0.1	0.053 6	0.497	177.	2.4	0.006 2
Gw - 87-2-1	SS	N	9/18/2019		6.42	157	10.9	84	96.3	0.85	< 0.02	0.054	1.22	< 0.01	< 0.005	< 10.	< 0.005	30.9	3.9	< 0.1	0.010 5	0.1	96.3	1.4	0.023 3
	SS		11/10/2019		6.84	161	9.7	98	111	1.03	< 0.02	< 0.02	0.994	< 0.01	< 0.005	12.	< 0.005	35.8	4.7	< 0.1	0.013 9	0.114	111.	3.8	< 0.005
Gw - 88-1-1	SS	N	9/18/2019		6.62	219	11.1	130	144	2.62	0.03	0.08	2.96	< 0.01	< 0.005	12.	< 0.005	48.4	3.9	< 0.1	0.022 2	0.152	144.	4.9	< 0.005
	SS		11/10/2019		6.98	217	10	140	156	0.75	< 0.02	0.035	2.71	< 0.01	< 0.005	14.	< 0.005	52.3	4.6	< 0.1	0.023 3	0.106	156.	< 1.	< 0.005
Gw - 88-2-1	SS	N	9/18/2019		5.97	403	11.7	70	182	707.	0.515	4.28	25.1	0.045	0.007 9	21.	0.153	61.	4.1	2.13	14.5	8.43	182.	4 260.	0.864
	SS		11/10/2019		6.47	378	10.6	82	271	8.	0.056	0.09	12.3	< 0.01	< 0.005	27.	0.207	91.9	6.3	< 0.1	0.503	1.65	271.	22.7	0.021 6
91-1-1	SS	N	3/4/2020		7.61	447	10.3	230	206	661.	0.58	1.38	47.6	0.096	0.033 4	78.	0.024 7	65.6	5.9	1.2	0.733	1.16	206.	1 150.	0.803
92-1-1	SS	N	3/5/2020		7.5	393	10	180	343	**9 650.** b	0.268	5.82	163.	1.41	0.48	437.	0.362	101.	7.3	22.7	12.3	9.65	343.	20 800.	**12.8** b
93-1-1	SS	N	3/4/2020		7.31	188	10	150	155	5.08	0.525	0.528	29.4	< 0.01	< 0.005	14.	0.011 8	51.8	3.9	< 0.1	0.145	6.82	155.	10.3	0.157
94-1-1	SS	N	3/5/2020		7.03	272	8.3	130	156	3.46	1.43	0.543	25.3	< 0.01	< 0.005	26.	0.018 5	46.9	7.9	< 0.1	0.408	0.302	156.	2.5	0.007 3
Gw - P1	SS	N	5/17/2019		6.98	1505	17.9	686	252	3.4	0.07	5.05	**1 290.** b	< 0.02	< 0.01	2 000.	< 0.01	69.7	130.	1.49	2.02	0.78	252.	3 160.	0.031
	SS		9/13/2019		7.2	1664	19	740	256	4.8	< 0.1	5.17	**1 430.** b	< 0.05	< 0.025	2 370.	< 0.025	69.	140.	0.85	2.74	4.08	256.	6 180.	0.199
	SS		11/13/2019		7.29	1981	17	750	291	4.8	0.066	7.13	**1 720.** b	< 0.02	< 0.01	2 280.	< 0.01	81.1	150.	0.96	2.95	0.5	291.	11 700.	0.035
	SS		2/14/2020	Clear and colourless	6.95	1068	15.8	530	277	4.9	0.062	6.47	**1 380.** b	< 0.02	< 0.01	1 240.	< 0.01	83.5	69.	0.54	1.16	1.48	277.	18 500.	0.094
Gw - P10	SS	N	5/24/2019		6.94	1213	16	600	277	2.58	0.081	1.04	798.	< 0.01	< 0.005	2 650.	< 0.005	73.5	98.	1.1	4.64	2.16	277.	190.	0.065 2
	SS		9/13/2019		7.05	1371	16.9	680	313	2.9	0.065	2.	**1 210.** b	< 0.02	< 0.01	1 980.	< 0.01	89.9	120.	0.9	2.44	1.36	313.	3 150.	0.036
	SS		11/4/2019		6.92	1229	16	580	289	2.4	0.04	1.55	**1 050.** b	< 0.02	< 0.01	1 380.	< 0.01	84.7	100.	0.5	1.59	5.59	289.	1 830.	0.248
	SS		2/14/2020	Clear and slightly orange	6.95	967	14.4	520	297	2.09	0.055	1.17	789.	< 0.01	< 0.005	1 090.	< 0.005	89.3	64.	0.53	1.16	1.34	297.	417.	0.040 3
Gw - P2	SS	N	5/24/2019		7.19	1878	16.3	870	275	3.4	0.07	0.927	726.	< 0.02	< 0.01	2 760.	< 0.01	73.7	190.	1.04	4.18	2.17	275.	191.	0.066
	SS		9/13/2019		7.23	2024	17	960	322	3.5	0.063	1.18	626.	< 0.02	< 0.01	2 830.	< 0.01	84.6	200.	1.22	4.37	0.72	322.	635.	0.013
	SS		11/4/2019		7.21	1981	16.1	900	314	4.3	0.049	1.42	647.	< 0.02	< 0.01	2 640.	< 0.01	84.5	190.	1.02	3.99	1.54	314.	817.	0.028
	SS		2/14/2020	Clear and slightly orange	7.04	1965	16.5	930	296	4.8	0.065	1.12	658.	< 0.02	< 0.01	2 880.	< 0.01	77.7	180.	1.13	4.03	6.27	296.	1 090.	0.197
Gw - P3	SS	N	5/17/2019		7	2327	16.8	1060	266	5.3	0.094	2.37	753.	< 0.02	< 0.01	3 770.	< 0.01	64.2	220.	2.17	4.7	1.37	266.	983.	0.066
	SS		9/13/2019		7.23	2287	16	1100	343	4.8	0.067	2.03	685.	< 0.02	< 0.01	4 010.	< 0.01	85.2	210.	1.33	5.35	1.26	343.	2 730.	0.017
	SS		11/4/2019		7.09	2201	15.2	1000	331	4.1	0.056	1.94	676.	< 0.02	< 0.01	3 450.	< 0.01	84.2	220.	1.08	4.81	1.14	331.	1 600.	0.04
	SS		2/14/2020	Clear and slightly orange	7.03	2223	15.4	1100	251	4.8	0.058	1.94	797.	< 0.02	< 0.01	3 320.	< 0.01	57.1	220.	1.09	3.98	4.4	251.	727.	0.13
Gw - P4	SS	N	5/17/2019		6.93	2098	17.3	947	299	7.9	0.065	1.58	144.	< 0.02	< 0.01	2 750.	< 0.01	75.1	210.	1.83	3.45	0.76	299.	1 790.	0.043
	SS		9/13/2019		7.13	1998	16.3	960	334	4.6	0.075	1.84	168.	< 0.02	< 0.01	3 030.	< 0.01	87.2	200.	1.11	3.81	0.8	334.	3 770.	< 0.01
	SS		11/4/2019		7.01	1961	15.3	910	325	4.8	0.047	1.93	165.	< 0.02	< 0.01	2 570.	< 0.01	86.9	200.	0.98	3.37	0.69	325.	5 840.	0.078
	SS		2/14/2020	Clear and slightly orange	6.8	1987	15.3	970	304	4.5	0.063	1.35	142.	< 0.02	< 0.01	2 420.	< 0.01	76.3	190.	0.98	3.2	2.09	304.	1 380.	0.034

Notes:

a	*Above CSR Schedule 3.2 AW Standard.*
b	*Above CSR Schedule 3.2 DW Standard.*
c	*Detection Limits above Applicable Standards.*
d	*Above CSR Schedule 3.2 AW Standard, but Below Regional Background Concentrations (South Vancouver Island Region).*
SS	*Single sample.*
FR1, FR2	*Field replicates.*
BC CSR	*CSR-Sch3.2: BC Contaminated Site Regulation - Schedule 3.2 - Generic Numerical Water Standards, be in effective on November 1, 2017.*
(1)	*Aquatic Life (AW) Freshwater, Column 3.*
(2)	*Drinking Water (DW), Column 6.*
(3)	*Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
(4)	*Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
(5)	*Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
(6)	*BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
(7)	*Standard is based on the trivalent (Cr(III)) species.*
(8)	*Interim standard used.*
(9)	*Regional Background Concentrations (South Vancouver Island Region).*

Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	Lithium	Magnesium	Manganese	Molybdenum	Nitrogen - ammonia	Nitrogen - nitrite	Nitrogen - nitrate	Nitrogen - nitrate plus nitrite	Nickel	Phosphorus
BC CSR				AW Maximum (1)	---	---	---	10000	1310-18400 (3)	200-2000 (4)	400	400	250-1500 (5)	---
				DW Maximum (2)	33 (9)	---	--- (6)	250	---	1	10	10	80	---
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/l	mg/l	µg/l	µg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l
				Method Detection Limit	0.5	0.05	0.05	0.05	0.015	0.005	0.02	0.02	0.02	2
Gw - 04-3-1	SS	Y	5/16/2019		< 0.5	7.71	0.268	2.41	< 0.015	< 0.005	0.044	0.044	0.54	8.5
	SS		9/11/2019		0.52	8.15	0.476	2.87	< 0.015	< 0.005	0.041	0.041	0.459	8.1
	SS		11/6/2019		0.54	8.48	0.076	2.67	< 0.015	< 0.005	0.041	0.041	0.389	11.4
	SS		2/13/2020	Clear and colourless	0.54	8.21	0.41	2.89	< 0.015	< 0.005	0.035	0.035	0.545	9.4
Gw - 04-4-1	SS	Y	5/16/2019		< 0.5	5.35	0.809	0.165	< 0.015	< 0.005	0.158	0.158	0.511	3.9
	SS		9/11/2019		< 0.5	7.09	8.23	0.161	< 0.015	< 0.005	0.174	0.174	0.48	3.
	SS		11/6/2019		< 0.5	7.55	2.27	0.152	< 0.015	< 0.005	0.298	0.298	0.516	5.6
	SS		2/13/2020	Clear and colourless	< 0.5	4.39	3.85	0.187	< 0.015	< 0.005	0.866	0.866	0.375	3.1
Gw - 07-1-0	SS	N	5/16/2019		< 0.5	11.3	1 510.	0.358	0.017	< 0.005	< 0.02	< 0.02	4.28	4.
	SS		9/9/2019		< 0.5	11.2	1 500.	0.346	0.018	< 0.005	< 0.02	< 0.02	3.82	3.5
	SS		11/7/2019		< 0.5	12.	1 760.	0.348	0.032	< 0.005	< 0.02	< 0.02	5.86	7.7
	SS		2/13/2020	Clear and colourless	< 0.5	11.7	1 440.	0.265	< 0.015	< 0.005	< 0.02	< 0.02	3.95	5.
Gw - 16-1-1	SS	N	9/6/2019		< 0.5	6.25	0.316	0.759	< 0.015	< 0.005	0.071	0.071	0.182	5.4
	SS		11/28/2019		< 0.5	4.82	7.93	0.178	0.018	0.006 1	0.695	0.701	0.379	5.
Gw - 16-1-2	SS	N	9/6/2019		< 1.	5.39	0.57	0.45	< 0.015	< 0.005	0.202	0.202	0.2	6.7
	SS		11/28/2019		0.53	5.19	1.49	0.296	< 0.015	< 0.005	0.751	0.751	0.2	< 2.
Gw - 16-2-1	SS	N	9/6/2019		1.48	6.84	0.592	2.04	< 0.015	< 0.005	0.177	0.177	0.484	8.2
	SS		11/28/2019		< 0.5	5.02	0.214	0.407	< 0.015	< 0.005	0.483	0.483	0.309	2.7
Gw - 16-2-2	NS	N	9/6/2019		Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
	SS		11/28/2019		< 0.5	4.68	0.719	0.263	< 0.015	< 0.005	0.535	0.535	0.483	2.3
Gw - 17-1-1	SS	Y	9/6/2019		1.34	9.58	8.22	0.808	< 0.015	< 0.005	0.11	0.11	0.875	7.5
	SS		11/28/2019		1.01	13.5	1.84	0.495	< 0.015	0.025 3	< 0.02	0.021	0.759	2.2
Gw - 17-1-2	SS	Y	9/6/2019		2.5	11.	0.54	1.08	0.018	< 0.005	0.072	0.072	0.354	11.5
	SS		11/28/2019		1.48	13.1	0.137	0.514	< 0.015	< 0.005	0.035	0.035	0.129	2.1
Gw - 17-1-3	SS	Y	9/6/2019		< 0.5	17.4	0.167	0.232	< 0.015	< 0.005	0.104	0.104	2.5	3.2
	SS		11/28/2019		< 0.5	12.2	0.244	0.143	< 0.015	0.010 8	0.817	0.828	0.864	< 2.
Gw - 18-1-1	SS	Y	5/29/2019		< 0.5	7.	38.8	0.263	< 0.015	< 0.005	< 0.02	< 0.02	0.441	6.7
	FRM		9/6/2019	Mean of duplicates	0.615	6.955	20.65	0.372	< 0.015	< 0.005	< 0.02	< 0.02	0.359 5	6.4
	FRM		11/29/2019	Mean of duplicates	0.67	7.325	0.477	0.388 5	< 0.015	< 0.005	< 0.02	< 0.02	0.248	---
	FRM		2/27/2020	Mean of duplicates	0.56	6.295	36.1	0.512 5	< 0.015	< 0.005	0.201	0.201	0.939	17.1
Gw - 18-2-1	SS	Y	5/29/2019		< 0.5	6.56	0.106	0.107	0.025	0.006 6	0.056	0.063	0.085	4.
	SS		9/6/2019		< 0.5	6.44	0.326	0.067	< 0.015	< 0.005	0.044	0.044	0.143	3.1
	SS		11/29/2019		< 0.5	7.18	0.069	< 0.05	< 0.015	0.007 4	0.608	0.616	0.083	0.
	SS		2/27/2020	Slightly silty and slightly grey	< 0.5	6.12	0.364	0.068	< 0.015	0.010 1	0.434	0.444	0.102	2.8
Gw - 18-2-2	SS	Y	5/29/2019		< 0.5	5.35	0.075	< 0.05	< 0.015	< 0.005	0.047	0.047	0.083	4.2
	SS		9/6/2019		< 0.5	6.07	< 0.05	0.066	< 0.015	< 0.005	0.033	0.033	0.074	3.4
	SS		11/29/2019		< 0.5	7.	0.459	< 0.05	< 0.015	< 0.005	0.786	0.786	0.129	---
	SS		2/27/2020	Clear and colourless	< 0.5	5.17	0.12	0.058	< 0.015	< 0.005	0.411	0.411	0.079	3.
Gw - 19-1-1	SS	N	5/15/2019		< 0.5	8.74	2 190.	0.406	0.031	< 0.005	< 0.02	< 0.02	0.848	5.4
	SS		9/11/2019		< 0.5	10.2	1 770.	1.07	0.02	< 0.005	< 0.02	< 0.02	1.25	8.4
	SS		11/7/2019		< 0.5	11.	2 690.	0.543	0.02	< 0.005	< 0.02	< 0.02	0.557	2.6
	SS		2/12/2020	Slightly silty and slightly orange	0.71	11.3	1 190.	1.31	< 0.015	< 0.005	< 0.02	< 0.02	0.44	5.2
Gw - 19-1-2	SS	N	5/15/2019		< 0.5	8.63	2 480.	0.305	2.4	< 0.005	< 0.02	< 0.02	0.831	3.4
	SS		9/11/2019		< 0.5	9.	2 250.	0.229	0.084	< 0.005	< 0.02	< 0.02	0.254	5.3
	SS		11/7/2019	resampled	< 0.5	10.7	2 120.	0.392	0.049	< 0.005	< 0.02	< 0.02	0.252	4.4
	SS		2/12/2020	Clear and colourless	< 0.5	10.7	245.	0.424	< 0.015	< 0.005	< 0.02	< 0.02	0.201	5.4
Gw - 19-2-1	SS	N	5/15/2019		< 0.5	10.1	81.7	0.517	0.12	< 0.005	< 0.02	< 0.02	0.276	4.3
	SS		9/11/2019		< 0.5	10.5	76.7	0.508	< 0.015	< 0.005	< 0.02	< 0.02	0.2	< 2.
	SS		11/7/2019		< 0.5	11.	102.	0.469	< 0.015	< 0.005	< 0.02	< 0.02	0.115	3.8
	SS		2/12/2020	Clear and colourless	< 0.5	11.8	88.6	0.538	< 0.015	< 0.005	< 0.02	< 0.02	0.178	6.3
Gw - 19-2-2	SS	N	5/15/2019		< 0.5	10.2	22.1	0.661	0.22	< 0.005	0.021	0.021	0.357	6.
	SS		9/11/2019		< 0.5	9.11	944.	0.296	< 0.015	< 0.005	< 0.02	< 0.02	1.35	12.6
	SS		11/7/2019	resampled	< 0.5	11.3	119.	0.504	< 0.015	< 0.005	0.051	0.051	0.271	5.7
	SS		2/12/2020	Moderately silty and moderately orange	1.74	8.68	3.27	0.308	< 0.015	< 0.005	< 0.02	< 0.02	0.138	4.9
Gw - 20-1-1	SS	Y	5/30/2019		< 2.5	4.1	18.1	0.51	0.025	0.014 8	0.05	0.065	1.01	< 10.
	SS		9/26/2019		1.6	3.85	2.22	0.8	0.044	< 0.005	0.052	0.052	2.08	< 4.
	SS		11/21/2019		< 2.5	3.31	5.47	0.32	< 0.015	< 0.005	0.07	0.07	0.44	37.
	SS		2/20/2020	Clear and colourless, contains some organics	1.3	4.82	27.6	0.52	0.17	0.009 7	0.036	0.045	0.462	8.1
Gw - 20-1-2	SS	Y	5/30/2019		< 2.5	5.17	37.5	0.53	0.23	< 0.005	< 0.02	< 0.02	0.75	< 10.
	SS		9/26/2019		1.5	5.59	35.9	0.57	0.2	< 0.005	< 0.02	< 0.02	0.466	< 4.
	SS		11/21/2019		1.4	4.74	27.3	0.43	0.14	< 0.005	< 0.02	< 0.02	0.231	< 4.
	SS		2/20/2020	Clear and colourless	1.2	6.06	42.	0.61	0.24	< 0.005	< 0.02	< 0.02	0.644	8.7

Station	Date Sampled	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulphate	Sulphur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
AW Maximum (1)		---	20	---	0.5-15 (5)	---	---	128-429 (5)	---	3	---	1000	85	---	75-2400 (5)	---
DW Maximum (2)		---	10	---	20	200	2500	500	---	---	2.5	---	20	20	3	---
Fraction		DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
Unit		µg/l	µg/l	µg/l	µg/l	mg/L	µg/l	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Method Detection Limit		0.05	0.04	50	0.005	0.05	0.05	1	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1
Gw - 04-3-1	5/16/2019	0.604	0.094	8 400.	< 0.005	12.3	164.	35.5	11.1	0.004	< 0.2	< 0.5	0.572	< 0.2	0.75	< 0.1
	9/11/2019	0.666	0.174	7 940.	< 0.005	10.8	186.	36.	11.9	< 0.002	< 0.2	< 0.5	0.591	< 0.2	0.46	< 0.1
	11/6/2019	0.61	0.124	8 930.	< 0.005	11.9	184.	34.	< 15.	0.002 9	< 0.2	< 0.5	0.627	< 0.2	0.36	< 0.1
	2/13/2020	0.61	0.114	8 630.	< 0.005	13.	178.	35.	12.6	0.005 1	< 0.2	< 0.5	0.707	< 0.2	6.2	< 0.1
Gw - 04-4-1	5/16/2019	1.25	< 0.04	5 570.	< 0.005	13.8	96.	20.5	6.4	0.004	< 0.2	< 0.5	0.017	0.5	2.2	< 0.1
	9/11/2019	1.4	0.046	5 620.	< 0.005	12.7	132.	29.	8.	0.002 2	< 0.2	< 0.5	0.041 6	0.52	0.24	< 0.1
	11/6/2019	1.59	0.066	5 610.	< 0.005	15.8	139.	80.	24.	0.002 4	< 0.2	< 0.5	0.015 2	0.5	0.28	< 0.1
	2/13/2020	1.12	0.054	5 610.	< 0.005	10.8	71.1	19.	5.9	0.002 5	< 0.2	< 0.5	0.013 8	0.53	3.98	< 0.1
Gw - 07-1-0	5/16/2019	1.27	0.1	7 520.	< 0.005	21.3	248.	43.9	14.9	< 0.002	< 0.2	< 0.5	0.304	< 0.2	18.3	< 0.1
	9/9/2019	1.33	0.089	7 090.	< 0.005	21.9	247.	43.	13.4	< 0.002	< 0.2	< 0.5	0.308	< 0.2	13.7	< 0.1
	11/7/2019	1.17	< 0.04	8 970.	< 0.005	20.8	271.	36.	12.4	< 0.002	< 0.2	< 0.5	0.281	< 0.2	31.6	< 0.1
	2/13/2020	1.25	0.14	7 680.	< 0.005	20.9	268.	35.	12.1	< 0.002	< 0.2	< 0.5	0.295	< 0.2	13.8	< 0.1
Gw - 16-1-1	9/6/2019	< 0.25	< 0.04	6 510.	< 0.005	4.83	177.	21.	< 15.	0.003	< 0.2	< 0.5	0.225	0.52	1.93	< 0.1
	11/28/2019	0.173	0.068	6 030.	< 0.005	3.18	103.	19.	6.	< 0.002	< 0.2	3.72	0.097 2	1.12	3.58	0.14
Gw - 16-1-2	9/6/2019	< 0.25	< 0.08	5 780.	< 0.01	5.44	152.	16.	< 15.	< 0.004	< 0.4	< 1.	0.202	< 0.4	1.81	< 0.2
	11/28/2019	0.192	0.079	5 880.	< 0.005	5.51	136.	19.	6.5	< 0.002	< 0.2	< 0.5	0.203	0.44	1.98	< 0.1
Gw - 16-2-1	9/6/2019	0.46	0.195	6 920.	< 0.005	12.	237.	30.	< 15.	0.002 8	0.41	< 0.5	0.64	1.55	2.91	< 0.1
	11/28/2019	0.234	0.101	5 620.	< 0.005	4.4	132.	20.	7.2	< 0.002	< 0.2	< 0.5	0.097 6	0.63	3.33	< 0.1
Gw - 16-2-2	9/6/2019	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
	11/28/2019	0.18	0.073	5 360.	< 0.005	3.47	101.	21.	7.3	< 0.002	< 0.2	< 0.5	0.078 1	0.49	2.33	< 0.1
Gw - 17-1-1	9/6/2019	0.77	0.081	16 300.	< 0.005	14.5	485.	39.	< 30.	0.003	< 0.2	< 0.5	0.412	2.37	1.81	< 0.1
	11/28/2019	0.662	0.075	14 600.	< 0.005	11.2	490.	41.	14.2	< 0.002	< 0.2	< 0.5	0.263	2.26	1.42	< 0.1
Gw - 17-1-2	9/6/2019	0.94	0.081	20 000.	< 0.01	15.7	586.	28.	< 30.	< 0.004	< 0.4	< 1.	0.71	1.72	2.79	< 0.2
	11/28/2019	0.752	0.065	16 700.	< 0.005	10.7	613.	29.	10.9	0.002 8	< 0.2	< 0.5	0.381	1.97	1.39	< 0.1
Gw - 17-1-3	9/6/2019	0.37	0.068	8 440.	< 0.005	4.26	466.	36.	< 15.	0.002 2	< 0.2	< 0.5	0.14	2.01	0.65	< 0.1
	11/28/2019	0.402	0.092	8 240.	< 0.005	4.16	285.	29.	10.3	< 0.002	< 0.2	< 0.5	0.043 6	1.37	1.99	< 0.1
Gw - 18-1-1	5/29/2019	0.149	0.094	6 940.	< 0.005	3.7	84.1	21.	6.	< 0.002	< 0.2	0.58	0.114	1.06	1.21	< 0.1
	9/6/2019	< 0.25	0.073	7 005.	< 0.005	3.98	87.4	21.5	< 15.	0.003	< 0.2	< 0.5	0.128 5	0.93	1.385	< 0.1
	11/29/2019	0.197	0.066	7 140.	< 0.005	4.465	83.7	19.	6.65	< 0.002	< 0.2	< 0.5	0.137	0.76	1.205	< 0.1
	2/27/2020	0.248	0.105	7 650.	< 0.005	4.14	82.85	22.	7.65	< 0.002	< 0.2	0.735	0.117	0.945	8.44	< 0.1
Gw - 18-2-1	5/29/2019	0.097	0.273	6 630.	< 0.005	3.6	69.1	22.	6.2	< 0.002	< 0.2	< 0.5	0.057 4	0.95	0.44	< 0.1
	9/6/2019	< 0.25	0.393	6 620.	< 0.005	3.29	69.9	18.	< 15.	< 0.002	< 0.2	< 0.5	0.045	0.66	0.51	< 0.1
	11/29/2019	0.101	0.996	6 920.	< 0.005	3.54	71.9	51.	16.2	< 0.002	< 0.2	< 0.5	0.04	0.61	1.3	< 0.1
	2/27/2020	0.104	0.747	7 320.	< 0.005	3.33	68.7	30.	9.4	< 0.002	< 0.2	< 0.5	0.024 2	0.68	0.92	< 0.1
Gw - 18-2-2	5/29/2019	0.114	0.318	6 630.	< 0.005	3.03	59.6	19.	5.2	< 0.002	< 0.2	< 0.5	0.033 7	0.89	0.26	< 0.1
	9/6/2019	< 0.25	0.35	6 640.	< 0.005	3.08	70.7	22.	< 15.	< 0.002	< 0.2	< 0.5	0.072 5	0.77	0.34	< 0.1
	11/29/2019	0.15	1.03	7 060.	< 0.005	3.65	75.	58.	18.8	< 0.002	< 0.2	< 0.5	0.054	0.7	2.09	< 0.1
	2/27/2020	0.12	0.602	7 280.	< 0.005	3.21	59.5	32.	9.2	< 0.002	< 0.2	< 0.5	0.024 5	0.69	1.46	< 0.1
Gw - 19-1-1	5/15/2019	0.17	< 0.04	9 920.	< 0.005	5.21	172.	27.4	9.1	< 0.002	< 0.2	< 0.5	0.041	< 0.2	0.61	< 0.1
	9/11/2019	0.179	< 0.04	11 800.	< 0.005	5.93	184.	18.	6.8	< 0.002	< 0.2	3.89	0.193	0.74	1.58	0.32
	11/7/2019	0.203	< 0.04	11 800.	< 0.005	6.59	207.	13.	4.8	< 0.002	< 0.2	< 0.5	0.079 4	< 0.2	1.18	< 0.1
	2/12/2020	0.186	< 0.04	13 100.	< 0.005	7.56	157.	35.	11.7	< 0.002	< 0.2	< 0.5	0.15	0.24	0.18	< 0.1
Gw - 19-1-2	5/15/2019	0.17	< 0.04	9 720.	< 0.005	4.74	177.	30.	9.3	< 0.002	< 0.2	0.68	0.009	< 0.2	0.23	< 0.1
	9/11/2019	0.163	< 0.04	10 200.	< 0.005	4.5	178.	14.	3.7	< 0.002	< 0.2	< 0.5	0.012 2	0.37	0.29	< 0.1
	11/7/2019	0.16	< 0.04	10 800.	< 0.005	5.97	192.	25.	8.	< 0.002	< 0.2	< 0.5	0.056 3	0.32	0.2	< 0.1
	2/12/2020	0.135	< 0.04	11 900.	< 0.005	5.	150.	38.	13.4	< 0.002	< 0.2	< 0.5	0.048 6	< 0.2	< 0.1	< 0.1
Gw - 19-2-1	5/15/2019	0.139	< 0.04	11 300.	< 0.005	4.65	161.	45.9	14.8	< 0.002	< 0.2	< 0.5	0.086	< 0.2	< 0.1	< 0.1
	9/11/2019	0.138	< 0.04	12 000.	< 0.005	4.59	169.	46.	13.4	< 0.002	< 0.2	< 0.5	0.111	< 0.2	0.39	< 0.1
	11/7/2019	0.15	< 0.04	12 700.	< 0.005	4.81	177.	40.	13.7	< 0.002	< 0.2	< 0.5	0.099 1	< 0.2	< 0.1	< 0.1
	2/12/2020	0.167	< 0.04	13 100.	< 0.005	5.14	180.	40.	15.2	< 0.002	< 0.2	< 0.5	0.105	< 0.2	0.22	< 0.1
Gw - 19-2-2	5/15/2019	0.16	< 0.04	11 200.	< 0.005	4.73	155.	44.9	14.6	< 0.002	0.24	< 0.5	0.083	< 0.2	2.1	< 0.1
	9/11/2019	0.158	0.045	11 500.	0.007 3	5.93	154.	33.	11.3	0.006 6	< 0.2	3.12	0.121	0.29	5.12	< 0.1
	11/7/2019	0.153	< 0.04	12 000.	< 0.005	5.1	168.	39.	12.8	< 0.002	< 0.2	< 0.5	0.102	< 0.2	0.74	< 0.1
	2/12/2020	0.211	< 0.04	9 490.	< 0.005	9.85	129.	36.	11.6	< 0.002	< 0.2	< 0.5	0.059 2	< 0.2	0.77	< 0.1
Gw - 20-1-1	5/30/2019	0.43	< 0.2	19 800.	< 0.025	14.3	490.	12.	< 15.	< 0.01	< 1.	< 2.5	0.018	< 1.	11.8	< 0.5
	9/26/2019	0.29	< 0.08	18 700.	< 0.01	12.2	477.	12.	< 6.	< 0.004	< 0.4	< 1.	0.016 5	< 0.4	0.54	< 0.2
	11/21/2019	0.4	< 0.2	20 000.	< 0.025	12.1	432.	11.	< 15.	< 0.01	< 1.	< 2.5	0.027	< 1.	5.67	< 0.5
	2/20/2020	0.43	< 0.08	18 800.	< 0.01	14.4	539.	12.	< 6.	< 0.004	< 0.4	< 1.	0.014 6	< 0.4	2.62	< 0.2
Gw - 20-1-2	5/30/2019	0.49	< 0.2	21 600.	< 0.025	16.	644.	12.7	< 15.	< 0.01	< 1.	< 2.5	0.017	< 1.	4.33	< 0.5
	9/26/2019	0.43	< 0.08	21 100.	< 0.01	15.7	631.	13.	< 6.	< 0.004	< 0.4	< 1.	0.016 5	< 0.4	1.15	< 0.2
	11/21/2019	0.35	< 0.08	20 800.	< 0.01	13.	564.	13.	< 6.	< 0.004	< 0.4	< 1.	0.015 7	< 0.4	0.8	< 0.2
	2/20/2020	0.57	< 0.08	18 500.	< 0.01	17.6	660.	13.	< 6.	< 0.004	< 0.4	< 1.	0.019 2	< 0.4	3.57	< 0.2

Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	Lithium	Magnesium	Manganese	Molybdenum	Nitrogen - ammonia	Nitrogen - nitrite	Nitrogen - nitrate	Nitrogen - nitrate plus nitrite	Nickel	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulphate	Sulphur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
BC CSR				AW Maximum (1)	---	---	---	10000	1310-18400 (3)	200-2000 (4)	400	400	250-1500 (5)	---	---	20	---	0.5-15 (5)	---	---	128-429 (5)	---	3	---	1000	85	---	75-2400 (5)	---
				DW Maximum (2)	33 (9)	---	--- (6)	250	---	1	10	10	80	---	---	10	---	20	200	2500	500	---	---	2.5	---	20	20	3	---
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/l	mg/l	µg/l	µg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/L	µg/l	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
				Method Detection Limit	0.5	0.05	0.05	0.05	0.015	0.005	0.02	0.02	0.02	2	0.05	0.04	50	0.005	0.05	0.05	1	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1
Gw - 21-1-1	SS	Y	5/30/2019		< 2.5	3.85	3.9	0.62	< 0.015	< 0.005	< 0.02	< 0.02	0.33	< 10.	0.26	< 0.2	21 100.	< 0.025	8.43	509.	11.1	< 15.	< 0.01	< 1.	< 2.5	0.026	< 1.	4.16	< 0.5
	FRM		10/2/2019	Mean of duplicates	1.8	3.78	7.825	0.595	< 0.015	< 0.005	< 0.02	< 0.02	0.316	< 7.	0.235	< 0.14	20 100.	< 0.017 5	8.475	496.5	11.	< 10.5	< 0.007	< 0.7	2.	0.051 05	< 0.7	0.81	< 0.35
	FRM		11/21/2019	Mean of duplicates	< 2.5	3.53	6.315	0.33	0.016	< 0.005	< 0.02	< 0.02	0.1	< 10.	< 0.25	< 0.2	19 150.	< 0.025	8.495	455.5	10.5	< 15.	< 0.01	< 1.	< 2.5	0.016	< 1.	1.165	< 0.5
	FRM		2/20/2020	Mean of duplicates	1.2	3.555	5.685	0.48	< 0.015	< 0.005	< 0.02	< 0.02	< 0.04	7.65	0.195	< 0.08	18 650.	< 0.01	8.235	445.5	10.5	< 6.	< 0.004	< 0.4	< 1.	0.022 3	< 0.4	2.17	< 0.2
Gw - 21-1-2	FRM	Y	5/30/2019	Mean of duplicates	< 0.5	9.515	1 950.	0.783 5	5.25	< 0.005	< 0.02	< 0.02	2.035	9.1	6.775	< 0.04	12 450.	< 0.005	29.8	511.5	12.75	4.65	0.004 65	< 0.2	0.55	0.073 05	0.5	1.335	< 0.1
	FRM		9/26/2019	Mean of duplicates	< 0.5	13.4	2 750.	0.687	7.3	< 0.005	< 0.02	< 0.02	3.04	7.5	7.57	< 0.04	13 000.	< 0.005	35.25	624.5	12.	4.3	0.003 25	< 0.2	< 0.5	0.116	0.335	0.295	< 0.1
	FRM		11/21/2019	Mean of duplicates	< 0.5	12.1	2 405.	0.779 5	7.05	< 0.005	< 0.02	< 0.02	2.8	8.8	7.565	< 0.04	14 350.	< 0.005	35.65	556.	13.	4.95	0.003 1	< 0.2	< 0.5	0.097 1	0.325	0.345	< 0.1
	FRM		2/20/2020	Mean of duplicates	< 0.5	7.87	1 515.	0.896 5	5.55	< 0.005	< 0.02	< 0.02	1.465	8.9	5.895	< 0.04	11 700.	< 0.005	27.45	380.	16.	5.1	0.003 6	< 0.2	< 0.5	0.055 65	0.34	2.61	< 0.1
Gw - 21-2-1	SS	Y	5/30/2019		< 0.5	10.1	2 230.	0.737	6.1	0.007 8	< 0.02	< 0.02	2.15	9.	6.99	< 0.04	12 300.	< 0.005	29.8	506.	14.7	5.	0.008 3	< 0.2	0.51	0.072 7	0.53	0.71	< 0.1
	FRM		9/26/2019	Mean of duplicates	< 0.5	13.65	2 920.	0.699 5	7.35	< 0.005	0.053	0.053	3.66	8.7	7.59	< 0.04	12 850.	< 0.005	40.25	615.5	14.	4.5	0.002 3	< 0.2	< 0.5	0.142	0.365	4.8	< 0.1
	FRM		11/21/2019	Mean of duplicates	< 0.5	11.7	2 470.	0.775 5	7.05	0.005 1	< 0.02	0.020 5	2.815	8.55	7.46	< 0.04	13 500.	< 0.005	38.15	525.	14.	4.9	0.003 3	< 0.2	< 0.5	0.092 05	0.36	1.735	< 0.1
	FRM		2/20/2020	Mean of duplicates	< 0.5	9.5	1 930.	0.943 5	5.85	< 0.005	< 0.02	< 0.02	1.58	8.05	6.785	< 0.04	13 700.	< 0.005	29.15	428.5	15.	6.5	0.003 6	< 0.2	< 0.5	0.054 25	0.27	6.275	< 0.1
Gw - 25-1-1	SS	N	6/13/2019		< 0.5	7.61	48.7	0.602	0.078	0.006 5	1.93	1.94	0.212	5.9	0.253	0.267	9 230.	< 0.005	4.02	236.	70.	20.4	< 0.002	< 0.2	< 0.5	0.187	0.45	2.43	< 0.1
	SS		9/30/2019		< 0.5	7.98	49.2	0.554	< 0.015	< 0.005	1.72	1.72	0.105	5.7	0.274	0.224	10 700.	< 0.005	4.19	260.	80.	24.6	< 0.002	< 0.2	< 0.5	0.204	0.29	0.38	< 0.1
	SS		11/15/2019		< 0.5	8.82	55.5	0.583	< 0.015	0.008 1	1.92	1.93	0.106	4.4	0.248	0.308	10 600.	< 0.005	4.26	261.	89.	30.2	< 0.002	< 0.2	< 0.5	0.155	< 0.2	1.02	< 0.1
	SS		2/24/2020	Clear and colourless	< 0.5	10.7	55.9	0.527	0.022	0.006 9	4.31	4.32	0.126	5.2	0.273	0.681	9 790.	< 0.005	4.36	324.	140.	44.3	< 0.002	< 0.2	< 0.5	0.149	0.4	0.95	< 0.1
Gw - 25-1-2	FRM	N	6/13/2019	Mean of duplicates	< 0.5	3.23	42.45	0.557 5	0.059 5	< 0.005	0.030 5	0.030 5	0.315 5	7.45	0.214 5	0.043	6 525.	< 0.005	3.115	100.7	33.5	10.75	< 0.002	< 0.2	< 0.5	0.108 5	0.385	0.34	< 0.1
	SS		9/30/2019		< 0.5	8.06	45.3	0.537	< 0.015	< 0.005	1.76	1.76	0.112	6.2	0.288	0.245	10 800.	< 0.005	4.53	262.	78.	24.	< 0.002	< 0.2	< 0.5	0.22	0.28	0.4	< 0.1
	SS		11/15/2019		< 0.5	3.84	66.6	0.604	0.021	< 0.005	0.141	0.141	0.306	5.5	0.243	0.126	8 170.	< 0.005	3.68	115.	32.	12.6	< 0.002	< 0.2	< 0.5	0.128	0.3	0.69	< 0.1
	SS		2/24/2020	Clear and colourless	< 0.5	3.49	31.1	0.432	0.024	< 0.005	0.032	0.032	0.233	6.2	0.227	< 0.04	8 490.	< 0.005	3.17	105.	34.	10.6	< 0.002	< 0.2	< 0.5	0.079 9	0.47	1.03	< 0.1
Gw - 27-1-1	FRM	N	5/22/2019	Mean of duplicates	0.65	5.68	20.95	0.288	0.019 5	< 0.005	< 0.02	< 0.02	0.132 5	5.15	0.098	< 0.04	17 100.	< 0.005	7.18	39.7	11.2	3.05	< 0.002	< 0.2	< 0.5	0.017 7	< 0.2	1.675	< 0.1
	SS		10/1/2019		< 0.5	5.11	16.3	0.175	< 0.015	< 0.005	< 0.02	< 0.02	0.031	3.3	0.098	< 0.04	17 400.	< 0.005	6.68	42.4	11.	3.1	< 0.002	< 0.2	< 0.5	0.023 3	< 0.2	0.3	< 0.1
	SS		11/13/2019		< 0.5	5.5	17.9	0.201	< 0.015	< 0.005	< 0.02	< 0.02	0.651	2.7	0.097	< 0.04	18 400.	< 0.005	6.92	42.9	11.	3.5	< 0.002	< 0.2	< 0.5	0.016 6	< 0.2	1.28	< 0.1
	SS		2/27/2020	Clear and colourless	< 0.5	5.52	20.	0.218	0.02	< 0.005	< 0.02	< 0.02	0.131	5.8	0.117	0.055	18 100.	< 0.005	6.93	43.1	11.	3.6	< 0.002	< 0.2	0.6	0.017 8	< 0.2	6.26	< 0.1
Gw - 27-1-2	SS	N	5/22/2019		0.94	9.91	1.55	1.3	< 0.015	< 0.005	1.92	1.92	0.52	6.3	0.36	0.093	8 400.	< 0.005	7.34	220.	101.	29.3	< 0.002	< 0.2	< 0.5	0.233	0.82	3.09	< 0.1
	SS		10/1/2019		0.51	6.79	1.66	0.792	< 0.015	< 0.005	1.02	1.02	0.511	4.1	0.317	0.062	8 670.	< 0.005	6.92	174.	50.	18.3	< 0.002	< 0.2	< 0.5	0.114	0.77	0.59	< 0.1
	SS		11/13/2019		0.55	7.37	0.406	1.19	< 0.015	< 0.005	1.96	1.96	0.558	4.7	0.338	0.125	11 500.	< 0.005	8.96	182.	64.	24.9	< 0.002	< 0.2	< 0.5	0.098	0.69	4.31	< 0.1
	SS		2/27/2020	Slightly silty and slightly orange	0.51	11.9	0.561	1.1	< 0.015	< 0.005	3.94	3.94	0.517	5.7	0.319	0.166	6 640.	< 0.005	5.92	284.	190.	69.5	< 0.002	< 0.2	< 0.5	0.071 3	0.56	7.57	< 0.1
Gw - 28-1-0	SS	Y	5/30/2019		< 0.5	6.92	5.3	1.08	< 0.015	< 0.005	0.09	0.09	0.4	5.3	0.207	0.109	9 200.	< 0.005	3.73	356.	26.4	8.3	< 0.002	< 0.2	< 0.5	0.209	0.9	0.11	< 0.1
	SS		9/30/2019		< 0.5	7.14	5.22	1.17	< 0.015	< 0.005	0.092	0.092	0.266	3.	0.197	0.125	8 700.	< 0.005	3.62	311.	32.	9.5	< 0.002	< 0.2	< 0.5	0.254	0.76	0.1	< 0.1
	SS		11/15/2019		< 0.5	7.85	5.17	1.23	< 0.015	< 0.005	0.108	0.108	0.286	2.5	0.211	0.106	9 590.	< 0.005	4.07	334.	27.	10.6	< 0.002	< 0.2	< 0.5	0.263	0.66	0.15	< 0.1
	SS		2/24/2020	Clear and colourless	< 0.5	7.39	4.44	1.2	< 0.015	< 0.005	0.198	0.198	0.346	4.4	0.221	0.15	8 490.	< 0.005	3.63	325.	22.	7.5	< 0.002	< 0.2	< 0.5	0.204	0.87	0.54	< 0.1
Gw - 29-1-1	SS	Y	5/23/2019		< 0.5	5.34	0.235	0.382	< 0.015	< 0.005	0.415	0.415	0.451	3.1	0.261	0.079	6 070.	< 0.005	21.6	181.	21.2	8.2	< 0.002	< 0.2	< 0.5	0.058 6	0.43	0.79	< 0.1
	SS		10/2/2019		< 0.5	5.76	0.185	0.367	< 0.015	< 0.005	0.434	0.434	0.545	2.1	0.309	0.091	6 360.	< 0.005	22.8	227.	25.	9.7	< 0.002	< 0.2	< 0.5	0.079	0.45	< 0.1	< 0.1
	SS		12/2/2019		< 0.5	6.24	0.369	0.344	< 0.015	< 0.005	0.699	0.699	0.582	2.9	0.296	0.168	5 880.	< 0.005	23.7	235.	32.	11.5	< 0.002	< 0.2	< 0.5	0.084 5	0.42	0.53	< 0.1
	SS		2/2/2020	Clear and colourless	< 0.5	5.18	0.333	0.437	0.058	< 0.005	0.21	0.21	0.433	3.9	0.263	0.143	5 770.	< 0.005	19.	199.	31.	8.4	< 0.002	< 0.2	< 0.5	0.077 5	0.49	0.66	< 0.1
Gw - 29-1-2	SS	Y	5/23/2019		< 0.5	4.61	3.86	0.334	< 0.015	< 0.005	0.891	0.891	0.398	3.5	0.303	0.048	5 880.	< 0.005	21.3	147.	34.5	11.5	0.002 8	< 0.2	< 0.5	0.034 3	< 0.2	2.09	< 0.1
	SS		10/2/2019		< 0.5	5.13	31.7	0.551	< 0.015	< 0.005	0.838	0.838	0.48	2.3	0.425	0.123	7 230.	< 0.005	28.2	198.	43.	15.8	0.003 1	< 0.2	< 0.5	0.047 5	< 0.2	0.15	< 0.1
	SS		12/2/2019		< 0.5	5.87	2.63	0.338	0.019	< 0.005	1.12	1.12	0.561	3.3	0.444	0.185	6 280.	< 0.005	32.1	213.	53.	18.3	0.003 1	< 0.2	< 0.5	0.048 9	< 0.2	1.63	< 0.1
	SS		2/2/2020	Clear and colourless	< 0.5	4.2	0.58	0.366	< 0.015	< 0.005	0.18	0.18	0.306	2.5	0.328	0.251	6 000.	< 0.005	27.7	150.	34.	10.6	< 0.002	< 0.2	< 0.5	0.029 8	< 0.2	< 0.1	< 0.1
Gw - 30-1-1	SS	Y	5/28/2019		1.84	8.67	47.9	1.19	0.038	0.014 6	0.032	0.046	0.552	8.6	0.649	< 0.04	8 380.	< 0.005	19.2	596.	0.	8.6	0.003 3	< 0.2	< 0.5	0.324	0.21	3.36	< 0.1
	SS		10/8/2019		1.42	8.19	15.2	1.05	0.061	< 0.005	0.067	0.067	0.314	10.7	0.615	< 0.04	6 890.	< 0.005	17.4	552.	28.	8.3	< 0.002	< 0.2	< 0.5	0.344	0.29	4.09	< 0.1
	SS		11/29/2019		1.77	8.3	66.3	0.792	0.044	< 0.005	< 0.02	< 0.02	0.636	0.	0.639	< 0.04	7 850.	< 0.005	20.4	537.	31.	9.2	0.002 1	< 0.2	< 0.5	0.305	0.22	9.52	< 0.1
	SS		2/4/2020	Clear and colourless	1.55	9.05	36.1	0.977	0.056	< 0.005	< 0.02	< 0.02	0.33	7.9	0.626	< 0.04	7 250.	< 0.005	19.9	538.	27.	8.4	< 0.002	< 0.2	< 0.5	0.288	0.2	0.96	< 0.1
Gw - 30-1-2	SS	Y	5/28/2019		< 0.5	5.99	1.37	2.35	0.016	< 0.005	0.065	0.065	0.941	13.8	2.3	0.049	5 020.	< 0.005	40.8	245.	0.	6.8	< 0.002	< 0.2	< 0.5	0.161	0.22	16.9	< 0.1
	SS		10/8/2019		< 0.5	6.76	2.46	12.2	0.02	< 0.005	0.063	0.063	1.08	15.3	1.96	0.059	5 420.	< 0.005	30.5	314.	27.	7.5	< 0.002	0.3	< 0.5	0.319	2.99	20.8	< 0.1
	SS		11/25/2019		< 0.5	2.75	1.54	0.452	< 0.015	< 0.005	2.29	2.29	0.904	12.3	1.58	0.099	4 670.	< 0.005	26.5	79.7	17.	6.9	< 0.002	< 0.2	< 0.5	0.007 8	0.24	44.3	< 0.1
	SS		2/4/2020	Clear and colourless	< 0.5	2.05	3.79	0.234	0.018	< 0.005	0.994	0.994	0.759	11.	1.62	0.064	4 030.	< 0.005	42.6	59.9	21.	6.3	< 0.002	< 0.2	< 0.5	0.008 2	< 0.2	46.9	< 0.1
Gw - 31-1-1	SS	Y	10/10/2019		< 0.5	3.7	37.8	1.14	< 0.015	< 0.005	0.07	0.07	0.18	9.7	0.468	< 0.04	5 350.	< 0.005	4.65	160.	12.	3.4	< 0.002	< 0.2	< 0.5	0.12	< 0.2	1.01	< 0.1
	FRM		12/2/2019	Mean of duplicates	< 0.5	4.765	45.4	1.013 5	< 0.015	< 0.005	1.895	1.895	0.179 5	10.4	0.544 5	0.102	4 990.	< 0.005	5.15	196.	38.5	12.15	< 0.002	< 0.2	< 0.5	0.163 5	0.26	0.72	< 0.1
Gw - 31-1-2	SS	Y	10/10/2019		< 0.5	3.91	0.469	0.44	< 0.015	< 0.005	0.884	0.884	0.142	3.	0.375	0.047	5 500.	< 0.005	5.42	148.	12.	4.3	< 0.002	< 0.2	< 0.5	0.137	0.46	2.7	< 0.1
	SS		12/2/2019		< 0.5	9.41	2.84	0.36	< 0.015	< 0.005	6.26	6.26	0.325	4.8	0.7	0.411	5 250.	< 0.005	9.44	318.	160.	52.6	< 0.002	< 0.2	< 0.5	0.229	0.49	6.27	< 0.1
Gw - 36-3-1	SS	N	5/29/2019		0.64	33.3	0.18	0.288	< 0.015	0.005 8	0.658	0.664	0.463	10.9	0.751	0.088	11 900.	< 0.005	12.1	445.	200.	72.6	< 0.002	< 0.2	< 0.5	0.268	0.49	0.49	< 0.1
	SS		9/25/2019		0.68	33.4	0.194	0.351	< 0.015	0.014 3	0.634	0.649	0.361	8.6	0.811	0.105	12 100.	< 0.005	11.4	439.	190.	68.8	0.004 9	< 0.2	< 0.5	0.283	0.39	0.4	< 0.1
	SS		11/20/2019		0.65	33.2	9.82	0.47	< 0.015	< 0.005	0.797	0.797	0.459	10.7	0.779	0.097	12 700.	< 0.005	11.4	471.	180.	65.4	0.006 9	< 0.2	< 0.5	0.286	0.52	1.31	< 0.1
	SS		2/20/2020	Clear and colourless	0.54	33.6	0.969	0.272	< 0.015	< 0.005	0.774	0.774	0.288	11.4	0.724	0.087	11 000.	< 0.005	14.5	431.	240.	84.6	0.005 3	< 0.2	< 0.5	0.272	0.35	2.49	< 0.1
Gw - 37-3-1	SS	N	5/29/2019		< 0.5	9.	322.	0.428	0.36	< 0.005	< 0.02	< 0.02	0.611	8.9	0.362	< 0.04	9 540.	< 0.005	4.46	187.	94.	30.5	0.005 4	< 0.2	< 0.5	0.081 3	0.4	0.3	< 0.1
	SS		9/25/2019		< 0.5	9.1	355.	0.434	0.61	< 0.005	< 0.02	< 0.02	0.416	8.8	0.322	< 0.04	9 550.	< 0.005	4.44	176.	92.	29.3	0.007 1	< 0.2	< 0.5	0.059 1	0.33	0.26	< 0.1
	SS		11/21/2019		< 0.5	11.3	407.	0.963	0.65	< 0.005	< 0.02	< 0.02	0.955	9.5	0.355	< 0.04	10 600.	< 0.005	5.	236.	160.	50.2	0.008 7	< 0.2	< 0.5	0.094	0.3	0.69	< 0.1
	SS		2/20/2020	Clear and colourless	< 0.5	10.6	257.	0.602	0.19	< 0.005	< 0.02	< 0.02	1.19	8.3	0.33	< 0.04	7 680.	< 0.005	4.43	213.	180.	56.6	0.005	< 0.2	< 0.5	0.092 3	0.2	4.68	< 0.1
Gw - 38-1-1	SS	N	5/24/2019		0.73	18.	0.501	2.69	0.032	< 0.005	0.425	0.425	4.02	7.6	0.407	0.446	14 100.	< 0.005	10.7	579.	41.5	14.2	< 0.002	0.25	< 0.5	0.584	1.76	4.67	< 0.1
	SS		10/1/2019		< 0.5	16.7	0.706	1.67	0.015	< 0.005	0.3	0.3	4.24	4.6	0.316	0.179	13 500.	< 0.005	8.22	514.	37.	12.6	< 0.002	< 0.2	< 0.5	0.483	1.65	1.51	< 0.1
	SS		11/21/2019		0.57	17.5	2.95	1.78	< 0.015	< 0.005	0.166	0.166	4.08	8.3	0.331	0.175	13 800.	< 0.005	8.79	529.	43.	14.4	< 0.002	< 0.2	< 0.5	0.519	1.82	2.1	< 0.1
	SS		2/21/2020	Clear and colourless	0.51	16.3	0.211	1.91	< 0.015	< 0.005	0.235	0.235	3.99	6.3	0.333	0.524	11 400.	< 0.005	9.12	497.	51.	12.8	< 0.002	< 0.2	< 0.5	0.565	1.6	3.59	< 0.1
Gw - 39-1-1	SS	Y	5/24/2019		< 0.5	3.6	0.301	2.24	0.034	< 0.005	0.057	0.057	0.32	3.4	0.282	0.121	5 640.	< 0.005	4.4	231.	21.9	8.2	< 0.002	0.21	< 0.5	0.13	1.89	2.91	< 0.1
	FRM		9/25/2019	Mean of duplicates	< 0.5	5.815	2.275	1.225	< 0.015	< 0.005	0.036	0.036	0.091	< 2.	0.195 5	0.080 5	8 425.	< 0.005	3.835	287.	20.	6.4	< 0.002	< 0.2	< 0.5	0.154	1.24	< 0.1	< 0.1
	FRM		11/20/2019	Mean of duplicates	< 0.5	3.525	0.053 5	1.84	< 0.015	< 0.005	0.074 5	0.074 5	0.140 5	3.3	0.258	0.077	5 350.	< 0.005	4.235	232.5	19.5	6.1	< 0.002	< 0.2	< 0.5	0.131 5	1.96	1.12	< 0.1
	FRM		2/20/2020	Mean of duplicates	< 0.5	3.41	0.055	2.115	< 0.015	< 0.005	0.058 5	0.058 5	0.249 5	3.45	0.257	0.187	5 135.	< 0.005	4.14	237.5	20.5	6.1	< 0.002	< 0.2	< 0.5	0.143	1.965	3.94	< 0.1
Gw - 39-2-1	FRM	Y	5/24/2019	Mean of duplicates	< 0.5	6.295	11.5	1.15	< 0.015	< 0.005	0.036 5	0.036 5	0.118	2.75	0.199 5	0.121	8 105.	< 0.005	3.545	320.5	20.5	6.2	< 0.002	< 0.2	< 0.5	0.166	1.155	0.105	< 0.1
	SS		9/25/2019		< 0.5	3.52	0.147	2.09	< 0.015	< 0.005	< 0.02	< 0.02	0.272	2.7	0.282	0.047	5 650.	< 0.005	4.42	237.	21.	7.2	< 0.002	< 0.2	< 0.5	0.15	1.88	1.12	< 0.1
	SS		11/20/2019		< 0.5	6.31	3.	1.16	< 0.015	< 0.005	< 0.02	< 0.02	0.073	3.1	0.207	0.064	7 740.	< 0.005	3.7	303.	16.	6.9	< 0.002	< 0.2	< 0.5	0.188	1.2	< 0.1	< 0.1
	SS		2/20/2020	Clear and colourless	< 0.5	6.1	1.81	1.17	< 0.015	< 0.005	0.05	0.05	0.111	4.2	0.207	0.194	7 400.	< 0.005	3.38	304.	19.	6.1	< 0.002	< 0.2	< 0.5	0.171	1.21	1.92	< 0.1
Gw - 40-1-1	SS	N	5/29/2019		0.5	8.54	65.7	0.962	0.86	0.019 9	1.37	1.39	1.63	3.5	4.64	0.043	7 030.	< 0.005	13.4	423.	47.	15.2	0.010 3	< 0.2	< 0.5	0.538	0.41	1.86	< 0.1
	SS		9/25/2019		0.51	11.5	132.	1.04	1.5	0.025 4	1.1	1.13	2.73	2.4	5.13	0.044	7 770.	< 0.005	17.1	531.	60.	19.	0.004 4	< 0.2	< 0.5	0.782	0.31	1.94	< 0.1
	SS		11/20/2019		< 0.5	12.8	193.	1.02	1.3	0.020 4	2.16	2.18	2.44	3.2	5.32	0.06	7 340.	< 0.005	17.5	612.	100.	32.6	0.009	< 0.2	< 0.5	0.846	0.4	4.59	< 0.1
	SS		2/20/2020	Slightly silty and colourless	0.56	8.95	22.3	0.933	0.52	0.018 1	1.62	1.64	2.29	4.3	4.38	0.052	7 230.	< 0.005	15.6	409.	46.	14.4	0.003 4	< 0.2	< 0.5	0.512	0.35	5.2	< 0.1

Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	Lithium	Magnesium	Manganese	Molybdenum	Nitrogen - ammonia	Nitrogen - nitrite	Nitrogen - nitrate	Nitrogen - nitrate plus nitrite	Nickel	Phosphorus
BC CSR				AW Maximum (1)	---	---	---	10000	1310-18400 (3)	200-2000 (4)	400	400	250-1500 (5)	---
				DW Maximum (2)	33 (9)	---	--- (6)	250	---	1	10	10	80	---
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/l	mg/l	µg/l	µg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l
				Method Detection Limit	0.5	0.05	0.05	0.05	0.015	0.005	0.02	0.02	0.02	2
Gw - 41-1-1	SS	Y	5/23/2019		< 0.5	8.27	252.	1.6	0.033	< 0.005	0.021	0.021	0.142	4.2
	FRM		9/19/2019	Mean of duplicates	< 0.5	8.305	553.5	2.12	0.06	< 0.005	< 0.02	< 0.02	0.166 5	2.55
	FRM		12/2/2019	Mean of duplicates	< 0.5	9.165	648.5	2.17	0.033	< 0.005	< 0.02	< 0.02	0.274 5	4.85
	FRM		3/4/2020	Mean of duplicates	< 0.5	8.675	164.	1.67	0.027	< 0.005	0.056	0.056	0.088	2.35
Gw - 42-1-1	FRM	Y	5/23/2019	Mean of duplicates	< 0.5	5.405	154.	0.207 5	0.063 5	< 0.005	< 0.02	< 0.02	0.088 5	7.
	SS		9/19/2019		< 0.5	5.76	160.	0.434	0.091	< 0.005	< 0.02	< 0.02	0.094	8.8
	FRM		12/2/2019	Mean of duplicates	< 0.5	5.94	159.	0.250 5	0.302	< 0.005	< 0.02	< 0.02	0.117 5	6.6
	FRM		3/4/2020	Mean of duplicates	< 0.5	6.13	153.	0.203 5	0.079 5	< 0.005	< 0.02	< 0.02	0.109 5	6.
Gw - 43-1-1	SS	N	5/24/2019		0.91	10.4	1.39	0.924	0.043	0.006	0.089	0.095	0.734	6.3
	SS		9/18/2019		0.7	9.87	2.68	0.946	< 0.015	< 0.005	< 0.02	< 0.02	0.507	4.2
	SS		11/15/2019		0.69	10.2	4.83	0.88	0.085	< 0.005	0.078	0.078	0.654	5.5
	SS		2/27/2020	Clear and colourless	0.76	10.7	1.71	0.965	< 0.015	< 0.005	0.027	0.027	0.598	8.6
Gw - 44-1-1	SS	N	5/24/2019		0.62	5.07	1.25	1.42	< 0.015	< 0.005	< 0.02	< 0.02	0.244	7.5
	SS		9/18/2019		0.6	5.09	7.71	1.3	< 0.015	< 0.005	< 0.02	< 0.02	0.223	8.9
	SS		11/14/2019		< 0.5	5.04	0.582	1.58	< 0.015	< 0.005	< 0.02	< 0.02	0.326	8.1
	SS		2/27/2020	Clear and colourless	0.64	5.26	0.69	1.52	< 0.015	< 0.005	0.025	0.025	0.254	7.3
Gw - 51-1-1	SS	N	10/2/2019		< 0.5	6.71	1.75	0.244	0.016	< 0.005	1.62	1.62	0.891	4.1
	SS		11/21/2019		< 0.5	6.31	5.32	0.253	< 0.015	< 0.005	2.21	2.21	0.679	4.2
Gw - 51-2-1	SS	N	10/2/2019		1.37	13.7	6.71	1.51	0.017	< 0.005	< 0.02	< 0.02	0.954	9.7
	SS		11/21/2019		1.18	13.2	7.81	1.27	< 0.015	< 0.005	0.028	0.028	0.903	10.3
Gw - 51-3-1	SS	N	10/2/2019		1.44	15.5	0.429	0.586	< 0.015	< 0.005	0.138	0.138	1.	5.1
	SS		11/21/2019		1.22	16.5	0.728	0.479	< 0.015	0.013 2	0.931	0.944	1.	5.1
Gw - 52-1-1	SS	N	5/29/2019		5.2	38.9	345.	0.37	30. a	< 0.005	< 0.02	< 0.02	13.1	20.
	SS		9/30/2019		5.6	41.5	396.	0.33	35. a	< 0.005	< 0.02	< 0.02	11.9	15.4
	SS		11/14/2019		5.4	44.3	402.	0.31	32. a	< 0.005	< 0.02	< 0.02	12.3	16.7
	SS		2/27/2020	Clear and slightly yellow	5.5	41.	373.	0.19	25. a	< 0.005	< 0.02	< 0.02	11.5	15.3
Gw - 52-4-0 (P7)	SS	N	5/30/2019		2.6	53.	1 080.	1.09	150. a	0.025	0.645	0.67	15.2	243.
	SS		9/13/2019		3.	74.5	1 390.	2.18	180. a	< 0.005	< 0.02	< 0.02	20.5	158.
	SS		11/18/2019		1.8	59.3	1 010.	1.6	180. a	0.036 6	1.34	1.38	17.1	64.3
	SS		2/27/2020	Clear and slightly yellow	1.7	51.2	1 000.	1.51	140. a	0.008 3	< 0.02	< 0.02	15.9	217.
Gw - 53-1-1	SS	Y	5/30/2019		< 0.5	7.02	192.	0.493	< 0.015	< 0.005	< 0.02	< 0.02	0.64	5.6
	SS		9/30/2019		< 0.5	7.14	205.	0.448	< 0.015	< 0.005	< 0.02	< 0.02	0.551	3.3
	SS		11/15/2019		< 0.5	7.43	194.	0.474	< 0.015	< 0.005	< 0.02	< 0.02	0.544	2.4
	SS		2/24/2020	Clear and colourless	< 0.5	7.59	221.	0.588	< 0.015	< 0.005	< 0.02	< 0.02	0.598	5.
Gw - 55-1-1	SS	Y	9/19/2019		< 0.5	7.29	0.449	0.302	< 0.015	< 0.005	0.269	0.269	0.1	2.7
	SS		12/2/2019		< 0.5	8.73	0.553	0.355	< 0.015	< 0.005	0.506	0.506	0.209	3.6
Gw - 56-1-1	SS	Y	5/23/2019		< 0.5	5.56	0.112	1.03	< 0.015	< 0.005	< 0.02	< 0.02	0.062	7.4
	SS		9/20/2019		< 0.5	5.36	0.058	1.04	< 0.015	< 0.005	< 0.02	< 0.02	0.069	7.8
	SS		11/29/2019		< 0.5	5.58	0.21	1.03	< 0.015	< 0.005	< 0.02	< 0.02	0.111	0.
	SS		3/4/2020	Clear and colourless	< 0.5	6.2	0.377	1.01	0.02	< 0.005	< 0.02	< 0.02	0.12	6.1
Gw - 57-1-1	SS	Y	9/19/2019		< 0.5	4.85	8.43	0.329	< 0.015	< 0.005	< 0.02	< 0.02	0.159	3.7
	SS		11/26/2019		< 0.5	5.62	14.2	0.296	< 0.015	< 0.005	< 0.02	< 0.02	0.214	3.2
Gw - 58-1-0	FRM	N	5/29/2019	Mean of duplicates	< 2.5	140.5	7 580.	7.12	96. a	0.045 3	< 0.02	0.051	88.1 b	86.
	SS		9/25/2019		< 1.	140.	7 350.	7.22	140. a	0.014 5	< 0.02	< 0.02	85.6 b	75.5
	SS		11/20/2019		< 2.5	147.	7 230.	6.75	0.042	< 0.005	< 0.02	< 0.02	91.1 b	95.
	SS		2/20/2020	Clear and moderately yellow brown	< 1.	120.	5 740.	6.73	140. a	< 0.005	0.452	0.452	81.3 b	92.7
Gw - 60-1-1	SS	N	5/15/2019		< 0.5	16.1	34.6	0.416	0.19	< 0.005	< 0.02	< 0.02	1.28	6.7
	SS		9/11/2019		< 0.5	16.	41.2	0.385	< 0.015	< 0.005	< 0.02	< 0.02	0.665	4.6
	SS		11/7/2019		< 0.5	17.4	81.9	0.362	0.017	< 0.005	< 0.02	< 0.02	0.599	6.8
	SS		2/13/2020	Clear and slightly orange	< 0.5	18.	116.	0.38	< 0.015	< 0.005	< 0.02	< 0.02	0.648	4.2
Gw - 60-2-1	SS	N	5/15/2019		0.71	14.	36.2	2.16	< 0.015	< 0.005	0.026	0.026	2.42	9.3
	SS		9/11/2019		0.55	13.9	129.	1.64	< 0.015	< 0.005	0.031	0.031	2.35	6.7
	SS		11/7/2019		0.7	14.6	60.4	1.92	< 0.015	< 0.005	0.023	0.023	1.97	9.4
	SS		2/13/2020	Clear and colourless	0.65	15.2	60.2	2.25	< 0.015	< 0.005	0.032	0.032	2.06	9.3
Gw - 60-3-1	SS	N	5/15/2019		< 0.5	8.99	335.	0.472	< 0.015	< 0.005	1.73	1.73	2.09	3.9
	SS		9/11/2019		< 0.5	9.96	483.	0.547	< 0.015	0.007 2	2.43	2.44	2.62	4.
	SS		11/7/2019		< 0.5	10.7	669.	0.52	0.02	0.048 3	1.87	1.92	3.05	< 2.
	SS		2/13/2020	Clear and slightly grey	< 0.5	10.6	481.	0.473	< 0.015	0.014	1.94	1.95	2.61	2.9
Gw - 62-1-1	SS	N	9/19/2019		< 0.5	4.16	0.756	0.256	< 0.015	< 0.005	0.126	0.126	0.148	3.1
	SS		11/13/2019		< 0.5	4.54	0.474	0.249	< 0.015	< 0.005	0.239	0.239	0.175	2.6
	SS		9/19/2019		< 0.5	4.4	7.2	0.285	< 0.015	< 0.005	0.175	0.175	0.115	4.5
	SS		11/13/2019		< 0.5	4.45	7.47	0.282	< 0.015	0.023 7	0.177	0.201	0.148	3.5
Gw - 63-1-1	SS	N	9/9/2019		< 0.5	7.43	38.2	0.145	< 0.015	< 0.005	< 0.02	< 0.02	0.193	4.6
	SS		11/7/2019		< 0.5	7.69	31.5	0.123	< 0.015	< 0.005	< 0.02	< 0.02	0.126	4.2
Gw - 63-2-1	SS	N	9/9/2019		< 0.5	4.97	0.972	0.227	< 0.015	< 0.005	< 0.02	< 0.02	0.094	7.6
	SS		11/7/2019		< 0.5	5.16	0.998	0.493	< 0.015	< 0.005	< 0.02	< 0.02	0.227	8.8
Gw - 71-1-1	FRM	Y	5/16/2019	Mean of duplicates	< 0.5	6.44	52.35	0.421 5	0.018 5	< 0.005	< 0.02	< 0.02	0.414 5	13.4
	FRM		9/12/2019	Mean of duplicates	< 0.5	7.055	53.35	0.362 5	< 0.015	< 0.005	< 0.02	< 0.02	0.281	11.2
	FRM		11/6/2019	Mean of duplicates	< 0.5	7.545	80.9	0.4	< 0.015	< 0.005	< 0.02	< 0.02	0.446 5	13.5
	FRM		2/13/2020	Mean of duplicates	< 0.5	7.	88.2	0.594 5	< 0.015	< 0.005	< 0.02	< 0.02	0.562 5	13.35
Gw - 71-2-1	SS	Y	5/16/2019		< 0.5	7.91	89.4	0.236	< 0.015	< 0.005	< 0.02	< 0.02	0.437	17.
	SS		9/12/2019		< 0.5	7.56	90.6	0.244	0.019	< 0.005	< 0.02	< 0.02	0.244	15.7
	SS		11/6/2019		< 0.5	8.17	82.3	0.227	< 0.015	< 0.005	< 0.02	< 0.02	0.44	31.8
	SS		2/13/2020	Clear and colourless	< 0.5	8.49	92.1	0.254	< 0.015	< 0.005	< 0.02	< 0.02	0.387	16.
Gw - 71-3-1	SS	Y	5/16/2019		< 0.5	4.44	0.116	0.119	< 0.015	< 0.005	0.773	0.773	0.408	5.4
	SS		9/12/2019		< 0.5	5.08	0.288	0.124	< 0.015	< 0.005	1.13	1.13	0.482	6.3
	SS		11/6/2019		< 0.5	5.53	0.324	0.124	< 0.015	0.016 1	0.965	0.981	0.321	7.2
	SS		2/13/2020	Clear and colourless	< 0.5	4.17	0.199	0.122	< 0.015	0.014 5	1.18	1.19	0.264	8.1

Station	Date Sampled	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulphate	Sulphur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
AW Maximum (1)		---	20	---	0.5-15 (5)	---	---	128-429 (5)	---	3	---	1000	85	---	75-2400 (5)	---
DW Maximum (2)		---	10	---	20	200	2500	500	---	---	2.5	---	20	20	3	---
Fraction		DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
Unit		µg/l	µg/l	µg/l	µg/l	mg/L	µg/l	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Method Detection Limit		0.05	0.04	50	0.005	0.05	0.05	1	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1
Gw - 41-1-1	5/23/2019	1.21	< 0.04	7 130.	< 0.005	5.22	209.	87.	26.9	< 0.002	< 0.2	< 0.5	0.253	< 0.2	0.81	< 0.1
	9/19/2019	0.984 5	< 0.04	7 640.	< 0.005	4.885	224.5	76.5	22.95	0.003 7	< 0.2	< 0.5	0.310 5	< 0.2	0.375	< 0.1
	12/2/2019	1.195	< 0.04	7 205.	< 0.005	5.495	254.	94.	30.1	0.004 2	< 0.2	< 0.5	0.327 5	< 0.2	0.93	< 0.1
	3/4/2020	0.974	< 0.04	6 550.	< 0.005	5.31	206.	79.	21.75	< 0.002	< 0.2	< 0.5	0.251	< 0.2	0.93	< 0.1
Gw - 42-1-1	5/23/2019	0.737 5	< 0.04	6 330.	< 0.005	8.76	352.	47.15	17.05	< 0.002	< 0.2	< 0.5	0.040 35	0.735	0.345	< 0.1
	9/19/2019	0.844	< 0.04	6 660.	< 0.005	10.1	351.	64.	20.6	< 0.002	< 0.2	0.82	0.105	0.81	0.15	< 0.1
	12/2/2019	0.844 5	< 0.04	6 530.	< 0.005	9.835	385.5	70.5	23.35	< 0.002	< 0.2	< 0.5	0.058 95	0.93	0.295	< 0.1
	3/4/2020	0.853 5	< 0.04	5 595.	< 0.005	9.88	355.5	68.	19.85	< 0.002	< 0.2	< 0.5	0.047 4	0.75	0.85	< 0.1
Gw - 43-1-1	5/24/2019	0.438	< 0.04	11 600.	< 0.005	9.57	490.	60.1	20.1	< 0.002	< 0.2	< 0.5	0.163	1.14	3.02	< 0.1
	9/18/2019	0.439	0.041	11 200.	< 0.005	9.52	459.	59.	19.5	0.002 1	< 0.2	< 0.5	0.132	0.91	1.06	< 0.1
	11/15/2019	0.431	0.055	11 700.	< 0.005	9.29	449.	63.	20.3	< 0.002	< 0.2	< 0.5	0.117	0.93	1.46	< 0.1
	2/27/2020	0.44	< 0.04	12 000.	< 0.005	9.65	494.	65.	21.8	0.002 1	< 0.2	< 0.5	0.144	1.31	1.52	< 0.1
Gw - 44-1-1	5/24/2019	0.39	< 0.04	8 080.	< 0.005	7.57	190.	29.3	8.2	< 0.002	< 0.2	< 0.5	0.232	0.45	1.29	< 0.1
	9/18/2019	0.42	< 0.04	7 260.	< 0.005	7.24	200.	29.	9.5	< 0.002	< 0.2	< 0.5	0.249	0.42	1.2	< 0.1
	11/14/2019	0.389	< 0.04	7 930.	< 0.005	8.45	188.	29.	7.5	< 0.002	< 0.2	< 0.5	0.26	0.28	1.19	< 0.1
	2/27/2020	0.414	< 0.04	8 130.	< 0.005	8.01	212.	32.	10.2	< 0.002	< 0.2	< 0.5	0.258	0.39	2.18	< 0.1
Gw - 51-1-1	10/2/2019	0.82	0.058	6 080.	< 0.005	5.76	237.	56.	30.1	0.005	< 0.2	< 0.5	0.063 9	0.35	0.33	< 0.1
	11/21/2019	0.578	0.048	5 120.	< 0.005	5.1	213.	58.	19.2	0.003 9	< 0.2	< 0.5	0.078	0.3	1.46	< 0.1
Gw - 51-2-1	10/2/2019	0.455	0.085	13 700.	< 0.005	11.8	676.	30.	11.1	0.004 9	< 0.2	< 0.5	0.434	0.55	0.66	< 0.1
	11/21/2019	0.389	0.078	11 900.	< 0.005	11.1	628.	34.	11.	0.007 2	< 0.2	< 0.5	0.306	0.49	1.24	< 0.1
Gw - 51-3-1	10/2/2019	0.389	0.065	16 400.	< 0.005	8.07	893.	24.	9.	0.002 2	< 0.2	< 0.5	0.090 3	0.26	0.2	< 0.1
	11/21/2019	0.336	0.048	13 700.	< 0.005	7.82	866.	47.	14.7	0.003 1	< 0.2	< 0.5	0.083	0.24	2.1	< 0.1
Gw - 52-1-1	5/29/2019	13.5	< 0.2	33 900.	< 0.025	236. b	3 070. b	< 1.	< 15.	0.023	< 1.	< 2.5	< 0.01	1.	7.16	< 0.5
	9/30/2019	13.9	0.156	38 200.	< 0.01	235. b	3 350. b	< 1.	< 6.	< 0.004	< 0.4	< 1.	< 0.004	0.77	0.48	< 0.2
	11/14/2019	14.4	0.138	37 200.	< 0.01	254. b	3 510. b	< 1.	< 6.	< 0.004	< 0.4	< 1.	< 0.004	0.86	0.78	< 0.2
	2/27/2020	13.7	< 0.08	36 500.	< 0.01	236. b	3 430. b	< 1.	< 6.	< 0.004	< 0.4	< 1.	< 0.004	0.88	4.16	< 0.2
Gw - 52-4-0 (P7)	5/30/2019	107.	0.157	18 800.	< 0.01	300. b	1 350.	14.6	6.2	< 0.004	0.65	< 1.	0.072 9	2.25	33.6	0.8
	9/13/2019	142.	0.241	25 000.	< 0.01	420. b	1 830.	11.	6.8	< 0.004	0.73	1.4	0.129	4.41	4.25	1.06
	11/18/2019	111.	0.161	17 700.	< 0.01	333. b	1 220.	28.	12.1	< 0.004	0.45	< 1.	0.095 7	2.49	31.5	0.72
	2/27/2020	101.	0.183	16 700.	< 0.01	291. b	1 150.	17.	6.2	0.031 8	0.74	2.2	0.157	5.68	18.6	1.12
Gw - 53-1-1	5/30/2019	0.264	< 0.04	11 000.	< 0.005	3.58	342.	27.6	9.8	0.007 4	< 0.2	< 0.5	0.078 7	< 0.2	0.83	< 0.1
	9/30/2019	0.25	0.045	12 000.	< 0.005	3.48	299.	30.	9.3	0.009 2	< 0.2	< 0.5	0.077 7	< 0.2	0.36	< 0.1
	11/15/2019	0.253	< 0.04	11 600.	< 0.005	3.74	311.	28.	9.9	0.009 1	< 0.2	< 0.5	0.078 8	< 0.2	1.32	< 0.1
	2/24/2020	0.283	< 0.04	11 300.	< 0.005	3.73	328.	29.	9.7	0.003 6	< 0.2	< 0.5	0.079 2	< 0.2	0.59	< 0.1
Gw - 55-1-1	9/19/2019	1.75	0.214	5 530.	< 0.005	11.8	224.	69.	22.7	< 0.002	< 0.2	< 0.5	0.282	0.25	0.2	< 0.1
	12/2/2019	1.89	0.214	5 510.	< 0.005	12.3	291.	110.	36.4	0.002	< 0.2	< 0.5	0.364	0.28	3.79	< 0.1
Gw - 56-1-1	5/23/2019	0.323	< 0.04	6 480.	< 0.005	4.24	257.	44.4	17.	0.004 7	< 0.2	< 0.5	0.098 3	< 0.2	0.36	< 0.1
	9/20/2019	0.304	< 0.04	6 570.	< 0.005	3.93	251.	42.	14.7	0.002 9	< 0.2	< 0.5	0.080 1	< 0.2	0.31	< 0.1
	11/29/2019	0.29	< 0.04	6 310.	< 0.005	4.4	259.	49.	16.1	0.003 7	< 0.2	< 0.5	0.103	< 0.2	3.33	< 0.1
	3/4/2020	0.326	< 0.04	5 170.	< 0.005	4.68	243.	58.	16.1	< 0.002	< 0.2	< 0.5	0.116	< 0.2	2.33	< 0.1
Gw - 57-1-1	9/19/2019	0.383	< 0.04	5 700.	< 0.005	7.95	182.	29.	8.8	0.003 7	< 0.2	< 0.5	0.031 3	< 0.2	0.5	< 0.1
	11/26/2019	0.393	< 0.04	5 950.	< 0.005	8.33	235.	62.	20.9	< 0.002	< 0.2	< 0.5	0.029 1	< 0.2	0.36	< 0.1
Gw - 58-1-0	5/29/2019	45.85	0.4	18 700.	< 0.025	523. b	4 095. b	62.5	24.	< 0.01	1.1	6.9	0.413	27.3 b	7.135	2.45
	9/25/2019	50.4	0.413	19 900.	< 0.01	547. b	4 540. b	58.	24.3	< 0.004	0.75	3.3	0.409	24.8 b	3.35	2.64
	11/20/2019	54.5	0.47	21 000.	< 0.025	583. b	4 410. b	60.	26.	< 0.01	1.3	4.9	0.409	32. b	3.11	2.56
	2/20/2020	49.1	0.523	17 900.	0.014	512. b	3 670. b	69.	28.1	< 0.004	0.69	3.4	0.349	25.7 b	4.04	2.01
Gw - 60-1-1	5/15/2019	0.342	< 0.04	10 300.	< 0.005	15.6	374.	44.4	14.2	0.007	< 0.2	< 0.5	0.174	< 0.2	1.64	< 0.1
	9/11/2019	0.306	< 0.04	11 100.	< 0.005	15.2	388.	45.	13.5	0.004 7	< 0.2	< 0.5	0.217	< 0.2	1.01	< 0.1
	11/7/2019	0.287	< 0.04	12 400.	< 0.005	15.9	393.	42.	13.4	0.003 9	< 0.2	< 0.5	0.158	< 0.2	0.38	< 0.1
	2/13/2020	0.287	< 0.04	12 300.	< 0.005	16.5	402.	40.	13.1	0.005 9	< 0.2	< 0.5	0.159	< 0.2	0.69	< 0.1
Gw - 60-2-1	5/15/2019	0.466	0.058	11 800.	< 0.005	11.9	267.	56.8	19.	0.008	< 0.2	< 0.5	0.384	< 0.2	0.94	< 0.1
	9/11/2019	0.437	0.056	11 400.	< 0.005	11.5	285.	61.	18.9	0.012 9	< 0.2	< 0.5	0.215	< 0.2	0.35	< 0.1
	11/7/2019	0.438	0.048	12 900.	< 0.005	12.	279.	57.	18.3	0.010 1	< 0.2	< 0.5	0.305	< 0.2	0.22	< 0.1
	2/13/2020	0.462	0.062	12 700.	< 0.005	13.3	287.	56.	19.3	0.011 1	< 0.2	< 0.5	0.384	< 0.2	0.94	< 0.1
Gw - 60-3-1	5/15/2019	2.89	0.12	6 130.	< 0.005	23.7	223.	57.9	18.	0.004	< 0.2	< 0.5	0.077	< 0.2	0.91	< 0.1
	9/11/2019	3.36	0.066	6 790.	< 0.005	28.5	264.	60.	15.8	0.002 4	< 0.2	< 0.5	0.094 5	0.3	2.53	< 0.1
	11/7/2019	3.36	0.074	7 600.	< 0.005	27.9	272.	63.	19.3	0.002 8	< 0.2	< 0.5	0.097 3	0.33	1.18	< 0.1
	2/13/2020	2.94	0.154	7 150.	< 0.005	23.9	267.	68.	20.5	0.005	< 0.2	< 0.5	0.086 4	0.21	1.61	< 0.1
Gw - 62-1-1	9/19/2019	0.15	< 0.04	6 370.	< 0.005	2.76	108.	12.	3.8	< 0.002	< 0.2	< 0.5	0.063 8	0.55	0.31	< 0.1
	11/13/2019	0.159	0.05	6 590.	< 0.005	2.95	114.	12.	4.2	< 0.002	< 0.2	< 0.5	0.067 8	0.46	0.3	< 0.1
	9/19/2019	0.205	< 0.04	7 230.	< 0.005	3.07	104.	12.	3.5	0.002 3	< 0.2	< 0.5	0.148	0.58	0.4	< 0.1
	11/13/2019	0.199	0.046	7 300.	< 0.005	3.09	101.	12.	3.6	< 0.002	< 0.2	< 0.5	0.136	0.44	2.66	< 0.1
Gw - 63-1-1	9/9/2019	< 0.05	< 0.04	7 770.	< 0.005	3.48	86.9	7.1	< 3.	< 0.002	< 0.2	< 0.5	0.013 3	< 0.2	1.01	< 0.1
	11/7/2019	< 0.05	< 0.04	8 360.	< 0.005	3.51	88.4	8.5	< 3.	0.002 5	< 0.2	< 0.5	0.005 5	< 0.2	0.12	< 0.1
Gw - 63-2-1	9/9/2019	0.119	0.054	5 690.	< 0.005	3.09	59.8	9.1	3.1	< 0.002	< 0.2	< 0.5	0.052 2	0.52	0.3	< 0.1
	11/7/2019	0.122	0.065	6 210.	< 0.005	3.34	63.4	12.	3.8	0.002 1	< 0.2	< 0.5	0.041 8	0.79	2.67	< 0.1
Gw - 71-1-1	5/16/2019	0.236 5	< 0.04	12 050.	< 0.005	6.545	125.	16.95	5.4	0.003 5	< 0.2	< 0.5	0.232	0.25	0.35	< 0.1
	9/12/2019	0.248 5	< 0.04	11 200.	< 0.005	6.37	152.	19.	4.8	< 0.002	< 0.2	< 0.5	0.243 5	0.31	0.215	< 0.1
	11/6/2019	< 0.25	< 0.04	12 700.	< 0.005	6.605	158.	17.5	< 15.	0.004 65	< 0.2	< 0.5	0.265	0.23	1.145	< 0.1
	2/13/2020	0.29	< 0.04	12 400.	< 0.005	9.35	142.	23.	7.	0.006 4	< 0.2	< 0.5	0.328 5	0.455	1.615	< 0.1
Gw - 71-2-1	5/16/2019	0.325	< 0.04	8 820.	< 0.005	7.28	192.	24.7	7.7	0.007	< 0.2	< 0.5	0.145	< 0.2	0.27	< 0.1
	9/12/2019	0.318	< 0.04	8 500.	< 0.005	6.89	199.	24.	6.8	0.003 4	< 0.2	< 0.5	0.133	< 0.2	1.65	< 0.1
	11/6/2019	0.47	< 0.04	9 530.	< 0.005	7.17	207.	27.	< 15.	0.016 4	< 0.2	2.9	0.235	0.24	0.39	< 0.1
	2/13/2020	0.333	< 0.04	9 450.	< 0.005	7.75	219.	27.	8.7	0.007 3	< 0.2	< 0.5	0.156	< 0.2	3.58	< 0.1
Gw - 71-3-1	5/16/2019	0.201	0.098	7 370.	< 0.005	6.43	76.3	24.7	7.6	0.003	< 0.2	< 0.5	0.124	0.44	0.72	< 0.1
	9/12/2019	0.251	0.107	7 470.	< 0.005	6.29	91.2	29.	7.6	0.002 3	< 0.2	< 0.5	0.223	0.5	1.14	< 0.1
	11/6/2019	< 0.25	0.148	8 600.	< 0.005	7.53	96.1	29.	< 15.	0.002 7	< 0.2	< 0.5	0.282	0.53	0.66	< 0.1
	2/13/2020	0.22	0.08	7 610.	< 0.005	6.41	72.3	27.	8.	0.003 9	< 0.2	< 0.5	0.105	0.56	3.11	< 0.1

Appendix B-1. Groundwater Quality Data 2019-2020

BC CSR				AW Maximum (1)	---	---	---	10000	1310-18400 (3)	200-2000 (4)	400	400	250-1500 (5)	---
				DW Maximum (2)	33 (9)	---	--- (6)	250	---	1	10	10	80	---
Station	Sample Type	Compliance Well (Y/N?)	Date Sampled	Parameter	Lithium	Magnesium	Manganese	Molybdenum	Nitrogen - ammonia	Nitrogen - nitrite	Nitrogen - nitrate	Nitrogen - nitrate plus nitrite	Nickel	Phosphorus
				Fraction	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
				Unit	µg/l	mg/l	µg/l	µg/l	mg/l	mg/l	mg/l	mg/l	µg/l	µg/l
				Method Detection Limit	0.5	0.05	0.05	0.05	0.015	0.005	0.02	0.02	0.02	2
Gw - 72-1-1	FRM	Y	5/16/2019	Mean of duplicates	< 0.5	13.95	126.	0.710 5	0.015 5	< 0.005	< 0.02	< 0.02	2.105	9.75
	FRM		9/11/2019	Mean of duplicates	< 0.5	12.85	120.	0.667	0.021	< 0.005	< 0.02	< 0.02	1.695	8.85
	FRM		11/6/2019	Mean of duplicates	< 1.	13.7	119.5	0.64	< 0.015	< 0.005	< 0.02	< 0.02	1.82	12.25
	FRM		2/12/2020	Mean of duplicates	0.54	14.1	122.5	0.697	0.015 5	< 0.005	< 0.02	< 0.02	1.835	11.3
Gw - 72-3-1	SS	Y	5/15/2019		< 0.5	7.79	39.9	0.601	0.017	0.026 1	< 0.02	0.037	1.59	11.2
	SS		9/11/2019		0.52	7.86	54.3	0.604	0.02	< 0.005	< 0.02	< 0.02	1.27	11.2
	SS		11/6/2019		0.53	8.42	8.38	0.563	0.016	0.008 5	< 0.02	< 0.02	1.59	20.8
	SS		2/12/2020	Clear and colourless	0.77	8.3	60.1	0.689	0.037	< 0.005	< 0.02	< 0.02	1.23	12.3
Gw - 73-1-1	SS	Y	5/15/2019		0.61	10.9	79.8	1.04	< 0.015	< 0.005	0.022	0.022	0.985	13.8
	FRM		9/12/2019	Mean of duplicates	< 0.5	10.7	96.2	0.883 5	< 0.015	< 0.005	< 0.02	< 0.02	0.808 5	11.5
	SS		11/6/2019		< 0.5	11.6	93.9	0.917	< 0.015	0.014 7	< 0.02	0.023	0.827	14.3
	SS		2/12/2020	Clear and colourless	< 0.5	11.6	88.	0.942	< 0.015	0.009 2	0.05	0.059	0.824	14.4
Gw - 73-2-1	SS	Y	5/15/2019		< 0.5	9.76	61.1	1.03	0.19	< 0.005	0.043	0.043	0.574	7.5
	SS		9/12/2019		< 0.5	11.1	56.4	1.35	< 0.015	< 0.005	< 0.02	< 0.02	0.317	5.4
	SS		11/6/2019		< 0.5	11.5	55.6	1.21	0.016	< 0.005	< 0.02	< 0.02	0.361	7.
	SS		2/12/2020	Clear and colourless	< 0.5	10.7	49.8	0.951	< 0.015	< 0.005	0.098	0.098	0.3	5.8
Gw - 73-3-1	SS	Y	5/15/2019		1.51	4.13	0.413	0.421	0.071	0.018 1	0.144	0.162	0.52	14.1
	SS		9/12/2019		1.27	6.93	0.14	0.545	< 0.015	0.009 2	0.077	0.087	0.677	14.
	FRM		11/6/2019	Mean of duplicates	1.58	5.235	0.511 5	0.300 5	< 0.015	0.020 75	0.595	0.615 5	0.578 5	16.95
	SS		2/12/2020	Clear and colourless	1.44	4.67	0.42	0.371	< 0.015	0.028 2	0.15	0.178	0.463	16.1
Gw - 77-1-1	SS	N	9/20/2019		< 0.5	9.89	35.5	0.38	< 0.015	0.006	< 0.02	< 0.02	0.247	3.9
	SS		11/14/2019		< 0.5	10.5	35.8	0.591	< 0.015	< 0.005	< 0.02	< 0.02	2.9	5.3
Gw - 77-2-1	SS	N	9/20/2019		0.74	14.	7.51	0.817	< 0.015	< 0.005	< 0.02	< 0.02	0.259	42.2
	SS		11/14/2019		0.64	14.4	10.1	0.669	< 0.015	< 0.005	< 0.02	< 0.02	0.619	41.8
Gw - 78-1-1	SS	N	9/18/2019		1.36	15.6	1.08	1.77	< 0.015	< 0.005	0.04	0.04	0.518	50.8
	SS		11/14/2019		1.25	15.3	7.99	2.06	< 0.015	< 0.005	0.09	0.09	0.714	51.8
Gw - 78-2-1	FRM	N	9/18/2019	Mean of duplicates	1.205	9.48	0.159 5	1.84	0.024	0.010 95	4.805	4.815	4.12	20.75
	SS		11/14/2019		1.24	12.2	0.167	2.38	< 0.015	0.059 5	7.34	7.4	4.14	41.5
Gw - 80-1-0 (P8)	SS	N	5/30/2019		< 0.5	24.9	1 080.	1.12	29. a	0.018 5	1.01	1.03	7.5	20.5
	SS		9/13/2019		0.62	35.2	1 540.	1.33	66. a	0.638	29.4 b	30. b	16.5	28.5
	SS		11/18/2019		0.67	24.2	1 080.	1.52	77. a	0.054 7	37.1 b	37.2 b	13.4	31.8
	SS		2/14/2020	Clear and moderately yellow, contains some organics	0.62	21.2	490.	2.42	68. a	0.022 5	4.53	4.56	12.4	155.
Gw - 81-1-0 (P9)	SS	N	5/30/2019		1.3	41.3	401.	0.98	4.9	< 0.005	< 0.02	< 0.02	8.85	20.3
	SS		9/13/2019		1.1	42.5	283.	0.94	5.	0.009 1	< 0.02	< 0.02	9.31	29.9
	SS		11/15/2019		< 1.	45.8	277.	0.92	4.8	0.027	0.054	0.081	9.16	6.3
	SS		2/14/2020	Clear and slightly yellow	0.91	42.3	313.	0.98	4.3	< 0.005	0.229	0.229	8.67	10.6
Gw - 85-1-1	SS	N	5/17/2019		< 0.5	13.	618.	1.22	0.14	< 0.005	1.73	1.73	1.37	7.2
	SS		9/9/2019		< 0.5	13.9	963.	1.41	0.3	< 0.005	1.48	1.48	1.55	8.2
	SS		11/7/2019		< 0.5	8.41	660.	1.34	0.14	0.006 8	3.55	3.56	0.967	6.9
	SS		2/13/2020	Slightly silty and slightly yellow	< 0.5	6.16	40.4	0.835	0.035	< 0.005	1.22	1.22	0.462 6	8.2
Gw - 87-1-1	SS	N	9/18/2019		< 0.5	8.84	108.	0.8	0.016	< 0.005	< 0.02	< 0.02	0.612	17.7
	SS		11/10/2019		< 0.5	9.51	23.1	0.735	< 0.015	< 0.005	0.048	0.048	0.636	31.6
Gw - 87-2-1	SS	N	9/18/2019		< 0.5	4.65	0.184	0.077	< 0.015	< 0.005	0.079	0.079	0.052	5.5
	SS		11/10/2019		< 0.5	5.31	0.725	0.093	< 0.015	< 0.005	0.26	0.26	0.166	5.1
Gw - 88-1-1	SS	N	9/18/2019		< 0.5	5.52	1.13	0.17	< 0.015	< 0.005	0.089	0.089	0.288	4.1
	SS		11/10/2019		< 0.5	6.2	0.864	0.184	< 0.015	< 0.005	0.087	0.087	0.198	5.3
Gw - 88-2-1	SS	N	9/18/2019		< 0.5	7.29	2 700.	0.076	< 0.015	0.016	1.41	1.43	2.21	99.6
	SS		11/10/2019		< 0.5	10.	596.	0.055	< 0.015	0.015 3	1.73	1.74	2.59	11.6
91-1-1	SS	N	3/4/2020		5.75	10.3	91.4	4.98	0.073	0.045	0.638	0.683	2.23	46.9
92-1-1	SS	N	3/5/2020		**11.5** d	21.9	694.	5.02	0.22	< 0.005	0.023	0.023	22.5	742.
93-1-1	SS	N	3/4/2020		< 0.5	6.32	41.9	1.52	< 0.015	< 0.005	0.063	0.063	0.481	8.7
94-1-1	SS	N	3/5/2020		2.37	9.47	162.	1.55	< 0.015	< 0.005	< 0.02	< 0.02	1.12	5.5
Gw - P1	SS	N	5/17/2019		**16.** d	18.9	107.	18.5	120. a	< 0.005	< 0.02	< 0.02	5.71	11.7
	SS		9/13/2019		**19.3** d	20.4	81.4	12.5	74. a	< 0.005	< 0.02	< 0.02	6.4	20.
	SS		11/13/2019		**19.1** d	21.5	95.8	15.9	68. a	< 0.005	< 0.02	< 0.02	7.24	17.6
	SS		2/14/2020	Clear and colourless	**12.4** d	16.6	154.	9.9	34. a	< 0.005	< 0.02	< 0.02	4.04	60.4
Gw - P10	SS	N	5/24/2019		3.95	22.7	231.	24.5	97. a	0.006 7	0.054	0.06	9.09	15.3
	SS		9/13/2019		**10.8** d	21.5	346.	10.2	59. a	< 0.005	< 0.02	< 0.02	5.81	19.3
	SS		11/4/2019		**9.** d	18.8	324.	6.13	74. a	0.008 3	0.055	0.063	4.53	9.5
	SS		2/14/2020	Clear and slightly orange	5.74	17.9	418.	6.52	35. a	< 0.005	< 0.02	< 0.02	3.21	7.3
Gw - P2	SS	N	5/24/2019		4.	22.2	227.	23.2	160. a	0.026 7	0.034	0.06	9.19	17.7
	SS		9/13/2019		2.5	26.9	315.	20.	91. a	< 0.005	< 0.02	< 0.02	9.24	14.7
	SS		11/4/2019		2.5	25.1	311.	17.2	170. a	0.006 2	< 0.02	< 0.02	8.44	15.3
	SS		2/14/2020	Clear and slightly orange	3.3	24.9	344.	17.9	82. a	0.005 2	0.135	0.14	8.65	17.1
Gw - P3	SS	N	5/17/2019		4.3	25.8	350.	29.9	190. a	< 0.005	< 0.02	< 0.02	10.1	21.8
	SS		9/13/2019		1.9	31.5	466.	25.1	120. a	< 0.005	< 0.02	< 0.02	10.3	21.5
	SS		11/4/2019		1.9	29.4	453.	19.1	130. a	0.007 5	< 0.02	< 0.02	9.38	19.8
	SS		2/14/2020	Clear and slightly orange	3.6	26.3	310.	17.2	98. a	0.008 1	< 0.02	< 0.02	8.43	17.2
Gw - P4	SS	N	5/17/2019		< 1.	27.1	538.	21.5	180. a	0.008 2	< 0.02	0.023	9.26	23.9
	SS		9/13/2019		< 1.	28.3	627.	25.4	90. a	< 0.005	< 0.02	< 0.02	9.3	16.9
	SS		11/4/2019		< 1.	26.2	586.	22.9	170. a	0.020 6	0.111	0.132	9.1	27.4
	SS		2/14/2020	Clear and slightly orange	< 1.	27.5	691.	16.7	85. a	0.015 4	< 0.02	0.027	7.52	18.3

Station	Date Sampled	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulphate	Sulphur	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
AW Maximum (1)		---	20	---	0.5-15 (5)	---	---	128-429 (5)	---	3	---	1000	85	---	75-2400 (5)	---
DW Maximum (2)		---	10	---	20	200	2500	500	---	---	2.5	---	20	20	3	---
Fraction		DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS	DIS
Unit		µg/l	µg/l	µg/l	µg/l	mg/L	µg/l	mg/L	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
Method Detection Limit		0.05	0.04	50	0.005	0.05	0.05	1	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1
Gw - 72-1-1	5/16/2019	0.251 5	< 0.04	18 700.	< 0.005	8.885	285.5	45.	15.4	< 0.002	< 0.2	< 0.5	0.020 5	< 0.2	0.28	< 0.1
	9/11/2019	0.247 5	< 0.04	18 100.	< 0.005	8.37	296.	47.5	13.3	< 0.002	< 0.2	< 0.5	0.021 65	< 0.2	< 0.1	< 0.1
	11/6/2019	< 0.25	< 0.08	20 500.	< 0.01	8.855	290.5	44.	< 15.	< 0.004	< 0.4	< 1.	0.02	< 0.4	1.215	< 0.2
	2/12/2020	0.268 5	< 0.04	19 750.	< 0.005	8.855	302.	44.5	15.5	< 0.002	< 0.2	< 0.5	0.018 4	< 0.2	0.43	< 0.1
Gw - 72-3-1	5/15/2019	0.989	< 0.04	7 740.	< 0.005	28.9	194.	45.4	16.6	0.007	< 0.2	< 0.5	0.2	< 0.2	0.31	< 0.1
	9/11/2019	0.978	0.048	8 130.	< 0.005	28.1	210.	64.	17.	0.006	< 0.2	< 0.5	0.223	< 0.2	0.27	< 0.1
	11/6/2019	0.91	0.064	9 030.	< 0.005	27.1	209.	61.	21.	0.009 8	< 0.2	0.6	0.266	0.27	0.4	< 0.1
	2/12/2020	1.07	0.041	8 810.	< 0.005	31.7	205.	55.	18.5	0.010 9	< 0.2	< 0.5	0.215	0.21	0.55	< 0.1
Gw - 73-1-1	5/15/2019	0.416	< 0.04	8 810.	< 0.005	7.91	194.	40.1	13.4	0.004	< 0.2	< 0.5	0.409	0.32	0.52	< 0.1
	9/12/2019	0.389 5	< 0.04	8 725.	< 0.005	6.55	200.5	39.5	12.45	0.002 45	< 0.2	< 0.5	0.283 5	0.51	0.705	< 0.1
	11/6/2019	0.36	< 0.04	9 950.	< 0.005	6.92	208.	42.	< 15.	0.005 3	< 0.2	0.95	0.308	0.43	0.75	0.14
	2/12/2020	0.41	< 0.04	9 350.	< 0.005	6.92	201.	39.	13.4	0.004 6	< 0.2	< 0.5	0.266	0.67	0.84	< 0.1
Gw - 73-2-1	5/15/2019	0.382	< 0.04	8 280.	< 0.005	6.6	164.	32.3	11.2	0.003	< 0.2	< 0.5	0.221	0.33	0.64	< 0.1
	9/12/2019	0.373	< 0.04	8 610.	< 0.005	6.92	191.	56.	16.3	< 0.002	< 0.2	< 0.5	0.269	0.55	0.12	< 0.1
	11/6/2019	0.33	< 0.04	9 840.	< 0.005	7.52	191.	44.	< 15.	< 0.002	< 0.2	< 0.5	0.268	0.51	0.18	< 0.1
	2/12/2020	0.376	< 0.04	9 140.	< 0.005	7.	170.	33.	10.5	< 0.002	< 0.2	< 0.5	0.236	0.44	0.12	< 0.1
Gw - 73-3-1	5/15/2019	0.583	0.047	6 460.	< 0.005	18.5	66.	20.8	6.3	0.006	< 0.2	< 0.5	0.019	0.27	1.16	< 0.1
	9/12/2019	0.675	0.082	6 880.	< 0.005	19.3	109.	30.	7.7	0.007 4	< 0.2	< 0.5	0.089 1	0.42	0.65	< 0.1
	11/6/2019	0.555	0.054	7 000.	< 0.005	18.9	80.05	24.	< 15.	0.007 55	< 0.2	< 0.5	0.028 75	0.26	1.155	< 0.1
	2/12/2020	0.568	0.05	7 160.	< 0.005	17.4	68.7	20.	6.	0.006 6	< 0.2	< 0.5	0.037 6	0.35	1.13	< 0.1
Gw - 77-1-1	9/20/2019	0.206	< 0.04	11 000.	< 0.005	4.12	189.	19.	6.5	< 0.002	< 0.2	< 0.5	0.016 6	< 0.2	0.15	< 0.1
	11/14/2019	0.212	< 0.04	11 300.	< 0.005	4.25	193.	19.	6.1	< 0.002	< 0.2	< 0.5	0.016	< 0.2	0.32	< 0.1
Gw - 77-2-1	9/20/2019	0.463	0.136	13 600.	< 0.005	5.76	517.	24.	7.7	0.005 8	< 0.2	< 0.5	0.16	0.47	0.95	< 0.1
	11/14/2019	0.423	0.062	14 800.	< 0.005	5.7	503.	21.	7.3	0.004 7	< 0.2	< 0.5	0.128	0.38	0.66	< 0.1
Gw - 78-1-1	9/18/2019	0.913	0.383	13 300.	< 0.005	10.2	446.	50.	15.9	0.016 5	< 0.2	< 0.5	0.946	0.74	0.82	< 0.1
	11/14/2019	0.747	0.201	15 400.	< 0.005	24.2	385.	52.	16.2	0.013 3	< 0.2	2.75	0.615	0.77	2.41	< 0.1
Gw - 78-2-1	9/18/2019	0.269 5	0.986 5	11 800.	< 0.005	5.1	104.5	80.5	27.5	0.013 8	< 0.2	< 0.5	0.158	0.505	197.	< 0.1
	11/14/2019	0.575	1.23	12 500.	< 0.005	4.67	165.	110.	33.7	0.019 2	< 0.2	< 0.5	0.6	0.61	145.	< 0.1
Gw - 80-1-0 (P8)	5/30/2019	24.6	0.098	8 970.	< 0.005	78.1	625.	68.2	22.6	0.006 4	0.22	0.81	0.447	1.74	9.94	0.39
	9/13/2019	49.3	0.236	11 900.	0.016 8	153.	842.	86.	24.	0.008 6	0.47	< 0.5	0.576	1.79	69.	0.55
	11/18/2019	49.	0.231	9 780.	< 0.005	129.	553.	130.	41.1	0.010 1	0.48	< 0.5	0.304	1.01	14.4	0.39
	2/14/2020	36.7	0.239	8 180.	< 0.005	104.	451.	77.	27.6	0.017	0.86	3.31	0.477	4.05	9.39	1.16
Gw - 81-1-0 (P9)	5/30/2019	2.84	< 0.08	24 900.	< 0.01	44.5	1 700.	109.	36.6	< 0.004	< 0.4	< 1.	0.066	< 0.4	4.62	< 0.2
	9/13/2019	3.12	0.12	25 600.	< 0.01	47.	1 580.	110.	37.2	< 0.004	0.87	< 1.	0.070 8	< 0.4	4.93	< 0.2
	11/15/2019	3.28	< 0.08	25 800.	< 0.01	49.7	1 580.	110.	40.	< 0.004	1.15	< 1.	0.059 9	< 0.4	3.25	< 0.2
	2/14/2020	2.91	0.051	21 700.	< 0.005	45.9	1 610.	110.	33.9	< 0.002	0.51	< 0.5	0.062	0.39	4.55	< 0.1
Gw - 85-1-1	5/17/2019	7.73	0.1	5 160.	< 0.005	59.6	314.	33.7	11.7	0.008	< 0.2	< 0.5	0.032	0.96	0.41	< 0.1
	9/9/2019	8.18	0.096	5 290.	< 0.005	60.7	363.	45.	13.8	0.005 4	< 0.2	< 0.5	0.052 3	1.15	0.28	< 0.1
	11/7/2019	6.8	0.215	5 610.	< 0.005	48.2	228.	50.	16.7	0.003 4	< 0.2	< 0.5	0.022	1.25	0.17	< 0.1
	2/13/2020	5.47	0.191	5 570.	< 0.005	39.	150.	27.	9.1	0.004 6	< 0.2	< 0.5	0.017	1.28	0.88	< 0.1
Gw - 87-1-1	9/18/2019	0.386	0.065	7 400.	< 0.005	4.59	154.	18.	6.1	0.010 3	< 0.2	< 0.5	0.281	0.66	0.26	< 0.1
	11/10/2019	0.965	0.209	7 990.	< 0.005	5.43	151.	26.	8.1	0.016 1	< 0.2	< 0.5	0.801	< 0.2	0.47	< 0.1
Gw - 87-2-1	9/18/2019	0.15	0.068	5 550.	< 0.005	3.19	49.6	13.	4.1	< 0.002	< 0.2	< 0.5	0.037 3	0.62	0.1	< 0.1
	11/10/2019	0.134	0.113	6 400.	< 0.005	3.44	53.5	19.	5.9	0.002 6	< 0.2	< 0.5	0.046	0.56	0.2	< 0.1
Gw - 88-1-1	9/18/2019	0.166	0.092	5 860.	< 0.005	3.3	89.6	17.	5.9	0.002 4	< 0.2	< 0.5	0.047 2	0.5	0.38	< 0.1
	11/10/2019	0.161	0.092	6 480.	< 0.005	3.45	92.	17.	7.	0.002 1	< 0.2	< 0.5	0.048 6	0.5	0.17	< 0.1
Gw - 88-2-1	9/18/2019	0.954	0.166	7 100.	0.073 1	5.44	143.	110.	32.3	0.034 3	< 0.2	23.4	0.218	5.81	3.68	0.22
	11/10/2019	1.	0.275	7 310.	< 0.005	7.76	212.	130.	64.8	0.007 1	< 0.2	< 0.5	0.108	< 0.2	0.97	< 0.1
91-1-1	3/4/2020	2.39	0.897	7 400.	0.006 1	45.7	332.	66.	21.3	0.023 4	0.27	13.7	4.32	1.29	3.65	0.73
92-1-1	3/5/2020	3.42	0.673	21 000.	0.089	35.5	352.	120.	37.7	0.175	1.4	149.	6.81	23.9 b	47.8	2.02
93-1-1	3/4/2020	0.391	0.633	4 750.	< 0.005	3.94	122.	14.	4.4	< 0.002	< 0.2	< 0.5	0.391	0.47	4.11	< 0.1
94-1-1	3/5/2020	0.921	0.254	7 380.	< 0.005	23.3	147.	63.	19.7	0.020 5	0.26	< 0.5	1.94	0.27	0.78	< 0.1
Gw - P1	5/17/2019	48.2	< 0.08	17 700.	< 0.01	143.	902.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.009	< 0.4	3.08	< 0.2
	9/13/2019	52.1	0.2	19 600.	< 0.025	163.	1 020.	< 1.	< 15.	< 0.01	< 1.	< 2.5	< 0.01	< 1.	6.22	< 0.5
	11/13/2019	55.	0.082	21 400.	< 0.01	180.	1 110.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.007 7	< 0.4	8.58	< 0.2
	2/14/2020	29.8	< 0.08	18 000.	< 0.01	81.2	1 010.	2.6	< 6.	< 0.004	< 0.4	< 1.	0.015 7	< 0.4	6.77	< 0.2
Gw - P10	5/24/2019	66.8	0.131	11 800.	< 0.005	236. b	1 040.	< 1.	< 3.	0.003 3	0.3	< 0.5	0.036 9	1.37	3.63	0.23
	9/13/2019	45.2	0.138	18 300.	< 0.01	142.	1 100.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.015 2	0.64	5.14	< 0.2
	11/4/2019	35.9	0.095	16 600.	< 0.01	104.	992.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.013 9	< 0.4	8.47	< 0.2
	2/14/2020	29.3	0.057	15 500.	< 0.005	82.	983.	1.1	< 3.	< 0.002	< 0.2	< 0.5	0.013 1	0.56	4.81	< 0.1
Gw - P2	5/24/2019	63.7	0.124	12 700.	< 0.01	225. b	1 040.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.036 4	1.28	4.59	< 0.2
	9/13/2019	72.3	0.169	13 500.	< 0.01	245. b	1 270.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.019 4	1.95	4.82	0.29
	11/4/2019	67.2	0.167	13 300.	< 0.01	229. b	1 200.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.017 9	1.71	3.46	0.33
	2/14/2020	71.1	0.138	13 100.	< 0.01	238. b	1 160.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.019 8	2.22	6.33	0.37
Gw - P3	5/17/2019	84.1	0.144	14 200.	< 0.01	289. b	992.	< 1.	< 6.	< 0.004	0.44	< 1.	0.007	2.83	3.69	0.34
	9/13/2019	92.7	0.184	15 000.	< 0.01	323. b	1 300.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.011 6	2.76	5.43	0.32
	11/4/2019	85.	0.228	14 400.	< 0.01	288. b	1 150.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.013 9	2.3	3.15	0.33
	2/14/2020	80.1	0.134	12 900.	< 0.01	265. b	1 020.	5.5	< 6.	< 0.004	< 0.4	< 1.	0.006 4	2.66	2.91	0.36
Gw - P4	5/17/2019	63.2	0.165	12 000.	< 0.01	249. b	797.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.014	2.68	4.14	0.29
	9/13/2019	67.9	0.207	14 500.	< 0.01	268. b	923.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.018 7	2.88	4.09	0.28
	11/4/2019	63.1	0.263	13 500.	< 0.01	243. b	846.	< 1.	< 6.	< 0.004	< 0.4	< 1.	0.018 9	2.72	3.36	0.26
	2/14/2020	61.9	0.119	11 900.	< 0.01	228. b	825.	1.9	< 6.	< 0.004	< 0.4	< 1.	0.014	2.18	4.93	0.27

Notes:

a	*Above CSR Schedule 3.2 AW Standard.*
b	*Above CSR Schedule 3.2 DW Standard.*
c	*Detection Limits above Applicable Standards.*
d	*Above CSR Schedule 3.2 AW Standard, but Below Regional Background Concentrations (South Vancouver Island Region).*
SS	*Single sample.*
FR1, FR2	*Field replicates.*
BC CSR	*CSR-Sch3.2: BC Contaminated Site Regulation - Schedule 3.2 - Generic Numerical Water Standards, be in effective on November 1, 2017.*
(1)	*Aquatic Life (AW) Freshwater, Column 3.*
(2)	*Drinking Water (DW), Column 6.*
(3)	*Standard varies with pH. Every ammonia result was compared to a standard based on the associated pH result for that sample.*
(4)	*Standard varies with chloride. Every nitrite result was compared to a standard based on the associated chloride result for that sample.*
(5)	*Standard varies with hardness. Every result was compared to a standard that was based on the associated hardness result for that sample.*
(6)	*BC CSR Schedule 3.2 criterion for iron and manganese were not applied as directed by the Stage 8 CSR Amendments.*
(7)	*Standard is based on the trivalent (Cr(III)) species.*
(8)	*Interim standard used.*
(9)	*Regional Background Concentrations (South Vancouver Island Region).*

AECOM

B2. Domestic Well Quality

Appendix B-2. Domestic Well Quality - 2019 to 2020

Parameters	Criteria: Canadian Guidelines [1]	Criteria: British Columbia Guidelines [2]	Well Number / Sample Date	Site #2 Kiowa Ave	Site #3 Spotts Close	Site #11 Farmington Rd	Site #12 Wallace Dr	Site #12 Wallace Dr	Site #13 Wallace Dr	Site #13 Wallace Dr	Site #10 Meadowbrook	Site #9 Wildview Cres
				24	25	36	37 (at House)	37 (at House)	38 (at Well Head)	38 (at Well Head)	61	47
				17-Jul-2019	17-Jul-2019	17-Jul-2019	17-Jul-2019	20-Sep-2019	17-Jul-2019	20-Sep-2019	17-Jul-2019	17-Jul-2019
Metals												
Aluminum, total	0.1 ‡	9.5	mg/L	< 0.00050	0.00133	0.00321	0.00553	0.00572	0.00103	0.00170	0.00425	0.01130
Antimony, total	0.006	n/a	mg/L	< 0.00002	< 0.00002	< 0.00002	0.000065	0.000078	0.000041	0.000115	< 0.00002	< 0.00002
Arsenic, total	0.010	0.010	mg/L	0.00003	0.000045	< 0.00002	0.00205	0.00186	0.00188	0.0019	0.000056	0.000047
Barium, total	1	n/a	mg/L	0.000509	0.00194	0.000101	0.0176	0.00718	0.00709	0.00713	0.000931	0.00469
Beryllium, total	n/a	n/a	mg/L	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.000011
Bismuth, total	n/a	n/a	mg/L	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Boron, total	5	5	mg/L	0.181	0.268	0.697	0.224	0.214	0.229	0.202	< 0.01	0.01
Cadmium, total	0.005	n/a	mg/L	0.0000308	< 0.000005	< 0.000005	< 0.000005	0.000014	< 0.000005	0.000014	< 0.000005	0.0000239
Calcium, total	n/a	n/a	mg/L	72	57.3	9.6	34.9	38.2	35.2	38.3	21	18.3
Chromium, total	0.05	n/a	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.00015	< 0.0001
Cobalt, total	n/a	n/a	mg/L	0.0000245	0.0000346	< 0.000005	0.000291	0.0000457	0.0000514	0.0000373	0.0000186	0.0000265
Copper, total	2 [1] and 1 †	1.0 †	mg/L	0.00638	0.0352	0.000053	0.00429	0.00328	0.00179	0.00563	0.0722	0.135
Iron, total	0.3 †	0.3 †	mg/L	0.0014	0.0021	0.0268	0.0323	0.0677	0.0034	0.0017	0.0038	0.0158
Lead, total	0.005	0.01	mg/L	0.000181	0.000844	0.000016	0.000244	0.00528	0.0000797	0.000446	0.000934	0.00148
Lithium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	0.00109	0.00088	0.00103	0.00087	0.00103	< 0.0005	< 0.0005
Magnesium, total	n/a	n/a	mg/L	5.52	5.79	2.63	7.72	8.1	7.85	8.42	6.17	3.13
Manganese, total	0.12 [1] and 0.02 †	0.05 †	mg/L	0.000209	0.000242	0.00384	**0.617** [1]	0.0521	0.0663	0.0361	0.000219	0.0147
Mercury, total	0.001	0.001	mg/L	0.000005	< 0.000002	< 0.000002	< 0.000002		< 0.000002		< 0.000002	< 0.000002
Molybdenum, total	n/a	0.25	mg/L	0.000112	0.000113	0.00106	0.00062	0.00108	0.000935	0.00111	< 0.00005	< 0.00005
Nickel, total	n/a	n/a	mg/L	0.000148	0.000265	0.000052	0.000856	0.000328	0.000311	0.000333	0.000231	0.000139
Phosphorus, total	n/a	n/a	mg/L	0.0037	0.0039	0.0066	0.0396		0.04		0.0077	0.0074
Potassium, total	n/a	n/a	mg/L	0.669	1.91	0.443	1.16	1.19	1.16	1.18	0.245	0.385
Selenium, total	0.05	0.01	mg/L	< 0.00004	< 0.00004	0.000142	< 0.00004	< 0.00004	< 0.00004	< 0.00004	0.000058	< 0.00004
Silicon, total	n/a	n/a	mg/L	9.58	9.32	8.61	8.37	8.55	8.41	8.59	9.4	8.45
Silver, total	n/a	n/a	mg/L	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.0000054	< 0.000005
Sodium, total	200 †	n/a	mg/L	13.3	11.4	39.1	17.2	17.3	17.6	17.8	7.23	10.2
Strontium, total	7.0	n/a	mg/L	0.0744	0.0771	0.0227	0.136	0.138	0.14	0.14	0.0457	0.0475
Sulphur, total	n/a	n/a	mg/L	4.6	6.7	5.7	8.9	9.6	9.2	10	< 3	< 3
Thallium, total	n/a	n/a	mg/L	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin, total	n/a	n/a	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Titanium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Uranium, total	0.02	n/a	mg/L	0.000139	0.000202	< 0.000002	0.000212	0.000259	0.000211	0.00026	0.000006	0.0000803
Vanadium, total	n/a	n/a	mg/L	0.00032	0.00074	0.00074	0.00058	0.00048	0.00058	0.00043	0.00083	0.0004
Zinc, total	5 †	5 †	mg/L	0.00194	0.017	0.00076	0.00386	0.00266	0.00202	0.00245	0.0043	0.00522
Zirconium, total	n/a	n/a	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Conventionals												
Hardness (as CaCO3)	n/a	n/a	mg/L	203	167	34.8	119	129	120	130	78	59
Chloride, dissolved	250 †	250 †	mg/L	22	26	9.2	14		14		16	9
Total dissolved solids	500 †	n/a	mg/L	290	270	160	200		180		140	130
Specific Conductivity (Lab)	n/a	n/a	µS/cm	460	410	250	320	228.7	320	255	200	170
Conductivity (Field)	n/a	n/a	µS/cm	363.2	337.4	176.5	254.5	254.8	242	229	151	124
pH (lab)	7.0 to 10.5 †	n/a	pH	8.28	8.01	8.34	8.28	7.62	8.27	7.41	7.38	7.52
pH (field)	7.0 to 10.5 †	n/a	pH	6.54	6.2	8.52	7.41	7.41	7.54	7.62	5.84	5.66
Temperature (field)	15 †	15 †	°C	13.9	16.2	11.8	13.9	13.4	12.2	12.5	11.9	11.7
Ammonia	n/a	n/a	mg/L									

(1) Guidelines for Canadian Drinking Water Quality (Sixth Edition, 1996 - updated 2019).

(2) British Columbia Approved Water Quality Guidelines (2015 edition - updated 2017).

‡ Limit for this parameter is an operational guideline only

† Limit for this parameter is an aesthetic objective, not a human health objective

 # Limit for this guideline is an iterim value

n/a - no drinking water quality guideline is available for this parameter

Sample concentrations expressed in bold exceed drinking water quality guidelines

Appendix B-2. Domestic Well Quality - 2019 to 2020

Parameters	Criteria			Site #4 Lohr Road	Site #6 Lohr Road	Site #7 Lohr Road	Site #8 Lohr Road	Site #16 Spotts Close	Site #5 Lohr Road	Site #14 Hartland Ave
	Canadian Guidelines (1)	British Columbia Guidelines (2)	Well Number Sample Date	50 18-Jul-2019	52 18-Jul-2019	53 18-Jul-2019	80 18-Jul-2019	81 18-Jul-2019	51 18-Jul-2019	n/a 17-Jul-2019
Metals										
Aluminum, total	0.1 ‡	9.5	mg/L	0.0139	0.00227	0.03610	< 0.0005	0.00180	0.00227	0.00709
Antimony, total	0.006	n/a	mg/L	0.000024	< 0.00002	0.000038	0.000022	< 0.00002	< 0.00002	< 0.00002
Arsenic, total	0.010	0.010	mg/L	0.000036	0.000065	0.000168	0.000056	< 0.00002	0.000065	0.000033
Barium, total	1	n/a	mg/L	0.00757	0.00902	0.00221	0.00678	0.00126	0.00902	0.00188
Beryllium, total	n/a	n/a	mg/L	< 0.00001	< 0.00001	0.000014	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Bismuth, total	n/a	n/a	mg/L	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Boron, total	5	5	mg/L	0.107	0.054	0.011	< 0.01	0.98	0.054	0.016
Cadmium, total	0.005	n/a	mg/L	0.0000117	< 0.000005	0.0000102	< 0.000005	< 0.000005	< 0.000005	0.000008
Calcium, total	n/a	n/a	mg/L	19.4	46.2	18.5	42.1	4.51	46.2	16.8
Chromium, total	0.05	n/a	mg/L	0.00013	< 0.0001	0.00011	< 0.0001	< 0.0001	< 0.0001	0.00011
Cobalt, total	n/a	n/a	mg/L	0.0000446	0.0000137	0.0000506	0.0000066	< 0.000005	0.0000137	0.000025
Copper, total	2 (1) and 1 †	1.0 †	mg/L	0.0536	0.00699	0.0235	0.00921	< 0.00005	0.00699	0.00144
Iron, total	0.3 †	0.3 †	mg/L	0.0258	0.0027	2.1	0.0078	0.0069	0.0027	0.3050
Lead, total	0.005	0.01	mg/L	0.00222	0.000396	0.000907	0.000377	0.0000909	0.000396	0.0000729
Lithium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.00116	< 0.0005	< 0.0005
Magnesium, total	n/a	n/a	mg/L	3.48	5.98	2.61	3.43	0.466	5.98	3.78
Manganese, total	0.12 (1) and 0.02 †	0.05 †	mg/L	0.00131	0.000169	0.00433	0.000503	0.0006	0.0002	0.0050
Mercury, total	0.001	0.001	mg/L	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Molybdenum, total	n/a	0.25	mg/L	0.000398	0.000742	0.000615	0.000334	0.00215	0.000742	0.000268
Nickel, total	n/a	n/a	mg/L	0.000195	0.000142	0.000107	0.000052	0.000137	0.000142	0.000229
Phosphorus, total	n/a	n/a	mg/L	0.0046	0.0041	0.0159	0.0041	0.0022	0.0041	0.0044
Potassium, total	n/a	n/a	mg/L	0.353	0.505	0.271	0.307	0.204	0.505	0.332
Selenium, total	0.05	0.01	mg/L	< 0.00004	0.000092	< 0.00004	0.000079	< 0.00004	0.000092	< 0.00004
Silicon, total	n/a	n/a	mg/L	6.07	6.87	7.39	7.17	10.5	6.87	6.56
Silver, total	n/a	n/a	mg/L	0.0000094	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Sodium, total	200 †	n/a	mg/L	7.92	6.08	4.73	4.51	42.5	6.08	16.7
Strontium, total	7.0	n/a	mg/L	0.0504	0.097	0.0377	0.0779	0.0404	0.097	0.0406
Sulphur, total	n/a	n/a	mg/L	< 3	< 3	< 3	< 3	4.6	< 3	4.7
Thallium, total	n/a	n/a	mg/L	0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin, total	n/a	n/a	mg/L	0.00025	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Titanium, total	n/a	n/a	mg/L	< 0.0005	< 0.0005	0.0017	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Uranium, total	0.02	n/a	mg/L	0.0000196	0.000579	0.000117	0.000488	0.0000026	0.000579	0.0000137
Vanadium, total	n/a	n/a	mg/L	0.00059	0.00055	0.00072	< 0.0002	0.00086	0.00055	0.00074
Zinc, total	5 †	5 †	mg/L	0.00945	0.00193	0.00628	0.00236	0.00682	0.00193	0.0113
Zirconium, total	n/a	n/a	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Conventionals										
Hardness (as CaCO3)	n/a	n/a	mg/L	62.7	140	56.8	119	13	140	58
Chloride, dissolved	250 †	250 †	mg/L	13	14	7	12	14	14	29
Total dissolved solids	500 †	n/a	mg/L	124	206	108	196	160	206	150
Specific Conductivity (Lab)	n/a	n/a	µS/cm	170	310	140	270	220	310	220
Conductivity (Field)	n/a	n/a	µS/cm	134.7	228.2	118.6	203.1	164	228	160
pH (lab)	7.0 to 10.5 †	n/a	pH	7.4	8.04	7.54	7.94	8.52	8.04	7.51
pH (field)	7.0 to 10.5 †	n/a	pH	5.7	6.5	5.93	6.06	8.99	6.5	5.34
Temperature (field)	15 †	15 †	°C	11.4	11.6	15.4	12.8	11.4	11.6	10.6
Ammonia	n/a	n/a	mg/L							

(1) Guidelines for Canadian Drinking Water Quality (Sixth Edition, 1996 - updated 2014).
(2) British Columbia Approved Water Quality Guidelines (2015 edition).
‡ Limit for this parameter is an operational guideline only
† Limit for this parameter is an aesthetic objective, not a human health objective
 # Limit for this guideline is an iterim value
n/a - no drinking water quality guideline is available for this parameter
Sample concentrations expressed in bold exceed drinking water quality guidelines

Appendix B-2. Domestic Well Quality - 2019 to 2020

Parameters	Criteria			Site #18 Willis Pt Rd	Site #19 Willis Pt Rd	Site #20 Mark Lane	Site #21 Mark Lane	Site #17 Durrance Close
	Canadian Guidelines [1]	British Columbia Guidelines [2]	Well Number / Sample Date	n/a / 19-Jul-2019	n/a / 19-Jul-2019	n/a / 18-Jul-2019	n/a / 18-Jul-2019	n/a / 23-Aug-2019
Metals								
Aluminum, total	0.1 ‡	9.5	mg/L					
Antimony, total	0.006	n/a	mg/L					
Arsenic, total	0.010	0.010	mg/L					
Barium, total	1	n/a	mg/L					
Beryllium, total	n/a	n/a	mg/L					
Bismuth, total	n/a	n/a	mg/L					
Boron, total	5	5	mg/L					
Cadmium, total	0.005	n/a	mg/L					
Calcium, total	n/a	n/a	mg/L					
Chromium, total	0.05	n/a	mg/L					
Cobalt, total	n/a	n/a	mg/L					
Copper, total	2 [1] and 1 †	1.0 †	mg/L					
Iron, total	0.3 †	0.3 †	mg/L					
Lead, total	0.005	0.01	mg/L					
Lithium, total	n/a	n/a	mg/L					
Magnesium, total	n/a	n/a	mg/L					
Manganese, total	0.12[1] and 0.02 †	0.05 †	mg/L					
Mercury, total	0.001	0.001	mg/L					
Molybdenum, total	n/a	0.25	mg/L					
Nickel, total	n/a	n/a	mg/L					
Phosphorus, total	n/a	n/a	mg/L					
Potassium, total	n/a	n/a	mg/L					
Selenium, total	0.05	0.01	mg/L					
Silicon, total	n/a	n/a	mg/L					
Silver, total	n/a	n/a	mg/L					
Sodium, total	200 †	n/a	mg/L	11.7	22.9	22.2	13.4	6.75
Strontium, total	7.0	n/a	mg/L					
Sulphur, total	n/a	n/a	mg/L					
Thallium, total	n/a	n/a	mg/L					
Tin, total	n/a	n/a	mg/L					
Titanium, total	n/a	n/a	mg/L					
Uranium, total	0.02	n/a	mg/L					
Vanadium, total	n/a	n/a	mg/L					
Zinc, total	5 †	5 †	mg/L					
Zirconium, total	n/a	n/a	mg/L					
Conventionals								
Hardness (as CaCO3)	n/a	n/a	mg/L					
Chloride, dissolved	250 †	250 †	mg/L	3.7	85	48	28	4.8
Total dissolved solids	500 †	n/a	mg/L					
Specific Conductivity (Lab)	n/a	n/a	µS/cm	208	689	450	514	390
Conductivity (Field)	n/a	n/a	µS/cm	144.7	509	341.1	388	300.1
pH (lab)	7.0 to 10.5 †	n/a	pH	8.25	7.68	8.28	8.23	8.05
pH (field)	7.0 to 10.5 †	n/a	pH	7.94	6.75	7.27	6.83	6.56
Temperature (field)	15 †	15 †	°C	9.50	11.6	11.5	12.1	12.1
Ammonia	n/a	n/a	mg/L	0.038	0.033	< 0.015	0.026	0.035

(1) Guidelines for Canadian Drinking Water Quality (Sixth Edition, 1996 - updated 2019).
(2) British Columbia Approved Water Quality Guidelines (2017 edition).
‡ Limit for this parameter is an operational guideline only
† Limit for this parameter is an aesthetic objective, not a human health objective
 # Limit for this guideline is an iterim value
n/a - no drinking water quality guideline is available for this parameter
Sample concentrations expressed in bold exceed drinking water quality guidelines
Sample concentrations highlighted blue exceed drinking water quality guidelines aesthetic objective

AECOM

B3. a. Quarterly Surface Water Quality – North

B3. b. Quarterly Surface Water Quality – South

B3.c. Annual Surface Water Quality – North and South

AECOM

B3. a. Quarterly Surface Water Quality – North

Appendix B-3A. Surface Water Quality - North 2019-2020

AECOM

B.C. Water Quality Guidelines (1)				Short-term Maximum (1)	32.80		100	---	---	5	---	---	0.038-2.8 (5)	---	600
				30-Day Average (2)	3.00		50	---	---	---	---	1200	0.018 - 0.645 (5)	---	150
Station	Sample Type	Sample Date	Compliance (Y/N?)	Parameter	Nitrogen-Nitrate+Nitrite		Aluminum	Aluminum	Arsenic	Arsenic	Boron	Boron	Cadmium	Cadmium	Chloride
				Fraction	TOT		DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
				Unit	mg/L as N		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
				Method Detection Limit	0.02		0.5	3	0.02	0.02	10	10	0.005	0.005	1
SW - N - 05	FRM	5/3/2019	Y		**4.96**	b	5.72	51.25	0.112 5	0.117 5	29.5	31.	0.006	0.005 5	5.35
SW - N - 05	FRM	10/8/2019			**5.08**	b	4.83	369.5	0.12	0.142	31.	35.5	0.010 75	0.010 5	7.7
SW - N - 05	FRM	12/5/2019			**10.95**	b	15.5	29.1	0.139 5	0.126	64.	55.	0.022 15	0.063 65	5.65
SW - N - 05	FRM	2/7/2020			**5.87**	b	21.7	77.5	0.095 5	0.132	41.5	39.	0.015 95	0.013 9	4.8
SW - N - 05	FRM	3/17/2020			1.87		13.85	143.55	0.128 5	0.106 5	33.	49.	0.007 6	< 0.006	5.3
SW - N - 14	SS	10/8/2019	N		0.51		3.42	56.5	0.155	0.174	83.	97.	0.006 5	0.010 7	15.
SW - N - 14	SS	12/4/2019			**3.34**	b	5.52	21.5	0.122	0.127	81.	73.	0.006 6	0.005 5	15.
SW - N - 16	FRM	5/2/2019	Y		0.114		5.595	62.65	0.286 5	0.289 5	93.	102.5	0.015	0.034	11.
SW - N - 16	FRM	10/9/2019			0.055		8.865	19.4	0.334 5	0.338	68.	76.	0.005 3	0.012 65	13.
SW - N - 16	FRM	12/4/2019			**6.40**	b	6.7	21.05	0.194	0.213	100.5	89.5	0.023 15	0.016 45	10.
SW - N - 16	FRM	2/7/2020			**3.23**	b	29.8	102.55	0.193	0.231	41.5	40.5	0.012 05	0.014 65	3.8
SW - N - 16	FRM	3/24/2020			0.19		8.39	15.6	0.208 5	0.217 5	72.	73.5	0.018 5	0.017 6	8.9
SW - N - 17	SS	5/2/2019	N		**3.10**	b	5.41	22.2	0.179	0.109	83.	88.	0.007	< 0.005	13.
SW - N - 17	SS	10/8/2019			2.73		5.07	22.4	0.106	0.094	89.	103.	0.063 2	0.008 1	11.
SW - N - 17	SS	12/4/2019			**5.35**	b	5.97	10.1	0.105	0.118	107.	100.	0.006 5	0.005	16.
SW - N - 17	SS	2/7/2020			**3.39**	b	19.5	59.	0.141	0.108	85.	66.	0.005 3	0.005 1	8.3
SW - N - 18	SS	5/3/2019	N		2.64		2.81	34.4	0.158	0.065	13.	11.	< 0.005	< 0.005	5.1
SW - N - 18	SS	10/9/2019			**7.47**	b	4.51	10.9	0.1	0.074	13.	14.	< 0.005	< 0.005	6.4
SW - N - 18	SS	12/5/2019			**8.96**	b	2.63	6.73	0.086	0.058	16.	13.	0.010 3	0.005	5.4
SW - N - 18	SS	2/7/2020			2.51		6.97	25.9	0.077	0.116	27.	23.	0.017 5	0.006	5.3
SW - N - 19	SS	5/2/2019	N		**3.38**	b	6.59	17.5	0.282	0.242	61.	69.	0.022	0.031	12.
SW - N - 19	SS	10/9/2019			1.08		6.56	6.8	0.239	0.265	49.	57.	< 0.005	0.006 4	11.
SW - N - 19	SS	12/4/2019			**12.95**	b	7.57	7.04	0.269	0.266	55.	50.	0.009 6	0.007 6	7.1
SW - N - 19	SS	2/7/2020			**4.32**	b	33.3	72.1	0.216	0.245	34.	33.	0.012 2	0.013 1	3.2
SW - N - 41s1	SS	5/2/2019	Y		0.62		3.44	21.1	0.195	0.158	19.	17.	0.008	< 0.005	3.8
SW - N - 41s1	FRM	10/9/2019			0.55		23.35	59.35	0.228	0.254 5	18.	22.5	0.008 5	0.010 05	4.9
SW - N - 41s1	FRM	12/6/2019			0.62		3.43	11.05	0.163 5	0.146 5	18.5	19.	0.006 8	0.006 5	3.8
SW - N - 41s1	FRM	2/6/2020			0.47		10.765	179.5	0.183 5	0.247 5	15.	16.	< 0.005	0.005 7	3.45
SW - N - 41s1	FRM	3/17/2020			0.21		6.165	21.8	0.137 5	0.134 5	18.5	31.	< 0.005 6	< 0.005	4.05
SW - N - 41s3	SS	5/2/2019	N		0.11		3.62	18.3	0.185	0.149	31.	31.	0.006	< 0.005	11.
SW - N - 41s3	SS	10/9/2019			0.10		3.77	20.4	0.184	0.168	48.	55.	< 0.005	< 0.005	12.
SW - N - 41s3	SS	12/6/2019			0.14		3.45	6.07	0.198	0.147	44.	44.	< 0.005	< 0.005	12.
SW - N - 41s3	SS	2/6/2020			0.03		8.14	79.6	0.109	0.093	11.	13.	< 0.005	0.005 1	5.9
SW - N - 42s1	SS	5/2/2019	Y		0.09		5.56	25.	0.191	0.121	46.	48.	0.007	< 0.005	15.
SW - N - 42s1	FRM	10/9/2019			0.04		6.55	11.65	0.176	0.155 5	47.	48.5	0.005 75	0.005 75	15.
SW - N - 42s1	FRM	12/4/2019			0.12		4.405	12.1	0.103 5	0.115	64.5	59.	< 0.005	< 0.005	10.5
SW - N - 42s1	FRM	2/7/2020			0.23		16.3	44.35	0.061	0.079	58.	54.	< 0.005	< 0.005	7.9
SW - N - 42s1	FRM	3/17/2020			0.08		6.11	9.9	0.069	0.06	47.	55.	< 0.005 05	< 0.005	9.6
SW - N - 45	SS	5/2/2019	N		**5.41**	b	5.21	22.	0.125	0.097	68.	73.	0.008	< 0.005	10.
SW - N - 45	NS	10/8/2019		Dry - no sample collected	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 45	SS	12/4/2019			**10.30**	b	4.64	7.75	0.112	0.113	93.	85.	0.009 5	0.007 3	10.
SW - N - 45	SS	2/7/2020			**5.60**	b	17.5	76.5	0.096	0.152	51.	47.	0.008 5	0.005 2	6.5
SW - N - 50	SS	5/3/2019	N		2.71		3.28	65.9	0.12	0.062	12.	11.	0.007	< 0.005	5.1
SW - N - 50	SS	10/8/2019			**7.84**	b	3.57	6.05	0.11	0.054	11.	18.	< 0.005	< 0.005	7.5
SW - N - 50	SS	12/5/2019			**8.87**	b	8.86	7.15	0.106	0.049	15.	13.	0.010 6	0.005	5.2
SW - N - 50	SS	2/7/2020			2.41		3.79	22.	0.049	0.081	13.	< 10.	0.007 3	< 0.005	5.
SW - N - 51	NS	10/8/2019	N	Dry. No sample collected.	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 51	NS	12/5/2019		Dry. No sample collected.	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 51	SS	2/7/2020			0.29		4.16	25.1	0.027	0.048	10.	< 10.	< 0.005	< 0.005	3.9
SW - N - 53	NS	5/2/2019	N	Dry. No sample collected.	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 53	NS	10/8/2019		Dry. No sample collected.	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 53	NS	12/5/2019		Dry. No sample collected.	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 53	SS	2/7/2020			**9.08**	b	14.4	234.	0.157	0.172	37.	35.	0.008	0.006 7	3.3
SW - N - 54	SS	5/3/2019	N		0.03		3.84	18.2	0.479	0.444	40.	40.	0.013	0.01	1.8
SW - N - 54	SS	10/9/2019			0.21		9.59	58.3	0.556	0.522	34.	40.	0.025 1	0.024 3	5.4
SW - N - 54	SS	12/5/2019			**38.25**	a b	4.32	9.76	0.381	0.32	49.	47.	0.014 9	0.013 4	4.5
SW - N - 54	SS	2/7/2020			1.30		9.66	394.	0.274	0.356	52.	49.	< 0.005	< 0.005	1.6
SW - N - CSs2	NS	10/8/2019	N	Dry. No sample collected.	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - CSs2	NS	12/6/2019		Dry. No sample collected.	Null		Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - CSs2	SS	2/6/2020			< 0.02		6.27	12.1	0.077	0.048	< 10.	< 10.	< 0.005	< 0.005	3.9

Notes:

na	*Not applicable.*
Null	*No sample collected.*
a	*Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*
b	*Above 30-day average British Columbia Water Quality Guideline.*
(1)	*British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment. The Guidelines cited specific to protection of freshwater aquatic life unless otherwise noted.*
(2)	*Maximum acceptable concentration unless otherwise noted.*
(3)	*The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*
(4)	*The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*
(5)	*This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*
(6)	*This value is the short-term daily for streams with unknown fish distribution.*
(7)	*The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*
(8)	*Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

B.C. Water Quality Guidelines [1]				Short-term Maximum (1)	---	110	Variable (8)	---	350	1000	---	3.28 - 416.7 (5)	---	815 - 33946 (5)
				30-Day Average (2)	---	4	Variable (8)	---	---	---	---	3.43 - 19.57 (5)	---	767 - 2585 (5)
Station	Sample Type	Sample Date	Compliance (Y/N?)	Parameter	Cobalt	Cobalt	Copper	Copper	Iron	Iron	Lead	Lead	Manganese	Manganese
				Fraction	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
				Unit	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
				Method Detection Limit	0.005	0.01	0.005	0.1	1	5	0.005	0.02	0.05	0.1
SW - N - 05	FRM	5/3/2019	Y		0.178	0.233	0.986	1.25	4.1	69.5	< 0.006	< 0.02	0.182	2.705
SW - N - 05	FRM	10/8/2019			0.138 5	0.519	3.795	4.965	16.3	627.	0.019 2	0.075 9	0.555 5	12.1
SW - N - 05	FRM	12/5/2019			0.138	0.148	2.14	1.72	14.6	38.3	0.010 35	0.012 6	1.34	1.925
SW - N - 05	FRM	2/7/2020			0.080 65	0.133 5	6.095	1.69	16.65	98.95	0.131 9	0.021	0.513	1.805
SW - N - 05	FRM	3/17/2020			0.052 6	0.193	1.36	1.545	30.25	218.	0.016 75	< 0.038 5	0.593	6.86
SW - N - 14	SS	10/8/2019	N		0.118	0.185	2.8	1.46	17.8	242.	0.032 4	0.122	0.703	32.4
SW - N - 14	SS	12/4/2019			0.088	0.098 6	1.9	1.31	13.5	63.2	0.025 4	0.035 9	0.502	6.24
SW - N - 16	FRM	5/2/2019	Y		0.557 5	0.973 5	7.31	5.805	168.	**1 755.** a	0.235	0.115	438.	904.5
SW - N - 16	FRM	10/9/2019			0.689	0.713 5	2.11	3.08	**470.** a	**1 240.** a	0.022 75	0.038	398.	413.5
SW - N - 16	FRM	12/4/2019			0.314 5	0.33	5.555	4.355	116.	359.	0.026 8	0.021 55	394.5	345.
SW - N - 16	FRM	2/7/2020			0.196	0.250 5	16.55	15.2	97.35	242.5	0.117 45	0.040 5	28.2	30.45
SW - N - 16	FRM	3/24/2020			0.532 5	0.535	**11.35** a	5.22	153.	684.	0.166	0.014 1	526.5	518.
SW - N - 17	SS	5/2/2019	N		0.253	0.265	5.83	0.63	41.	66.6	0.372	< 0.02	21.3	22.4
SW - N - 17	SS	10/8/2019			0.158	0.274	1.12	0.747	19.8	74.3	0.017 6	0.023 3	19.8	43.2
SW - N - 17	SS	12/4/2019			0.105	0.106	1.32	0.554	11.5	16.	< 0.022	< 0.005	7.19	7.83
SW - N - 17	SS	2/7/2020			0.068 3	0.099	7.98	1.15	12.7	77.	0.204	0.022	1.36	2.58
SW - N - 18	SS	5/3/2019	N		0.097	0.129	5.76	0.33	12.3	50.4	0.338	0.027	0.658	2.08
SW - N - 18	SS	10/9/2019			0.11	0.113	1.53	0.388	30.8	18.7	0.043 6	0.012 5	0.66	0.625
SW - N - 18	SS	12/5/2019			0.098 4	0.098 8	0.863	0.274	34.6	10.	0.020 5	0.009 8	0.472	0.476
SW - N - 18	SS	2/7/2020			0.124	0.159	7.11	1.06	15.6	54.5	0.186	0.027 8	7.97	9.12
SW - N - 19	SS	5/2/2019	N		0.618	0.969	14.5	14.9	21.9	73.	0.062	0.046	22.7	82.3
SW - N - 19	SS	10/9/2019			0.707	0.697	2.76	2.89	151.	133.	0.017 6	0.046	65.6	67.1
SW - N - 19	SS	12/4/2019			0.352	0.359	13.9	8.02	31.	30.5	0.042 1	0.006	23.1	22.9
SW - N - 19	SS	2/7/2020			0.225	0.26	25.4	22.2	40.9	102.	0.205	0.024	5.16	6.58
SW - N - 41s1	SS	5/2/2019	Y		0.084	0.091	5.89	0.24	19.6	49.4	0.388	< 0.02	48.3	56.1
SW - N - 41s1	FRM	10/9/2019			0.228 5	0.308	2.355	0.395	154.	233.	0.042 45	0.065	196.	270.
SW - N - 41s1	FRM	12/6/2019			0.119	0.129 5	0.719 5	0.219	18.65	55.7	0.016 15	0.012 5	95.7	104.
SW - N - 41s1	FRM	2/6/2020			0.047 6	0.175	4.29	0.705	18.4	269.5	0.111 65	0.121	20.85	77.7
SW - N - 41s1	FRM	3/17/2020			0.067 15	0.083 5	3.582	0.23	30.75	50.45	0.101 25	< 0.02	39.85	46.05
SW - N - 41s3	SS	5/2/2019	N		0.035	0.032	5.69	0.32	12.5	16.9	0.361	< 0.02	1.63	2.86
SW - N - 41s3	SS	10/9/2019			0.015 6	0.027	0.482	0.31	7.6	22.1	0.011 4	0.025	2.78	5.6
SW - N - 41s3	SS	12/6/2019			0.025 7	0.020 2	2.18	0.196	24.2	10.3	0.027 1	0.007 6	2.12	2.81
SW - N - 41s3	SS	2/6/2020			0.020 5	0.059	3.	0.75	6.1	78.6	0.092 3	0.133	0.642	4.86
SW - N - 42s1	SS	5/2/2019	Y		0.096	0.118	5.36	0.42	16.5	44.7	0.322	0.021	24.3	41.6
SW - N - 42s1	FRM	10/9/2019			0.065 45	0.07	0.913 5	0.415 5	23.05	27.95	0.019 55	0.012 4	11.5	16.
SW - N - 42s1	FRM	12/4/2019			0.091 55	0.111	0.773 5	0.407 5	22.45	39.55	0.017 65	0.020 5	31.3	43.6
SW - N - 42s1	FRM	2/7/2020			0.052 15	0.068	4.595	0.975	17.4	43.1	0.119 35	0.029	5.495	9.775
SW - N - 42s1	FRM	3/17/2020			0.051 85	0.060 55	0.530 5	0.484 5	14.45	24.	0.013 15	< 0.014 9	14.25	18.1
SW - N - 45	SS	5/2/2019	N		0.254	0.245	6.44	0.85	11.3	26.8	0.369	< 0.02	2.73	3.05
SW - N - 45	NS	10/8/2019		Dry - no sample collected	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 45	SS	12/4/2019			0.157	0.154	1.65	0.794	46.9	12.6	0.029 9	0.010 7	4.21	4.08
SW - N - 45	SS	2/7/2020			0.074 2	0.127	5.92	1.51	26.3	93.4	0.133	0.017	0.847	2.63
SW - N - 50	SS	5/3/2019	N		0.092	0.179	5.08	0.52	9.3	107.	0.291	< 0.02	1.05	3.57
SW - N - 50	SS	10/8/2019			0.115	0.124	1.48	0.366	19.5	6.8	0.029 9	0.012 8	0.791	0.726
SW - N - 50	SS	12/5/2019			0.108	0.095 8	1.28	0.341	56.6	7.2	< 0.030 4	< 0.005	1.54	0.675
SW - N - 50	SS	2/7/2020			0.047 6	0.074 6	6.99	0.557	8.6	32.	0.168	< 0.005	0.369	0.946
SW - N - 51	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 51	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 51	SS	2/7/2020			0.042 3	0.069	5.84	0.62	12.	49.2	0.149	0.056	0.339	0.73
SW - N - 53	NS	5/2/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 53	NS	10/8/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 53	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - 53	SS	2/7/2020			0.093 7	0.325	6.72	1.37	7.3	404.	0.159	0.041	1.66	9.1
SW - N - 54	SS	5/3/2019	N		0.22	0.243	13.2	12.3	16.3	37.1	0.22	< 0.02	114.	122.
SW - N - 54	SS	10/9/2019			0.92		11.8	14.4	84.9	218.	0.03	0.021	567.	618.
SW - N - 54	SS	12/5/2019			0.233	0.247	12.9	12.7	33.7	15.1	0.030 1	0.005 8	68.5	69.7
SW - N - 54	SS	2/7/2020			0.093 3	0.55	20.4	17.3	14.8	679.	0.201	0.092	4.66	14.5
SW - N - CSs2	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - CSs2	NS	12/6/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - N - CSs2	SS	2/6/2020			0.022 1	0.02	7.64	0.37	98.	9.3	0.205	< 0.02	0.825	0.22

Notes:

na — *Not applicable.*

Null — *No sample collected.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment. The Guidelines cited specific to protection of freshwater aquatic life unless otherwise noted.*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*

(8) — *Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

B.C. Water Quality Guidelines [1]				Short-term Maximum (1)	---	2000	---	---	---	---	2	---	0.1 - 3 (5)	---	33 - 340.5 (5)	
				30-Day Average (2)	---	1000	---	25 - 150 (5)	---	---	2	---	0.05 - 1.5 (5)	---	7.5 - 187.5 (5)	
Station	Sample Type	Sample Date	Compliance (Y/N?)	Parameter	Molybdenum	Molybdenum	Nickel	Nickel	Phosphorus - ortho phosphate	Selenium	Selenium	Silver	Silver	Zinc	Zinc	
				Fraction	DIS	TOT	DIS	TOT	TOT	DIS	TOT	DIS	TOT	DIS	TOT	
				Unit	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
				Method Detection Limit	0.05	0.05	0.02	0.1	0.005	0.04	0.04	0.005	0.01	0.1	1	
SW - N - 05	FRM	5/3/2019	Y		0.879 5	0.877	0.337 5	0.485	---	0.284	0.314 5	< 0.005	< 0.01	1.14	1.6	
SW - N - 05	FRM	10/8/2019			0.649 5	0.608 5	0.574	1.06	---	0.347 5	0.358 5	< 0.005	< 0.007 5	3.62	3.855	
SW - N - 05	FRM	12/5/2019			1.65	1.43	0.605 5	0.62	---	0.781 5	0.812	< 0.005	< 0.005	3.07	3.025	
SW - N - 05	FRM	2/7/2020			1.075	1.14	0.514 5	0.61	---	0.472	0.490 5	< 0.005	< 0.01	4.63	2.85	
SW - N - 05	FRM	3/17/2020			1.125	1.11	0.295 5	0.49	---	0.272	0.255	< 0.005	< 0.01	3.145	2.3	
SW - N - 14	SS	10/8/2019	N		0.597	0.481	0.626	0.588	---	0.066	0.07	< 0.005	< 0.005	4.81	2.51	
SW - N - 14	SS	12/4/2019			0.566	0.358	0.314	0.357	---	0.125	0.135	< 0.005	< 0.005	4.37	2.94	
SW - N - 16	FRM	5/2/2019	Y		0.861	0.926 5	2.145	2.265	---	0.094 5	0.119 5	< 0.005	< 0.01	9.135	12.75	
SW - N - 16	FRM	10/9/2019			0.928	0.962 5	2.085	2.07	---	0.099 5	0.122	< 0.005	< 0.01	4.295	4.3	
SW - N - 16	FRM	12/4/2019			0.668 5	0.607	1.45	1.405	---	0.080 5	0.089 5	< 0.005	< 0.005	17.3	12.9	
SW - N - 16	FRM	2/7/2020			0.733	0.658 5	1.95	1.975	---	0.138 5	0.118 5	< 0.005	< 0.01	9.635	7.8	
SW - N - 16	FRM	3/24/2020			0.568	0.584	1.52	1.405	---	0.071 5	0.097 5	< 0.005	< 0.005	12.35	9.205	
SW - N - 17	SS	5/2/2019	N		0.771	0.733	0.299	0.25	---	0.147	0.159	< 0.005	< 0.01	5.64	1.1	
SW - N - 17	SS	10/8/2019			0.694	0.643	0.292	0.28	---	0.157	0.185	< 0.005	< 0.005	4.78	3.14	
SW - N - 17	SS	12/4/2019			1.06	0.542	0.249	0.195	---	0.351	0.355	< 0.005	< 0.005	4.75	1.38	
SW - N - 17	SS	2/7/2020			0.885	0.768	0.421	0.34	---	0.322	0.287	< 0.005	< 0.01	5.47	1.9	
SW - N - 18	SS	5/3/2019	N		0.426	0.405	0.197	0.15	---	0.283	0.277	< 0.005	< 0.01	5.53	1.2	
SW - N - 18	SS	10/9/2019			0.514	0.494	0.228	0.148	---	0.458	0.482	< 0.005	< 0.005	7.45	3.66	
SW - N - 18	SS	12/5/2019			0.443	0.385	0.155	0.155	---	0.633	0.597	< 0.005	< 0.005	5.25	2.57	
SW - N - 18	SS	2/7/2020			0.372	0.383	1.14	0.471	---	0.251	0.477	< 0.005	< 0.005	10.8	7.04	
SW - N - 19	SS	5/2/2019	N		1.19	1.26	3.78	3.66	---	0.139	0.183	< 0.005	< 0.01	7.8	3.9	
SW - N - 19	SS	10/9/2019			0.542	0.624	2.12	2.27	---	0.126	0.117	< 0.005	< 0.01	1.32	5.8	
SW - N - 19	SS	12/4/2019			0.858	0.798	2.1	2.06	---	0.125	0.147	< 0.005	< 0.005	6.87	3.32	
SW - N - 19	SS	2/7/2020			0.879	0.854	2.68	2.71	---	0.162	0.16	< 0.005	< 0.01	8.63	5.8	
SW - N - 41s1	SS	5/2/2019	Y		0.36	0.335	0.215	0.17	---	0.19	0.205	< 0.005	< 0.01	5.57	< 1.	
SW - N - 41s1	FRM	10/9/2019			0.404 5	0.392	0.300 5	0.305	---	0.217 5	0.245	< 0.005	< 0.01	3.615	2.2	
SW - N - 41s1	FRM	12/6/2019			0.342	0.348	0.243	0.183 5	---	0.173	0.194 5	< 0.005	< 0.005	2.805	6.325	
SW - N - 41s1	FRM	2/6/2020			0.254 5	0.241	0.152	0.285	---	0.085 5	0.089 5	< 0.005	< 0.01	3.945	1.4	
SW - N - 41s1	FRM	3/17/2020			0.292	0.289 5	0.264	0.125	---	0.104	0.088	< 0.005	< 0.01	2.695	< 1.	
SW - N - 41s3	SS	5/2/2019	N		0.352	0.321	0.216	0.13	---	0.104	0.099	< 0.005	< 0.01	5.13	< 1.	
SW - N - 41s3	SS	10/9/2019			0.395	0.367	0.117	< 0.1	---	0.1	0.115	< 0.005	< 0.01	1.86	< 1.	
SW - N - 41s3	SS	12/6/2019			0.4	0.339	0.154	0.084	---	0.13	0.145	< 0.005	< 0.005	4.73	0.52	
SW - N - 41s3	SS	2/6/2020			0.199	0.178	0.081	0.17	---	0.056	0.067	< 0.005	< 0.01	2.21	< 1.	
SW - N - 42s1	SS	5/2/2019	Y		0.388	0.409	0.253	0.23	---	0.047	0.054	< 0.005	< 0.01	4.75	< 1.	
SW - N - 42s1	FRM	10/9/2019			0.454	0.434 5	0.272	0.183 5	---	0.045 5	0.057 5	< 0.005	< 0.005	3.535	0.955	
SW - N - 42s1	FRM	12/4/2019			1.028 5	0.321 5	0.222 5	0.218	---	0.071 5	0.072	< 0.005	< 0.005	6.59	5.42	
SW - N - 42s1	FRM	2/7/2020			0.294 5	0.306 5	0.148	0.15	---	0.076 5	0.053 5	< 0.005	< 0.01	2.285	< 1.05	
SW - N - 42s1	FRM	3/17/2020			0.430 5	0.424 5	0.16	0.139 5	---	0.044 5	0.057	< 0.005	< 0.007 5	1.48	< 0.815	
SW - N - 45	SS	5/2/2019	N		0.994	0.974	0.277	0.22	---	0.252	0.253	< 0.005	< 0.01	5.26	5.26	
SW - N - 45	NS	10/8/2019		Dry - no sample collected	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - 45	SS	12/4/2019			0.933	0.801	0.313	0.26	---	0.73	0.642	< 0.005	< 0.005	4.6	0.94	
SW - N - 45	SS	2/7/2020			1.06	1.04	0.474	0.476	---	0.443	0.818	< 0.005	< 0.005	4.27	2.82	
SW - N - 50	SS	5/3/2019	N		0.45	0.408	0.184	0.95	---	0.301	0.308	< 0.005	< 0.01	4.49	< 1.	
SW - N - 50	SS	10/8/2019			0.602	0.506	0.228	0.121	---	0.503	0.513	< 0.005	< 0.005	4.51	0.12	
SW - N - 50	SS	12/5/2019			0.46	0.377	0.252	0.142	---	0.645	0.677	< 0.005	< 0.005	3.92	0.16	
SW - N - 50	SS	2/7/2020			0.322	0.297	0.346	0.286	---	0.236	0.422	< 0.005	< 0.005	4.23	0.94	
SW - N - 51	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - 51	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - 51	SS	2/7/2020			0.305	0.287	0.14	0.14	---	0.122	0.104	< 0.005	< 0.01	39.3	**38.3**	a b
SW - N - 53	NS	5/2/2019	N	Dry. No sample collected.	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - 53	NS	10/8/2019		Dry. No sample collected.	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - 53	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - 53	SS	2/7/2020			0.607	0.573	2.76	3.	---	0.796	0.721	< 0.005	< 0.01	24.8	23.6	
SW - N - 54	SS	5/3/2019	N		0.915	0.889	1.65	1.64	---	0.196	0.219	< 0.005	< 0.01	3.37	< 1.	
SW - N - 54	SS	10/9/2019			0.922	0.799	2.46	2.5	---	0.226	0.235	< 0.005	< 0.01	4.14	< 1.	
SW - N - 54	SS	12/5/2019			0.87	0.766	1.26	1.32	---	0.226	0.249	< 0.005	< 0.005	3.76	0.84	
SW - N - 54	SS	2/7/2020			0.412	0.429	1.39	1.92	---	0.169	0.171	< 0.005	< 0.01	4.11	2.6	
SW - N - CSs2	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - CSs2	NS	12/6/2019		Dry. No sample collected.	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null	
SW - N - CSs2	SS	2/6/2020			0.079	0.064	0.154	< 0.1	---	0.043	< 0.04	< 0.005	< 0.01	3.79	< 1.	

Notes:

na	*Not applicable.*
Null	*No sample collected.*
a	*Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*
b	*Above 30-day average British Columbia Water Quality Guideline.*
(1)	*British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment. The Guidelines cited specific to protection of freshwater aquatic life unless otherwise noted.*
(2)	*Maximum acceptable concentration unless otherwise noted.*
(3)	*The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*
(4)	*The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*
(5)	*This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*
(6)	*This value is the short-term daily for streams with unknown fish distribution.*
(7)	*The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the North landfill are derived from stations SW-N-CSs2, SW-N-41s3 and SW-N-14.*
(8)	*Dissolved copper guideline varies with water hardness, temperature and dissolved organic carbon; Dissolved copper results were only compared with guidelines where DOC was analyzed.*

AECOM

B3. b. Quarterly Surface Water Quality – South

B.C. Water Quality Guidelines [1]														
				Short-term Maximum (1)	---	6.5-9	---	128 - 429 (4)	---	---	---	Variable (7)	---	1900 - 24900 (3)
				30-Day Average (2)	---	---	---	---	---	---	---	Variable (7)	---	135 - 1770 (3)
Station	**Sample Type**	**Sample Date**	**Compliance (Y/N?)**	**Parameter**	Alkalinity - Total - Ph 4.5	PH	Conductivity	Sulphate	Hardness (As Caco3)	Hardness (As Caco3)	Temperature	TSS	Dissolved Organic Carbon	Nitrogen - ammonia
				Fraction	TOT	TOT	TOT	DIS	TOT	DIS	TOT	TOT	DIS	DIS
				Unit	mg/L	pH	µS/cm	mg/L	mg/L	mg/L	°C	mg/L	ug/L	mg/L
				Method Detection Limit	1	0.1	1	1	0.5	0.5	0.1	1	0.5	0.015
SW - S - 03	SS	5/3/2019	N		---	7.45	223.	25.3	110.	108.	10.5	5.	---	0.15
SW - S - 03	SS	10/8/2019			---	7.19	429.	160.	225.	208.	15.1	5.1 b	---	0.022
SW - S - 03	SS	12/5/2019			---	7.21	257.	58.	138.	143.	11.5	< 1.	---	< 0.015
SW - S - 03	SS	2/6/2020			---	6.64	94.	17.	79.5	68.4	7.7	42. a b	---	0.73
SW - S - 04	SS	5/3/2019	Y		---	6.89	206.	23.5	109.	110.	9.	< 2.	---	0.1
SW - S - 04	FRM	10/8/2019			---	6.27 b	288.	74.5	152.	142.5	11.1	2.1	---	0.016
SW - S - 04	FRM	12/5/2019			---	6.95	250.	59.5	138.5	145.5	8.5	< 1.	---	< 0.015
SW - S - 04	FRM	2/6/2020			---	6.96	119.	15.	63.3	60.65	6.7	6.8 b	---	0.14
SW - S - 04	FRM	3/17/2020			---	6.24 b	169.	23.5	96.9	96.5	6.2	6.2 b	2.9	0.018
SW - S - 12	SS	5/3/2019	N		---	7.03	238.	48.4	131.	126.	12.2	< 2.	---	0.81
SW - S - 12	SS	10/8/2019			---	7.53	474.	170.	285.	266.	15.3	5.9 b	---	0.026
SW - S - 12	SS	12/5/2019			---	7.13	293.	110.	178.	184.	10.2	1.6	---	< 0.015
SW - S - 12	SS	2/6/2020			---	6.45 b	84.	24.	105.	89.3	8.4	74. a b	---	1.9 b
SW - S - 20	NS	10/8/2019	N	Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 20	NS	12/5/2019		Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 20	SS	2/6/2020			---	6.82	54.	3.1	33.5	33.6	5.9	77. a b	---	0.043
SW - S - 21	NS	5/2/2019	N	Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 21	NS	10/8/2019		Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 21	NS	12/5/2019		Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 21	SS	2/6/2020			---	7.13	55.	3.2	36.1	33.6	5.8	2.8	---	< 0.015
SW - S - 24	SS	5/3/2019	N		---	7.01	245.	25.3	132.	128.	10.2	2.	---	0.48
SW - S - 24	SS	10/8/2019			---	7.35	297.	100.	161.	148.	10.7	1.9	---	0.019
SW - S - 24	SS	12/5/2019			---	7.23	280.	65.	163.	169.	7.7	< 1.	---	< 0.015
SW - S - 24	SS	2/6/2020			---	7.04	169.	24.	85.8	81.5	7.3	9.2 b	---	0.24
SW - S - 27	NS	5/2/2019	N	Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 27	NS	10/8/2019		Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 27	NS	12/5/2019		Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 27	SS	2/6/2020			---	6.46 b	148.	20.	74.1	72.1	6.3	2.4	---	< 0.015
SW - S - 52	NS	10/8/2019	N	Dry. No sample collected.	---	Null	Null	Null	Null	Null	Null	Null	---	Null
SW - S - 52	SS	12/5/2019			---	7.96	118.	8.3	69.5	72.4	7.3	< 1.	---	< 0.015
SW - S - 52	SS	2/6/2020			---	7.12	69.	4.4	34.9	35.7	6.6	< 1.	---	< 0.015

Notes:

na — *Not applicable.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment. The Guidelines cited specific to protection of freshwater aquatic life unless otherwise noted.*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the South landfill are derived from stations SW-S-52.*

B.C. Water Quality Guidelines [1]					Nitrogen-Nitrite	Nitrogen-Nitrate	Nitrogen-Nitrate+Nitrite	Aluminum	Aluminum	Arsenic	Arsenic	Boron	Boron	Cadmium	Cadmium	Chloride	Cobalt	Cobalt	Copper	Copper	Iron
				Short-term Maximum (1)	0.06 - 0.6 (4)	32.8	32.8	100	---	---	5	---	---	0.038-2.8 (5)	---	600	---	110	Variable (8)	---	350
				30-Day Average (2)	0.02 - 0.20 (4)	3	3	50	---	---	---	---	1200	0.018 - 0.645 (5)	---	150	---	4	Variable (8)	---	---
Station	**Sample Type**	**Sample Date**	**Compliance (Y/N?)**	**Parameter**	Nitrogen-Nitrite	Nitrogen-Nitrate	Nitrogen-Nitrate+Nitrite	Aluminum	Aluminum	Arsenic	Arsenic	Boron	Boron	Cadmium	Cadmium	Chloride	Cobalt	Cobalt	Copper	Copper	Iron
				Fraction	TOT	TOT	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	DIS	TOT	DIS	TOT	DIS
				Unit	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L
				Method Detection Limit	0.005	0.02	0.02	0.5	3	0.02	0.02	10	10	0.005	0.005	1	0.005	0.01	0.05	0.01	1
SW - S - 03	SS	5/3/2019	N		< 0.005	1.72	1.72	6.12	332.	0.116	0.173	52.	56.	0.007	0.029	26.	0.124	0.53	5.72	6.01	109.
SW - S - 03	SS	10/8/2019			< 0.005	5.75 b	5.75	7.26	54.1	0.272	0.253	57.	67.	0.012 1	0.011 8	17.	0.156	0.226	8.72	8.92	27.5
SW - S - 03	SS	12/5/2019			< 0.005	2.66	2.66	16.7	27.1	0.211	0.172	47.	44.	0.011 6	0.010 1	17.	0.149	0.156	11.9	6.26	33.1
SW - S - 03	SS	2/6/2020			0.032 7	1.28	1.31	34.4	3 360.	0.279	0.518	45.	47.	0.021 6	0.046 5	15.	0.27	3.35	10.1	20.1	87.
SW - S - 04	SS	5/3/2019	Y		< 0.005	0.323	0.32	8.89	61.1	0.163	0.102	56.	58.	0.016	0.014	27.	0.082	0.122	6.51	1.44	8.1
SW - S - 04	FRM	10/8/2019			< 0.005	0.62	0.62	8.76	17.1	0.096	0.086 5	73.	84.	0.020 6	0.020 15	33.	0.074 55	0.088 05	1.52	1.535	2.05
SW - S - 04	FRM	12/5/2019			< 0.005	1.06	1.06	10.5	18.15	0.101 5	0.087	69.	62.5	0.016 65	0.017 15	26.5	0.081 35	0.087 05	2.35	1.48	13.
SW - S - 04	FRM	2/6/2020			0.015 85	0.922 5	0.94	36.6	359.5	0.166 5	0.151 5	35.5	36.5	0.009	0.023 65	15.	0.076 8	0.385 5	3.585	4.58	53.5
SW - S - 04	FRM	3/17/2020			< 0.005	1.46	1.46	19.85	48.8	0.105 5	0.100 5	58.5	83.	0.011 85	0.01	21.	0.080 15	0.105 5	1.8 a	1.91	21.15
SW - S - 12	SS	5/3/2019	N		0.014 1	3.49 b	3.50	17.7	112.	0.324	0.282	45.	47.	0.02	0.043	12.	0.258	0.339	16.6	12.	77.7
SW - S - 12	SS	10/8/2019			< 0.005	8.47 b	8.47	35.1	116.	0.387	0.398	27.	36.	0.038 7	0.043 2	4.9	0.236	0.37	22.9	24.4	81.5
SW - S - 12	SS	12/5/2019			< 0.005	5.86 b	5.86	29.8	197.	0.324	0.355	40.	38.	0.010 7	0.015 8	8.7	0.146	0.452	11.6	12.6	35.8
SW - S - 12	SS	2/6/2020			0.008 9	1.67	1.68	58.3 b	5 290.	0.279	0.551	60.	61.	0.025	0.053 4	11.	0.387	5.44 b	15.4	30.5	187.
SW - S - 20	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 20	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 20	SS	2/6/2020			< 0.005	0.027	0.027	37.6	406.	0.134	0.129	< 10.	11.	0.007	0.017 9	4.1	0.054 4	0.431	1.83	1.84	32.9
SW - S - 21	NS	5/2/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 21	NS	10/8/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 21	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 21	SS	2/6/2020			< 0.005	0.068	0.068	110. a b	172.	0.096	0.097	11.	13.	0.008 2	< 0.005	4.3	0.107	0.135	1.66	1.46	141.
SW - S - 24	SS	5/3/2019	N		< 0.005	0.125	0.125	7.92	262.	0.215	0.189	84.	90.	0.022	0.033	30.	0.163	0.516	7.01	3.25	29.
SW - S - 24	SS	10/8/2019			< 0.005	0.813	0.813	7.64	22.8	0.194	0.141	74.	85.	0.014 8	0.017 3	24.	0.111	0.134	3.5	2.88	11.5
SW - S - 24	SS	12/5/2019			< 0.005	0.655	0.655	8.09	16.3	0.153	0.126	110.	102.	0.013 8	0.011 6	27.	0.11	0.123	3.31	2.26	24.5
SW - S - 24	SS	2/6/2020			0.028 6	1.38	1.4086	23.3	555.	0.199	0.236	57.	59.	0.019 3	0.029 4	23.	0.122	0.666	8.1	8.03	55.
SW - S - 27	NS	5/2/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 27	NS	10/8/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 27	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 27	SS	2/6/2020			< 0.005	0.432	0.432	22.8	103.	0.172	0.108	51.	53.	0.037 5	0.038 9	25.	0.099 6	0.175	3.67	1.54	44.5
SW - S - 52	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null	Null
SW - S - 52	SS	12/5/2019			< 0.005	< 0.02	0.02	6.73	4.93	0.062	0.046	16.	15.	< 0.005	< 0.005	5.7	0.021 3	0.025 5	0.31	5.01	7.7
SW - S - 52	SS	2/6/2020			< 0.005	< 0.02	0.02	12.6	19.8	0.098	0.036	13.	15.	0.016 3	< 0.005	5.	0.035 2	0.022	1.46	0.38	30.4

Notes:

na	*Not applicable.*
a	*Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*
b	*Above 30-day average British Columbia Water Quality Guideline.*
(1)	*British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment. The Guidelines cited specific to protection of freshwater aquatic life unless otherwise noted.*
(2)	*Maximum acceptable concentration unless otherwise noted.*
(3)	*The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*
(4)	*The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*
(5)	*This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*
(6)	*This value is the short-term daily for streams with unknown fish distribution.*
(7)	*The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the South landfill are derived from stations SW-S-52.*

B.C. Water Quality Guidelines [1]				Short-term Maximum (1)	1000	---	3.28 - 416.7 (5)	---	815 - 33946 (5)	---	2000	---	---	---	---	2	---	0.1 - 3 (5)	---	33 - 340.5 (5)
				30-Day Average (2)	---	---	3.43 - 19.57 (5)	---	767 - 2585 (5)	---	1000	---	25 - 150 (5)	---	---	2	---	0.05 - 1.5 (5)	---	7.5 - 187.5 (5)
Station	Sample Type	Sample Date	Compliance (Y/N?)	Parameter	Iron	Lead	Lead	Manganese	Manganese	Molybdenum	Molybdenum	Nickel	Nickel	Phosphorus - ortho phosphate	Selenium	Selenium	Silver	Silver	Zinc	Zinc
				Fraction	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	TOT	DIS	TOT	DIS	TOT	DIS	TOT
				Unit	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
				Method Detection Limit	5	0.005	0.02	0.05	0.1	0.05	0.05	0.02	0.1	0.005	0.04	0.04	0.005	0.01	0.1	1
SW - S - 03	SS	5/3/2019	N		703.	0.064	0.419	10.7	52.6	0.396	0.223	0.59	1.08	---	0.078	0.086	< 0.005	< 0.01	7.99	9.1
SW - S - 03	SS	10/8/2019			110.	0.021 6	0.066 8	14.5	19.8	0.337	0.338	1.04	1.02	---	0.146	0.14	< 0.005	< 0.005	8.14	6.18
SW - S - 03	SS	12/5/2019			48.7	0.047 2	0.031 1	16.3	16.9	0.447	0.258	0.767	0.814	---	0.12	0.124	< 0.005	< 0.005	7.88	5.
SW - S - 03	SS	2/6/2020			**5 930.** a	0.036 6	1.67	135.	237.	0.204	0.212	1.85	6.34	---	0.077	0.085	< 0.005	0.015	16.2	**34.7** a b
SW - S - 04	SS	5/3/2019	Y		76.1	0.392	0.078	1.5	10.	0.152	0.132	0.437	0.41	---	0.05	0.046	< 0.005	< 0.01	5.95	2.
SW - S - 04	FRM	10/8/2019			13.65	0.009 05	0.024 15	0.729	2.225	0.128	0.121	0.428	0.416	---	0.070 5	0.066	< 0.005	< 0.005	4.135	2.04
SW - S - 04	FRM	12/5/2019			16.5	0.028 25	0.023 5	0.767	2.695	0.206	0.130 5	0.468	0.426 5	---	0.062 5	0.067 5	< 0.005	< 0.005	4.57	1.475
SW - S - 04	FRM	2/6/2020			622.5	0.038 15	0.35	8.55	33.9	0.137 5	0.113 5	0.568 5	1.05	---	0.059 5	0.051 5	< 0.005	< 0.01	10.45	**13.2** b
SW - S - 04	FRM	3/17/2020			82.4	0.028 65	0.05	1.995	6.73	0.141	0.189	0.345 5	0.44	---	0.053 5	0.052	< 0.005	< 0.01	2.895	3.
SW - S - 12	SS	5/3/2019	N		435.	0.415	0.119	67.8	77.1	0.226	0.191	2.51	2.75	---	0.11	0.129	< 0.005	< 0.01	7.22	4.2
SW - S - 12	SS	10/8/2019			201.	0.019	0.149	4.45	9.76	0.7	0.244	5.86	5.96	---	0.226	0.251	< 0.005	< 0.005	5.77	5.38
SW - S - 12	SS	12/5/2019			387.	0.061 7	0.157	6.5	41.9	0.239	0.172	2.3	2.64	---	0.125	0.146	< 0.005	< 0.005	7.15	4.6
SW - S - 12	SS	2/6/2020			**9 250.** a	0.045 5	1.7	237.	390.	0.144	0.188	2.83	9.97	---	0.118	0.138	< 0.005	0.019	15.1	**34.** b
SW - S - 20	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	0 Null	Null	Null	Null
SW - S - 20	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	0 Null	Null	Null	Null
SW - S - 20	SS	2/6/2020			655.	0.039 2	0.11	6.61	15.9	0.066	0.051	0.225	0.54	---	< 0.04	< 0.04	< 0.005	< 0.01	34.8	**32.9** b
SW - S - 21	NS	5/2/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null
SW - S - 21	NS	10/8/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	0 Null	Null	Null	Null
SW - S - 21	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	0 Null	Null	Null	Null
SW - S - 21	SS	2/6/2020			219.	0.058 9	0.077	4.04	5.08	0.106	0.053	0.298	0.32	---	< 0.04	0.041	< 0.005	< 0.01	17.6	**17.9** b
SW - S - 24	SS	5/3/2019	N		496.	0.317	0.468	74.3	123.	0.19	0.183	0.597	0.99	---	0.048	0.056	< 0.005	< 0.01	7.18	8.
SW - S - 24	SS	10/8/2019			34.1	0.044 5	0.058 6	7.27	13.	0.155	0.168	0.646	0.605	---	0.071	0.071	< 0.005	< 0.005	7.95	4.19
SW - S - 24	SS	12/5/2019			23.2	0.028	0.023 5	5.68	8.87	0.176	0.166	0.635	0.625	---	0.067	0.06	< 0.005	< 0.005	6.71	2.9
SW - S - 24	SS	2/6/2020			**1 040.** a	0.046 6	0.625	31.9	66.2	0.288	0.166	1.08	1.83	---	0.07	0.063	< 0.005	< 0.01	12.9	**14.8** b
SW - S - 27	NS	5/2/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	Null	Null	Null	Null
SW - S - 27	NS	10/8/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	0 Null	Null	Null	Null
SW - S - 27	NS	12/5/2019		Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	0 Null	Null	Null	Null
SW - S - 27	SS	2/6/2020			163.	0.075 9	0.316	9.65	16.9	0.152	0.108	0.382	0.44	---	0.048	0.054	< 0.005	< 0.01	8.8	6.
SW - S - 52	NS	10/8/2019	N	Dry. No sample collected.	Null	Null	Null	Null	Null	Null	Null	Null	Null	---	Null	Null	0 Null	Null	Null	Null
SW - S - 52	SS	12/5/2019			8.6	0.005	0.035	0.3	0.361	0.05	0.06	0.037	0.098	---	< 0.04	< 0.04	< 0.005	< 0.005	3.67	6.06
SW - S - 52	SS	2/6/2020			11.	0.045 4	< 0.02	0.827	0.25	0.081	< 0.05	0.166	< 0.1	---	< 0.04	< 0.04	< 0.005	< 0.01	6.56	< 1.

Notes:

na — *Not applicable.*

a — *Above Maximum allowable concentration (MAC) British Columbia Water Quality Guideline.*

b — *Above 30-day average British Columbia Water Quality Guideline.*

(1) — *British Columbia Approved Water Quality Guidelines (Criteria), 1998 Edition, Updated in August 2019. British Columbia Ministry of Environment and a Compendium of Working Water Quality Guidelines for British Columbia, 1998 Edition, Updated in June 2017. British Columbia Ministry of Environment. The Guidelines cited specific to protection of freshwater aquatic life unless otherwise noted.*

(2) — *Maximum acceptable concentration unless otherwise noted.*

(3) — *The ammonia guideline is pH and temperature (15°C assumed) dependant. All ammonia results were compared to standards based on the associated pH and temperature results for that sample.*

(4) — *The nitrite guidelines are chloride dependant. All nitrite results were compared to standards based on the associated chloride result for that sample.*

(5) — *This value is hardness dependent. All metals results were compared to standards based on the associated hardness result for a particular sample.*

(6) — *This value is the short-term daily for streams with unknown fish distribution.*

(7) — *The TSS guidelines are "change from background" and flow condition dependent. The background TSS in the South landfill are derived from stations SW-S-52.*

B4. Monthly Leachate Quality Data – Hartland Valve Chamber

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2019-2020

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber	Hartland Valve Chamber	Hartland Valve Chamber	Hartland Valve Chamber	Hartland Valve Chamber	Hartland Valve Chamber	Hartland Valve Chamber	Hartland Valve Chamber
					FR1	FR2	FRM	SS	SS	NS	NS	SS
			min	max	11-Apr-2019	11-Apr-2019	11-Apr-2019	1-May-2019	4-Jun-2019	15-Jul-2019	6-Aug-2019	5-Sep-2019
CONVENTIONALS												
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	24	24	24	22.	48.	---	---	28.
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	380	340	360	340.	410.	---	---	560.
Total	COD	mg/L	---	1000	370	370	370	383.	396.	---	---	639.
Total	Conductivity	μS/cm	---	---	2540	2540	2540	4 123.	4 738.	---	---	5 726.
Total	Cyanide SAD	mg/L	---	1	0.00965	0.0102	0.0099	0.008 2	0.007 3	---	---	0.018
Total	Cyanide WAD	mg/L	---	1	0.00398	0.00414	0.00406	0.006 7	< 0.002 5	---	---	0.006 1
Total	Dissolved Oxygen	mg/L	---	---	0.64	0.64	0.64	1.8	1.76	---	---	3.96
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---
Total	N - Ammonia (As N)	mg/L	---	---	230	230	230	350.	310.	---	---	350.
Total	N - Nitrite (As N)	mg/L	---	---	3.89	3.61	3.750	1.61	0.568	---	---	0.019 3
Total	N - Nitrate (As N)	mg/L	---	---	13	12	13	5.98	1.81	---	---	< 0.02
Total	N - Nitrite+Nitrite (As N)	mg/L	---	---	17	16	16	8	2.38	---	---	0.04
Total	N - TKN (As N)	mg/L	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 1	< 1	< 1.	< 1.	< 1.	---	---	< 1.
Total	Oil & grease, total	mg/L	---	100	< 2	< 2	< 2.	< 2.	< 2.	---	---	< 2.
Total	ORP	mV	---	---	59.0	59.0	59	60.	- 107.5	---	---	6.3
Total	pH	pH	5.5	11	7.42	7.42	7.42	7.47	7.37	---	---	8.05
Dissolved	Sulphide	mg/L	---	1	0.037	0.032	0.0345	0.015	0.16	---	---	0.03
Total	Sulphide	mg/L	---	1	0.035	0.037	0.0360	0.029	0.12	---	---	0.015
Dissolved	Sulphate	mg/L	---	1500	38	32	35	47.	26.	---	---	26.
	Temperature	°C	---	---	13.6	13.6	14	16.	19.8	---	---	20.6
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.15	0.17	0.16	0.1	0.2	---	---	0.087
Total	TSS	mg/L	---	350	24	26	25	24.	21.	---	---	19.

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2019-2020

State	Parameter	Unit	Sewer Use Criteria		Hartland Valve Chamber FR1	Hartland Valve Chamber FR2	Hartland Valve Chamber FRM	Hartland Valve Chamber SS	Hartland Valve Chamber SS	Hartland Valve Chamber NS	Hartland Valve Chamber NS	Hartland Valve Chamber SS
			min	max	11-Apr-2019	11-Apr-2019	11-Apr-2019	1-May-2019	4-Jun-2019	15-Jul-2019	6-Aug-2019	5-Sep-2019
METALS												
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	0.4	1.09	1.13	1.11	5.82	5.43	---	---	11.1
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	0.3	0.0116	0.0129	0.0123	0.057	0.047	---	---	0.082
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4	8.27	9.36	8.82	40.5	31.3	---	---	67.3
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5	2.52	2.66	2.59	13.3	13	---	---	22.4
Total	Copper	µg/L	---	1	1.94	2.02	1.98	8.02	3.68	---	---	20.3
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50	363	378	371	1700	2070	---	---	2900
Total	Lead	µg/L	---	1	0.19	0.196	0.193	0.89	0.613	---	---	1.12
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5	123	126	125	650	780	---	---	679
Total	Mercury	µg/L	---	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.04	---	---	0.049
Total	Molybdenum	µg/L	---	5	0.55	0.703	0.6265	2.5	3.05	---	---	3.75
Total	Nickel	µg/L	---	3	7.94	7.91	7.925	40	37	---	---	64.3
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	0.3	0.069	0.101	0.085	0.33	0.324	---	---	0.66
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	0.5	< 0.01	< 0.01	< 0.01	< 0.05	0.032	---	---	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3	9.6	18.3	13.95	15.7	14.3	---	---	22.1
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---

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Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2019-2020

State	Parameter	Unit	Sewer Use Criteria min	Sewer Use Criteria max	Hartland Valve Chamber FR1 11-Apr-2019	Hartland Valve Chamber FR2 11-Apr-2019	Hartland Valve Chamber FRM 11-Apr-2019	Hartland Valve Chamber SS 1-May-2019	Hartland Valve Chamber SS 4-Jun-2019	Hartland Valve Chamber NS 15-Jul-2019	Hartland Valve Chamber NS 6-Aug-2019	Hartland Valve Chamber SS 5-Sep-2019
POLYCYCLIC AROMATIC HYDROCARBONS												
Total	Total PAHs	µg/L	---	0.05	1.6	1.9	1.7500	3.9	12.	---	---	4.7
LOW WEIGHT												
Total	2-Chloronaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---
Total	2-Methylnaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Acenaphthene	µg/L	---	---	0.082	0.044	0.063	1.5	2.7	---	---	1.1
Total	Acenaphthylene	µg/L	---	---	0.016	0.014	0.015	0.047	0.025	---	---	0.052
Total	Anthracene	µg/L	---	---	0.16	0.17	0.165	0.16	0.22	---	---	0.067
Total	Fluorene	µg/L	---	---	0.076	0.057	0.067	0.86	1.3	---	---	0.92
Total	Naphthalene	µg/L	---	---	0.012	< 0.01	0.011	0.21	5.3	---	---	0.033
Total	Phenanthrene	µg/L	---	---	0.45	0.57	0.510	0.14	0.64	---	---	0.53
Total	Total Lmw-Pah'S	µg/L	---	---	0.796	0.865	0.831	2.917	10.185	---	---	2.702
HIGH WEIGHT												
Total	Benzo(A)Anthracene	µg/L	---	---	0.052	0.082	0.067	0.053	0.029	---	---	0.091
Total	Benzo(A)Pyrene	µg/L	---	---	0.014	0.016	0.015	0.013	0.006 7	---	---	0.032
Total	Benzo(B)Fluoranthene + Benzo(J)Fluoranthene	µg/L	---	---	0.014	0.02	0.017	0.019	< 0.01	---	---	0.066
Total	Benzo(G,H,I)Perylene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	---	---	< 0.02
Total	Benzo(K)Fluoranthene	µg/L	---	---	< 0.01	< 0.01	0.01	< 0.01	< 0.01	---	---	0.02
Total	Chrysene	µg/L	---	---	0.054	0.076	0.065	0.053	0.03	---	---	0.11
Total	Dibenzo(A,H)Anthracene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	---	---	< 0.02
Total	Fluoranthene	µg/L	---	---	0.39	0.5	0.445	0.37	0.2	---	---	0.5
Total	Indeno(1,2,3-C,D)Pyrene	µg/L	---	---	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	---	---	< 0.02
Total	Pyrene	µg/L	---	---	0.3	0.4	0.35	0.26	0.14	---	---	0.35
Total	Total Hmw-Pah'S	µg/L	---	---	0.894	1.164	1.029	0.838	0.485 7	---	---	1.229
VOLATILE ORGANICS												
Dissolved	Benzene	µg/L	---	100.	0.47	0 0.48	0.48	< 0.4	0.63	---	---	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200.	0.59	0 0.59	0.59	0.62	0.79	---	---	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200.	0.59	0 0.64	0.62	0.5	0.47	---	---	< 0.4
Dissolved	Xylenes	µg/L	---	200	0.9	0 0.95	0.93	0.47	1.6	---	---	< 0.4

Notes:
a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922
b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922
--- = Not available.
FR1 - Field replicate 1.
FR2 - Field replicate 2.
FR3 - Field replicate 3.
FRM - Mean of field replicates.

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Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2019-2020

State	Parameter	Unit	Sewer Use Criteria min	Sewer Use Criteria max	Hartland Valve Chamber SS 17-Oct-2019	Hartland Valve Chamber SS 5-Nov-2019	Hartland Valve Chamber FR1 3-Dec-2019	Hartland Valve Chamber FR2 3-Dec-2019	Hartland Valve Chamber FRM 3-Dec-2019	Hartland Valve Chamber SS 21-Jan-2020	Hartland Valve Chamber FR1 20-Feb-2020	Hartland Valve Chamber FR2 20-Feb-2020	Hartland Valve Chamber FRM 20-Feb-2020	Hartland Valve Chamber SS 24-Mar-2020
CONVENTIONALS														
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	18.	20.	16.	18.	17.	22.	24.	25.	25	26.
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	450.	350.	370.	360.	365.	270.	270.	270.	270.	420.
Total	COD	mg/L	---	1000	562.	474.	402.	434.	418.	389.	404.	446.	425	550.
Total	Conductivity	µS/cm	---	---	3 796.	3 519.	3 242.	3 242.	3 242.	3 021.	2 852.	2 852.	2852	2 923.
Total	Cyanide SAD	mg/L	---	1	0.017 4	0.014 6	0.017 2	0.017 7	0.017 45	0.011 4	0.012 6	0.013 2	0.0129	0.011
Total	Cyanide WAD	mg/L	---	1	0.006 4	0.005 6	0.008 8	0.010 3	0.009 55	< 0.005	0.004 72	0.004 54	0.00463	< 0.005
Total	Dissolved Oxygen	mg/L	---	---	3.6	2.5	1.82	1.82	1.82	2.36	5.91	5.91	5.91	2.1
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Ammonia (As N)	mg/L	---	---	330.	290.	260.	270.	265.	240.	240.	250.	245	310.
Total	N - Nitrite (As N)	mg/L	---	---	0.524	7.69	1.8	1.79	1.795	1.1	0.421	0.408	0.4145	2.69
Total	N - Nitrate (As N)	mg/L	---	---	10.7	2.78	9.29	9.18	9.235	3.34	< 0.2	< 0.2	< 0.2	6.55
Total	N - Nitrite+Nitrite (As N)	mg/L	---	---	11.22	10.47	11.09	10.97	11.03	4.44	0.62	0.61	0.61	9.24
Total	N - TKN (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 1.	< 1.	1.3	< 1.	< 1.15	< 1.	< 1.	< 1.	< 1	< 1.
Total	Oil & grease, total	mg/L	---	100	< 2.	< 2.	< 2.	< 2.	< 2.	< 2.	< 2.	< 2.	< 2	< 2.
Total	ORP	mV	---	---	85.	68.	51.	51.	51.	30.	- 48.	- 48.	-48.0	17.
Total	pH	pH	5.5	11	7.8	7.69	7.37	7.37	7.37	7.54	7.51	7.51	7.51	8.17
Dissolved	Sulphide	mg/L	---	1	< 0.018	0.045	< 0.018	< 0.018	< 0.018	0.042	< 0.018	< 0.018	< 0.018	0.061
Total	Sulphide	mg/L	---	1	< 0.018	0.053	< 0.018	0.023	0.020 5	0.033	< 0.018	< 0.018	< 0.018	0.085
Dissolved	Sulphate	mg/L	---	1500	69.	140.	130.	130.	130.	90.	51.	49.	50	52.
	Temperature	°C	---	---	12.6	14.5	11.	11.	11.	13.4	11.2	11.2	11.2	13.3
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.19	0.21	0.18	0.25	0.215	0.23	0.3	0.3	0.3	0.33
Total	TSS	mg/L	---	350	20.	24.	24.4	26.	25.2	26.	8.8	12.	10.4	30.

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2019-2020

AECOM

State	Parameter	Unit	Sewer Use Criteria min	Sewer Use Criteria max	Hartland Valve Chamber SS 17-Oct-2019	Hartland Valve Chamber SS 5-Nov-2019	Hartland Valve Chamber FR1 3-Dec-2019	Hartland Valve Chamber FR2 3-Dec-2019	Hartland Valve Chamber FRM 3-Dec-2019	Hartland Valve Chamber SS 21-Jan-2020	Hartland Valve Chamber FR1 20-Feb-2020	Hartland Valve Chamber FR2 20-Feb-2020	Hartland Valve Chamber FRM 20-Feb-2020	Hartland Valve Chamber SS 24-Mar-2020
METALS														
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	0.4	7.52	8.38	7.31	7.37	7.34	8.28	9.31	9.76	9.535	8.1
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	0.3	0.131	0.071	0.054	0.051	0.0525	0.063	0.071	0.079	0.075	0.076
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4	56.1	46	40.2	41.9	41.05	47.2	42.9	45.5	44.2	49.1
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5	18.6	13	12.4	13.1	12.75	11.9	11.1	11.7	11.4	14.5
Total	Copper	µg/L	---	1	26.2	9.83	7.56	8.02	7.79	13.6	17	18.2	17.6	10.1
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50	1830	2000	1650	1730	1690	1580	2370	2450	2410	1880
Total	Lead	µg/L	---	1	1.08	0.906	0.685	0.692	0.6885	1.05	1.43	1.51	1.47	1.43
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5	718	787	753	777	765	550	591	631	611	652
Total	Mercury	µg/L	---	0.02	< 0.04	< 0.04	< 0.16	< 0.04	< 0.1	0.14	< 0.038	< 0.038	< 0.038	< 0.019
Total	Molybdenum	µg/L	---	5	2.39	2.12	2.28	2.46	2.37	2.63	3.21	2.7	2.955	1.89
Total	Nickel	µg/L	---	3	52.4	42.5	37.7	39.9	38.8	33.6	32	33.8	32.9	43.3
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	0.3	0.49	0.375	0.344	0.368	0.356	0.379	0.379	0.416	0.3975	0.47
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---		
Total	Silver	µg/L	---	0.5	< 0.05	< 0.02	0.02	0.021	0.0205	< 0.02	< 0.02	< 0.02	< 0.02	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3	22.8	17.8	14.9	16.5	15.7	21.4	21	22.6	21.8	19.3
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---

Appendix B-4. Monthly Leachate Quality Data - Hartland Valve Chamber 2019-2020

AECOM

State	Parameter	Unit	Sewer Use Criteria min	Sewer Use Criteria max	Hartland Valve Chamber SS 17-Oct-2019	Hartland Valve Chamber SS 5-Nov-2019	Hartland Valve Chamber FR1 3-Dec-2019	Hartland Valve Chamber FR2 3-Dec-2019	Hartland Valve Chamber FRM 3-Dec-2019	Hartland Valve Chamber SS 21-Jan-2020	Hartland Valve Chamber FR1 20-Feb-2020	Hartland Valve Chamber FR2 20-Feb-2020	Hartland Valve Chamber FRM 20-Feb-2020	Hartland Valve Chamber SS 24-Mar-2020
POLYCYCLIC AROMATIC HYDROCARBONS														
Total	Total PAHs	µg/L	---	0.05	7.	26	11.	11.	11.	11.	15.	15.	15	8.6
LOW WEIGHT														
Total	2-Chloronaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	2-Methylnaphthalene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Acenaphthene	µg/L	---	---	2	5.4	2.7	2.4	2.55	3.4	3.8	3.8	3.8	3.4
Total	Acenaphthylene	µg/L	---	---	0.035	0.076	0.049	0.048	0.0485	0.064	0.056	0.054	0.055	0.04
Total	Anthracene	µg/L	---	---	0.13	0.95	0.24	0.27	0.255	0.52	0.38	0.39	0.385	0.37
Total	Fluorene	µg/L	---	---	1.1	3.7	1.6	1.5	1.55	2	2.2	2.2	2.2	2
Total	Naphthalene	µg/L	---	---	0.44	0.15	0.29	0.24	0.265	1.1	2.3	2.2	2.25	0.021
Total	Phenanthrene	µg/L	---	---	0.66	5	1.2	1.3	1.25	1.1	1.6	2	1.8	0.52
Total	Total Lmw-Pah'S	µg/L	---	---	4.365	15.276	6.079	5.758	5.9185	8.184	10.336	10.644	10.49	6.351
HIGH WEIGHT														
Total	Benzo(A)Anthracene	µg/L	---	---	0.06	0.74	0.086	0.11	0.098	0.16	0.12	0.12	0.12	0.094
Total	Benzo(A)Pyrene	µg/L	---	---	0.009 9	0.23	0.019	0.022	0.0205	0.043	0.026	0.024	0.025	0.019
Total	Benzo(B)Fluoranthene + Benzo(J)Fluoranthene	µg/L	---	---	0.014	0.38	0.026	0.029	0.0275	0.07	0.041	0.037	0.039	0.027
Total	Benzo(G,H,I)Perylene	µg/L	---	---	< 0.02	0.091	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Benzo(K)Fluoranthene	µg/L	---	---	< 0.01	0.13	0.011	0.012	0.0115	0.022	0.014	0.012	< 0.013	0.011
Total	Chrysene	µg/L	---	---	0.069	0.75	0.083	0.11	0.0965	0.14	0.11	0.11	0.11	0.094
Total	Dibenzo(A,H)Anthracene	µg/L	---	---	< 0.02	0.029	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Fluoranthene	µg/L	---	---	0.58	4.6	0.58	0.76	0.67	1	1.1	1.2	1.15	0.86
Total	Indeno(1,2,3-C,D)Pyrene	µg/L	---	---	< 0.02	0.06	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Pyrene	µg/L	---	---	0.38	2.8	0.41	0.54	0.475	0.72	0.75	0.78	0.765	0.57
Total	Total Hmw-Pah'S	µg/L	---	---	1.182 9	9.81	1.275	1.643	1.459	2.215	6.592	11.909	9.2505	1.735
VOLATILE ORGANICS														
Dissolved	Benzene	µg/L	---	100.	< 0.4	0.5	0.63	0.64	0.635	0.51	0.68	0.72	0.7	0.62
Dissolved	Ethylbenzene	µg/L	---	200.	< 0.4	< 0.4	0.57	0.58	0.575	< 0.4	1.3	1.3	1.3	1.2
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200.	< 0.4	0.48	< 0.4	0.42	0.41	0.82	2.4	2.4	2.4	0.8
Dissolved	Xylenes	µg/L	---	200	0.49	0.58	1.4	1.4	1.4	1.4	4	4	4	2.8

Notes:
a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922
b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922
--- = Not available.
FR1 - Field replicate 1.
FR2 - Field replicate 2.
FR3 - Field replicate 3.
FRM - Mean of field replicates.

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B5. Quarterly Leachate Quality – Trace Organics

Appendix B-5. Quarterly Leachate Quality - Trace Organics - 2019-2020

AECOM

Sate	Parameters	Unit	Sewer Use Criteria		Hartland Valve Chamber FR1 11-Apr-2019	Hartland Valve Chamber FR2 11-Apr-2019	Hartland Valve Chamber FRM 11-Apr-2019	Hartland Valve Chamber SS 5-Sep-2019	Hartland Valve Chamber SS 5-Nov-2019	Hartland Valve Chamber SS 19-Jan-2020
			min	max						
PHTHALATE ESTERS										
TOT	Bis(2-Ethylhexyl)Phthalate	µg/L	---	---	---	---	---	---	---	---
NA	N-Butylbenzyl Phthalate	µg/L	---	---	---	---	---	---	---	---
PHENOLS - HALOGENATED										
TOT	2,4 + 2,5 Dichlorophenol	µg/L	---	---	< 0.5	< 0.5	< 0.5	0.1	< 0.5	< 0.1
TOT	2,4,6-trichlorophenol	µg/L	---	---	< 0.5	< 0.5	< 0.5	< 0.1	< 0.5	< 0.1
TOT	2-Chlorophenol	µg/L	---	---	< 0.5	< 0.5	< 0.5	< 0.1	< 0.5	< 0.08
NA	Pentachlorophenol	µg/L	---	---	< 0.5	< 0.5	< 0.5	< 15.	< 0.5	< 0.1
PHENOLS - NON-HALOGENATED										
TOT	2-Methyl-4,6-Dinitrophenol	µg/L	---	---	---	---	---	---	---	---
TOT	Phenol	µg/L	---	---	---	---	---	---	---	---
TOTAL CHLORINATED PHENOLIC COMPOUNDS										
TOT	Chlorinated phenols (total)	µg/L	---	---	< 0.5	< 0.5	< 0.5	< 15	< 0.5	< 0.1
TOT	Total Dichlorophenols	µg/L	---	---	< 0.5	< 0.5	< 0.5	0.1	< 0.5	< 0.1
TOT	Total Monochlorophenols	µg/L	---	---	< 0.5	< 0.5	< 0.5	< 0.1	< 0.5	< 0.08
TOT	Total Nonchlorinated phenols	µg/L	---	---	< 0.5	< 0.5	< 0.5	< ---	< 50	< 10
TOT	Total Tetrachlorophenols	µg/L	---	---	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.1
TOT	Total Trichlorophenols	µg/L	---	---	< 0.5	< 0.5	< 0.5	< 0.1	< 0.5	< 0.1
TOT	Total Phenolic Compounds	µg/L	---	---	< 0.5	< 0.5	< 0.5	---	< 50	< 10
ETHERS - HALOGENATED										
TOT	4-Bromophenyl Phenyl Ether	µg/L	---	---	---	---	---	---	---	---
TOT	Bis(2-Chloroethoxy)Methane	µg/L	---	---	---	---	---	---	---	---
TOT	Bis(2-Chloroethyl)Ether	µg/L	---	---	---	---	---	---	---	---
TOT	Bis(2-Chloroisopropyl)Ether	µg/L	---	---	---	---	---	---	---	---
TOT	N-Nitrosodimethylamine	µg/L	---	---	---	---	---	---	---	---
TOT	N-Nitrosodi-N-Propylamine	µg/L	---	---	---	---	---	---	---	---
TOT	N-Nitrosodiphenylamine	µg/L	---	---	---	---	---	---	---	---
TOT	1,2-diphenylhydrazine	µg/L	---	---	---	---	---	---	---	---
TOT	3,3-dichlorobenzidine	µg/L	---	---	---	---	---	---	---	---
TOT	Alpha-Terpineol	µg/L	---	---	---	---	---	---	---	---
TOT	Hexachlorobutadiene	µg/L	---	---	---	---	---	---	---	---
TOT	Hexachlorocyclopentadiene	µg/L	---	---	---	---	---	---	---	---
TOT	Isophorone	µg/L	---	---	---	---	---	---	---	---
ALKANES - HALOGENATED										
TOT	Hexachloroethane	µg/L	---	---	---	---	---	---	---	---
OTHER ORGANICS										
TOT	1,1,1,2-Tetrachloroethane	µg/L	---	---	---	---	---	---	---	---
TOT	1,1,1-trichloroethane	µg/L	---	---	---	---	---	---	---	---
TOT	1,1,2,2-tetrachloroethane	µg/L	---	---	---	---	---	---	---	---
TOT	1,1,2Trichloro-1,2,2Trifluoroethane	µg/L	---	---	---	---	---	---	---	---
TOT	1,1,2-trichloroethane	µg/L	---	---	---	---	---	---	---	---
TOT	1,1-dichloroethane	µg/L	---	---	---	---	---	---	---	---
TOT	1,1-dichloroethene	µg/L	---	---	---	---	---	---	---	---
TOT	1,2,3-Trichlorobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	1,2,4-trichlorobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	1,2-dichlorobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	1,2-dichloroethane	µg/L	---	---	---	---	---	---	---	---
TOT	1,2-dichloropropane	µg/L	---	---	---	---	---	---	---	---
TOT	1,3,5-trimethylbenzene	µg/L	---	---	---	---	---	---	---	---
TOT	1,3-Butadiene	µg/L	---	---	---	---	---	---	---	---
TOT	1,3-dichlorobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	1,3-dichloropropane	µg/L	---	---	---	---	---	---	---	---
TOT	1,4-dichlorobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	1-Methylnaphthalene	µg/L	---	---	---	---	---	---	---	---
TOT	2,3,4,5-tetrachlorophenol	µg/L	---	---	< 0.5	< 0.5	0.5	< 0.1	< 0.5	< 0.1
TOT	2,3,4,6-tetrachlorophenol	µg/L	---	---	< 0.5	< 0.5	0.5	< 0.1	< 0.5	< 0.1
TOT	2,3,5,6-tetrachlorophenol	µg/L	---	---	< 0.5	< 0.5	0.5	< 0.5	< 0.5	< 0.1
TOT	2,4-dimethylphenol	µg/L	---	---	---	---	---	---	---	---
TOT	2,4-dinitrophenol	µg/L	---	---	---	---	---	---	---	---
TOT	2,4-dinitrotoluene	µg/L	---	---	---	---	---	---	---	---
TOT	2,6-dinitrotoluene	µg/L	---	---	---	---	---	---	---	---
TOT	2-Nitrophenol	µg/L	---	---	---	---	---	---	---	---
NA	4,6-dinitro-2-methylphenol	µg/L	---	---	---	---	---	---	---	---
TOT	4-Chloro-3-Methylphenol	µg/L	---	---	---	---	---	---	---	---
TOT	4-Chlorophenyl Phenyl Ether	µg/L	---	---	---	---	---	---	---	---
TOT	4-Methyl-2-Pentanone	µg/L	---	---	---	---	---	---	---	---
TOT	4-Nitrophenol	µg/L	---	---	---	---	---	---	---	---
TOT	Acridine	µg/L	---	---	---	---	---	---	---	---
TOT	Acrolein	µg/L	---	---	---	---	---	---	---	---
TOT	Acrylonitrile	µg/L	---	---	---	---	---	---	---	---
TOT	Benzidine	µg/L	---	---	---	---	---	---	---	---
TOT	Bromobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	Bromodichloromethane	µg/L	---	---	---	---	---	---	---	---
TOT	Bromomethane	µg/L	---	---	---	---	---	---	---	---
TOT	Butylbenzyl Phthalate	µg/L	---	---	---	---	---	---	---	---
NA	Carbon Tetrachloride	µg/L	---	---	---	---	---	---	---	---
TOT	Chlorobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	Chlorodibromomethane	µg/L	---	---	---	---	---	---	---	---
TOT	Chloroethane	µg/L	---	---	---	---	---	---	---	---
TOT	Chloroethene	µg/L	---	---	---	---	---	---	---	---
NA	Chloroform	µg/L	---	---	---	---	---	---	---	---
TOT	Chloromethane	µg/L	---	---	---	---	---	---	---	---
TOT	Cis-1,2-Dichloroethene	µg/L	---	---	---	---	---	---	---	---
TOT	cis-1,3-dichloropropene	µg/L	---	---	---	---	---	---	---	---
TOT	Csr Vph C6-C10 (Vh Minus Btex)	µg/L	---	---	---	---	---	---	---	---
TOT	Dibromoethane	µg/L	---	---	---	---	---	---	---	---
NA	Dibromomethane	µg/L	---	---	---	---	---	---	---	---
TOT	Dichlorodifluoromethane	µg/L	---	---	---	---	---	---	---	---
TOT	Dichloromethane	µg/L	---	---	---	---	---	---	---	---
TOT	Diethyl Phthalate	µg/L	---	---	---	---	---	---	---	---
TOT	Dimethyl Ketone	µg/L	---	---	---	---	---	---	---	---
TOT	Dimethyl Phthalate	µg/L	---	---	---	---	---	---	---	---
TOT	Di-N-Butyl Phthalate	µg/L	---	---	---	---	---	---	---	---
TOT	Di-N-Octyl Phthalate	µg/L	---	---	---	---	---	---	---	---
TOT	Isopropylbenzene	µg/L	---	---	---	---	---	---	---	---
TOT	Methyl Ethyl Ketone	µg/L	---	---	---	---	---	---	---	---
TOT	Nitrobenzene	µg/L	---	---	---	---	---	---	---	---
TOT	PCP	µg/L	---	---	---	---	---	---	---	---
TOT	Quinoline	µg/L	---	---	---	---	---	---	---	---
TOT	Sulfolane	µg/L	---	---	---	---	---	---	---	---
TOT	Tetrabromomethane	µg/L	---	---	---	---	---	---	---	---
TOT	Tetrachloroethene	µg/L	---	---	---	---	---	---	---	---
TOT	Tetrachloromethane	µg/L	---	---	---	---	---	---	---	---
TOT	Trans-1,2-Dichloroethene	µg/L	---	---	---	---	---	---	---	---
TOT	trans-1,3-dichloropropene	µg/L	---	---	---	---	---	---	---	---
TOT	Tribromomethane	µg/L	---	---	---	---	---	---	---	---
TOT	Trichloroethene	µg/L	---	---	---	---	---	---	---	---
TOT	Trichlorofluoromethane	µg/L	---	---	---	---	---	---	---	---
TOT	Trichloromethane	µg/L	---	---	---	---	---	---	---	---
TOT	VH C6-C10	µg/L	---	---	---	---	---	---	---	---
NA	Vinyl Chloride	µg/L	---	---	---	---	---	---	---	---

Notes:
a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922
b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.
--- = Not available.
FR1 - Field replicate 1.
FR2 - Field replicate 2.
FRM - Mean of field replicates.

AECOM

B6. Monthly Leachate Quality – Phase 2 Cleanout

Appendix B6. Monthly Leachate Quality - Phase 2 Cleanout - 2019-2020

AECOM

State	Parameter	Units	Sewer Use Criteria min	Sewer Use Criteria max	Phase 2 Cleanout SS 11-Apr-2019	Phase 2 Cleanout SS 1-May-2019	Phase 2 Cleanout SS 4-Jun-2019	Phase 2 Cleanout SS 15-Jul-2019	Phase 2 Cleanout SS 6-Aug-2019	Phase 2 Cleanout NS 5-Sep-2019	Phase 2 Cleanout SS 17-Oct-2019	Phase 2 Cleanout SS 5-Nov-2019	Phase 2 Cleanout SS 3-Dec-2019	Phase 2 Cleanout SS 21-Jan-2020	Phase 2 Cleanout SS 21-Feb-2020	Phase 2 Cleanout SS 24-Mar-2020
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	50	55.	49.	36.	70.	---	69.	23.	24.	37.	41.	32.
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
DIS	Chloride	mg/L	---	1500	630	680.	860.	540.	980.	---	760.	1600 a	450.	1 100.	510.	410.
Total	COD	mg/L	---	1000	1080 a	1080 a	1140 a	814.	1610 a	---	1080 a	2240 a	560.	969.	877.	465.
Total	Conductivity	µS/cm	---	---	4920	10 022.	11 806.	7 979.	12 828.	---	9 226.	8 907.	5 178.	4 929.	6 777.	3 062.
Total	Cyanide SAD	mg/L	---	1	0.0106	0.013	< 0.01	0.016 7	0.02	---	0.021	0.238	0.019 9	0.029	< 0.01	0.006 4
Total	Cyanide WAD	mg/L	---	1	< 0.0025	0.011	< 0.01	0.002 7	< 0.01	---	< 0.01	0.02	0.010 9	< 0.01	< 0.01	< 0.005
Total	Dissolved Oxygen	mg/L	---	---	0.03	0.02	0.05	0.1	---	0.22	0.05	0.17	0.36	0.27	0.94	---
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	650	710.	820.	490.	840.	---	810.	650.	490.	350.	530.	320.
Total	N - NO2 (As N)	mg/L	---	---	0.102	< 0.5	< 0.5	0.103	< 0.5	---	0.123	60.6	0.098	0.126	0.109	0.134
Total	N - NO3 (As N)	mg/L	---	---	< 0.2	< 2.	< 2.	< 0.2	< 2.	---	< 0.2	86.2	< 0.2	< 0.2	< 0.2	< 0.2
Total	N - NO3 + NO2 (As N)	mg/L	---	---	0.302	2.5	0.302	0.303	2.5	---	0.323	146.8	0.298	0.326	0.309	0.334
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 1	< 1.	< 1.	< 1.	< 1.	---	< 1.	< 1.	< 1.	< 1.	< 1.	< 1.
Total	Oil & grease, total	mg/L	---	100	< 2	< 2.	< 2.	< 2.	< 2.	---	< 2.	< 2.	< 2.	< 2.	< 2.	< 2.
Total	ORP	mV	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	pH	pH	5.5	11	7.49	7.53	7.38	7.7	---	7.63	7.75	7.25	7.41	7.39	7.55	---
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	0.	0.	---	---	---
Total	Sulphide	mg/L	---	1	0.15	4.3 a	3.4 a	5.1 a	1.3 a	---	2.9 a	0.027	2.1 a	1.2 a	0.68	1.6 a
Total	Sulphate	mg/L	---	1500	< 10	< 10.	< 10.	< 10.	< 10.	---	< 10.	150.	140.	42.	13.	160.
Total	Temperature	°C	---	---	22.7	25.7	24.3	25.2	25.9	---	24.4	24.6	20.9	22.8	21.6	23.
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.62	1.2 a	0.98	0.81	1.4 a	---	0.75	0.15	0.52	0.48	0.86	0.5
Total	TSS	mg/L	---	350	4	5.	< 3.	4.	4.	---	8.6	10.	12.	12.	12.	2.
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	1.21	11.6	14.6	8.27	15.7	---	14.7	63.4	8.15	9.71	12.2	5.68
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.008 5	0.077	0.133	0.059	0.097	---	0.121	0.366	0.068	0.079	0.086	0.047
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	10.2	110.	126.	73.6	144.	---	123.	350.	60.4	92.8	97.6	43.4
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	2.62	28.7	32.7	22.2	36.8	---	33.6	76.6	18.1	25.4	23.	12.8
Total	Copper	µg/L	---	1000	0.53	3.5	3.77	1.21	1.34	---	5.19	100.	3.94	5.38	7.93	3.42
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	87.9	645.	661.	518.	876.	---	1 400.	4 700.	1 370.	1 350.	1 400.	2 530.
Total	Lead	µg/L	---	1000	0.161	1.65	1.99	0.89	2.53	---	2.24	4.34	1.14	1.62	2.07	0.8
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	81.5	417.	525.	822.	475.	---	524.	399.	808.	423.	690.	247.
Total	Mercury	µg/L	---	20	< 0.02	< 0.02	0.006	< 0.002	< 0.002	---	< 0.04	< 0.04	< 0.04	< 0.04	< 0.038	< 0.019
Total	Molybdenum	µg/L	---	5000	0.316	1.33	1.59	1.13	1.87	---	1.61	11.3	1.25	1.61	2.45	1.39
Total	Nickel	µg/L	---	3000	8.51	98.5	108.	75.5	128.	---	98.8	228.	55.9	78.4	70.2	37.
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.076	0.49	0.59	0.54	0.69	---	0.53	3.24	0.35	0.55	0.51	0.29
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	< 0.01	< 0.1	0.094	< 0.05	0.073	---	0.053	< 0.1	< 0.05	< 0.05	< 0.05	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	9.3	23.	27.6	19.	32.5	---	26.2	96.	14.7	19.1	24.5	12.8
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	1.7	1.6	1.6	1.3	1.5	---	1.3	< 0.4	1.4	0.76	2.1	0.77
Dissolved	Ethylbenzene	µg/L	---	200	3.6	5	3.8	1.8	3.5	---	2.5	< 0.4	1.7	1.6	8.4	1.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	1.4	1.8	1.5	0.91	1.7	---	1.1	< 0.4	0.64	0.96	5.2	0.71
Dissolved	Xylenes	µg/L	---	200	5.8	7.6	5.8	3.4	5.7	---	4.5	< 0.4	3.1	3.2	15.	2.9

Notes:

a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.

b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.

--- = Not available.

FR1 - Field replicate 1.

FR2 - Field replicate 2.

FRM - Mean of field replicates.

AECOM

B7. Monthly Leachate Quality – North Purge Wells

Appendix B-7. Monthly Leachate Quality - North Purge Well 2019-2020

AECOM

State	Parameters	Unit	Sewer Use Criteria		North Purge Well System SS 11-Apr-2019	North Purge Well System SS 1-May-2019	North Purge Well System SS 4-Jun-2019	North Purge Well System SS 15-Jul-2019	North Purge Well System SS 6-Aug-2019	North Purge Well System NS 5-Sep-2019	North Purge Well System SS 17-Oct-2019	North Purge Well System SS 5-Nov-2019	North Purge Well System SS 3-Dec-2019	North Purge Well System SS 21-Jan-2020	North Purge Well System SS 21-Feb-2020	North Purge Well System SS 24-Mar-2020
			min	max												
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	12	16	98	17	20	---	13	17	7.3	8.9	11	12
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	240	250	290	350	290	---	330	330	400	180	190	290
Total	COD	mg/L	---	1000	200	158	191	237	225	---	256	264	253	141	181	260
Total	Conductivity	µS/cm	---	---	2753	2971	3237	3306	3222	---	3196	3236	3157	1945	1957	2685
Total	Cyanide SAD	mg/L	---	1	0.00262	0.00118	0.00255	0.00371	0.00363	---	0.00399	0.00475	0.00411	0.00237	0.0031	< 0.0025
Total	Cyanide WAD	mg/L	---	1	0.00053	0.00106	0.00068	< 0.0005	< 0.0005	---	0.00097	0.0009	0.00084	< 0.0005	< 0.0005	< 0.0025
Total	Dissolved Oxygen	mg/L	---	---	0.63	1.45	0.42	0.09	0.13	---	0.76	0.18	0.16	0.21	0.11	0.14
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Nh3 (As N)	mg/L	---	---	120	120	140	120	140	---	150	0.54	150	88	130	160
Total	N - No2 (As N)	mg/L	---	---	0.0184	< 0.05	0.0181	0.0546	0.0205	---	0.0229	0.695	0.0161	0.0254	< 0.05	0.0333
Total	N - No3 (As N)	mg/L	---	---	1.26	1.04	0.432	0.881	0.155	---	3.72	0.0269	1.28	1.12	1.29	0.416
Total	N - No3 + No2 (As N)	mg/L	---	---	1.2784	1.09	0.4501	0.9356	0.1755		3.7429	0.7219	1.2961	1.1454	1.34	0.4493
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2	2	< 2	< 2	< 2	---	< 2	< 2	< 2	< 2	< 2	< 2
Total	Oil & grease, total	mg/L	---	100	< 1	< 1	< 1	< 1	1	---	< 1	< 1	< 1	< 1	< 1	< 1
Total	ORP	mV	---	---	-101	-81	-97	-175	-79	---	-71	-95	-100	-110	-92	-127
Total	pH	pH	5.5	11	6.68	6.66	6.63	6.75	6.66	---	6.77	6.86	6.69	6.93	6.93	7.5
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	0.0089	< 0.0095	0.011	0.021	0.0065	---	0.012	0.024	0.051	0.019	< 0.018	0.026
Dissolved	Sulphate	mg/L	---	1500	19.4	< 10	17.6	15	15	---	23	35	34	60	51	34
Total	Temperature	°C	---	---	15.6	17.2	18	18.9	18.8	---	17.4	18.4	18	14.1	13.5	16
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.021	0.027	0.017	0.039	0.029	---	0.016	0.05	0.025	0.016	0.029	0.051
Total	TSS	mg/L	---	350	24	28	13	40	33	---	32	37	50.7	20	32	32
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	0.938	3.91	4.67	6.57	4.88	---	4.39	6.06	6.44	3.21	4.84	5.94
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	< 0.005	< 0.025	0.013	< 0.01	< 0.01	---	0.011	0.013	0.013	0.0141	0.0359	0.039
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4 000.	< 0.005	< 0.025	0.013	< 0.01	< 0.01	---	0.011	0.013	0.013	0.0141	0.0359	0.039
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	1.15	5.32	6.02	6.46	6.33	---	6.84	7.22	6.68	4.3	4.86	7.24
Total	Copper	µg/L	---	1000	0.66	2.55	1.8	1.89	0.79	---	2.33	3.13	1.99	4.63	6.62	4.84
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50 000.	2160	11700	12600	17400	12900	---	11200	17700	16800	6930	7760	8420
Total	Lead	µg/L	---	1 000.	< 0.02	< 0.1	< 0.04	0.049	< 0.04	---	< 0.04	< 0.04	< 0.04	0.076	0.192	0.27
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	199	1070	1150	1150	1280	---	1220	1230	1160	695	617	935
Total	Mercury	µg/L	---	20	0.0051	< 0.002	< 0.002	< 0.002	< 0.002	---	< 0.04	< 0.002	< 0.04	< 0.002	< 0.038	< 0.019
Total	Molybdenum	µg/L	---	5000	0.382	0.99	1.33	1.15	1.41	---	1.16	1.22	1.18	1.18	1.54	1.21
Total	Nickel	µg/L	---	3000	2.96	14.3	14.6	15.7	15.5	---	17.1	18.7	16.7	9.92	12.3	19.5
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.06	< 0.2	0.143	0.23	0.156	---	0.164	0.208	0.181	0.204	0.193	0.28
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	< 0.01	< 0.05	< 0.02	< 0.02	< 0.02	---	< 0.02	< 0.02	< 0.02	< 0.01	< 0.01	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	
Total	Zinc	µg/L	---	3000	7.9	< 5	2.7	3.8	< 2	---	< 2	< 2	2.8	3.9	7.6	14.8
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.4	< 0.4	< 0.4	< 0.4	0.46	< 0.4
Dissolved	Xylenes	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.4	< 0.4	< 0.4	< 0.4	0.42	< 0.4

Notes:

a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.

b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.

--- = Not available.

B8. Monthly Leachate Quality – Controlled Waste Drainage

Appendix B-8. Monthly Leachate Quality - Controlled Waste Drainage 2019-2020

AECOM

States	Parameter	Units	Sewer Use Criteria min	Sewer Use Criteria max	Controlled Waste Ditch SS 11-Apr-2019	Controlled Waste Ditch SS 1-May-2019	Controlled Waste Ditch SS 4-Jun-2019	Controlled Waste Ditch SS 15-Jul-2019	Controlled Waste Ditch SS 6-Aug-2019	Controlled Waste Ditch NS 5-Sep-2019	Controlled Waste Ditch SS 17-Oct-2019	Controlled Waste Ditch SS 5-Nov-2019	Controlled Waste Ditch SS 3-Dec-2019	Controlled Waste Ditch SS 21-Jan-2020	Controlled Waste Ditch SS 21-Feb-2020	Controlled Waste Ditch SS 24-Mar-2020
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	90	25	76	56	37	---	18	20	42	36	---	35
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Chloride	mg/L	---	1500	430	620	670	570	670	---	360	600	610	350	440	680
Total	COD	mg/L	---	1000	560	605	692	695	758	---	380	686	626	362	503	622
Total	Conductivity	µS/cm	---	---	4520	6906	7303	6622	7530	---	3563	5316	5117	3462	4587	5389
Total	Cyanide SAD	mg/L	---	1	0.0129	< 0.005	0.0179	0.0149	0.0151	---	0.0137	0.017	0.0149	0.0085	0.0079	0.0124
Total	Cyanide WAD	mg/L	---	1	0.00477	0.008	< 0.0025	0.00259	0.00263	---	0.005	0.0026	< 0.005	< 0.0025	< 0.005	< 0.005
Total	Dissolved Oxygen	mg/L	---	---	0.88	6.95	6.8	3.23	2.21	---	7.62	5.86	6.66	5.56	4.69	7.16
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	250	490	570	400	550	---	270	320	440	230	380	650
Total	N - NO2 (As N)	mg/L	---	---	6.17	2.82	17.1	8.86	5.26	---	2.42	0.7	2.17	1.78	3.65	0.823
Total	N - NO3 (As N)	mg/L	---	---	74	< 2	4.4	5.69	0.51	---	46.7	2.9	1.39	14.9	11.9	1.16
Total	N - NO3 + NO2 (As N)	mg/L	---	---	80.17	4.82	21.5	14.55	5.77	---	49.12	3.6	3.56	16.68	15.55	1.983
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2	< 2	< 2	< 2
Total	Oil & grease, total	mg/L	---	100	< 1	< 1	< 1	< 1	< 1	---	< 1	< 1	< 1	< 1	< 1	< 1
Total	ORP	mV	---	---	0.0	-7.0	11.3	14.0	47.0	---	14.0	23.0	18.0	22.0	13.0	2.0
Total	pH	pH	5.5	11	7.99	8.26	6.89	8.35	8.22	---	8.39	8.62	6.55	8.13	8.27	8.76
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	0.014	0.039	0.027	0.019	0.025	---	0.02	< 0.018	< 0.018	< 0.018	< 0.018	< 0.009
Dissolved	Sulphate	mg/L	---	1500	< 10	< 10	< 10	< 10	< 10	---	26	< 10	< 10	11	< 10	< 10
Total	Temperature	°C	---	---	16.3	17.7	19.3	21	22.9	---	18.4	16.5	14.9	15.7	17	15.7
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.045	0.046	0.094	0.07	0.058	---	0.019	0.061	0.079	0.037	0.038	0.015
Total	TSS	mg/L	---	350	105	22	12	6	8	---	12	2	10	11	---	26
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	1.21	6.58	6.73	6.84	6.98	---	4.18	5.9	6.2	4.51	6.05	6.09
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.0388	< 0.05	0.033	0.03	< 0.025	---	0.101	< 0.025	0.03	0.093	0.065	< 0.025
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	12.5	53.1	50.5	49.3	52.5	---	30.9	39.1	39.6	33.8	35.3	37.2
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	4.19	26	25.7	26.2	27.5	---	17	22.1	23.1	15.1	17.3	20.2
Total	Copper	µg/L	---	1000	8.12	5.3	1.15	5.29	2.15	---	23.5	0.76	1.22	14.2	8.83	0.94
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	2040	4010	3340	3180	3840	---	1660	2640	2630	1890	2870	3410
Total	Lead	µg/L	---	1000	0.337	0.24	0.12	0.18	0.79	---	0.506	0.14	0.17	0.399	0.417	0.15
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	530	518	484	286	184	---	1060	209	254	1620	1920	742
Total	Mercury	µg/L	---	20	< 0.02	< 0.02	< 0.04	< 0.002	< 0.002	---	0.043	< 0.04	< 0.04	< 0.04	< 0.038	< 0.019
Total	Molybdenum	µg/L	---	5000	0.579	1.86	1.77	2.13	2.09	---	1.97	1.41	1.52	1.56	1.49	1.02
Total	Nickel	µg/L	---	3000	12.6	68	59.3	59.7	62	---	46.1	51.7	51.2	40	42.6	43
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.131	0.63	0.79	0.76	0.69	---	0.479	0.63	0.69	0.47	0.5	0.63
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	0.017	< 0.1	< 0.05	< 0.05	< 0.05	---	0.046	< 0.05	< 0.05	< 0.02	< 0.02	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	23.4	41	43.1	38.8	44.4	---	22.9	19.8	28.4	29.8	36.8	28.2
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ethe	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.8	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Dissolved	Xylenes	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	---	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4

Notes:

a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.

b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.

--- = Not available.

AECOM

B9. Monthly Leachate Quality – Markham Valve Chamber

Appendix B-9. Leachate Quality - Markham Valve Chamber 2019-2020

AECOM

State	Parameter	Units	Sewer Use Criteria min	Sewer Use Criteria max	Markham Valve Chamber SS 11-Apr-2019	Markham Valve Chamber SS 1-May-2019	Markham Valve Chamber SS 4-Jun-2019	Markham Valve Chamber NS 15-Jul-2019	Markham Valve Chamber NS 6-Aug-2019	Markham Valve Chamber NS 5-Sep-2019	Markham Valve Chamber SS 17-Oct-2019	Markham Valve Chamber SS 5-Nov-2019	Markham Valve Chamber SS 10-Dec-2018	Markham Valve Chamber SS 3-Jan-2020	Markham Valve Chamber SS 27-Feb-2020	Markham Valve Chamber SS 24-Mar-2020
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	22	17	51	---	---	---	19	18	14	20	32	22
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chloride	mg/L	---	1500	330	340	400	---	---	---	450	340	420	270	300	440
Total	COD	mg/L	---	1000	370	395	463	---	---	---	577	458	607	401	428	515
Total	Conductivity	µS/cm	---	---	3603	3720	4861	---	---	---	2620	3354	2053	2850	2837	3627
Total	Cyanide SAD	mg/L	---	1	0.0103	0.0089	0.008	---	---	---	0.0136	0.0143	0.0166	0.0102	0.0121	0.0102
Total	Cyanide WAD	mg/L	---	1	0.00302	0.0078	< 0.0025	---	---	---	0.0052	0.0086	0.0074	< 0.005	0.0045	< 0.005
Total	Dissolved Oxygen	mg/L	---	---	0.03	3.32	6.75	---	---	---	4.62	3.82	4.8	3.89	5.86	4.58
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	240	320	380	---	---	---	340	240	270	250	270	370
Total	N - NO2 (As N)	mg/L	---	---	2.68	1.06	0.144	---	---	---	0.219	5.64	0.938	1.09	0.182	2.52
Total	N - NO3 (As N)	mg/L	---	---	10.2	8.49	< 0.2	---	---	---	10.5	1.14	12.2	2.63	< 0.2	7.91
Total	N - NO3 + NO2 (As N)	mg/L	---	---	12.88	9.55	0.344	---	---	---	10.719	6.78	13.138	3.72	0.382	10.43
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2	< 2	< 2	---	---	---	< 2	< 2	< 2	< 2	< 2	< 2
Total	Oil & grease, total	mg/L	---	100	< 1	< 1	< 1	---	---	---	< 1	< 1	< 1	< 1	< 1	< 1
Total	ORP	mV	---	---	53.0	52.0	35.0	---	---	---	52.0	71.0	57.0	51	-70	9
Total	pH	pH	5.5	11	7.37	7.46	7.66	---	---	---	7.74	7.52	7.45	7.41	7.47	9.55
Dissolved	Sulphide	mg/L	---	1	0.03	0.058	0.059	---	---	---	0.023	< 0.018	< 0.018	0.047	0.11	0.057
Total	Sulphide	mg/L	---	1	0.039	0.065	0.055	---	---	---	0.019	< 0.018	0.027	< 0.018	0.1	0.11
Dissolved	Sulphate	mg/L	---	1500	28	42	25	---	---	---	83	140	120	64	59	53
Total	Temperature	°C	---	---	12.4	11.6	16.0	---	---	---	12.9	13.7	10.1	11.9	11.1	9.5
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.18	0.1	0.18	---	---	---	0.25	0.22	0.25	0.22	0.29	0.33
Total	TSS	mg/L	---	350	15	16	4	---	---	---	10.4	5.3	10.4	8	18	14
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	1.15	6.22	6.19	---	---	---	7.19	7.83	9.05	8.15	8.1	9.39
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.0059	0.068	0.052	---	---	---	0.161	0.076	0.078	0.151	0.095	0.102
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	7.9	43.5	41.5	---	---	---	55.4	43.9	49.1	45.5	43.7	52.9
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	2.5	13.6	14	---	---	---	18.3	13	14.2	12	12	16.1
Total	Copper	µg/L	---	1000	8.37	51.3	30.9	---	---	---	134	40.3	36.6	32.2	57.9	52.1
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	327	1480	2730	---	---	---	1720	1950	1510	1460	2710	1910
Total	Lead	µg/L	---	1000	0.274	1.28	1.3	---	---	---	1.59	1.35	1.12	1.3	3.18	2.29
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	113	644	737	---	---	---	712	807	711	561	698	654
Total	Mercury	µg/L	---	20	< 0.02	< 0.02	< 0.04	---	---	---	< 0.002	< 0.04	< 0.04	< 0.04	< 0.019	< 0.019
Total	Molybdenum	µg/L	---	5000	12.8	2.7	4.84	---	---	---	2.31	2.13	2.83	2.53	2.74	1.93
Total	Nickel	µg/L	---	3000	8.48	42.7	40.9	---	---	---	52.8	40.4	41.2	33.4	35.4	46.6
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.089	0.37	0.378	---	---	---	0.44	0.356	0.454	0.45	0.423	0.55
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	< 0.01	< 0.05	0.035	---	---	---	< 0.05	< 0.02	0.025	< 0.02	< 0.02	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	18.9	59.4	53.1	---	---	---	67.4	57.9	61.9	39.5	92.1	57.4
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Total	Benzene	µg/L	---	100	0.48	< 0.4	0.7	---	---	---	< 0.4	0.51	0.53	0.41	0.68	0.44
Total	Ethylbenzene	µg/L	---	200	0.85	< 0.4	0.52	---	---	---	< 0.4	0.42	< 0.4	< 0.4	0.65	0.75
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Toluene	µg/L	---	200	0.79	< 0.5	< 0.4	---	---	---	< 0.4	< 0.4	< 0.4	0.54	1	0.5
Total	Xylenes	µg/L	---	200	1.1	< 0.4	1	---	---	---	0.43	0.57	0.57	1.5	2.6	2

Notes:
a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.
b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.
--- = Not available.

AECOM

B10. Monthly Leachate Quality – West Face Drainage

Appendix B-10. Monthly Leachate Quality - West Face Drainage 2019-2020

AECOM

State	Parameter	Units	Sewer Use Criteria min	Sewer Use Criteria max	West Face Drainage SS 11-Apr-2019	West Face Drainage SS 1-May-2019	West Face Drainage SS 4-Jun-2019	West Face Drainage SS 15-Jul-2019	West Face Drainage NS 6-Aug-2019	West Face Drainage NS 5-Sep-2019	West Face Drainage SS 17-Oct-2019	West Face Drainage SS 5-Nov-2019	West Face Drainage SS 3-Dec-2019	West Face Drainage SS 21-Jan-2020	West Face Drainage SS 24-Feb-2020	West Face Drainage SS 24-Mar-2020
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	290	290	510 a	280	---	---	310	320	290	190	100	240
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Chloride	mg/L	---	1500	1200	1200	1400	1400	---	---	1400	1200	1300	890	860	1100
Total	COD	mg/L	---	1000	3540 a	3370 a	3900 a	3920 a	---	---	3690 a	3410 a	2840 a	1910 a	2120 a	2250 a
Total	Conductivity	µS/cm	---	---	15654	16830	18976	18528	---	---	16534	16433	15904	12682	11806	11923
Total	Cyanide SAD	mg/L	---	1	0.14	0.011	0.022	0.0462	---	---	0.047	0.045	0.051	0.027	0.035	0.037
Total	Cyanide WAD	mg/L	---	1	0.0278	< 0.01	< 0.01	0.005	---	---	< 0.01	< 0.01	0.015	0.024	< 0.013	< 0.013
Total	Dissolved Oxygen	mg/L	---	---	0.86	0.84	0.2	0.4	---	---	1.09	0.88	0.45	0.61	0.16	1.75
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Nh3 (As N)	mg/L	---	---	1700	2200	1700	1800	---	---	1900	1700	2000	1200	1300	1500
Total	N - No2 (As N)	mg/L	---	---	< 0.5	< 0.5	< 0.5	< 0.5	---	---	2.72	< 2	< 0.5	< 0.5	0.767	< 0.5
Total	N - No3 (As N)	mg/L	---	---	< 2	< 2	< 2	< 2	---	---	2.6	< 0.5	< 2	< 2	2.38	< 2
Total	N - No3 + No2 (As N)	mg/L	---	---	< 2.5	< 2.5	< 2.5	< 2.5	---	---	5.32	< 2.5	< 2.5	< 2.5	3.147	< 2.5
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	< 2	< 2	< 2	< 2	---	---	2.4	< 2	< 2	< 2	2.5	< 2
Total	Oil & grease, total	mg/L	---	100	< 1	< 1	< 1	< 1	---	---	8.8	7.7	6.7	2.1	9.4	13
Total	ORP	mV	---	---	-37	-68	-29	-39	---	---	-56	-63.0	-83.0	-157.0	-171.0	-21.00
Total	pH	pH	5.5	11	7.38	7.59	7.96	7.99	---	---	8.26	8.18	7.99	7.59	7.9	8.55
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	0.039	< 0.019	0.16	0.034	---	---	< 0.018	< 0.018	0.18	< 0.036	0.024	0.18
Dissolved	Sulphate	mg/L	---	1500	< 10	< 10	< 10	< 100	---	---	54	< 100	< 10	< 10	18	< 10
Total	Temperature	°C	---	---	15.3	18.5	20.1	21.5	---	---	22.5	22.6	18.9	26.6	24.6	17.1
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	1.2 a	1.5 a	1.4 a	2.5 a	---	---	1.9 a	0.96	2.0 a	1.7 a	1.8 a	2.3 a
Total	TSS	mg/L	---	350	15	46	11	99	---	---	22	34	66	13	27	13
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	3.77	79.6	96.3	94.4	---	---	95.5	102	100	63.9	55.2	72.5
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.0142	0.44	0.673	0.458	---	---	0.44	0.524	0.471	0.29	0.288	0.297
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	22.3	469	481	511	---	---	393	499	439	262	208	243
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	2.45	57.4	57.5	61.5	---	---	59	52.5	53	34.6	36.5	31.9
Total	Copper	µg/L	---	1000	0.72	24.8	52.1	13.2	---	---	26.7	25	17.4	18.1	55.7	7.96
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	136	4020	5030	2750	---	---	3130	3460	3360	2760	2550	2580
Total	Lead	µg/L	---	1000	0.323	9.89	13.7	8.03	---	---	6.66	8.57	8.05	5.33	4.79	5.45
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	16.8	507	373	337	---	---	348	322	334	288	256	280
Total	Mercury	µg/L	---	20	< 0.02	0.05	< 0.04	< 0.02	---	---	0.093	0.066	0.084	0.132	0.066	< 0.019
Total	Molybdenum	µg/L	---	5000	0.282	3.3	3.46	3.56	---	---	3.43	7.31	2.86	1.91	1.76	1.77
Total	Nickel	µg/L	---	3000	7.99	173	178	189	---	---	166	162	146	97.8	101	95.3
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.072	1.15	1.47	1.65	---	---	1.32	1.39	1.38	1.07	0.84	0.99
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	< 0.01	< 0.2	0.21	0.17	---	---	0.12	< 0.1	< 0.1	< 0.1	< 0.05	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	26.9	181	253	182	---	---	136	177	153	93	81.8	105
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Total	Benzene	µg/L	---	100	5.2	1.7	< 0.4	0.52	---	---	0.51	0.84	0.93	3	1.2	1.1
Total	Ethylbenzene	µg/L	---	200	8.5	4.4	0.85	1.6	---	---	1.8	2.4	3.4	11	4.3	2.5
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Toluene	µg/L	---	200	46	25	1.7	4.2	---	---	5.5	8.2	10	43	17	11
Total	Xylenes	µg/L	---	200	83	40	4.7	8.3	---	---	8.4	11	12	36	18	12

Notes:
a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.
b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.
--- = Not available.

AECOM

B11. Monthly Leachate Quality - Cell 3 Pipe Outlet

Appendix B-11. Monthly Leachate Quality - Cell 3 Pipe Outlet 2019-2020

AECOM

State	Parameter	Units	Sewer Use Criteria min	Sewer Use Criteria max	Cell 3 Pipe Outlet SS 11-Apr-2019	Cell 3 Pipe Outlet SS 1-May-2019	Cell 3 Pipe Outlet SS 4-Jun-2019	Cell 3 Pipe Outlet SS 15-Jul-2019	Cell 3 Pipe Outlet NS 6-Aug-2019	Cell 3 Pipe Outlet NS 5-Sep-2019	Cell 3 Pipe Outlet SS 17-Oct-2019	Cell 3 Pipe Outlet SS 5-Nov-2019	Cell 3 Pipe Outlet SS 3-Dec-2019	Cell 3 Pipe Outlet SS 21-Jan-2020	Cell 3 Pipe Outlet SS 24-Feb-2020	Cell 3 Pipe Outlet SS 24-Mar-2020
CONVENTIONALS																
Total	Alkalinity - Total - Ph 4.5	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	BOD	mg/L	---	500	36	35	160	30	---	---	25	47	17	73	46	55
Total	CBOD	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Chloride	mg/L	---	1500	1000	1100	**1600** a	**1700** a	---	---	920	670	1000	690	730	1200
Total	COD	mg/L	---	1000	**1130** a	**1450** a	**1690** a	**2590** a	---	---	**1270** a	**1110** a	**1500** a	990	**1400** a	**1970** a
Total	Conductivity	µS/cm	---	---	7263	8460	10583	12473	---	---	9309	9154	6427	6655	7715	8274
Total	Cyanide SAD	mg/L	---	1	0.139	0.105	0.281	0.196	---	---	0.176	0.021	0.175	0.031	0.042	0.104
Total	Cyanide WAD	mg/L	---	1	0.0256	0.041	< 0.01	0.0165	---	---	0.016	< 0.01	0.027	< 0.01	< 0.013	0.02
Total	Dissolved Oxygen	mg/L	---	---	0.74	1.33	1.53	1.48	---	---	0.07	1.07	1.74	0.15	0.15	0.59
Total	Fecal Coliforms	CFU/100 mL	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - NH3 (As N)	mg/L	---	---	640	450	550	730	---	---	620	750	520	480	1300	680
Total	N - NO2 (As N)	mg/L	---	---	66.7	56	105	107	---	---	66	< 0.2	66.2	12	23.9	58.2
Total	N - NO3 (As N)	mg/L	---	---	94.4	76.7	121	91.4	---	---	84.1	0.128	40	17.8	26.7	35.5
Total	N - No3 + No2 (As N)	mg/L	---	---	161.1	132.7	226	198.4	---	---	150.1	0.328	106.2	29.8	50.6	93.7
Total	N - Tkn (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	N - Total (As N)	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & Grease, Mineral	mg/L	---	15	---	---	---	---	---	---	---	---	---	---	---	---
Total	Oil & grease, total	mg/L	---	100	< 1	< 1	< 1	< 1	---	---	< 1	4.4	3.6	< 1	< 1	< 1
Total	ORP	mV	---	---	-55	-79	-27	-24	---	---	-67	-40	-36	-47	-84	-62
Total	pH	pH	5.5	11	8.62	8.77	8.62	8.76	---	---	9.01	9.11	8.87	8.64	8.65	9.34
Dissolved	Sulphide	mg/L	---	1	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphide	mg/L	---	1	0.018	0.044	0.0099	0.058	---	---	< 0.018	**2.8** a	0.079	< 0.036	< 0.018	< 0.018
Dissolved	Sulphate	mg/L	---	1500	134	129	302	190	---	---	200	89	150	31	71	67
Total	Temperature	°C	---	---	15.5	16.3	17.8	19.6	---	---	17.4	15.4	15.1	23.2	21.4	16.5
Total	TOC	mg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Total Phenols	mg/L	---	1	0.13	0.065	< 0.03	0.3	---	---	0.031	0.88	0.053	0.23	0.15	0.066
Total	TSS	mg/L	---	350	4	11	13	4	---	---	17.2	< 1	13.5	20	30	19
METALS																
Total	Aluminum	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Antimony	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Arsenic	µg/L	---	400	1.22	32.6	46.6	62.3	---	---	39.6	10.1	42.6	33.5	41.8	49.5
Total	Barium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Beryllium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Bismuth	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Boron	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cadmium	µg/L	---	300	0.0083	0.26	0.415	0.374	---	---	0.285	0.062	0.273	0.172	0.289	0.352
Total	Calcium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium	µg/L	---	4000	7.95	200	244	301	---	---	186	92.9	183	135	170	204
Total	Chromium III	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Chromium Vi	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Cobalt	µg/L	---	5000	2.07	49	63.9	73.3	---	---	53.4	24.8	46.7	33.4	40.6	41.8
Total	Copper	µg/L	---	1000	3.51	66.2	77.2	71.5	---	---	91.7	1.2	61.5	52.9	63.4	65.6
Total	Hardness (As Caco3)	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Iron	µg/L	---	50000	122	2440	3130	3800	---	---	2540	566	2890	3090	4190	3500
Total	Lead	µg/L	---	1000	0.1	2.36	2.76	4.8	---	---	2.3	1.36	2.78	2.83	4.03	4.24
Total	Lithium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Magnesium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Manganese	µg/L	---	5000	14.4	324	417	356	---	---	306	421	345	395	435	364
Total	Mercury	µg/L	---	20	< 0.02	0.024	< 0.04	< 0.02	---	---	0.08	< 0.04	< 0.04	< 0.04	0.052	0.029
Total	Molybdenum	µg/L	---	5000	0.446	5.8	8.23	9.42	---	---	7.36	1.38	4.97	3.4	4.76	3.12
Total	Nickel	µg/L	---	3000	6.59	162	205	250	---	---	143	93.3	139	88.1	103	123
Total	Phosphorus	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Potassium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Selenium	µg/L	---	300	0.103	2.06	2.98	3.63	---	---	2.51	0.47	2	1.34	1.66	2.07
Total	Silicon	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Silver	µg/L	---	500	< 0.01	< 0.2	< 0.1	0.13	---	---	< 0.1	< 0.05	0.068	< 0.05	< 0.05	< 0.05
Total	Sodium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Strontium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Sulphur	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Thallium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Tin	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Titanium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Uranium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Vanadium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Zinc	µg/L	---	3000	33.7	75	93	117	---	---	55	18.8	54.4	65.3	91	95.5
Total	Zirconium	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
VOLATILE ORGANICS																
Dissolved	Benzene	µg/L	---	100	< 0.4	< 0.4	< 0.4	< 0.4	---	---	< 0.4	1.3	< 0.4	< 0.4	< 0.4	< 0.4
Dissolved	Ethylbenzene	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	---	---	< 0.4	2.9	< 0.4	< 0.4	< 0.4	< 0.4
Total	M & P Xylenes	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Methyl Tertiary Butyl Ether	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	O-Xylene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Total	Styrene	µg/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved	Toluene	µg/L	---	200	< 0.4	< 0.4	< 0.6	0.87	---	---	< 0.4	1.1	< 0.4	< 0.4	1	< 0.4
Dissolved	Xylenes	µg/L	---	200	< 0.4	< 0.4	< 0.4	< 0.4	---	---	< 0.4	5.4	< 0.4	< 0.4	< 0.4	< 0.4

Notes:
a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.
b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.
--- = Not available.

AECOM

Appendix B-12. Monthly Leachate Quality - Emerging Contaminant 2019-2020

State	Parameter	Units	Sewer Use Criteria		Hartland Valve Chamber FR1	Hartland Valve Chamber FR2	Hartland Valve Chamber FRM	Hartland Valve Chamber BLF	Hartland Valve Chamber BLT	Hartland Valve Chamber SS	Hartland Valve Chamber FR1	Hartland Valve Chamber FR2	Hartland Valve Chamber FRM	Hartland Valve Chamber BLF	Hartland Valve Chamber BLT
			min	max	11-Apr-2019	11-Apr-2019	11-Apr-2019	11-Apr-2019	11-Apr-2019	5-Nov-2019	20-Feb-2020	20-Feb-2020	20-Feb-2020	20-Feb-2020	20-Feb-2020
EMERGING CONTAMINANTS															
Total	Perfluorobutanesulfonic acid	µg/L	---	---	0.42	0.39	0.41	< 0.02	< 0.02	0.44	0.28	0.29	0.285	< 0.02	< 0.02
Total	Perfluorodecanesulfonic acid (PFDS)	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Perfluoroheptanesulfonic acid	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Perfluorohexanesulfonic acid	µg/L	---	---	0.65	0.64	0.65	< 0.02	< 0.02	0.62	0.4	0.45	0.425	< 0.02	< 0.02
Total	Perfluorononanesulfonic acid	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	Perfluorooctanesulfonic acid	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	0.17	0.14	0.15	0.145	< 0.02	< 0.02
Total	Perfluorooctanoic acid (PFOA)	µg/L	---	---	0.65	0.64	0.65	< 0.02	< 0.02	0.74	0.64	0.7	0.67	< 0.02	< 0.02
Total	Perfluoropentanesulfonic acid	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PF3A	µg/L	---	---	---	---	---	---	---	< 0.2	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PF4A	µg/L	---	---	---	---	---	---	---	< 0.2	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PFBoA	µg/L	---	---	---	---	---	---	---	0.74	0.34	0.36	0.35	< 0.02	< 0.02
Total	PFDA	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	0.042	0.054	0.058	0.056	< 0.02	< 0.02
Total	PFDoA	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PFHpA	µg/L	---	---	0.23	0.22	0.23	< 0.02	< 0.02	0.26	0.18	0.19	0.185	< 0.02	< 0.02
Total	PFHxA	µg/L	---	---	1.1	1.	1.05	< 0.02	< 0.02	1.4	0.94	1.2	1.07	< 0.02	< 0.02
Total	PFNA	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	0.03	0.035	0.037	0.036	< 0.02	< 0.02
Total	PFOSA	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	PFPeA	µg/L	---	---	0.48	0.47	0.48	< 0.02	< 0.02	0.56	0.37	0.4	0.385	< 0.02	< 0.02
Total	PFUA	µg/L	---	---	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total	1,4-Dioxane	µg/L	---	---	18.	0.	9.00	< 0.02	< 0.02	14.	---	---	---	---	---

Notes:
a - Exceeded maximum allowable value specified in CRD Sewer Use Bylaw 2922.
b - Exceeded minimum allowable value specified in CRD Sewer Use Bylaw 2922.
--- = Not available.

Appendix C

Climate Data

- C1. Daily Rainfall Data –
  Hartland Landfill Weather Station
- C2. Monthly Rainfall Data –
  Hartland Landfill Weather Station

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C1. Daily Rainfall Data – Hartland Landfill Weather Station

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
January	1	2.4	11.6	0	7.6	0	8	5.4	0	11	5	35	0	22.2	22	0	0	3	2	0	0	0	0	0	0
January	2	0	0	0	0	0	2.6	32.6	0	0	0.8	64.4	11.2	0	1.3	0.0	0.8	0.0	1.5	0.0	0.0	0.0	0.0	0	0
January	3	0	0.2	0	16.8	4.6	2.6	6.8	5.8	0	1.6	7.8	1.6	0.2	0.0	0.0	5.5	0.0	10.5	4.3	0.0	0.0	0.0	17.75	0
January	4	0	16.2	0	11.2	13	0.2	15	0	0	1.4	9.6	0.4	20.4	40.0	4.3	8.3	5.3	0.0	3.5	0.5	0.0	0.8	74	0
January	5	0	20.8	0	0	30.2	0	0	0	0	23.8	57.4	11	2.8	5.8	21.8	22.8	1.8	0.0	31.5	2.0	0.0	4.0	1.5	0
January	6	0	20.4	0.4	6.4	0	10.2	0	9.8	3	11.4	2.6	0	21	0.0	23.8	8.5	3.8	0.0	26.0	2.5	0.0	0.0	0.5	0
January	7	0	1	0	1.8	0	44.4	0	16.4	14.2	6	55.8	0	28.6	0	11	1	9	0	0	0	0	14	7.5	0
January	8	0	0	0	7.6	0.2	21.8	0	2.2	12.8	1.8	4.2	8.2	2.2	15.0	0.0	1.8	6.0	9.0	0.3	0.0	0.0	6.5	0	0
January	9	0	0	19.6	19.8	0	0	0	2	0	16.4	10.8	0.6	0.2	2.0	0.3	0.5	6.8	7.5	0.3	0.0	0.3	1.5	1.5	0
January	10	0	0	21	3	0	0.4	0	1.2	0	42.4	12	36.6	17.2	1.5	0.0	0.3	2.3	5.0	2.3	0.0	0.0	2.5	1.5	23
January	11	0	0	1	1.2	0	0.4	0	1.6	0.6	14.2	0.6	3.4	0.8	27.8	0.0	0.0	0.0	2.5	3.0	0.0	0.0	4.0	1.5	2
January	12	0	0	0.2	4.2	0	7.8	7	0	0	17	0	1.8	0	4	3	0	1	4	1	6	0	5	0	12.5
January	13	0	17.2	0	0.6	3.2	0	0.4	2.2	0	8.4	0	0	0	2.5	16.3	0.0	0.0	2.3	0.3	12.5	0.0	3.8	0	0
January	14	0	20.4	65.6	6	0	n/a	2.2	2.2	0	0	0	12	0	22	14	1	0	0	0	2	0	0	0	0
January	15	0	22.8	0.2	10.8	0	0	0	2	3.6	0	0	0	0	21	15	6	1	0	0	0	0	0	0	3.75
January	16	0	13.4	10.2	6.4	0	0.8	0	0	8.6	36	5.6	0	0	0	11	0	0	0	3	2	1	0	0	0
January	17	0	16.4	8.6	2.2	0.4	0.8	0	0	54.4	1.4	0	0	0	1.3	0.3	0.5	0.0	0.0	0.0	12.0	14.5	12.5	0	0
January	18	0	0.2	20.6	0	10.2	1.8	0	5.4	18.4	0	12.4	0.4	0	2	0	0	0	0	21	6	6	4	7.75	1.75
January	19	0	0.4	3.2	0	2.6	8.6	0	2.6	15.4	3.6	5.4	2.8	0	0.0	0.0	0.0	0.3	0.3	37.0	0.5	2.3	4.0	5.25	1.5
January	20	0	0	2.8	5.4	0.4	11.6	0.6	0	10	6	0	0	0	0	8	0	0	0	1	0	0	3	4.5	1.75
January	21	0	0.4	1	10	21.4	10.8	9.4	0	0.4	2.2	2	0	0	0.0	8.8	19.5	0.0	0.0	0.0	7.8	0.5	12.0	0.25	18
January	22	0	1	1.6	0	0	4	27.6	0	42.2	0	18.2	0	0	0	0	5	0	0	1	34	0	12	0	21.25
January	23	0	16	0.4	0.4	0	4.4	10	8.6	0.2	0.2	8.8	0	0	0.0	5.0	4.3	0.0	0.0	8.8	2.5	0.0	23.0	31.5	19.5
January	24	0	6.2	0	0	1.2	22.8	9.4	0.6	0	0	0	0	0	4	10	1	4	0	14	0	0	1	3.5	3.25
January	25	0	0.4	0.4	0.8	1	20.4	0.6	0	0	0	0.2	0	0	1	0	20	6	0	4	0	0	4	0.25	3.75
January	26	0	6.6	2	0	0	3	24.4	3.6	0	18.6	0	1	0	0.0	0.0	21.5	0.3	0.0	0.0	0.0	0.0	6.5	0	3
January	27	0	4	7.4	0	0	6.2	6.2	4.4	0	3	0	0.2	6	0	0	0	3	0	0	10	0	6	0	12
January	28	0	1.2	19.2	0	0	0	0	16.8	0.2	11.2	0	0.4	0	0.0	5.0	0.0	0.0	1.5	0.3	0.5	0.0	3.0	0	8.5
January	29	0	0	88.2	0	5.8	0	7.4	13.4	0	33.2	0	8.2	0	0.5	6.0	1.5	0.0	1.3	0.0	1.3	2.0	2.8	0	15.25
January	30	0	3.2	2.2	0	5.2	16	2.8	18.6	11.4	10.8	0	4.2	0	6.5	0.0	21.8	0.5	21.3	0.0	8.8	0.0	13.0	0	9.5
January	31	0	0	5	1	0	3.6	38	0.4	3.8	1	0	2.8	0	0	0	1	1	2	0	4	0	5	0	6.25
Total Monthly Rainfall		***2.4***	***200***	***280.8***	***123.2***	***99.4***	***213.2***	***205.8***	***119.8***	***210.2***	***277.4***	***312.8***	***106.8***	***121.6***	***180.5***	***161.75***	***150.75***	***53.75***	***70.25***	***162.6***	***114.9***	***26.6***	***153.5***	***158.75***	***166.5***
Maximum Daily Rainfall		***2.4***	***22.8***	***88.2***	***19.8***	***30.2***	***44.4***	***38***	***18.6***	***54.4***	***42.4***	***64.4***	***36.6***	***28.6***	***40***	***23.75***	***22.75***	***8.5***	***21.25***	***37***	***34***	***14.5***	***23***	***74***	***23***

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

AECOM

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
February	1	0	0	28.8	26.4	0	0.8	0.2	6	0	10.2	0	0	1.4	3.0	0.0	4.8	0.5	0.0	1.0	7.5	0.0	14.50	1.0	24.25
February	2	0	0	45.4	0.4	9.4	0	0.2	8	0	11	0	0.2	4.6	2	0	5	0	0	3	1	0	5.50	11.3	0.25
February	3	0	0.4	3.2	0	3.2	0.4	0	1.2	1.6	5.6	1.6	0	0	1.0	2.0	0.0	0.0	0.0	3.5	0.3	0.0	1.50	0.0	0
February	4	0	0	6.2	0	9.2	0	0	2.2	10.6	32.6	6.6	0.2	0	0.5	9.8	0.0	1.8	0.0	1.0	1.8	14.0	1.3	0.3	13
February	5	0	0	0.6	0	4	2.6	0	0	0	0	0	12.8	0	1	0	0	0	0	4	0	3	0.0	0.0	18.5
February	6	0	0	17.6	0.4	0.4	11.8	0	6.4	25.4	0	0	14	4.4	0	9	0	10	0	28	0	0	0.8	1.3	17.75
February	7	0	0	5.4	0.4	0	8.2	0	0	0	0.2	4	13	0	2.8	0.3	0.0	6.8	0.0	17.3	0.0	0.3	0.3	0.3	18.25
February	8	0	1	11.4	5.4	13.4	0.2	0	0	0	0.4	1	1.8	0	0.5	0.0	0.0	0.0	0.0	10.8	0.0	0.0	0.3	0.0	0.25
February	9	0	1.6	1.6	1.8	0	0	0	0	0	0	1.4	3.4	0	0	0	6	0	0	5	0	15	0.0	0.0	0
February	10	0	0.8	2.2	0	0	0.6	0	0	0	0	0.4	5.8	12.2	0	0	15	0	0	11	0	4	0.0	0.0	0
February	11	0	0	0	0	0	4	0	0	0	0	1.2	3.4	1.4	3	1	2	0	17	2	4	1	0.0	0.0	0
February	12	0	13.8	0	0	0	0	0	0	0.6	0	0.8	0	0	4	23	1	0	7	0	15	0	0.0	0.0	0
February	13	0	11.8	2.4	0	0	0	0	0	0	5.8	1	0	0	2.0	1.8	4.0	1.0	5.8	5.8	10.5	0.0	1.3	0.0	2.5
February	14	0	0.2	0	0	0	0	0	1	0	0	14.6	0	0	4	12	1	0	2	4	12	5	1.0	0.0	0.25
February	15	0	0.6	0	0.6	0.6	0	1.2	3.8	0	0	10.8	3.4	0	1	0	0	9	10	0	8	5	1.0	0.0	4.5
February	16	0	0	4.8	0.2	10.8	7.8	2.4	2.8	0	0	0.8	0	0	5	7	0	1	18	0	74	0	6.0	10.5	0
February	17	0	0	12.8	0	0.4	0.6	5.4	3	0	0	2.8	0	0	0	0	7	0	3	0	0	0	20.8	0.5	0
February	18	0	0.6	10.6	0	3.4	0	1.6	8	0	0	1.6	0	0	0	0	9	0	13	0	15	0	0.5	0.0	0
February	19	0	3.2	9.6	0	0	4.8	2.4	0	0	0	22.2	0	0	0	0	28	6	18	0	6	0	0.0	0.0	0
February	20	0	0	0	0	0	0.4	10.2	0	0	0	16	2.2	0	0	0	0	0	11	2	1	0	0.0	0.8	0
February	21	0	3.2	3.8	1.4	0	65.8	2.4	0	0	0	1.2	0	0	0	1	3	1	3	0	3	0	0.0	0.3	0
February	22	0	3	24.4	1.4	4.4	38.2	0.8	0	0	0	0.6	0	2.4	0	0	2	1	0	0	1	0	2.8	0.0	2.5
February	23	0	2.6	10.6	4	0	14.4	0.2	0	0	1.2	0	0	1.6	2.3	0.0	0.0	21.3	4.0	0	11	0	3.3	4.5	15.25
February	24	0	0	54.2	0	0	0	0	0	0	0	5.4	0	1.8	10	0	1	0	0	0	0	0	3.5	5.3	0
February	25	0	1.8	1.6	0	0	0	0	4.2	0	0	0	0	13.4	1	0	28	2	4	0	0	0	5.0	3.5	0.25
February	26	0	0	0.2	5.8	0	0	0	3.8	0	12	0	0	0	5	0	6	6	16	1	0	0	0.0	0.0	0.25
February	27	0	1	21.6	16.8	0	0	0	1.8	0	0.2	0	1.2	0	3.0	2.5	0.0	1.3	0.0	15.0	0.3	0.0	0.8	0.0	0
February	28	0	13	7.4	1	0	0	2	0	1	0	0	0	0.6	0	4	2	0	0	20	1	4	0.3	0.0	10.25
February	29	n/a	n/a	n/a	13.6	n/a	n/a	n/a	0.8	n/a	n/a	n/a	1.6	n/a	n/a	n/a	0	n/a	n/a	n/a	3.25	n/a	n/a	n/a	1
Total Monthly Rainfall		***0***	***58.6***	***286.4***	***79.6***	***59.2***	***160.6***	***29***	***53***	***39.2***	***79.2***	***94***	***63***	***43.8***	***50.25***	***72.5***	***122.5***	***67.3***	***130.0***	***133.0***	***176.0***	***51.3***	***70.0***	***39.3***	***129.0***
Maximum Daily Rainfall		***0***	***13.8***	***54.2***	***26.4***	***13.4***	***65.8***	***10.2***	***8***	***25.4***	***32.6***	***22.2***	***14***	***13.4***	***9.75***	***22.5***	***27.5***	***21.25***	***18.25***	***27.75***	***74***	***15***	***20.75***	***11.25***	***24.25***

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

AECOM

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
March	1	0	11.8	9.8	0.4	6.6	0	0	0	6.6	0	0	2.8	0	0	4.25	5.00	18.00	0.00	0.00	3.00	1.75	0.25	0.00	0.75
March	2	0	1	3.6	2.6	11.2	0	1.2	0	0.2	0	5.4	1.6	0.2	2	6.5	0.0	3.3	0.0	4.0	22.5	7.0	14.0	0.0	5.75
March	3	0	2	32	6.2	2.2	0	1.4	2.2	0	0	2.4	4.6	0	0	1.75	5.75	6.25	13.00	0.25	5.50	11.75	0.75	0.00	0
March	4	2.2	0	9	5.8	0	0	0	0.2	0	0	0.2	0.2	0	0	7.25	0.00	0.00	4.00	0.00	7.50	0.00	0.00	0.00	0.75
March	5	0.8	0	0	0	0	0	0.4	11	0	0	1.2	0	0	0	5.5	4.8	0.0	14.0	0.0	0.0	4.0	0.0	0.0	1.25
March	6	0	0	0	0	0	0	0.4	0	0	2.2	0	0	0	0	0.25	12.25	3.75	2.5	0	0	1.75	0	0	0
March	7	0.2	0	0	0	0	0.2	4.8	43.8	0.6	0.4	2.8	2.2	0	1.5	0	0	6.5	14.75	0	7.75	10.25	0	0	0
March	8	0	2.6	0	0	5.2	2.8	0.8	0	1.6	15.8	8.8	0	1	0	0	0	1.5	0	0	11.75	7.75	5.25	0.25	0
March	9	8.8	8.2	0	1	2.8	1.2	20.4	0.2	3.4	5.4	1.6	4.4	0	0.25	7	0	0	2.5	0	1.75	11.75	0.25	0	0
March	10	0	5.8	0.6	0.2	0	3.4	3	0	0	0.8	12	0	0	2.25	15.75	15.5	0	0	0	6.25	0.25	0	0	0.75
March	11	0	0.4	0	4.6	0	44.8	13.6	0	0	3.8	65.8	0	0	11	2.75	5.5	0.25	2.75	0.25	38.5	7.5	0	0	0
March	12	0	1.2	2	0.6	0	18	17.4	0	0	0	3.4	0	0	13.25	1	0.75	6.25	0	3	1.5	2.25	0	9.5	0.5
March	13	0	2.8	3.6	1.8	3	16.6	17.6	0	0	0	1.2	0	0	1	1	7.25	2.5	0	0.75	0.25	9	2	1.25	0.25
March	14	0.6	0	7	14.4	0.2	0	6.8	0	0	0.4	3.2	10	0	5.75	2.75	0.75	13.25	3	1	8.5	11.25	0.25	0	0
March	15	0	0.6	0.4	0	4.6	1.6	0	0	0	0	6.4	24	0	2.5	19.25	3.5	9.5	6.25	16	2.5	1.75	0	1	0
March	16	0	0	8	3	0.6	15	0	0	4.6	1	6	15	0	1.5	8	19	2.5	22.25	36.25	0	2.5	0	0.25	0
March	17	0	0	0	5.8	0	0	1.2	0	1	0.8	9.8	3.8	2.2	0.25	4	1.75	0	0.75	0	0	13.75	2.75	0	0
March	18	1	0	0	4	5.4	8.6	0.8	6.6	0	0	0	2	0	0	0.25	1.25	0	0	0.75	0	9	0	0	0
March	19	0	0	0.6	5.2	7.2	2.2	3	15.8	11	0	6	4.6	0	0	1.25	0.25	8.5	0.75	0	0	0	0	0	0
March	20	0	0	0	1	0.8	13.4	0	0	4	0	1.4	2.2	0	0	0.5	0	3.25	1.25	17.25	0	0.25	0	0	0
March	21	0.2	2.2	4.6	0	0	1.6	8.6	0	0.4	0	0.4	0	0	0.75	0	15	5.75	0	7.25	2.25	2.75	0.5	0	0
March	22	0	7	0	7.6	0	0	27.4	0	0	1.4	4.4	0	0	0	4.75	0.25	0	0	13	1.25	0.75	2.5	0	0
March	23	0	8.8	1	0	0	0	6.2	0.2	0	0	9.6	0.8	0	0	0.25	0	0	1	0.5	0	1.5	0	0	0
March	24	0.8	3.4	0	0	0	0	1	7.8	0	2.6	8.4	0	0	0	0	0	0	0	1.5	4.5	2	0.25	0	1.25
March	25	0	1.4	0	0	8.4	0	0.4	2.4	0	0	0	0.2	0	5.25	0.5	0	0	0	0.5	1.5	1.25	0	0	0
March	26	1.6	0.4	15.2	0	5	2.2	6.4	1.6	34.8	1	0	0	0	0.5	1.5	0	0	8	6.75	0	2	3.25	2	0.75
March	27	7.6	0	0	0.2	5.6	0.6	3.6	0.2	4	0	0	0.6	0	0	0	1.75	0	2.75	0	3.25	1.75	0.25	0.5	5
March	28	0	4	0.4	0	7.6	3.6	0.4	0	4.4	0.6	0	4.6	0	2.75	0	0	0	0.5	1.25	7	20.75	0	0	9.25
March	29	0.2	0	5.4	0	1.8	0	0	0	3.8	0	0	0	0.2	40	0	2	0	7	0.25	0	11.75	0.75	0	1.25
March	30	0	3	6.8	0	0.8	0	0.6	2.2	0	0.4	0.4	0.6	0	1	2	16.5	0	5	11.75	0	0	0	0	12
March	31	0.6	6.2	0	0	2	0	2.2	2.8	5.6	0	1.4	15	0	0	10.25	10.75	0	0.5	0.25	0	0	0	0	0.25
Total Monthly Rainfall		***24.6***	***72.8***	***110***	***64.4***	***81***	***135.8***	***149.6***	***97***	***86***	***36.6***	***162.2***	***99.2***	***3.6***	***92***	***108***	***130***	***91***	***113***	***123***	***137***	***158***	***33***	***15***	***40***
Maximum Daily Rainfall		***8.8***	***11.8***	***32***	***14.4***	***11.2***	***44.8***	***27.4***	***43.8***	***34.8***	***15.8***	***65.8***	***24***	***2.2***	***40***	***19.25***	***19***	***18***	***22.25***	***36.25***	***38.5***	***20.75***	***14***	***9.5***	***12***

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station AECOM

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
April	1	9	0	0	0	1.2	0	0	0	7.6	13.4	0.4	0	18.6	0	4.25	2.25	0.00	0.00	0.25	0.00	4.50	0.0	0	
April	2	0	0	1.4	0	0	0	0	0	0.6	0	0	0	18.2	16	16	3	0	0	1	0	0	0.0	0.5	
April	3	0	0	1.2	0	0	0	0.4	0	2.2	5.6	0	0	0	3.5	16.5	0.0	0.0	0.0	1.0	4.8	0.0	0.0	3.5	
April	4	0	0	0	0	0	0	4.6	0	0	0	0	5	0	0	0.25	1.00	0.00	0.50	0.00	0.25	4.00	0.0	0	
April	5	0	0	0	0	3	0	0	0	9.2	0	0.2	0	0	0	15	0	11	0	0	1	12	19.0	1	
April	6	0	0	0	3.4	2.4	0	1.8	0	1.6	0	0	0.4	0	0.5	10.75	0.75	2.50	3.50	0.00	0.00	3.00	17.8	2	
April	7	0	0	2.2	0	6.4	2	3.8	0	4.6	0	4.6	4.6	0	8	2.75	6.75	3.75	0.00	0.00	0.00	10.50	1.3	0	
April	8	0	0.6	0.6	0	0	0	2.6	0	0	3.6	6	1.4	0	5.75	0	0	12	0	0	0	3	12.0	11.5	
April	9	0	0	0.2	0	0	2.4	1.8	0	0	5.6	2	0	n/a	0.5	0	0	0	12	0	0	0	3.0	3.5	
April	10	0	1.6	0	0	4	1	0	0	0.4	4.2	1.2	0	0	0	0	0	1	0	0	0	1	0.0	2	
April	11	0	1	0	0	0	0	0	0	1	0	0	0	0	0	4.5	0.0	14.8	0.0	4.5	0.0	0.0	0.5	8	
April	12	0	0.8	0.4	0	1.2	0.2	1	0	0.4	0.2	0	0	17.4	0	0.75	4.50	0.25	0.00	8.50	4.25	20.50	1.0	0.25	
April	13	0	0	0	1.6	0.6	11.2	13.6	0	0.6	4.8	1.4	0.2	3.6	0	1.75	2.25	5.50	0.00	0.25	0.00	6.25	0.5	6.75	
April	14	0	0	0	0.8	0	32	0.2	0	0	8.6	0.4	10.8	31.4	0	1.25	0.00	6.50	0.00	1.00	2.50	0.00	24.5	0	
April	15	0	0	0	0.4	0	9	0.8	2.2	8	0.4	0	0	n/a	0.5	7.5	0.0	0.8	0.0	1.5	0.0	10.0	3.5	0	
April	16	0.8	0	0	0	0	3.2	0.8	0	5	0	3.4	0	0	0	1.25	0.00	3.00	4.25	0.00	0.00	0.00	1.3	0	
April	17	1.2	0	0	0	12.2	0.6	0.6	0	0.2	2.4	0.8	0	4.4	3.25	0	9	1	7	0	0	1	12.0	0	
April	18	3.2	0.6	0	0	2.2	0	0.2	0	1.6	0.2	1	6.6	0	0	0	1	0	11	0	0	1	1.0	11.25	
April	19	2.8	0	4.4	0	0	0	2.8	0	0	0	0	22.6	0	3	0	1	1	0	0	0	0	0.0	0.75	
April	20	21.8	0	2.4	0	0	0	0	0	0	0.4	0	0	0	11.25	1.25	12.25	6.50	2.00	0.00	0.00	0.50	0.0	0	
April	21	0	1	0	0	0	0.2	1.4	0	0	1.2	0	8	0	0.5	1.5	0.3	0.8	1.0	0.0	0.0	0.0	3.8	0	
April	22	0	0	4.4	4.4	3	0	0	0	0	0	0.8	0	1	0	0	0	0	3	0	0	3	2.0	3.25	
April	23	4	0	0	1	3.6	0	1	0	0	0	0	1.4	0	7.25	0	0	0	2	0	1	1	0.0	0	
April	24	1.6	0.2	0	0	0	0	7.6	0	0.6	0	3.8	0	0	3.75	0	0	0	7	2	0	0	0.0	0	
April	25	0.8	0	0	0	0	0	0	0	0	0	0.8	0	0	0	2	5	0	11	12	0	0	0.0	0	
April	26	0.6	0	1.2	0	0	9.4	0	0	0	0	2.6	0	0	0	8.25	3.25	0.00	0.25	0.75	0.00	0.25	0.0	0	
April	27	1	0	0	0.4	0	0.6	1.2	2.2	0	0	11.4	3	0	1	0	0	0	1	0	0	5	0.0	0	
April	28	4.2	0	0	0	2	0	0	0.4	0	0	0	6.4	0	2.25	10.75	0.00	0.00	2.25	2.25	0.00	0.00	0.0	0	
April	29	1.8	0	0	0.2	1.4	0	0	0	0	5	0	0	0	0	3.5	0.0	0.8	0.0	0.5	0.0	4.8	6.0	0	
April	30	2	0	0	0.2	4.4	0	0	0	0	0	0	0	0	0.75	0	2	1	0	0	0	0	0.0	0	
Total Monthly Rainfall		***54.8***	***5.8***	***18.4***	***12.4***	***47.6***	***71.8***	***46.2***	***4.8***	***43.6***	***55.6***	***40.8***	***70.4***	***94.6***	***67.75***	***109.75***	***53.5***	***70.5***	***66***	***35.5***	***13.8***	***90.75***	***109.05***	***54.25***	
Maximum Daily Rainfall		***21.8***	***1.6***	***4.4***	***4.4***	***12.2***	***32***	***13.6***	***2.2***	***9.2***	***13.4***	***11.4***	***22.6***	***31.4***	***16***	***16.5***	***12.25***	***14.75***	***11.75***	***12.00***	***4.80***	***20.50***	***24.50***	***11.50***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																						
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
May	1	0.8	0	0.4	2.2	3.6	0	0	0	0	0	0	0	0	0.75	0	4.25	0	0	0	0	2.5	1.5	0	
May	2	0	0	5.2	0	0	0	0	0.2	2	0	2.8	0.4	4	15.75	0	0.75	0	0	0	0	2	0	0	
May	3	0	0	0.2	2	0	0	1.4	1	0	0	2.2	2.8	0	8.25	9.75	0	0	0	0	0.75	2	0	0	
May	4	0.6	0	2	3	2.2	0	11.4	0.6	0.4	0	0.2	0	3.2	6.75	0	10.75	0	1.75	0	0.25	0	0	0	
May	5	15.8	0	0	2	4	1	4.4	0.6	0	0	0.2	0	8.6	0	0	0	0	15	0	0	0	0	0	
May	6	3.6	0	0	1.6	1	0	0	0	0	0.8	1	0	11.8	2.75	2	0	0	5	3.5	0	0.25	0	0	
May	7	0	0	0.4	0	0	0	0	1	0	3.6	0	0	0	0	4.75	0	0	0	0	0	0	0	0	
May	8	0	0	3.4	1.6	0	0	0	0.2	0.8	0	0	0	0	0	1.5	0	0	0	0	0	0	0	0	
May	9	0	0	1.4	0	0	0	0	0	0.8	0	0	0	0	0	0	0	0	9.5	0	0	0	0	0	
May	10	0	0	0.4	11	0	0	0	1	0	0	0	0.2	3.6	2.25	0	0	0	0	0	0	0	0.75	0	
May	11	0	0.2	1.4	0.4	0	0	0	0.6	0	0	0	0.2	2.8	0	0.5	0	0	0	0	0	10.25	8.25	0	
May	12	0	0.8	0	0	0	0	0	0	0	0	0	0	0.4	0	5.75	0	2.5	0	0	0	1.25	0	0	
May	13	0	0	0.4	0	0	1	0	0	0.2	0	0	5.2	10.2	0	0	0	5.5	0	0	0	6.75	0	0	
May	14	0	3.6	0.2	0	6	0.2	1.4	0	0.2	0	0	0.2	9	0	0	0	3.25	0	0	0	0	0	4.75	
May	15	0	1	0	0	1	0	0.2	0	0.8	0	0	0	0	0	9.75	0	0	0	0.5	0	8.25	0	1.75	
May	16	0	0	0.2	0	5.2	0	0	0	0.2	0	0	0	0	0	20.75	0	1.75	0	0	0	2.75	0	0	
May	17	0	0	9.4	0	0	6.2	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
May	18	0	0	1.8	0	0	0	0	0	0.4	0	0	0	7.8	4.5	0	0	3	0	0	0	0	0	0	
May	19	0	0	0	7.2	0	0	2.4	0	1.6	0	1.6	1.8	0	1.5	0	0	1	0	0	0	0	0	0	
May	20	0	0	0	0	0	1.8	0.6	0	0	0	10.4	0.2	0	7.25	0	0	0	0	0	0.75	0	0	9.75	
May	21	3	0.6	0	4.4	0	0.4	0.4	0	0.4	2.6	0	4.6	n/a	0	0	0.5	4.75	0	0	0	0	0	1.25	
May	22	1	0	0	0	0	0	2	9.4	0.4	17.4	0	0	0	1	1.5	5.75	6.75	0	0	0	0	0	0	
May	23	3.6	0	0	0	0	0	1	1.2	0.4	0	0	0	0	0	0.25	0	8	0	0	0.25	0	0	0	
May	24	0	0.4	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	1.25	3.25	0	0	0	0	0	
May	25	0	6.8	0	0	0	2.6	0	1.2	0	3	0	0	0	1.5	0	1.25	0	0	0	0	0	0	13.5	
May	26	0	1.8	0	9.6	0	2.4	0	0.6	0	6.2	0	0.2	1.2	7	2.25	0	0.25	2	0	0	0	0	0.25	
May	27	0.4	22.8	0	7.2	0	0	0.2	9	0	0.4	0	0	0	0	0	0	3.5	0.75	0	0	0	0	0	
May	28	4.8	2.4	0	0.8	3.2	2.4	0	3.2	0	0	0	0	n/a	6.25	2.5	0	5.25	3	0	9.75	0	0	0	
May	29	6	0	0	0	0	1.4	0	7.6	0	0	0	0	0	0.75	0.5	0.25	1.5	0	0	0	0	0	0	
May	30	5.2	0	0	6.2	1.2	0	0	1	0	0	0	0	0	3.75	0	0	4.25	0	0	0	5	0	0	
May	31	14	0	0	0.8	0	0	0	0	0.4	0	0	0	0	6.5	0	8.5	1	0	0	0	0.25	0	0	
Total Monthly Rainfall		***58.8***	***40.4***	***26.8***	***60***	***27.4***	***19.4***	***25.4***	***38.4***	***9.2***	***34.2***	***18.4***	***15.8***	***62.6***	***76.5***	***61.75***	***32***	***53.5***	***40.25***	***4***	***11.75***	***41.25***	***10.5***	***31.25***	
Maximum Daily Rainfall		***15.8***	***22.8***	***9.4***	***11***	***6***	***6.2***	***11.4***	***9.4***	***2***	***17.4***	***10.4***	***5.2***	***11.8***	***15.75***	***20.75***	***10.75***	***8***	***15***	***3.5***	***9.75***	***10.25***	***8.25***	***13.5***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

AECOM

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
June	1	0.2	0	0.6	0	8.4	0	0	0	0.4	5.4	0	0	0	0	0	1.75	0.5	0	0	7.5	0	0	0	
June	2	0.4	0	0	0	2.8	0	0	0	0	0.6	0	0.4	0	0	0	5.25	0.25	0	0.25	0.25	0.75	0.25	0	
June	3	8.2	0	0	0	0.8	0	0	0	0	0	1.4	4.4	0	0	1	0	0	0	0.25	0	0	0.25	0	
June	4	0.4	0	0	0	0	0	0	0	0	0	1.4	0.4	0	0	0	0	0	0	0	0	0	0	0	
June	5	0	0	4	1.6	0	2.4	0	4.8	0	0	0.8	2.8	0	0	0	0	0	0	0	0	0	0	0.25	
June	6	0	0	0.4	3.6	0.6	0	0	1	0	0	0.8	5.8	0	0	0	0	0	0	0	0	0	0	0.25	
June	7	0.6	0	1.6	0.4	0	0	0	0.2	0	6.2	0	0	0	0	0	0	0	0	0	0	0	0	1.75	
June	8	0	0	0.6	0	0	0	0	0	0.4	16.8	0	0	0	0	0	15	0.25	0	0	0	11.25	0	0	
June	9	0	0	0	0	10	0	0	5	0	0	9	10.2	0	0	0	0.25	0	0	0	0	0	8	0	
June	10	0	10.8	0	2.4	1.4	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	5.5	0.5	0	
June	11	3	0	0	2.6	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	
June	12	0.2	0	0	15.8	1.2	0	0	0.4	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	
June	13	0	0	0.2	0	0	0	0.6	8.4	0.2	0	0	0	0	0	0	0	12	0	0	0	0	0	0	
June	14	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	1.5	1	0	3	0	2	0	
June	15	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	4.25	14	0	0	
June	16	1.2	3.6	2.4	0	0	0	0	0	0.2	0.8	0	0	0	0	1	0	0	0	0	11.75	0	0	0	
June	17	13.4	0	0	0	0.4	2.6	0	0	0	0.6	0	0	1.4	0.35	0	1	0	6.25	0	0	0.25	0	0	
June	18	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	1	0	0	0.25	2.25	0	0	
June	19	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	2.25	1.75	0.25	0	2.75	0	0	0	0	
June	20	0.4	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	3.25	0	0.25	0	0	0	0	
June	21	11.8	0	1.6	0	0	0	0	0	0.4	0	5.8	0	1.4	0.35	0	0	2.5	0	0	0	0	0	0	
June	22	0	0	0.2	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	0	0	8.5	0	0	0	
June	23	2.2	0	6.2	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	4.75	0	0	0	
June	24	0	7.8	7.6	0	0	0	0	0	0	0	3.2	0	2.8	0.7	0	4.25	1.25	0.75	0	1.25	0	0	0	
June	25	0.8	0	0.4	0	0	0	0	0.4	0	0	0	0	0.2	0.05	3	0	2	0	0	0	0	7.75	0	
June	26	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
June	27	0.6	0	0	0	0.8	1	0	0	0	0	0	0	1.4	0.35	0	0	1.5	0	0	0	0	0	16.75	
June	28	0	0	7.4	0	0.2	6.6	0	0	0	0	4	0	0	0	0.25	0	3	2	0	0	0	0	0	
June	29	27.4	0	0	0	0	5	0	0	0	0	4.4	0	0	0	0	2.5	0	1.75	0	0	0	0	0	
June	30	0	0	3.6	0.8	0	0	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	
Total Monthly Rainfall		***73.8***	***23.2***	***37***	***27.6***	***28***	***18***	***2***	***20.2***	***1.6***	***30.4***	***34.4***	***24.2***	***7.2***	***1.8***	***7.5***	***44.75***	***30.25***	***12***	***3.5***	***41.5***	***34***	***19.25***	***19***	
Maximum Daily Rainfall		***27.4***	***10.8***	***7.6***	***15.8***	***10***	***6.6***	***1.4***	***8.4***	***0.4***	***16.8***	***9***	***10.2***	***2.8***	***0.7***	***3***	***15***	***12***	***6.25***	***2.75***	***11.75***	***14***	***8***	***16.75***	

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
July	1	0	0	0	0	0	0	1.2	0	0	0	0	0	0	0	0	3	0	0	0	0.5	0	3	0	
July	2	0	0	3.2	0.2	0	0	0	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.25	
July	3	0	20.6	3.2	1.8	0	0	0	0	0	0	0	2.2	0	0	0.25	5.5	0	0	0	0	0	0	0	
July	4	0	1.8	0	0	0	0	0	0	0	0	0	0	0	0	0	4.25	0	0	0	0	0	0	0	
July	5	2.4	0	0	1	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0.25	0	0.25	0	0	0	
July	6	4.8	0	0	0	0	0	0	3.4	0.4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
July	7	0	0	0	0	0	0	0	0	0	0	0	0	1.6	0.4	0	0	0	1	0	3.5	0	0	1.75	
July	8	23	0	0	0	0	7.4	0	0	0.6	0	0	0	6	1.5	0	0	0	0	0	0.75	0	0	0	
July	9	2.4	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0	0	0	11.5	0	0	4	
July	10	0	0	0	0	0	0	0	0.8	0	1.8	0	0	0	0	0	0	0	0	0	0	0	0.25	5.25	
July	11	0	0	0	0	0	0	0	2.6	0.2	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0.5	
July	12	0	0.2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	
July	13	0	0	0	0	n/a	0	3	0	0	0	0	0	0	0	2.25	0	0	0	0	0	0	0	0	
July	14	0	1.8	0.6	0	n/a	0	4.2	0	0	0	0	0	0	0	0.25	1.25	0	0	0	0	0	0	0	
July	15	0	9.2	0	0	n/a	0	0	0	0	0	0	0	0	0	9.75	0	0	0	0	0	0	0	0	
July	16	0	0	0.8	0	n/a	0	0	0	0	0	0	0	0	0	0.75	3	0	0	0	0	0	0	0	
July	17	0	0	0.6	0	n/a	0	0	0	0	0	5.6	0	0	0	12.75	0	0	0	0	0	0	0	2.5	
July	18	0	0	0	0	0	0	0	0	0	0	14.45	0	0	0	0.25	0	0	0	0	0	0	0	0	
July	19	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
July	20	0	0	0	0	0	0	0.4	0	0	0	3.4	0	0	0	0	0	0	0	0	0	0	0	0	
July	21	2.4	0	0	0	0	0	0	0	0	0	9.2	0	0	0	0	4	0	0	0	0	0	0	0	
July	22	0	0	0	0	0	0	0	0	0	0	7.8	0	0	0	0	0	0	0	0	1.5	0	0	0	
July	23	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	
July	24	0	0	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.25	0	0	0	0	0	
July	25	0	0	0	0	0	0	0	0	0	0	0	0	3	0.75	0	0	0	3	7.75	0	0	0	0	
July	26	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	
July	27	0	0	0	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.5	0	0	0	0	
July	28	0	0	0	10.2	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	
July	29	0	0	0.4	0	0	0	0	0	0	0	0	3.8	0	0	0	0	0	0	0	0	0	0	0	
July	30	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	
July	31	0	0.8	0	0	0	0	0	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	
Total Monthly Rainfall		***35***	***34.4***	***9.6***	***16.6***	***10***	***7.4***	***11.8***	***31***	***1.2***	***2***	***41.65***	***7***	***10.6***	***2.65***	***26.25***	***21***	***0***	***6.5***	***17.5***	***18.5***	***0***	***3.25***	***22.25***	
Maximum Daily Rainfall		***23***	***20.6***	***3.2***	***10.2***	***10***	***7.4***	***4.2***	***21***	***0.6***	***1.8***	***14.45***	***3.8***	***6***	***1.5***	***12.75***	***5.5***	***0***	***3***	***9.5***	***11.5***	***0***	***3***	***8.25***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

AECOM

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
August	1	0	0	0	0	0	0	0	0	0	0	0	1.6	0	0	0	0	0	0	0	0	0	0	0.5	
August	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.25	
August	3	0	0	0.2	0	13.6	0	0	0.4	0	0	0	0	0	0	0	0	2.75	0	0	0	0	0	0	
August	4	0	0	0.2	0	5.4	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	5	0	0	7.8	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	6	5.4	0	0	0	2.4	0	0	25.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	7	0	0	0	0	0	0	0	0.2	0	0	0	0	0	12.25	0	0	0	0	0	0	0	0	0	
August	8	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0.25	0	2	0	0	0	0	0	0	0	
August	9	0	0	0	0	0	0	0	0	0	0	0	4.4	2	1.25	0	0.25	0	0	1	0	0	0	0	
August	10	0	0	0	0	0	0	0	0	0	0.8	0	0	12	0	0	0	0	0	0	0.5	0	0	0.75	
August	11	0	0	0	0	0	0	0	0	0	0.2	0	0	1	0	0	0	0	0	0	0	0	0	0	
August	12	0	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	1.75	0.5	0	
August	13	0	0	0.2	0	0	0	0	0	0	0	0	0	7.2	0	0	0	0	0	0	0	1.5	0	0	
August	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.75	0	0	0	0	0	
August	15	0	0	8.2	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	1.75	0	0	0	0	0	
August	16	0	5.4	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	
August	17	0	0	0	0	0	0.8	0	0	2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	18	0	0.2	0	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	19	0	0	0	0	0	0	0	0	0	0	12.2	5.8	0	0	0	0	0	0	0	0	0	0	0	
August	20	0.2	0	0	0	0	0	0	0	0	0	0.8	4.8	0	0	0	0	0	0	0	0	0	0	0	
August	21	5.4	0	0	0	2.2	0	0	11.2	0	0	7.6	0.4	0	0	0	0	0	0	0	0	0	0	4.75	
August	22	0	0	0	0	11.2	0	0	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
August	23	0.2	0	0	0	6.4	0	0	0	0	0	0	0	0	0	16.5	0	0	0	0	0	0	0	2.25	
August	24	0.2	0	0	0	1.8	0	0	30	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0.25	
August	25	3.4	0	0	0	0	0	0	31.6	0	0	0	0.6	0	0	0	0	0	0	0	0	0	0	0	
August	26	5	0	0	0	0	0	0	0.8	0	0	0	4.6	0	0	0	0	0	0	0	0	0	0	0	
August	27	7.2	0	0	0	0	0	0	2.6	0	0	0	5.2	0	0.5	0	0	0	0	0	0	0	0	0	
August	28	0	0	0	0	0	0	0	0	0	2.4	0	1.2	0	0	0	0	0	0	0.25	0.5	0	0	0	
August	29	0	0	3.8	4.8	0	0	0	0	0.4	0	0	0	0	0	0	0	0	0	6.25	0	0	0	0	
August	30	0	0	0	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.75	0	0	0	0	
August	31	0	0	0	0	0	0	0	0	0	0	1.2	0	0	12	0	0	0	0	1.25	1.75	0	0	0	
Total Monthly Rainfall		***27***	***5.6***	***24.4***	***9.6***	***43.2***	***0.8***	***0.6***	***106.2***	***2.8***	***3.4***	***23.2***	***43.6***	***22.2***	***26.25***	***16.5***	***2.25***	***3***	***12.75***	***15.5***	***2.75***	***3.25***	***0.5***	***12.75***	
Maximum Daily Rainfall		***27***	***5.4***	***8.2***	***4.8***	***13.6***	***0.8***	***0.6***	***31.6***	***2.4***	***2.4***	***12.2***	***15***	***12***	***12.25***	***16.5***	***2***	***2.75***	***10.75***	***6.75***	***1.75***	***1.75***	***0.5***	***4.75***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

AECOM

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
September	1	0	0	0	0	5.2	0	0	2	0	0	0	0	0	0	0	0	0	0	8.5	3.5	0	0	0	
September	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	11.25	0	0	0	
September	3	0	0	0	0	1.6	0	0	0	0	0	5.6	0	1.6	0	0	0	0	19	12.25	0	0	0	0	
September	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.5	0	0	0	0	
September	5	0.4	0	2	0.2	0	0	0	0	0	0	0	0	1.4	0	0	0	0	0	0	2.5	0	0	0	
September	6	0	0	0.4	0	0	0	1.2	0	0	0	0	0	13.8	10.25	0	0	0	0	4.5	2	0	0	0	
September	7	0	0	0	0.4	0	0	7.6	0	0	0	0	0	5.4	7	0	0	0	0	15.25	2.5	0	0	0	
September	8	0	1.2	0	6	0	0	0	2.2	0	0	0	0	0	2.5	0	0	0	0	0	0	0.5	6	0	
September	9	0	0	0	0	0	0	0	0	0	11.6	0	0	12.2	0.25	0	0	0	0	0	0	7.75	1.5	1	
September	10	0	0	0	0	0	0	1.6	0	0	0	0	0	0	0.25	0	0.5	0	1	0	0	0	8	0	
September	11	0	0	0	0	0	0	0.8	21.4	0	0	0	0	0	1.25	0	0	0	0	0	0	0	0	0	
September	12	0.2	0	0	0	0	0	0	0.2	0	0	0	0	0	14.25	0	0	3.75	0	0	0	0	2.5	2.5	
September	13	0	0	0	0	0	0	0	11.4	0	0.6	0	0	0	8	0	0	0	0	0	0	0	0.5	0	
September	14	6.4	0	0	0	0	0	0.8	0.8	0	0.6	0	0	0	0.25	0	0	0	0	0	0	0	0	8.25	
September	15	3	0	0	0	0	0	0	17.2	0	0.2	0	0	0	1.25	0	0	0	0	3	0	0	0	13.5	
September	16	9.6	0	0	0	0	0	10	2.2	0	0	5.2	0	5.4	2.75	0	0	3	0	0	0	0	4.5	0.75	
September	17	9.6	0	0	0	0	0	0	6.8	0	3.2	0	0	0	13.25	0	0	0	0	1.25	13.25	1	4	20.75	
September	18	5.4	0.2	0	0	0	n/a	8	5.8	0	4.4	2.4	0	0	18	0.25	0	0	0.25	1.25	0	1.25	0	1.25	
September	19	0	0	0	0	0	n/a	4.6	7.6	0	1.2	0	0	6.2	10.75	2.25	0	0	0.75	0.25	5	2.75	0	0.5	
September	20	0	0	0	3.2	0	n/a	0	0	0	10	1	0.2	0	0.5	0	0	0	0	0.75	0	0.25	0	0	
September	21	0	0	0	0	5.8	n/a	0	0	0	0	0.6	0	0	0	0	0	8.75	0	4.5	0	0	5.25	0	
September	22	0	0	0	0	0	n/a	0	1.4	0	0	0.6	0	0	0	1.75	0	0.25	0	0	0	0	6.25	6.25	
September	23	0	0	0.4	0	0	n/a	0	4.2	0	0	0	0	0	10.5	11.5	0	12.5	0	0	2	0	2	12.5	
September	24	0	0	0	0	0	n/a	0	0	0	0	1	11.6	0	1.5	0	0	3.5	12.5	0	0.5	0	0	0.25	
September	25	0	2.2	6.2	0	0	n/a	0	0	0	0	0.4	8.4	0	7.75	0	0	9.25	3	4.5	0.25	3.25	0	0	
September	26	23	0	0.8	0	14.6	n/a	0	0	0	0	0	1.2	0	17.5	3	0	4.75	1.25	2.75	0	0	0	0.5	
September	27	12.4	0	0	0	0	n/a	0	0	0	0	0	0	0	6	24	0	0	12	0.25	0	0	0	12	
September	28	8.6	0	0	0	0.6	n/a	0	0	0	0	0.6	0	0.8	0	1	0	6.5	0	0	0	0	0	0.25	
September	29	0	0	0	15.6	0.8	n/a	0	0	0.4	0	1	0	8	0	0	0	4.75	0	0	0	1	0	0	
September	30	11	0	0	1.4	0	n/a	0	0	0	0	8.8	0	0	0	0	0	3.25	1.5	0	0	1.5	0	0	
Total Monthly Rainfall		***89.6***	***3.6***	***9.8***	***26.8***	***28.6***	***0***	***34.6***	***83.2***	***0.4***	***31.8***	***27.2***	***21.4***	***54.8***	***133.75***	***43.75***	***0.5***	***60.25***	***51.25***	***76.5***	***42.75***	***19.25***	***40.5***	***80.25***	
Maximum Daily Rainfall		***23***	***2.2***	***6.2***	***15.6***	***14.6***	***0***	***10***	***21.4***	***0.4***	***11.6***	***8.8***	***11.6***	***13.8***	***18***	***24***	***0.5***	***12.5***	***19***	***15.25***	***13.25***	***7.75***	***8***	***20.75***	

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
October	1	3	0	0	0	0	n/a	0	0	0	0	0	0	3.4	0	0	0	9.25	0	0	0.5	0	11	0	
October	2	0.4	9.6	0	0	0	n/a	0	0	0	0	10.2	2	0	0	0	0	7	0	0	0.5	0	3	0.75	
October	3	12	2.6	0	0	0	n/a	0	0	0	0	1	13.4	0	0	0.5	0	5.75	0	2.25	4.25	0	0.5	0.25	
October	4	15	0.4	0	0	0	n/a	0	0	0	0	1	6.4	0	0	0.25	0	0	0	0	1	0	0	9.25	
October	5	1	0	21	0	0	0	0	4.8	0.4	0	0	1.8	0	0	0	0	0	0	0	0.25	0	0	2.5	
October	6	0	0	0	0	0	0	4.6	5.2	0	1.6	9	1.8	0	0	2	0	0	0	0	8	2	8.75	0	
October	7	8	0	9.2	0	0	0	8.2	3.6	0.4	0	10.4	2.4	0	0	0	0	0	0	0	12.25	0	0	9	
October	8	13.6	3.4	23.6	1.4	2	0	7.4	19.2	0	5.2	0	0	0	2.75	0.5	0	1.75	0	11.75	5	0	8.5	0.75	
October	9	0.2	1.8	1	5.2	0	0	7.6	3.4	0	0	0.4	0.6	0	23	0.5	0	0	0	0	0.25	0	5.25	0	
October	10	12.2	0	0	3	16.2	0	2.8	0	0.4	0	0	0	0	3.5	0.5	0	0	0	0	0	0	0.25	0	
October	11	0.8	0	0	0	0	0	1.6	0	0	0	0	0	0	2.25	8	0.25	0.25	1.25	12.75	0	0.25	0	0	
October	12	2.2	13.2	3.2	0	7	0	24	0	0	0	0	0	0	0.5	15.75	0	0	4.25	0	4.5	3.25	0	5	
October	13	2.4	3	7.8	0	0	0	0	0	0	0	n/a	8.2	0.8	0	2.5	3.5	4	1	6.75	3.25	1.75	0	0	
October	14	6.6	14.2	0	0	7.4	0	0	0	0	5	0	0	3.2	0	0	17.75	0	7	0	2.5	0	0	0	
October	15	2	0	0	0	0	0	8	0	0	10	0	7.6	3.2	0	0	3	0	0	0.25	9.25	0	0	3.25	
October	16	0	0	0	8	0.4	0	100	0	0	1.6	0.2	7	14.2	0	0	14.25	0	3	0	2.75	0.5	0	10.5	
October	17	0.8	7.6	0	24.8	0	0	104.4	27.2	0	0	1.2	0	48.6	0	0	0	0	0.75	0	2.25	13	0	11.25	
October	18	0	0	0	5.8	1.2	0	0.6	5.2	0	11.8	22.6	0	0	0	0	0	0	4.5	0	3.75	5.75	0	11.5	
October	19	0	0	0	0.2	3.2	1.6	12.8	10.2	0	8.2	27.4	0	0	0	0	19.75	0.5	0.25	0	6.5	9.75	0	2.5	
October	20	0	0	0	19.2	0	1.2	85.4	3.2	0	0	9.8	1.8	0	0	0.25	1	0.5	6.25	0.25	23	2	0	4.5	
October	21	0	0	0	0	14.4	0	13.6	0	0	0	1.6	0	4.4	0	0	0.75	0	4.5	0.25	11.5	2.5	0	22.25	
October	22	0.2	0	0	0	10.4	0	1.6	1.6	0	0	5.6	0	1.4	0.25	5.25	0	0.25	2	0.25	0.25	5	0	0	
October	23	0	0	0	0	9.6	0	1.8	0	0	0	0	0	34.8	2.25	16.25	5.75	0.5	25.75	0.25	1.5	0	0	0	
October	24	0	0	3.2	0	0.4	0	0	0	0	3	0	0	0	17.75	0	3	0	8.75	0	0	0	0.25	0	
October	25	0	0	0.4	0	21.4	0	0	7.2	3	0.4	0	0	10	22.75	0	3.75	0	1.5	0.5	0.25	0	1	0.5	
October	26	6.8	0	0	0	9.2	0	0	0	0	0.2	0	0	7.6	3.25	0	0	0.25	22.75	14.5	14.25	0	4	0	
October	27	0	0	1.2	0	1.6	1.8	0	0	0	0	0	0	0	0	1.75	9.75	0	9.75	2.25	4.75	0	6.25	0	
October	28	4.2	0	20	4.6	0	0	0	1.6	11	0	0	0	8.4	2.75	4.25	21.25	0	5.25	0	0.25	0	22.5	0	
October	29	21	0	8	0	0	0	0	0.2	3.2	1	0	0	13.4	0.5	15	1.25	0	14.75	12.5	0.5	0	8.75	0	
October	30	47.2	0	44.4	0	6.4	0	0	12.6	12	0	0	0.6	14.4	0.5	0	22.5	0	2.75	0.75	6	0	3.5	0	
October	31	7.8	1.8	27.4	1.8	13.6	0	0	0	17.8	0	0	2.4	3	4.25	7	3.75	0.25	11.25	15.75	6	0	6	0	
Total Monthly Rainfall		***167.4***	***57.6***	***170.4***	***74***	***124.4***	***4.6***	***384.4***	***105.2***	***48.2***	***48***	***100.4***	***56***	***170.8***	***86.25***	***80.25***	***131.25***	***30.25***	***137.25***	***81***	***135***	***45.75***	***89.5***	***93.75***	
Maximum Daily Rainfall		***47.2***	***14.2***	***44.4***	***24.8***	***21.4***	***1.8***	***104.4***	***27.2***	***17.8***	***11.8***	***27.4***	***13.4***	***48.6***	***23***	***16.25***	***22.5***	***9.25***	***25.75***	***15.75***	***23***	***13***	***22.5***	***22.25***	

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
November	1	0.8	1	0	0	0.6	0	0	15.4	5.6	0	0	0	0	2.75	0	10	1.5	3	48.5	14.5	0	2.25	0	
November	2	0	19.4	0	0	0	0	0.6	36.4	12.6	16.6	0	1.4	0.8	0.25	0	1.25	4	0	16	14.5	22.25	20	0	
November	3	9.4	0	0.8	0	0	0	0	0	2.2	15.6	4	3.4	0	0	7.75	3	3	1.75	0	0.25	3.5	7	0	
November	4	0	7.4	1.2	9.8	5	0	0	n/a	10.2	21.4	0.2	6.4	0	0	1	5.75	0	21.25	0	2.25	4.75	21.5	0	
November	5	0.4	13	0	1.4	0.8	0	0	n/a	21.2	26.2	0	0	19.4	9	0	11	2.25	5	0.25	19	0.5	9.25	0	
November	6	3.2	0	14	7.8	0	4.2	0	n/a	2.2	88	2.6	66	17	2.75	0	0	5.75	8.25	0.5	0.5	0	0	0	
November	7	3.6	0	0	0	0	2.8	0	n/a	0	4.2	2	36.6	18.6	0.25	0	3.75	3.25	10.25	4.25	2.75	0	0	0	
November	8	0	0	2.8	11.8	0	4	0	n/a	2.4	17.6	7.4	2.2	0.8	0	0.75	0.25	11.75	0	15	1.75	3	0	0.75	
November	9	0	0	1.4	4	0	7	0	n/a	0.8	1	2	3	6.4	1	2.75	0	0	0	0.5	8.25	1.75	0	3.25	
November	10	0	0.2	6.2	0	0	4	0	n/a	3.4	18.2	4.2	2.2	8.2	0	0	0	0	3.25	2.5	0	0	4.25	0	
November	11	0	0	18.8	0	0	7.6	0	n/a	27.8	1.2	1.6	12	0.6	3.25	0	0	0	0	6.25	0	3.25	0.25	0	
November	12	0	22.2	14.6	0	4.8	11.6	0	n/a	0	42.2	22.6	22	0	0	9.5	24.5	0	0	0.5	0.75	2.5	0	0	
November	13	0	53.6	7.8	1.4	4.6	5.6	0	n/a	14	18	1.8	0	6.4	6.25	8.25	4	3.75	0	44.5	7	14.5	0	0	
November	14	0	22.2	4.4	0	25.8	4	0	n/a	0	0.6	2	0.8	0	2.25	0.25	3	0.5	0	23.25	0	20.5	9	0	
November	15	0	33.6	2.6	0	18.4	0	2.2	n/a	0	39.8	14.2	0.2	17	1.5	0	0.25	0	0	13	5.25	10.5	18	0	
November	16	0	27	10.6	0	6.4	11	22.6	n/a	0.6	0	4.6	0	58.4	0	0	0	3	0	3.75	6.5	2.5	0	0.75	
November	17	2.4	0	3.8	0	0	0	1.2	n/a	0	12.8	5.4	0	15	12.75	11.75	0.5	0	0	7	0	0.25	0.25	0.25	
November	18	0	0	0	0	0	15.2	68	14.4	0	6.8	1	0	16.4	2	6.5	4.5	5	0	49	0	0.25	0	9.75	
November	19	1.2	3.6	1	0	15.2	21.8	27.4	0	0	7.8	1.6	0	42.2	0.75	0	7	24	0	0	0	18.75	0	0.25	
November	20	8.4	35.2	9.4	0	6.8	1	0	0	0	14.4	0	3.4	7.2	0	0.25	3.75	0	0	0	1.25	7.75	0	0	
November	21	0.2	28.8	4	0	7.6	0	0	0	0	35.2	0	7.2	1	0	0	10.75	0	2.25	0	0	2.75	0	0	
November	22	1.4	19.6	3.4	0	7.2	0	0	1.2	0	1.8	0	0	17.6	0	5.75	14	0	17.75	0	16	7.75	9	0	
November	23	0.8	3.8	4.8	6.6	0.8	0	10.6	5.6	0	10.2	0	0	10.2	0	58	0.25	0	1.5	0	0.5	8.5	6.5	2.25	
November	24	3.2	28.2	18.4	0	0	0	5	13.4	0.8	1.4	0	0	2.6	0	15	10.25	0	18	8	11	2	8.75	0.5	
November	25	2.2	43.2	7.2	9	0.6	0	8	2.8	20.4	14.4	0	0	17.2	4.5	9.75	0.25	0	9.75	0.75	8.25	5.25	0	0	
November	26	0	10.8	0	25.6	2	0	0	1.6	0	32	10.6	0	9.4	14.25	0	0	0	27.75	0	6.5	6.5	3	0	
November	27	8	0.8	0.4	3.8	6.8	0	0.2	0.8	0	17.8	0	0	0	0.25	1.25	0	0	5.75	0	5.75	0.75	36	0	
November	28	16.8	0	0.4	0	33	0	66.8	0	5.2	0.8	10.4	2.2	8.2	0	24.25	0	0	7.25	0	0	2.25	13.5	0	
November	29	1.8	0.6	0	2	8.8	0	2.6	1.2	12	17.4	0.2	6	7	8	0	5.5	0	3.25	0	1.5	0.5	2	0	
November	30	9.4	1.2	2.8	4.4	2.4	0	0	5.6	0.2	2	0	0.6	1	17.75	7	0.5	7.75	0.25	0.25	0.25	7.5	0.25	0	
Total Monthly Rainfall		***73.2***	***375.4***	***140.8***	***87.6***	***157.6***	***99.8***	***215.2***	***98.4***	***141.6***	***485.4***	***98.4***	***175.6***	***308.6***	***89.5***	***169.75***	***124***	***75.5***	***146.25***	***243.75***	***134.25***	***160.25***	***170.75***	***17.75***	
Maximum Daily Rainfall		***16.8***	***53.6***	***18.8***	***25.6***	***33***	***21.8***	***68***	***36.4***	***27.8***	***88***	***22.6***	***66***	***58.4***	***17.75***	***58***	***24.5***	***24***	***27.75***	***49***	***19***	***22.25***	***36***	***9.75***	

Appendix C-1. Daily Rainfall Data: Hartland Landfill Weather Station

Date		Daily Rainfall (mm)																							
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
December	1	0	5.2	9.4	0	8.2	0	0	0	2.6	0	15.2	1.8	0	0.25	0.25	16	6.75	0.25	0.25	1	17.25	2.5	0	
December	2	0	19.4	16.4	12.4	12.8	0	1.4	0.2	0	0	46.4	0	0	0.25	0	23.25	5.75	0	9.5	0	2.5	1	0	
December	3	0	3.6	0	0	0	0	9	0.2	0	0	100.4	0	0	0.25	0	10.25	0	0.25	2.25	4.5	0	0	0	
December	4	0	0	0	0	6	3.2	0	16.6	0	3.6	18	0	0	0	0	13	0	0	7.75	0	0	0	0	
December	5	0	2.4	4.8	0	4.6	0	6.6	1.4	0	0.4	0.2	0	0	0	0	10.75	0	2	2.25	5	0	0	0	
December	6	0	0.4	16.2	0	5.2	0	9.8	12.4	0	0	0	4.2	0	0	0	8.5	0	1	17.5	0.25	0	0	0.25	
December	7	0.4	3	0	0	0	0	10.8	6	0	0.2	0	0.4	0	7	0	11	0	5.25	9.75	0	0	0	0.75	
December	8	1	2.8	1	0	12.4	0	0	16.2	0	0.2	0	0	0	4.25	1.75	7	0	0	5.75	0	0	0	0	
December	9	2.6	2.8	2.6	1.6	0	0	0	22	0	0.6	3.4	9.6	0	18.25	0	0	0	19.75	43	0	0.25	0	0	
December	10	1.8	8.4	3.2	0.8	5.4	4.4	9.2	38.4	0	1.4	0.2	3.8	0	0	0	9.25	0	13.75	15.25	8.25	0	8	0	
December	11	0	2.8	2.2	0	2.8	6.2	2	0	0	19.2	0.4	0	0	3.75	0	0.25	0	38.25	8	1.5	0	4.25	0	
December	12	0	11.4	28.8	0	8.4	20	4.4	0	0.2	17	0	22.2	0	5	0	6	0	6	0	0.25	0	36.75	4.75	
December	13	0	33.2	7.2	0	32.4	0.4	3.4	3	0	29.4	2.2	4.2	0	0.5	0	0	2	1.25	19	0	0	22.25	0.5	
December	14	1.6	0	22.6	1.2	15	21.4	18.6	14.4	0	31.8	9	1.6	10.4	3.25	0	7.75	2	0	10.25	0	0	24	0	
December	15	2.8	10	63	4.2	3.6	5	0	0.8	0	6.4	16.2	0	25.75	2	2.25	1.5	2.5	0	0	0	3	2.25	0	
December	16	47.6	7	0	49.2	61.8	5.8	8.4	0.6	0	0	0	0	14.25	0	1.25	0.75	4.5	0	0.25	0	4.5	0.75	0	
December	17	24.6	1	9.8	5.6	29.8	0.2	1.6	3.8	0	0	1.8	5.8	9.5	0	0.75	24.75	0	0.25	0	0	11	7	0.25	
December	18	2.2	0	3.8	0	1.6	0.2	0	1.8	0	1.8	6.2	3.4	4	0.75	0.75	10.75	0	2	25.75	1	6.5	13.5	0	
December	19	9.8	0	2.4	1.2	6	0.2	0	0	2	10	15.2	0	4.75	0.75	0.5	1.75	0	3.25	15.25	4	3	20	0	
December	20	7.8	0	1	3.8	0	0	0.6	0	15.2	6.2	0	0	11	1.5	0	22.75	0	3.75	0	1.25	0.75	5.5	0.5	
December	21	0.6	6.6	0	1.2	0	0	0.4	0	6.4	15.8	0	27.4	4.75	0	0	7.25	10.75	23.5	9	0	2.25	11.25	0.25	
December	22	0	0	0	4.8	0	0.4	0	0	10.6	1	19.4	13.2	0	0	0	0	2.5	3	9.25	0.25	0.75	0	0	
December	23	7	0.6	0	3.2	0	0	0	0	11.8	17.2	12.6	0.4	0	7	0.25	2.5	7.25	0	2.5	1.5	0	10.75	0	
December	24	0.2	18.2	0	4.6	0	1.2	4.8	0.8	15.4	23	0.2	21.8	0	5.25	1.25	4.25	6.75	11.75	8.25	0.25	0	12.25	0	
December	25	0	17.6	0	7.6	0	14.6	5.2	9.4	12.8	3.4	0	1.8	0	1	5.75	2	0	0.75	0	0	2.75	0	0	
December	26	7.4	21.8	0	2.4	0	12.2	0	4.4	0.4	4.8	0	7.8	0	8	3.5	22.25	0	0	0	0	0	0.5	0	
December	27	4.6	17	0	4.8	0	22.4	3.6	0	6.2	0	4.2	5	0	10.75	5.25	10	0	1.5	1	1	0.25	5.5	0	
December	28	10.6	15.4	0	0	2	1	1.8	0	13.8	0	7.6	0.6	0.25	0.5	30.75	0.75	2.5	6.25	12.25	0.25	19	1	0	
December	29	0.2	46.4	0.2	0	0	0	0	5.6	0.2	0.6	4.2	12.6	0	0	19.75	3	0	0.25	0	2.75	2.75	24.25	0	
December	30	0	0	0.2	3	0	4.2	0.2	0.6	5.6	0	1.8	1.6	3.5	0	5.25	3	0	0	0	0	4	19.5	0	
December	31	0	0.8	11.6	3.6	6.4	0	4.6	3.2	16.2	0	0	3	16.25	0	3.75	0	0.25	0	0	0.25	0	0	0	
Total Monthly Rainfall		***132.8***	***257.8***	***206.4***	***115.2***	***224.4***	***123***	***106.4***	***161.8***	***119.4***	***194***	***284.8***	***152.2***	***104.4***	***80.25***	***83***	***240.25***	***53.5***	***144***	***234***	***33.25***	***80.5***	***232.75***	***7.25***	
Maximum Daily Rainfall		***47.6***	***46.4***	***63***	***49.2***	***61.8***	***22.4***	***18.6***	***38.4***	***16.2***	***31.8***	***100.4***	***27.4***	***25.75***	***18.25***	***30.75***	***24.75***	***10.75***	***38.25***	***43***	***8.25***	***19***	***36.75***	***4.75***	

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C2. Monthly Rainfall Data – Hartland Landfill Weather Station

Appendix C-2. Monthly Rainfall Data: Hartland Landfill Weather Station

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Month	Monthly Rainfall (mm)																			
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Avg
January	213.2	205.8	119.8	210.2	277.4	312.4	106.8	121.6	180.5	161.8	150.75	53.75	70.25	160.8	114.5	26	153.5	158.8	166.5	152.9
February	160.6	29	53	39.2	79.2	94	63	43.8	50.25	72.5	122.5	67.3	130	133	172.8	50	70	39.3	129.0	86.8
March	135.8	149.6	97	86	36.6	162.2	71.4	99.2	92	108	129.5	91	113	123	137	158	132	15.0	40.0	97.0
April	71.8	46.2	4.8	43.6	55.6	40.8	70.4	94.6	67.75	109.75	53.5	70.5	66	35	14	90.75	108	54.3		53.8
May	19.4	25.4	38.4	9.2	34.2	18.4	15.8	62.6	76.5	61.75	32	53.5	40.25	4	11.8	41.25	10.5	31.3		34.8
June	18	2	20.2	1.6	30.4	34.4	24.2	7.2	1.8	7.5	44.75	30.25	12	3.5	41.5	34	19.3	19.0		23.5
July	7.4	11.8	31	1.2	2	41.7	7	10.6	2.65	26.25	21	0	6.5	17.5	18.5	0	3.3	22.3		14.6
August	0.8	0.6	106.2	2.8	3.4	23.2	43.6	22.2	26.25	16.5	2.25	3	12.75	15.5	2.8	3.25	0.5	12.8		17.7
September	0	34.6	83.2	0.4	31.8	27.2	21.4	54.8	133.75	43.75	0.5	60.25	51.25	76.5	42.8	19.25	40.5	80.3		41.8
October	4.6	384.4	105.2	48.2	48	100.4	56	170.8	86.25	80.25	131.25	30.25	137.25	81	135	45.75	89.5	93.8		105.3
November	99.8	215.2	98.4	141.6	485	98.4	175.6	308.6	89.5	169.75	124	75.5	146.25	243.8	134.3	160.25	170.8	17.8		164.7
December	123	106.4	161.8	119.4	194	284.8	152.2	104.4	80.25	83	240.25	53.5	144	234	33.3	80.5	232.8	7.3		146.6
Total Yearly Rainfall	***854.4***	***1211***	***919***	***703.4***	***1277.6***	***1237.9***	***807.4***	***1100.4***	***887.45***	***940.8***	***1052.25***	***588.8***	***929***	***1127.1***	***858.3***	***709***	***1030.7***			***939.5***

Note:

No weather data was collected from Nov 4 - 17, 2004

Weather data collected in 2009 is unreliable due to equipment failure

Appendix D

Leachate Pipeline Flow Data

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-1997	13	2148	0	2148	40816
Feb-1997	0	2700	732	2226	62334
Mar-1997	0	2759	2412	2696	83557
Apr-1997	0	2655	214	2545	78899
May-1997	4	2654	0	956	29561
Jun-1997	11	1563	0	546	17503
Jul-1997	17	2452	0	525	16090
Aug-1997	15	1608	0	386	11606
Sep-1997	21	2662	0	456	14159
Oct-1997	6	2782	0	1233	36996
Nov-1997	4	2533	0	1437	44565
Dec-1997	2	2408	0	1695	52547
TOTAL	93	2782	0	1404	488633

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-1998	0	2603	879	2187	65977
Feb-1998	3	2603	0	1624	43531
Mar-1998	3	2419	0	n/a	35275
Apr-1998	10	1542	0	542	16675
May-1998	13	1890	0	423	12574
Jun-1998	17	1241	0	239	7239
Jul-1998	21	1919	0	240	7645
Aug-1998	31	0	0	0	0
Sep-1998	27	1020	0	58	1821
Oct-1998	19	2379	0	511	14962
Nov-1998	7	2462	0	1538	45248
Dec-1998	0	2619	n/a	n/a	76518
TOTAL	151	2619	0	736	327465

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-1999	0	n/a	n/a	n/a	69000
Feb-1999	0	2970	1966	2681	74930
Mar-1999	0	2970	2539	2875	92028
Apr-1999	5	2894	0	1812	57986
May-1999	11	2889	0	660	20656
Jun-1999	18	1215	0	257	7480
Jul-1999	18	2772	0	365	11687
Aug-1999	30	n/a	n/a	n/a	1000
Sep-1999	4	1193	0	148	4597
Oct-1999	19	1473	0	163	4719
Nov-1999	4	2840	0	1497	43972
Dec-1999	4	3480		n/a	67907
TOTAL	113	3480	0	1162	455962

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2000	3	2791	0	n/a	55088
Feb-2000	7	2235	0	n/a	29318
Mar-2000	7	2211	0	n/a	37258
Apr-2000	8	1737	0	n/a	21289
May-2000	19	2772	0	501	15547
Jun-2000	19	2685	0	396	11902
Jul-2000	22	1086	0	155	4831
Aug-2000	26	907	0	116	3619
Sep-2000	21	2640	0	354	10623
Oct-2000	n/a	n/a	n/a	n/a	8572
Nov-2000	n/a	n/a	n/a	n/a	11737
Dec-2000	12	2926	0	943	29235
TOTAL	144	2926	0	411	239019

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2001					38089
Feb-2001					30154
Mar-2001					24565
Apr-2001	15	2622	0	646	18746
May-2001	16	1647	0	400	12407
Jun-2001	22	2026	0	295	8862
Jul-2001	22	1521	0	244	7576
Aug-2001	24	2873	0	291	9047
Sep-2001	23	1633	0	157	4723
Oct-2001	15	2631	0	552	17112
Nov-2001	7	2899	0	993	29819
Dec-2001	0	3397	58	2241	69492
TOTAL	144	3397	0	647	270592

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2002	1	2892	0	1946	60342
Feb-2002	1	3395	0	1946	54497
Mar-2002	2	3412	0	2200	68224
Apr-2002	6	2444	0	1022	29651
May-2002	13	2118	0	578	17928
Jun-2002	16	1683	0	381	11435
Jul-2002	20	2330	0	330	10231
Aug-2002	23	1521	0	253	7848
Sep-2002	28	1154	0	72	2160
Oct-2002	26	1356	0	143	4450
Nov-2002	14	2477	0	618	18555
Dec-2002	9	2896	0	987	30615
TOTAL	159	3412	0	873	315936

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Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	***Maximum Daily Flow in M^3***	***Minimum Daily Flow in M^3***	***Average Daily Flow in M^3***	***Monthly Total Flow in M^3***
Jan-2003	5	4880	0	1569	48664
Feb-2003	4	2819	0	1354	37921
Mar-2003	3	2849	0	1533	47546
Apr-2003	6	2185	0	846	24562
May-2003	18	1892	0	514	15962
Jun-2003	15	1397	0	340	10224
Jul-2003	20	1126	0	282	8768
Aug-2003	21	1140	0	214	6658
Sep-2003	23	1147	0	222	6671
Oct-2003	15	3869	0	1621	50260
Nov-2003	4	3681	0	2546	76397
Dec-2003	0	3587	96	2218	68773
TOTAL	134	4880	0	1105	402406

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	***Maximum Daily Flow in M^3***	***Minimum Daily Flow in M^3***	***Average Daily Flow in M^3***	***Monthly Total Flow in M^3***
Jan-2004	0	2859	99	1597	49509
Feb-2004	0	2833	2	1536	44551
Mar-2004	2	2792	0	1170	36288
Apr-2004	22	1675	0	319	9272
May-2004	31	0	0	0	0
Jun-2004	13	3565	0	1104	33135
Jul-2004	30	63	0	2	63
Aug-2004	23	3007	0	601	18636
Sep-2004	24	2998	0	454	13640
Oct-2004	14	3668	0	1138	35284
Nov-2004	2	2889	0	1631	48938
Dec-2004	4	3659	0	2191	67947
TOTAL	165	3668	0	979	357263

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	***Maximum Daily Flow in M^3***	***Minimum Daily Flow in M^3***	***Average Daily Flow in M^3***	***Monthly Total Flow in M^3***
Jan-2005	7	3671	0	2247	69680
Feb-2005	2	3662	0	2571	72002
Mar-2005	11	2484	0	824	25551
Apr-2005	4	2800	0	1041	30206
May-2005	18	2840	0	691	21437
Jun-2005	16	1800	0	431	12946
Jul-2005	18	1301	0	274	8512
Aug-2005	22	2771	0	417	12927
Sep-2005	19	1301	0	274	8512
Oct-2005	24	3025	0	432	13393
Nov-2005	5	2999	0	1347	40421
Dec-2005	5	2916	0	1180	36601
TOTAL	151	3671	0	977	352188

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2006	0	3415	1123	3075	95329
Feb-2006	2	3435	0	2206	61795
Mar-2006	8	2926	0	846	26247
Apr-2006	14	2141	0	558	16762
May-2006	19	2058	0	464	14402
Jun-2006	21	2175	0	359	10795
Jul-2006	28	1996	0	105	3277
Aug-2006	23	1991	0	327	10148
Sep-2006	22	1770	0	255	7654
Oct-2006	23	2043	0	304	9427
Nov-2006	2	3677	0	2872	86167
Dec-2006	0	3563	3130	3425	106180
TOTAL	162	3677	0	1233	448183

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2007	0	3657	3272	3464	107411
Feb-2007	0	3619	815	2398	67168
Mar-2007	0	3442	38	2130	66034
Apr-2007	6	1929	0	872	26177
May-2007	14	2120	0	572	17740
Jun-2007	18	2127	0	477	14331
Jul-2007	22	2157	0	387	12019
Aug-2007	28	1730	0	92	2859
Sep-2007	29	76	0	2	76
Oct-2007	14	3288	0	945	29316
Nov-2007	11	2306	0	793	23813
Dec-2007	1	3715	0	2549	79041
TOTAL	143	3715	0	1223	445985

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2008	0	2949	260	1644	50970
Feb-2008	2	2927	0	1322	38343
Mar-2008	0	1874	0	901	27953
Apr-2008	7	1849	0	845	25364
May-2008	18	2946	0	537	16670
Jun-2008	25	2695	0	286	8594
Jul-2008					0
Aug-2008					0
Sep-2008					28892
Oct-2008					29892
Nov-2008					17433
Dec-2008					37620
TOTAL	52	2949	0	923	281731

Appendix D. Leachate Pipeline Flow Data

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Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2009	0	3522	799	2400.13	74404
Feb-2009	2	1551	0	866.54	24263
Mar-2009	0	2388	42	1040.23	32247
Apr-2009	5	2838	0	1056.40	31692
May-2009	11	2292	0	760.94	23589
Jun-2009	18	1839	0	426.58	13224
Jul-2009	9	2880	0	804.66	25749
Aug-2009	0	2871	402	942.19	29208
Sep-2009	18	2847	0	313.20	9396
Oct-2009	7	2838	0	814.52	25250
Nov-2009	0	3345	210	2426.10	72783
Dec-2009	0	3246	1125	2169.39	67251
TOTAL	70	3522	0	1168	429056

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2010	0	3438	1080	2460.58	76278
Feb-2010	0	1824	387	1013.46	28377
Mar-2010	10	1617	0	629.32	19509
Apr-2010	10	2853	0	1280.63	38419
May-2010	11	1989	0	704.32	21834
Jun-2010	16	1776	0	498.70	14961
Jul-2010	17	1815	0	399.87	12396
Aug-2010	18	2481	0	391.84	12147
Sep-2010	13	1752	0	647.50	19425
Oct-2010	7	1719	0	791.61	24540
Nov-2010	1	2034	0	1107.90	33237
Dec-2010	1	3462	0	2673.97	82893
TOTAL	104	3462	0	1050	384016

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2011	1	3324	0	2521.00	75630
Feb-2011	5	2823	0	1544.10	46323
Mar-2011	2	2832	0	1762.00	52860
Apr-2011	5	2715	0	1429.70	42891
May-2011	7	2847	0	894.68	27735
Jun-2011	13	1563	0	534.80	16044
Jul-2011	15	1428	0	441.19	13677
Aug-2011	13	1434	0	338.06	10818
Sep-2011	8	2604	0	454.94	14103
Oct-2011	20	1932	0	359.61	11148
Nov-2011	8	3288	0	1020.30	30609
Dec-2011	6	2589	0	1011.77	31365
TOTAL	103	3324	0	1026	373203

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2012	0	2556	156	1693.94	52512
Feb-2012	1	2742	0	1634.28	47394
Mar-2012	1	2472	0	1518.68	47079
Apr-2012	3	2121	0	914.60	27438
May-2012	11	1671	0	563.16	17458
Jun-2012	16	1848	0	449.77	13493
Jul-2012	10	2979	0	606.97	18816
Aug-2012	20	1266	0	205.55	6372
Sep-2012	9	1410	0	460.90	13827
Oct-2012	15	2688	0	641.03	19872
Nov-2012	3	2847	0	1601.70	48051
Dec-2012	0	2610	779	2346.68	72747
TOTAL	89	2979	0	1053	385059

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2013	0	2526	43	1615.94	50094
Feb-2013	2	1986	0	1017.00	28476
Mar-2013	3	2694	0	1750.26	54258
Apr-2013	5	2136	0	997.30	29919
May-2013	10	1840	0	627.00	19437
Jun-2013	12	2515	0	594.30	17829
Jul-2013	14	1390	0	379.26	11757
Aug-2013	16	1590	0	355.55	11022
Sep-2013	9	2199	0	523.50	15705
Oct-2013	6	2448	0	772.81	23957
Nov-2013	6	2418	0	844.87	25346
Dec-2013	7	1848	0	708.74	21971
TOTAL	90	2694	0	849	309771

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2014	1	2316	0	1348.52	41804
Feb-2014	2	3366	0	1951.21	54634
Mar-2014	0	3387	150	2252.39	69824
Apr-2014	2	2535	0	1004.27	30128
May-2014	7	2562	0	796.90	24704
Jun-2014	5	1677	0	473.77	14213
Jul-2014	18	2517	0	485.68	15056
Aug-2014	14	911	0	302.55	9379
Sep-2014	16	959	0	305.43	9163
Oct-2014	16	2163	0	447.48	13872
Nov-2014	8	2808	0	1420.00	42601
Dec-2014	0	2589	600	1814.42	56247
TOTAL	89	3387	0	1050	381625

Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2015	0	2472	460	1976.13	61260
Feb-2015	0	2508	312	1750.36	49008
Mar-2015	0	2481	45	1493.71	46305
Apr-2015	1	2763	0	1118.30	33549
May-2015	15	2078	0	519.23	16096
Jun-2015	17	1744	0	449.57	13487
Jul-2015	23	1758	0	267.19	8283
Aug-2015	19	2595	0	376.71	11678
Sep-2015	15	1679	0	454.97	13649
Oct-2015	15	2251	0	460.35	14271
Nov-2015	3	3186	0	2154.30	64629
Dec-2015	0	3350	386	2693.29	83492
TOTAL	108	3350	0	1143	415707

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2016	1	3240	0	1836.23	56923
Feb-2016	1	3267	0	2639.38	76542
Mar-2016	1	3099	0	1818.87	56385
Apr-2016	8	3096	0	784.40	23532
May-2016	16	3098	0	540.00	16740
Jun-2016	10	1251	0	454.73	13642
Jul-2016	16	1222	0	340.00	10540
Aug-2016	16	1553	0	330.42	10243
Sep-2016	19	1707	0	324.00	9720
Oct-2016	7	2610	0	1328.81	41193
Nov-2016	0	3228	603	2038.40	61152
Dec-2016	0	3378	774	2344.35	72675
TOTAL	95	3378	0	1232	449287

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2017	1	2436	0	1390.29	43099
Feb-2017	2	3234	0	2049.18	57377
Mar-2017	0	3192	384	2050.16	63555
Apr-2017	0	2328	111	1547.40	46422
May-2017	11	3312	0	758.90	23526
Jun-2017	21	1410	0	291.60	8748
Jul-2017	7	882	0	356.03	11037
Aug-2017	15	2790	0	494.32	15324
Sep-2017	17	3375	0	494.00	14820
Oct-2017	23	2028	0	290.32	9000
Nov-2017	3	3324	0	1850.90	55527
Dec-2017	5	3276	0	1763.90	54681
TOTAL	105	3375	0	1111	403116

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Appendix D. Leachate Pipeline Flow Data

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2018	2	3213	0	2401.16	74436
Feb-2018	1	3438	0	2097.71	58736
Mar-2018	9	27775	0	1048.97	32518
Apr-2018	11	3111	0	1023.00	30690
May-2018	17	2892	0	629.00	19497
Jun-2018	17	2184	0	482.00	14473
Jul-2018	11	1608	0	385.00	11942
Aug-2018	21	1593	0	158.00	4908
Sep-2018	18	1286	0	234.00	7026
Oct-2018	8	1692	0	520.00	16127
Nov-2018	1	2676	0	1157.00	35865
Dec-2018	1	3234	0	2428.00	75255
TOTAL	117	27775	0	1047	381473

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2019	2	3300	0	2607.00	80823
Feb-2019	3	2787	0	1302.00	36442
Mar-2019	5	2439	0	1013.00	31393
Apr-2019	8	2526	0	769.00	23078
May-2019	11	2172	0	595.00	18437
Jun-2019	21	802	0	152.00	4546
Jul-2019	29	14	0	1.00	19
Aug-2019	25	3320	0	158.00	4888
Sep-2019	12	3298	0	858.00	25725
Oct-2019	14	3010	0	897.00	27803
Nov-2019	7	2114	0	785.00	23560
Dec-2019	2	2196	0	1196.00	37091
TOTAL	139	3320	0	861	313805

Hartland Leachate System Monthly Flow Data					
	Days Without Flow	*Maximum Daily Flow in M^3*	*Minimum Daily Flow in M^3*	*Average Daily Flow in M^3*	*Monthly Total Flow in M^3*
Jan-2020	0	3108	1092	2793.00	86573
Feb-2020	0	2990	2608	2910.00	84399
Mar-2020	3	2892	0	1117.00	34616
Apr-2020					
May-2020					
Jun-2020					
Jul-2020					
Aug-2020					
Sep-2020					
Oct-2020					
Nov-2020					
Dec-2020					
TOTAL	3	3108	0	2273	205588

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Appendix E

Hartland Landfill Site Plan and Sampling Locations

- E1. Hartland Landfill Site Plan
- E2. Groundwater Level Monitoring Locations
- E3. Groundwater Quality Monitoring Locations
- E4. Surface Water Quality Monitoring Locations
- E5. Leachate Quality Monitoring Locations

E1. Hartland Landfill Site Plan

CRD - Parks & Environmental Services - Facilities Management & Engineering Services - Sep 14, 2017 - Technologist: jpbezeau - Map Document: HartlandSiteFacilitiesPhases2015.mxd

HARTLAND LANDFILL SITE PLAN

Making a difference...together

Metres
0 50 100 200

Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

- Observation Chamber
- Pump Station
- Leachate Pipeline

Contours (5m interval)
- Index
- Index-Depression

- Cell Phases
- Lot Lines
- Regional Park

E2. Groundwater Level Monitoring Locations

HARTLAND LANDFILL
GROUNDWATER LEVEL MONITORING LOCATIONS

CRD
Making a difference...together

Metres
0 25 50 100 150
Projection: UTM ZONE 10N NAD 83

Important This map is for general information purposes only. The Capital Regional District (**CRD**) makes no representations or warranties regarding the accuracy or completeness of this map or the suitability of the map for any purpose. **This map is not for navigation.** The CRD **will not be liable** for any damage, loss or injury resulting from the use of the map or information on the map and the map may be changed by the CRD at any time.

Groundwater Level Monitoring Locations
Monitoring Frequency (# times per year)
- 4
- Continuous

Roads
Contours (5m interval)

E3. Groundwater Quality Monitoring Locations

HARTLAND LANDFILL
GROUNDWATER QUALITY MONITORING LOCATIONS

CRD
Making a difference...together

Metres
0 25 50 100 150
Projection: UTM ZONE 10N NAD 83

Groundwater Monitoring Location – Non-Compliance Well
Groundwater Monitoring Location – Compliance Well
Roads
Contours (5m interval)

E4. Surface Water Quality Monitoring Locations

HARTLAND LANDFILL
LEACHATE QUALITY MONITORING LOCATIONS

Making a difference...together

Metres

0 25 50 100 150

Projection: UTM ZONE 10N NAD 83

Leachate Quality Monitoring Locations

Contours (5m interval)

Roads

E5. Leachate Quality Monitoring Locations

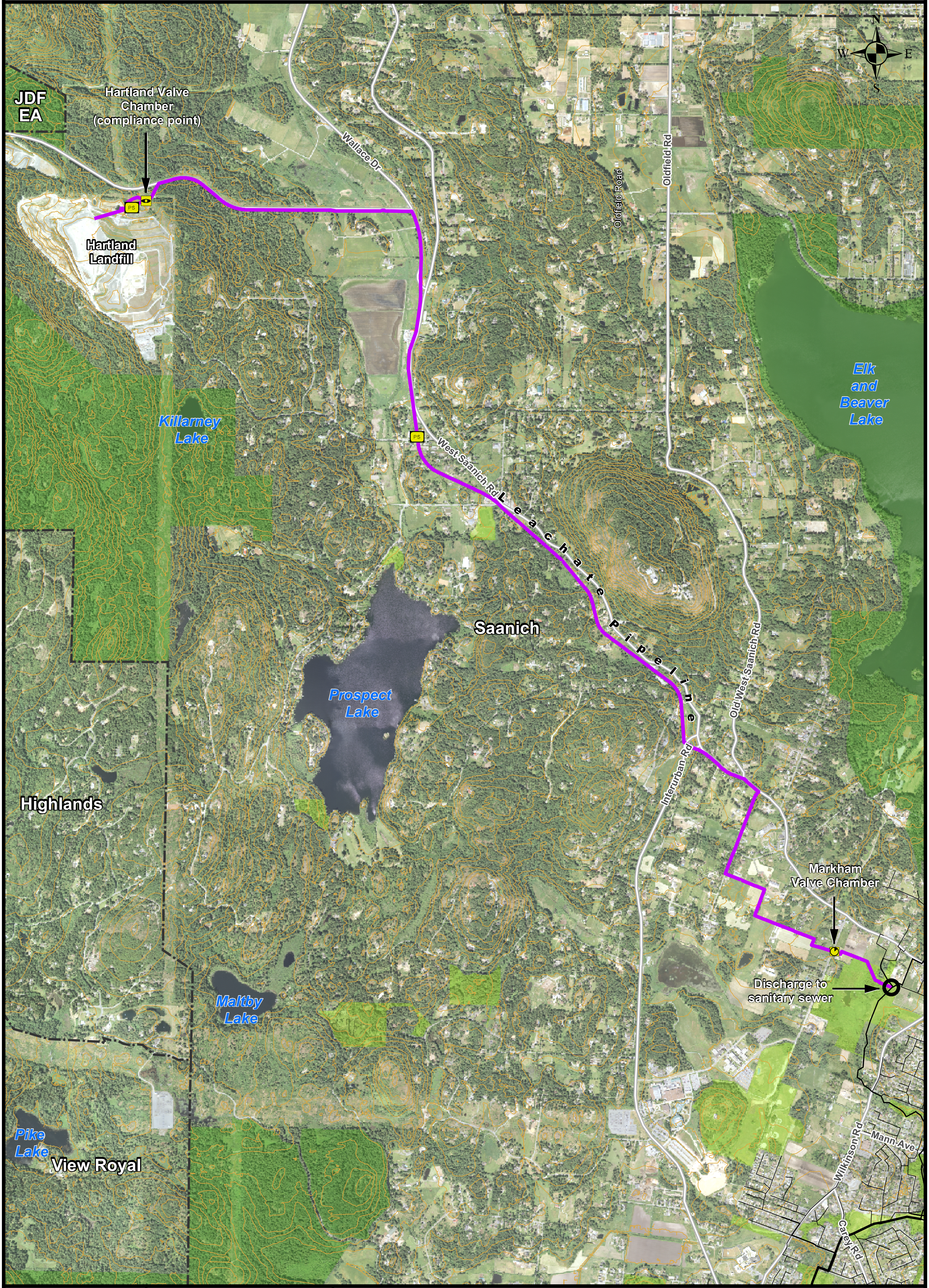
AECOM

Appendix F

Hartland Landfill Leachate Pipeline Plan

CRD Environmental Services - Jul 7, 2009 - Technologist: SR - Map Document: Hartland_Leachate_Line.mxd

HARTLAND LANDFILL - LEACHATE PIPELINE PLAN



Leachate Pipeline Features	Saanich Municipal Sewers		
Metering Chamber	0 - 200 mm	Municipal Boundaries	Municipal Park
Observation Chamber	201 - 599 mm	Major Roads	Regional Park
Pump Station	600 - 899 mm	**Contours (10m Interval)**	
Leachate Pipeline	> 900 mm	Major Contour	
		Major Contour - Depression	Orthophoto flown in 2007

Making a difference...together

0 100 200 400 600 Metres

Projection: UTM ZONE 10N NAD 83

Appendix G

Results of Statistical Analysis

- G1. Groundwater
- G2. Surface Water
- G3. Leachate

G1. Groundwater

Appendix G-1. Results of Statistical Analysis - Groundwater

AECOM

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing
	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
Boundary Compliance Monitoring Wells										
Gw-04-3-1	N	Y	N	N	N	N	N	N	Y	N
Gw-04-4-1	N	N	N	N	Y	N	N	N	N	N
Gw-18-1-1	N	Y	N	N	N	N	Y	N	N	N
Gw-18-1-2	N	N	N	N	N	N	N	N	N	N
Gw-18-2-1	N	Y	N	N	N	N	Y	N	N	N
Gw-18-2-2	N	Y	N	N	N	N	N	Y	N	N
Gw-20-1-1	N	Y	N	Y	N	N	N	Y	N	N
Gw-20-1-2	N	Y	N	Y	N	N	N	Y	N	N
Gw-21-1-1	N	Y	N	N	N	N	N	Y	N	N
Gw-21-1-2	N	N	N	N	N	N	N	N	N	N
Gw-21-2-1	N	Y	N	N	N	N	N	N	N	N
Gw-28-1-0	N	Y	N	N	N	N	N	N	Y	N
Gw-29-1-1	N	Y	N	N	Y	N	N	N	Y	N
Gw-29-1-2	N	Y	N	N	Y	N	Y	N	Y	N
Gw-30-1-1	N	Y	N	N	N	Y	N	N	N	N
Gw-30-1-2	N	N	N	N	N	N	N	N	N	N
Gw-31-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-31-1-2	N	N	N	N	N	N	N	N	Y	N
Gw-39-1-1	N	Y	N	N	N	N	Y	N	N	N
Gw-39-2-1	N	Y	N	N	N	N	N	N	N	N
Gw-41-1-1	N	Y	N	N	Y	N	N	Y	N	N
Gw-42-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-53-1-1	N	Y	N	N	N	Y	N	Y	N	N
Gw-54-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-54-2-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-54-3-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-55-1-1	N	Y	N	N	Y	N	N	N	N	N
Gw-56-1-1	N	Y	N	N	Y	N	N	Y	N	N
Gw-57-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-71-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-71-2-1	N	N	N	Y	Y	N	Y	N	N	N
Gw-71-3-1	N	N	N	N	Y	N	Y	N	Y	N
Gw-72-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-72-2-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-72-3-1	N	Y	N	Y	N	Y	N	N	N	N
Gw-73-1-1	N	Y	N	N	N	Y	N	Y	N	N
Gw-73-2-1	N	Y	N	N	N	N	N	N	N	N
Gw-73-3-1	N	Y	N	N	N	N	N	N	Y	N
Gw-76-1-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-76-2-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gw-76-3-1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

NA - Not Applicable

N - No Trend

Green highlights indicate decreasing trends

Red highlights indicate increasing trends

Appendix G-1. Results of Statistical Analysis - Groundwater

AECOM

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing	Increasing	Decreasing
	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N
Additional Monitoring Wells										
Gw-07-1-0	N	N	N	Y	Y	N	N	N	N	N
Gw-16-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-16-1-2	N	Y	N	N	N	N	N	N	N	N
Gw-16-2-1	N	N	N	N	N	N	N	N	N	N
Gw-16-2-2	N	Y	N	N	N	N	Y	N	N	N
Gw-17-1-1	N	Y	N	Y	N	N	N	N	N	N
Gw-17-1-2	N	Y	N	N	N	N	N	Y	N	N
Gw-17-1-3	N	N	N	N	N	N	N	N	N	N
Gw-19-1-1	N	N	N	Y	Y	N	N	Y	N	N
Gw-19-1-2	N	Y	N	N	N	N	N	N	N	N
Gw-19-2-1	N	N	N	N	N	N	N	Y	N	N
Gw-19-2-2	N	Y	N	N	Y	N	N	Y	N	N
Gw-25-1-1	N	Y	N	N	N	N	Y	N	Y	N
Gw-25-1-2	N	Y	N	Y	N	N	N	N	N	N
Gw-27-1-1	N	Y	N	Y	N	N	N	N	N	N
Gw-27-1-2	N	Y	N	Y	Y	N	N	N	N	N
Gw-36-2-1	N	N	N	Y	N	N	N	N	N	N
Gw-36-3-1	N	Y	N	Y	N	N	N	Y	N	Y
Gw-37-2-1	N	N	N	N	N	N	Y	N	N	N
Gw-37-3-1	N	N	N	N	N	N	Y	N	N	N
Gw-38-1-1	N	Y	N	N	Y	N	N	N	N	N
Gw-40-1-1	N	N	N	Y	Y	N	N	N	N	N
Gw-43-1-1	N	Y	N	N	N	Y	N	N	N	N
Gw-44-1-1	N	N	N	Y	N	Y	N	N	N	Y
Gw-51-1-1	N	Y	N	Y	N	N	Y	N	Y	N
Gw-51-2-1	N	Y	N	N	N	N	Y	N	N	N
Gw-51-3-1	N	Y	N	N	N	N	Y	N	Y	N
Gw-52-1-1	N	Y	Y	N	N	Y	N	N	N	N
Gw-52-4-0 (P7)	N	N	Y	N	N	N	N	N	N	N
Gw-58-1-0	N	N	Y	N	Y	N	N	N	N	N
Gw-60-1-1	N	N	N	N	Y	N	N	Y	N	N
Gw-60-2-1	N	Y	N	Y	N	N	N	N	Y	N
Gw-60-3-1	N	Y	N	Y	Y	N	Y	N	N	N
Gw-62-1-1	N	Y	N	N	N	Y	N	N	Y	N
Gw-62-2-1	N	Y	N	N	N	N	N	N	N	Y
Gw-63-1-1	N	Y	N	N	N	N	N	Y	N	N
Gw-63-2-1	N	Y	N	N	N	N	N	Y	N	N
Gw-77-1-1	N	N	N	N	Y	N	Y	N	N	N
Gw-77-2-1	N	Y	N	N	N	N	N	Y	N	N
Gw-78-1-1	N	N	N	N	N	Y	Y	N	N	N
Gw-78-2-1	N	N	Y	N	Y	N	Y	N	N	N
Gw-79-1-1	N	N	Y	N	N	Y	N	N	N	N
Gw-79-2-1	N	N	N	N	N	Y	N	N	N	N
Gw-85-1-1	N	N	N	Y	Y	N	N	N	N	Y
Gw-87-1-1	N	Y	N	N	N	Y	N	N	N	N
Gw-87-2-1	N	Y	N	N	N	Y	N	N	N	N
Gw-88-1-1	N	Y	N	N	N	N	N	N	N	N
Gw-88-2-1	N	N	N	N	N	Y	Y	N	N	N
Gw-P1	Y	N	Y	N	Y	N	Y	N	N	N
Gw-P2	Y	N	Y	N	Y	N	Y	N	N	N
Gw-P3	N	N	Y	N	Y	N	Y	N	N	N
Gw-P4	N	N	N	N	N	N	Y	N	N	N
Gw-80-1-0 (P8)	N	N	Y	N	Y	N	N	N	Y	N
Gw-81-1-0 (P9)	N	N	N	N	N	N	Y	N	N	N
Gw-P10	N	N	Y	N	Y	N	N	Y	N	N

Notes:

NA - Not Applicable

N - No Trend

Green highlights indicate decreasing trends

Red highlights indicate increasing trends

G2. Surface Water

Appendix G-2. Results of Statistical Analysis - Surface Water

AECOM

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N
Boundary Surface Water Quality Location										
SW-S-04	N	N	N	N	N	Y	N	N	N	N
SW-N-05	N	N	N	N	N	N	Y	N	Y	N
SW-N-16	N	N	N	N	N	N	N	N	N	N
SW-N-41s1	N	N	N	N	N	N	N	N	N	N
SW-N-42s1	N	N	N	N	N	N	Y	N	N	N
Routine Surface Water Quality Location										
SW-S-03	N	N	N	N	N	N	N	N	N	N
SW-N-CSs2	N	Y	Y	N	N	N	N	Y	N	N
SW-N-06*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-07*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-08*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-09*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-11*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-12	N	N	N	N	N	N	N	N	N	N
SW-N-14	N	N	N	N	N	N	Y	N	N	N
SW-N-15*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-17	N	N	N	N	N	N	Y	N	Y	N
SW-N-18	N	N	N	Y	N	N	N	N	N	N
SW-N-19	N	N	N	N	N	N	N	N	N	N
SW-S-20	N	Y	N	N	N	Y	N	Y	N	N
SW-S-21	N	N	N	N	N	N	N	N	N	N
SW-S-23*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-24	N	N	N	N	N	N	N	N	N	N
SW-S-25*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-27	N	Y	N	N	N	N	N	N	N	Y
SW-S-31*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-S-52	N	N	N	N	N	N	N	N	N	N
SW-N-41s3	N	N	N	N	N	N	N	N	N	N
SW-N-41s4*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-41s6*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-43*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-45	N	N	N	N	N	N	N	N	N	N
SW-N-47*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-50	N	N	N	N	N	N	N	N	N	N
SW-N-51	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-N-54	N	N	N	N	N	N	N	N	N	N

Notes:

NA - location does not have sufficient data to run statistical analysis

** Inactive well*

Green highlights indicate decreasing trends

Red highlights indicate increasing trends

AECOM

G3. Leachate

Appendix G-3. Results of Statistical Analysis - Leachate

Station	Parameter									
	Conductivity		Ammonia		Chloride		Sulphate		Nitrate	
	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N	Increasing Y/N	Decreasing Y/N
Hartland Valve Chamber	N	Y	N	Y	N	N	N	N	Y	N

Notes:

Green highlights indicate decreasing trends

Red highlights indicate increasing trends