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Hartland Landfill

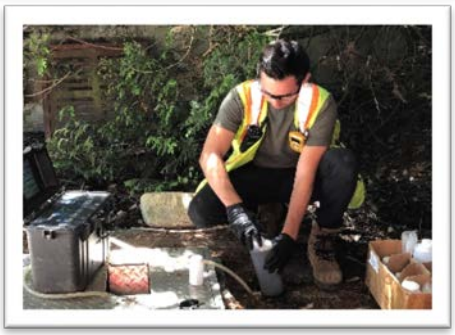
Operating & Environmental Monitoring 2017 Annual Report

Operational Certificate 12659

Parks & Environmental Services | Environmental Protection

Prepared By
Korene Torney, Supervisor
GeoEnvironmental Programs, Environmental Protection

Capital Regional District
625 Fisgard Street, Victoria, BC V8W 2S6
T: 250-360-3000 F: 250-360-3079
www.crd.bc.ca



October 2018

HARTLAND LANDFILL
OPERATING & ENVIRONMENTAL MONITORING 2017 ANNUAL REPORT

EXECUTIVE SUMMARY

Hartland Landfill is owned and operated by the Capital Regional District (CRD) and is located about 14 km northwest of Victoria. It is the only sanitary landfill in the capital region, serving nearly 392,000 people. The operation is a multi-purpose facility providing recycling; household hazardous waste collection; a salvage area; yard and garden waste collection and processing; controlled waste disposal; and landfill services to commercial and residential customers.

The facility operates under an approved Solid Waste Management Plan and Operational Certificate #12659 issued by the BC Ministry of Environment and Climate Change Strategy (MOE). An authorization is in place for the Hartland Landfill to deposit waste asbestos. This annual report is requirement of the Hartland Operational Certificate and is intended for internal and external CRD stakeholders and regulators, including the MOE. The report compiles data regarding total waste tonnages, landfill lifespan, closure funding, operational and construction related activities in 2017, and environmental monitoring program results.

In 2017, the Hartland Landfill received a total of 156,875 tonnes of waste (including controlled waste) at the active landfilling location and a total of 3,236 tonnes at the asbestos location. Based upon comparison of surface elevation data and documented landfill final contours, the estimated remaining capacity[1] is 5,780,000 cubic metres, compared to 6,040,000 cubic metres in 2016. It is estimated that there has been approximately 7,190,938 tonnes of municipal waste deposited at the site at the end of 2017. The estimated landfill capacity will be reached in 31 years (i.e., 2048), assuming current rates of waste deposit.

Since 1985, over $44 million has been invested in capital works, environmental controls and general site improvements.

<u>Summary of Operational Activities for 2017:</u>
- Annual Invasive Species Control
- Landfill Operations, Mechanical Services, Security and Vector Control Contracts
- Fire Protection/Water System Upgrades
- Bylaw Amendments
- Demolition and Renovation Waste Management Pilot
- Baseline Odour Assessment Study

<u>Summary of Capital Projects Underway in 2017:</u>
- Aggregate Management Area Development (Hartland North)
- Interim Landfill Cover – Phase 2, Cell 2 (North edge of Southeast Face)
- Gas and Leachate Collection Infrastructure
- Micro Tunnel Retrofit
- Landfill Criteria Conformance Assessment
- Landfill Master Filling Plan (Detailed Phase 2 Filling Plan)
- Leachate Control Verification of North Purge Well System
- Hartland North Preliminary Water Balance
- Leachate Geochemical Review
- Monitoring Network Upgrades
- Planning for Hartland North Residual Treatment Facility

1 Estimated capacities for 2017 and 2016 are rounded values to thousandths

Hartland Landfill employs a number of control measures to prevent or reduce effects on groundwater, surface water and air. An environmental monitoring program is in place to assess the effectiveness of these controls and to confirm regulatory compliance. Monitoring data is reported either for the year or between April 1, 2017 and March 31, 2018, depending on the program. The monitoring program confirms that for 2017/2018 the regulatory requirements were met and effective measures are in place to mitigate environmental impacts and to contain leachate prior to discharge to the sanitary sewer.

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HARTLAND LANDFILL
OPERATING & ENVIRONMENTAL MONITORING 2017 ANNUAL REPORT

1.0 INTRODUCTION

Hartland Landfill is owned and operated by the Capital Regional District (CRD) and is located about 14 km northwest of Victoria. It is the only sanitary landfill in the capital region, serving a population of nearly 392,000 people. The operation is a multi-purpose facility providing recycling; household hazardous waste collection; a salvage area; yard and garden waste collection and processing; controlled waste disposal; and landfill services to commercial and residential customers.

This report represents the consolidation of 3 historically separate documents (i.e., Hartland Operations Annual Report; Hartland Environmental Programs Annual Report; and Landfill Gas Annual Report) and is intended for a diverse audience, including the BC Ministry of Environment and Climate Change Strategy (MOE); CRD internal staff, CRD committee and board members and the public. The data compiled herein is required to meet internal requirements and BC regulatory requirements per Section 3.2 of the Operational Certificate. As required by the Operational Certificate, this report summarizes the following:

- waste tonnages
- remaining landfill lifespan
- post closure funding
- 2017 operations activities
- 2017 construction contract related activities, and
- 2017-2018 environmental monitoring program results[2]

2 Note, some data is presented in a calendar year (January to December) but for technical reasons environmental monitoring data is presented from April 2017 through March 2018.

2.0 SITE OVERVIEW

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

The landfill is situated in a north-south trending bedrock saddle with Mount Work to the west and an unnamed bedrock ridge 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.

Filling with waste commenced at the site in the 1950s under private ownership. The site continued to be owned and operated privately until 1975 when the CRD purchased the property. Hartland Landfill is the primary solid waste disposal site for all areas of the capital region. Landfilling operations and equipment maintenance is conducted by private companies under contract and direction of CRD staff.

The Hartland Landfill site is divided into 2 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. Subsequently, the filling of Phase 2, Cell 2 was completed in 2016 and its interim closure is in progress. Phase 2, Cell 3 was prepared in the summer of 2016 and became active in September 2016.

Leachate and surface runoff from the active landfill areas are directed to 2 leachate lagoons at the north end of the landfill. The leachate is then transported by a pipeline through the northwest trunk sewer system and ultimately to the Macaulay Point deep ocean outfall. Leachate discharge to sewer is authorized by CRD Regional Source Control Program (RSCP) Waste Discharge Permit SC97.001 and is subject to the CRD Sewer Use Bylaw.

The CRD initiated a surface water and groundwater monitoring program for the landfill in 1983. Annual monitoring reports have been prepared and issued by consultants since 1988. The present Hartland monitoring program is required under the Amended Operational Certificate #12659 issued by the MOE and last amended January 21, 2013.

3.0 REGULATORY SETTING

The Hartland Landfill operates in accordance with an approved Solid Waste Management Plan (SWMP) and an Operational Certificate. The following lists key regulatory approvals for Hartland Landfill:

- SWMP last revised in 1995.
- Amended Operational Certificate (#12659) approved by the MOE, last amended on January 21, 2013.
- Authorization to Dispose of Hazardous Waste Asbestos at the Hartland Landfill approved by the MOE on July 23, 2012.
- RSCP Waste Discharge Permit SC97.001, last amended on April 4, 2016, and subject to the CRD Sewer Use Bylaw.
- Landfill gas is regulated by the Landfill Gas Management Regulation and various provincial guidelines and criteria. In April 2012, CRD submitted the Hartland Landfill Gas Management Plan, in accordance with the Landfill Gas Regulation requirements.

3.1 BC Landfill Criteria Revised

In June 2016, the MOE Landfill Criteria for Municipal Solid Waste, Second Edition, June 2016 (Landfill Criteria) was released. The Landfill Criteria reflect MOE expectations regarding the standards for municipal landfills in BC and provide guidance to landfill owners, operators and consultants on environmentally sound landfilling practices and procedures. Although the Landfill Criteria is not a regulatory document itself, it is legally enforceable at Hartland Landfill, because is it incorporated into the Hartland Operational Certificate. The Landfill Criteria is prescriptive in nature and has many new requirements, however, modified practices and exceptions are allowable, if supported by technical justification and formally approved. Several requirements do not apply to existing landfills until vertical or horizontal expansion is proposed.

Many aspects of Hartland's design and operation are already compliant; however, a preliminary review identified some conformance requirements for Hartland under the status quo (i.e., no expansion). Non-conformance issues at Hartland are generally technical assessments (e.g., hydrologic model), administrative reporting updates (e.g., Design, Operations and Closure Plan Update upgrade) or capital improvements (e.g., landfill fire management). Many of these initiatives are already in the planning stages and have been included in the Hartland 5-year capital plan.

The Landfill Criteria requires submission of a conformance review and related upgrading plan during the next SWMP review or within 5 years of issuance of the Landfill Criteria, i.e., June 2021. The Hartland Landfill conformance review is in progress and will be completed in 2018. Additionally, Hartland Landfill is operated under a SWMP. The original SWMP was approved by the MOE in 1989 and has been revised via 2 revisions and several amendments. Revision 3 resumed in March 2018 and is currently in progress.

3.2 BC Contaminated Sites Regulation

On November 1, 2017, the Stage 10 and 11 (Omnibus) amendments to the BC Contaminated Sites Regulation (CSR) and related consequential amendments to other related regulations came into effect. These amendments updated over 8,500 environmental quality standards, many of which are compared against leachate, groundwater and surface water quality data at Hartland. Additionally, several new 'emerging contaminants' are now regulated. This report includes comparison to the applicable CSR standards (including the Omnibus amendments).

4.0 WASTE VOLUMES AND AIR SPACE CONSUMPTION

In 2017, the Hartland Landfill received a total of 156,875 tonnes of waste at the active landfilling location and a total of 3,236 tonnes at the asbestos location. The active landfilling location receives general refuse and controlled waste (excluding asbestos). The following section reports annual landfill air space and waste tonnage statistics.

4.1 Landfilling Location – Airspace Consumption and Waste Tonnage

CRD Engineering Services Division conducts monthly volumetric surveys at the following key locations: active landfilling (general refuse), active asbestos (asbestos), and daily cover aggregate storage (daily cover). Volumetric surveys document changes in airspace volume and support quality control, design conformance assessment, and ongoing landfilling optimization.

The annual airspace consumed at the active landfilling location from waste and daily cover, tonnage of waste landfilled, and associated waste/cover ratio and waste density is shown Table 1.

Table 1 Waste Airspace/Density Calculations at Landfilling Location

2017 Waste Airspace/Density Calculations	Quantity
Airspace consumed by landfilling waste (m^3) (includes waste and cover)	240,497
Airspace consumed by daily cover (m^3)	49,103
Airspace consumed by waste only (m^3) (i.e., excludes daily cover)	191,395
Tonnage of waste landfilled (tonnes) (scale data)	156,875
Waste/cover ratio (m^3/m^3) [1]	3.90
Waste density (tonnes/m^3) [2]	0.82

Notes:
1 Waste/cover ratio = Airspace consumed by waste only/Airspace consumed by daily cover
2 Waste density = Tonnage of waste landfilled/Airspace consumed by waste only

4.2 Asbestos Location – Airspace Consumption and Asbestos Tonnage

The annual airspace consumed at the asbestos location from asbestos and daily cover, tonnage of asbestos received, and associated asbestos/cover ration and asbestos density is shown in Table 2.

Table 2 Asbestos Airspace/Density Calculations at Asbestos Location

2017 Asbestos Airspace/Density Calculations	Quantity
Airspace consumed by asbestos (m^3) (includes asbestos and cover)	17,493
Airspace consumed by daily cover (m^3)	9,356
Airspace consumed by asbestos only (m^3) (i.e., excludes daily cover)	8,137
Tonnage of asbestos (tonnes)	3,236
Asbestos/cover ratio (m^3/m^3) [1]	0.87
Asbestos density (tonnes/m^3) [2]	0.40

Notes:
1 Asbestos/Cover ratio = Airspace consumed by asbestos only/Airspace consumed by daily cover
2 Asbestos Density = Tonnage of asbestos/Airspace consumed by asbestos only

4.3 Total Airspace Consumption

Comparison volumes of airspace consumed, weight received, and daily cover used at the active landfilling and active asbestos locations are shown in Table 3.

Table 3 Airspace Consumption

Material	Airspace Consumed (m^3)	% Total	Daily Cover (m^3)	% Total	Weight Received (tonnes)	% Total
Waste	191,395	96%	49,103	84%	156,875	98%
Asbestos	8,137	4%	9,356	16%	3,236	2%
Total	**199,532**	**100%**	**58,459**	**100%**	**160,111**	**100%**

Based upon surveyed volumes, 96% of Hartland's total airspace was consumed for landfill waste, which required 84% of the daily cover used. Conversely, 4% of Hartland's total airspace was consumed for asbestos, which required 16% of the daily cover used in 2017. Based upon scale data, Hartland accepted 156,875 tonnes of waste and 3,236 tonnes of asbestos, which accounted for 98% and 2% of the total tonnage received, respectively.

4.4 Uncertainties

Daily cover volumes are tracked via survey in stockpiles prior to placement. Distributed daily cover (aggregate vs. soil material) volumes to the active landfilling area vs. asbestos areas are estimated. Estimates are based upon vehicle load counts and assumed vehicle capacities. These estimates are incorporated into total landfill volume estimates.

4.5 Quality Control

Compaction tests are performed to support the landfill operations and to verify target compaction rates. Three different compaction tests were completed throughout 2017 at random locations throughout Hartland's recently landfilled areas. With an average compaction result of 1.24 tonnes/m^3, the target compaction density (0.85 tonnes/m^3) was achieved.

In 2017, there was variability between calculated waste densities (0.82 tonnes/m^3) and measured compaction (1.24 tonnes/m^3). In 2018, variability between these 2 monitoring methods will be evaluated.

4.6 Design Conformance

Hartland Landfill is currently in Phase 2 of construction. The landfill phase is designed to be constructed in a series of cells. Each cell is divided into a series of lifts, which are progressively filled with waste. In 2017, Cell 3 – 147 m lift was completed, and Cell 3 – 151 m and 155 m filling commenced. These 2 lifts (151 m and 155 m) were progressed to 85% of the target volume at the end of 2017, and are expected to be completed in 2018. Filling within Cell 2 of Hartland Landfill was completed, as designed.

5.0 REMAINING SITE LIFE

As of 2017, LIDAR (Light Detection of Ranging) surveys are used for annual landfilling surveys at Hartland. Previously, planemetric methods were used for this purpose. The annual survey was completed in the summer of 2017 and the data was used to define the surface elevations within the landfill site. Each year the annual survey is completed and compared to the final surface elevations associated with a filling plan prepared as part of the *Hartland Landfill Phase 2 Long Term Leachate Management Plan* (Sperling Hansen Associates, June 2007). From this surface comparison, it is estimated that the remaining landfill capacity is 5,780,000 m^3, compared to 6,040,000 m^3 in 2016. Remaining capacity volumes are greater than previously reported (2016 and prior), because the quarry area 'airspace' was previously excluded, but is now included.

With a remaining capacity of 5,780,000 m^3, it is estimated that at the current landfilling rate, Hartland's capacity will be reached by the year 2048, giving a remaining landfill life of 31 years at current disposal rates. A Landfill Master Filling Plan will commence in early 2018 to optimize landfill operations for the next 20-year period.

6.0 CLOSURE AND POST-CLOSURE FUND

A requirement of the Operational Certificate is a closure and post-closure liability fund to meet or exceed the estimated closure and post-closure costs with a reasonable contingency. At the end of 2017, the closure/post-closure fund was $9,506,000.

7.0 2017 ACTIVITIES (OPERATIONS AND CAPITAL)

7.1 Operations

The following is a brief summary of 2017 operations activities at the landfill.

- **Annual Invasive Plant Species Control:** Invasive species control continued with removal of some species and spraying of others with herbicide.

- **Landfill Operations, Mechanical Services, Security and Vector Control:** Throughout 2017, staff executed and managed contracts for mechanical services, on-site security, seasonal bird control, bin haul, stewardship, household hazardous waste, recycling and ozone depleting substance removal. The landfill operations contract was procured via a competitive public process and included an incentive bonus for high compaction rates to ensure landfill air space is managed effectively.

- **Fire Protection/Water System Upgrades:** As a result of a 2015 active face fire, fire protection resources (including water availability) were evaluated in coordination with the local municipality and emergency service providers. Fire protection planning continued throughout 2017.

- **Bylaw Amendments:** An increase in the tipping fee for out-of-region asbestos came into effect in 2017.

- **Demolition and Renovation Waste Management Pilot:** To improve health and safety, and reduce potential hazardous materials exposure, the CRD developed a new screening process for residential demolition loads and a supporting outreach campaign. In fall 2017, Hartland commenced the initial phase of the new process, including a pilot program. The pilot program raises homeowner awareness about proper disposal of renovation waste materials. Renovation waste may contain asbestos and is dangerous to homeowners, contractors, and visitors/staff at waste disposal facilities. The pilot program precedes a 2018 campaign and pre-approval requirements.

- **Baseline Odour Assessment Study:** In the absence of complaints, limited data is available regarding odour potential at the landfill. A study commenced in fall 2017 to monitor odour in support of future monitoring, if warranted. The study documents baseline odour data using a variety of methods and evaluates odour monitoring options and continues through 2018.

7.2 Capital Works

Since 1985, over $44 million has been invested in capital works, environmental controls and general site improvements. The annual budget is approximately $4 million and the following capital projects completed/commenced in 2017:

- **Aggregate Management Area Development (Hartland North):** Development of a new aggregate management area located north of the landfill continued throughout 2017, including removal of overburden, access construction, and planning/procurement for 2018 aggregate production activities.

- **Interim Landfill Cover – Phase 2, Cell 2 (North Edge of Southeast Face):** Interim cover was placed on northeast face of Phase 2, Cell 2 as required in the Landfill Criteria for Municipal Solid Waste to reduce leachate generation and improve landfill gas capture. Hartland interim closures include a gravel layer overlain by a synthetic tarpaulin cover.

- **Gas and Leachate Collection Infrastructure:** Landfill gas infrastructure was installed per the Hartland Landfill Gas Management Plan. Wellheads, valves, condensation traps, monitoring points and piping are installed and commissioned to convey landfill gas to the gas plant and leachate to the storage lagoons. In 2017, combined landfill gas and leachate collectors previously installed in Phase 2, Cell 2 were activated. Horizontal gas and leachate collectors were installed in the Phase 2, Cell 3, 151 m and 155 m lifts collectors in 2017.

- **Micro Tunnel Retrofit:** In 2017/2018, the CRD retrofitted the micro tunnel clean out chamber to support safe cleaning and inspection. The micro tunnel conveys leachate from the basin at the bottom of Phase 2 and unobstructed operation of the micro tunnel is critical to leachate containment. The micro tunnel retrofit represents a successful major capital project involving significant planning, procurement, safety considerations, WorkSafeBC approvals, and specialty contractors.

- **Landfill Criteria Conformance Assessment:** A conformance assessment respecting the Revised Landfill Criteria for Municipal Solid Waste (BC MOECC) commenced in 2017. The Revised Landfill Criteria requires submission of a Landfill Criteria Conformance Assessment for the next SWMP review or within 5 years of issuance of the Landfill Criteria. This conformance assessment is in progress.

- **Landfill Master Filling Plan (Detailed Phase 2 Filling Plan):** In 2017, the CRD initiated procurement of an updated Master Filling Plan, which will support the long-term vision and engineering design of the landfill. The plan will update the 2007 Long Term Leachate Management and Master Filling Plan and will detail filling plans and phasing, road access, controlled waste relocation strategy, controlled stormwater relocation strategy, quarry development and lining strategy, progressive closure plans, gas system management plans, and others, relating to the development of the landfill.

- **Leachate Control Verification of North Purge Well System:** In 2017, CRD completed routine drawdown testing to document the north purge well system extent of influence. The test used pressure transducers to measure well responses to variable north purge well pumping and scenarios.

- **Hartland North Preliminary Water Balance:** A preliminary water balance was commissioned and completed for the Hartland North area to build on the hydrogeologic conceptual model of this area. The model and this water balance support a fulsome understanding of the groundwater flow divide and its long-term viability during future landfill development activities and in light of recently available revised climate predictions.

- **Leachate Geochemical Review:** Leachate geochemistry was evaluated to identify mechanisms contributing to recent biofouling of the leachate conveyancing infrastructure and decreased flow rates. The review identified preliminary mitigation and prevention alternatives.

- **Monitoring Network Upgrades:** 2017 upgrades included a weir and automated flow measurement along the new Phase 2, Cell 3 leachate collector (Toutle Drain); and automated water/leachate level monitoring device upgrades.

- **Planning for Hartland North Residual Treatment Facility:** Hartland will house the residual treatment facility associated with the regional wastewater treatment facility, which is under construction. To support ongoing Hartland activities and environmental controls, CRD staff will work with residual treatment facility and regional wastewater treatment facility staff and contractors to plan and design work on or near the Hartland facility. Construction will commence in 2018.

8.0 2018 PLANS (OPERATIONS AND CAPITAL)

8.1 Planned 2018 Operations Projects

- **Annual Invasive Plant Species Control:** Invasive species control will continue with removal of some species and spraying of others with herbicide.
- **Landfill Operations, Mechanical Services, Security and Vector Control:** Ongoing management of CRD contractors, including security, bird control, operations and kitchen scraps management.
- **Fire Protection/Water System Upgrades:** Fire protection planning continued throughout 2018.
- **Demolition and Renovation Waste Management and Outreach:** A new screening process for residential demolition loads and supporting outreach campaign will commence in 2018 to improve health and safety, and reduce potential hazardous materials exposure. All building demolition and renovation wastes will be screened similar to the existing commercial screening process. As a result, consistent and prescriptive rules will apply to all building demolition wastes. Exposure monitoring for dust and asbestos will continue on the site.
- **Household Hazardous Waste Campaign:** An outreach campaign will be developed to increase public awareness about risks associated with improper disposal of household hazardous wastes, such as batteries and pool chemicals.
- **Love Food/Hate Waste Campaign:** An outreach campaign will be developed to encourage public awareness about food wastes to reduce organic waste in the landfill.
- **Baseline Odour Assessment Study:** The odour assessment study that commenced in 2017 will continue through 2018.

8.2 Planned 2018 Capital Projects

- **Air Space/Aggregate Production:** Construction of the new aggregate storage area at Hartland North will require levelling of in-situ bedrock and creation of a flat pad for future aggregate storage. The blasted bedrock will be crushed into aggregate that will be used for landfilling activities.
- **Gas and Leachate Collection Infrastructure:** Combined landfill gas and leachate collectors will continue to be installed as landfilling progresses. Wellheads, valves, condensation traps, monitoring points and piping are installed and commissioned to convey landfill gas to the gas plant and leachate to the storage lagoons. Horizontal gas and leachate collectors will be installed in the Phase 2, Cell 3, 151 m and 155 m lifts collectors are expected to be connected and activated in 2018. As waste placement occurs throughout 2018, the Phase 2, Cell 3 – 159 m lift gas and leachate collectors will be installed.
- **Landfill Criteria Conformance Assessment:** A conformance assessment that commenced in 2017 will be completed in 2018.
- **Landfill Master Filling Plan:** In 2017, the CRD commenced a detailed filling plan design for an approximate 20-year timeframe. The plan will include detailed phasing and sequencing of landfilling activities, and infrastructure design for landfill gas, leachate and surface water management, quarry and aggregate design, progressive closure design, and other infrastructure design (i.e., power, roads, etc.). This will continue throughout 2018.
- **Planning for Hartland North Residual Treatment Facility:** Hartland Landfill will work with CRD and external entities in planning for the future residual treatment facility at Hartland North to support ongoing Hartland activities and maintenance of environmental controls.
- **Design Commercial Scale Decks – Hartland North:** Design and construction of automated commercial weigh scales for Hartland North will be completed in 2018. The scales will support both Hartland Landfill and the future residual treatment facility.

- **Monitoring Network Upgrades:** Ongoing upgrades to the environmental monitoring network will continue through 2018. Planned works include installation of several monitoring wells and monitoring devices to enable tracking of leachate mounding.

9.0 2017-2018 LANDFILL GAS AND ENVIRONMENTAL MONITORING

CRD staff monitor landfill gas, groundwater, surface water and leachate quality to ensure the effectiveness of management activities and confirm regulatory compliance. Based on monitoring conducted in 2017[3], the program continues to provide data needed to:

- meet Operational Certificate requirements;
- identify potential impacts of landfill operations, if any;
- plan environmental mitigation, if required; and
- evaluate the effectiveness of control measures.

The key findings of the landfill gas, groundwater, surface water and leachate monitoring program presented here are referenced from the following:

- Hartland Landfill Groundwater, Surface Water, Leachate Monitoring Program Annual Report (April 2017 to March 2018), AECOM Canada Ltd. (AECOM) – Appendix I
- Hartland Landfill – Landfill Gas Monitoring, Annual Report, 2017, Parks & Environmental Services, Environmental Protection, CRD, November 2018 – Appendix II

9.1 Landfill Gas Monitoring Program

Decomposition of refuse creates landfill gas; the composition and amount of gas generated varies based on factors, such as amount, type and age of waste, as well as environmental conditions, such as moisture content. Peak gas generation occurs during the first 1-3 years after disposal. Landfill gas is primarily composed of methane and carbon dioxide with small amounts of water vapour, oxygen, nitrogen and trace gases. Trace gases include hydrogen sulphide, ammonia, nitrous oxide, volatile organic compounds and chlorofluorocarbons. Initially, decomposition of waste is an aerobic process and produces mainly carbon dioxide. As oxygen is depleted, the decomposition occurs under anaerobic conditions.

Landfill gas management is dictated by a variety of BC regulations (including the BC Landfill Gas Management Regulation), design guidelines, criteria, Hartland-specific management plans, and WorkSafeBC. The BC Landfill Gas Management Regulation requires landfills generating more than 1,000 tonnes per year of methane to develop landfill gas management plans that targets 75% collection efficiency in 4 years. A plan was completed for Hartland Landfill and submitted to the MOE in April 2012 with an implementation target of the end of 2016.

Since the 1990s, Hartland Landfill has implemented a system to assess and control fugitive landfill gas emissions. The objective of these controls is ultimately to reduce emissions, ensure staff health and safety, and comply with regulations. Since the implementation of the Landfill Gas Management Regulation in 2010, landfill gas collection and/or management program at Hartland now includes gas generation modelling, gas collection infrastructure installation and maintenance, and operation of a landfill gas beneficial use facility. Additionally, the landfill gas program monitors the effectiveness of the collection infrastructure through a variety of monitoring programs.

Landfill gas generated in the landfill is drawn under vacuum to the gas plant where it is directed to a generator and/or to a flare. The gas is then conditioned (cleaned) and methane and oxygen content is measured. Excess gas is fed back to a candlestick flare, while the ground flare is only used during extended generator downtime.

3 Monitoring periods vary such that the landfill gas 'year' is January to December, but the groundwater, surface water and leachate 'year' is April to March.

To monitor the effectiveness of the landfill gas collection infrastructure, Hartland Landfill monitors landfill gas collection and utilization; perimeter and foundation probes; ambient air; and landfill gas speciation. In 2017, the monitoring program confirmed that landfill gas was contained within the landfill and results were within specified criteria or regulatory limits.

9.1.1 Gas Generation

In 2017, Hartland Landfill generated 7,957 tonnes of methane, based on the MOE provided gas generation model. As required, the MOE gas generation model is updated annually with waste quantity and composition data to enable annual calculation of collection efficiency and greenhouse gas emissions. An organics diversion program and ban took effect in January 2015. Continued diversion of a large portion of highly decomposable waste stream from the landfill is expected to result in a decrease in overall gas production.

9.1.2 Gas Collection and Utilization

In 2017, the gas collection system consisted of 67 vertical wells, 74 horizontal wells, for a total of 141 wells. 12 non-productive wells were removed from the well field monitoring program and rendered inactive. Twenty-two wells were connected to the system (Phase 2, Cell 2) and 5 new horizontal wells were installed in completed lifts in Phase 2, Cell 3. The well field was balanced monthly in 2017, as recommended by the Landfill Gas Management Facilities Design Guidelines.

Total fugitive greenhouse gas emissions generated from the landfill for 2017 are estimated at 64,173 tonnes CO_2. This represents an overall improvement with a 15% decrease from 2016 quantities and a 27% decrease since the implementation of the Landfill Gas Management Plan in 2012. It is expected that fugitive greenhouse gas emissions will continue to decline due to improvements in gas extraction infrastructure. As noted, overall gas production is expected to decline with continued waste diversion initiatives (e.g., kitchen scraps, etc.).

Since 2012, the CRD has implemented the Landfill Gas Management Plan with some minor changes. In 2017, landfill gas collection efficiency was 67.7%. Modelled methane generation was 1,627 standard cubic feet per minute (scfm) and of that an average of 1,102 scfm was captured through the gas plant. Current landfill gas collection efficiencies are within estimated ranges. Implementation of the Landfill Gas Management Plan, and related efficiency target achievement, is somewhat delayed as a result of reduced waste volumes as compared to predicted values, changes in fill sequencing, and improvements to installation methods. As a result of these changes, it is unclear when the efficiency target (75%) will be achieved. To optimize landfill gas management methods and to reassess the plan implementation, the CRD anticipates and update of the Landfill Gas Management Plan in the next 5 years.

9.1.3 Gas Monitoring and Compliance Summary

Numerous monitoring programs are in place to evaluate the performance of landfill gas system. Table 4 summarizes the results of these monitoring programs, compliance status, remedial actions, if any, and recommendations.

Table 4 Landfill Gas Compliance Summary 2017

Program	Compliance Location	Criteria	Findings	Actions	Recommendations
Perimeter Probe Monitoring	Probes GP-1A, 1B, 2A, 2B, 3A, 3B, 11A, 11B, 12A and 12B	Maximum 1.25% methane in subsurface soil (MOE Landfill Criteria for Municipal Solid Waste)	No exceedances. Low risk of sub-surface gas migration to adjacent properties.	None	Continue quarterly monitoring.
Building Foundation Probe Monitoring	Probes GP- 4A, 5A, 6A, 6B, 7A, 7B, 8A, 9A, 13A, 14A, 17A, 18A	Maximum 1.25% methane in any on-site facility (MOE Landfill Criteria for Municipal Solid Waste). Maximum 1% methane inside buildings (Landfill Gas Management Facility Design Guidelines).	No exceedances. Low risk of subsurface gas migration to adjacent building.	None	Continue quarterly monitoring.
Ambient Grid Monitoring	N/A	100 ppm THC (CRD internal guideline)	8 grid locations >100 ppm No cover system failures suspected in the closed area of Phase 1.	Investigated hot spots and mitigated were possible.	Continue biannual monitoring.
Hot Spot Monitoring	N/A	1,000 ppm THC (CRD internal guideline).	5 new hot spots >1,000 ppm 1 hot spot removed. Currently 22 locations for hot spot investigation.	Added new locations of hot spots to the monitoring program.	Continue biannual monitoring. Investigate remediation measures.
Well Field Monitoring and Balancing	N/A	Monitor monthly. Oxygen <3% - gas optimization and reduction of fire potential	Monitoring completed monthly; oxygen did not exceed 3%.	None	Continue monthly monitoring at minimum.
Gas Speciation (2017)	N/A	N/A	Undiluted LFG exceeded WorkSafeBC criteria for methane, carbon dioxide, hydrogen sulphide, vinyl chloride and benzene; however, ambient concentrations are likely well below WorkSafeBC limits due to dilution with ambient air. Siloxane monitoring should continue on a routine basis to better understand trends and engine wear and tear impacts.	None	Conduct speciation of LFG in 2019.
Gas Collection	N/A	75% gas collection efficiency target by the end of 2016, as per LFGMP.	Gas collection efficiency was estimated at 67.7% at the end of 2017, based on the MOE gas generation model and is within the estimated efficiency range specified in the LFGMP.	LFGMP submitted to MOE.	Continue to implement the gas management plan.

Notes:
LFGMP = Landfill Gas Management Plan
ppm = parts per million
THC = total hydrocarbons
LFG = landfill gas

9.2 Groundwater Quality Monitoring Program

Engineered controls at Hartland Landfill collect and contain leachate to reduce or eliminate potential effects to groundwater and surface water quality. Since 1990, the leachate has been captured and contained on site and discharged via pipeline to the sanitary sewer.

Groundwater and surface water monitoring stations on the Hartland Landfill property and specific off-site locations have been monitored since 1983. The purpose of the groundwater and surface water monitoring program is to assess impacts of landfill processes and operations on water quality and to assess compliance with water quality standards at the property boundary. In addition to this, leachate, generated by the infiltration of precipitation through the municipal waste, is also monitored for flow and quality. Monitoring data is collected to assess the potential for effect of landfill processes on groundwater and surface water resources. The annual monitoring program has 3 main components:

1. Groundwater monitoring on site and at selected off-site domestic wells
2. Surface water monitoring at on-site and off-site locations
3. Leachate quality and flow monitoring

Hartland Landfill has an extensive network of groundwater wells to monitor conditions immediately adjacent to the Phase 1 and Phase 2 areas, and at points adjacent to the landfill property boundary. Groundwater elevations are routinely monitored in approximately 120 well locations to understand the direction of groundwater flow within the landfill property. Groundwater quality is monitored at groundwater well locations to evaluate and identify changes in water chemistry that may be attributed to landfill processes and operations and, specifically, the effect of landfill leachate on groundwater resources. In addition, 12 privately owned, domestic drinking water wells within a 2-km radius of Hartland Landfill are monitored.

Groundwater quality is assessed against BC CSR numerical standards for the protection of drinking water and aquatic life. Current water quality is generally similar to previous years, though when compared to the new standards, site conditions have improved.

In 2017, AECOM evaluated the applicability of new emerging contaminants at Hartland Landfill (i.e., newly regulated by the CSR, as of November 2017). Phased monitoring of applicable emerging contaminants began in late 2017.

9.2.1 Results

Of over 120 wells at Hartland, 34 groundwater monitoring wells are Boundary Compliance Monitoring Locations, including wells at locations 4, 18, 20, 21, 28, 29, 30, 31, 39, 41, 42, 53, 55, 56, 57, 71, 72, 73 between April 1, 2017 and March 31, 2018.

Groundwater quality at all landfill boundary compliance locations was less than the applicable BC CSR standards. The results of the 2017-2018 program were similar to those measured in recent years and showed improvement in several areas. The results of groundwater monitoring for each of the landfill boundary areas are presented in the following sections.

9.2.1.1 Phase 1

Groundwater flow was consistent with historical trends. Groundwater flow directions in the Phase 1 area were primarily to the north, and this component of flow is captured by the northern leachate containment system. At the south end of Phase 1, a groundwater divide corresponding with a bedrock high influences the groundwater flow such that north of this divide, groundwater flows north and south of this divide, groundwater flows south. The southerly component of flow is intercepted by the south leachate containment system.

The water quality data south of Phase 1 confirms that leachate containment has successfully controlled leachate impacts. Water level and quality monitoring in this area should continue to confirm ongoing effectiveness of leachate containment and identify any changes in the extent or magnitude of leachate impacts.

9.2.1.2 North of the Landfill

Groundwater quality in boundary compliance locations north of the landfill met the applicable BC CSR groundwater standards. Groundwater quality in this area is stable or improving. Improvements are attributed to the effective operation of the north purge well system.

Table 5 Groundwater Quality Compliance Summary North of the Landfill (2017-2018)

Well	Exceedances	# of Exceedances	5-year Trend
20-1-1	none	-	Decreasing sulphate, increasing nitrate but very low concentration
20-1-2	none	-	Decreasing conductivity, ammonia, sulphate
21-1-1	none	-	Decreasing sulphate
21-1-2	none	-	Decreasing sulphate
21-2-1	none	-	Decreasing sulphate and nitrate
28-1-0	none	-	Decreasing conductivity, increasing nitrate
29-1-1	none	-	Decreasing conductivity, chloride, sulphate
29-1-2	none	-	Decreasing conductivity, sulphate
30-1-1	none	-	Decreasing conductivity, chloride, ammonia, nitrate
30-1-2	none	-	Decreasing conductivity, chloride
31-1-1	none	-	Increasing ammonia (although decreasing in last year)
31-1-2	none	-	Decreasing chloride
39-1-1	none	-	Increasing ammonia
39-2-1	none	-	Decreasing conductivity, sulphate, chloride
53-1-1	none	-	Decreasing sulphate

Concentrations of groundwater quality in other Phase 1 wells were consistent with previous years. Leachate impacts continued in areas within or immediately adjacent to the landfill (e.g., monitoring well 58-1-0). Impacted groundwater in this area is collected by the north purge well system. In fall 2015, the CRD augmented leachate collection in the area west of the lower leachate lagoon (e.g., near monitoring well 40-1-1) by installing a permanent pump system in well (P9). P9 works in conjunction with existing purge well system (P7 and P8) to capture leachate in this area. Performance of the north purge well system is routinely assessed through drawdown testing.

Continued operation of the north purge well system will reinforce leachate collection and containment and to contribute to water quality improvements. Augmentation of the north purge well system is recommended to further reduce the persistent presence of these leachate indicator parameters in groundwater in this area.

Wells along Willis Point Road met the BC CSR standards, but continued to show road salt-related impacts.

9.2.1.3 South of Phase 1

To the south of the Phase 1 groundwater divide, groundwater flows towards the south. A number of leachate containment measures have been installed in this area since the mid-1980s. The containment system in this area is composed of a grout curtain, a clay berm, a shallow toe drain and 5 purge wells, which, in combination, obstruct and intercept southward-flowing leachate. The leachate is then directed to the leachate collection system.

Water quality in the boundary compliance stations south of Phase 1 met the BC CSR standards. Consistent with the previous reporting periods, leachate indicator parameter concentrations indicate some leachate influence in this area; however, 5-year concentration trends are improving. The CRD continues to optimize and maintain the south purge well system.

As shown in Table 6, leachate indicator parameter trends indicate that concentrations are generally either stable or decreasing.

Table 6 Groundwater Quality Compliance Summary South of the Landfill (2017-2018)

Well	Exceedances	# of Exceedances	Trend
04-3-1	none	-	Decreasing conductivity, sulphate, chloride
04-4-1	none	-	Decreasing conductivity, chloride
07-1-0	none	-	Decreasing conductivity, sulphate
71-1-1	none	-	Decreasing conductivity, sulphate
71-2-1	none	-	Decreasing conductivity, chloride, sulphate
71-3-1	none	-	Decreasing conductivity
72-1-1	none	-	Increasing chloride, decreasing conductivity
72-3-1	none	-	Stable
73-1-1	none	-	Decreasing conductivity, sulphate
73-2-1	none	-	Decreasing conductivity, sulphate
73-3-1	none	-	Decreasing conductivity, sulphate

9.2.1.4 East of Phase 1

Similar to previous years, water quality east of Phase 1 met BC CSR standards for the reporting period (as shown in Table 7). Water level and quality data confirm that leachate is effectively contained on site in this area. Groundwater in this area is directed from east to west (inward towards the landfill), preventing off-site leachate migration to the east. This area should continue to be monitored.

Table 7 Groundwater Quality Compliance Summary East of the Landfill (2017–2018)

Well	Exceedances	# of Exceedances	Trend
18-1-1	none	-	Decreasing conductivity, chloride
18-2-1	none	-	Decreasing chloride
18-2-2	none	-	Decreasing chloride

9.2.1.5 Phase 2

In the Phase 2 area, immediately west of Phase 1, groundwater flow is directed inward toward the base of the former Heal Lake, where leachate is collected by an underdrain system and discharged to the leachate lagoons. This area of the leachate collection and containment system is known as the Phase 2 basin. Because the groundwater flow is directed inward toward the basin, it is considered a hydraulic trap. Leachate and water levels are monitored in Phase 2 to ensure that the hydraulic trap is maintained. The 2017-2018 data indicate that the hydraulic trap functioned effectively throughout the year.

Automated leachate level monitoring has traditionally been conducted within the refuse in Phase 2. That monitoring equipment failed in 2014, but is scheduled for replacement in late 2018.

9.2.1.6 North of Phase 2 and North of the Hartland North Pad

Groundwater quality met BC CSR standards at all boundary compliance locations north of Phase 2, including locations north of the Hartland North pad.

Groundwater quality has improved in the vicinity of the Hartland North pad, northwest of Phase 2. Previous impacts from former composting activities have reduced and impacts from aggregate stockpiling on the Hartland North pad have stabilized or are decreasing. As of winter 2017/2018, aggregate is no longer stored in this location.

Two separate areas in Hartland North area are being developed for new uses. The area closest to the landfill will be used for aggregate storage and the area near Willis Point Road will house the residual treatment facility associated with the CRD Wastewater Treatment Plant Project.

Continued monitoring is warranted in this area to document ongoing improvements and to monitor environmental quality during and after development activities.

Table 8 Groundwater Quality Compliance Summary North of the Hartland North Pad (2017-2018)

Well	Exceedances	# of Exceedances	Trend
41-1-1	none	-	Decreasing conductivity, sulphate
42-1-1	none	-	Decreasing conductivity, chloride, sulphate
55-1-1	none	-	Decreasing conductivity, chloride, sulphate
56-1-1	none	-	Decreasing conductivity, chloride, sulphate
57-1-1	none	-	Decreasing conductivity, chloride, sulphate

Between 2015 and 2017, the CRD has improved the understanding of the groundwater flow in the Hartland North area. These studies have been conducted to support a fulsome understanding of the groundwater flow divide and its long-term viability during future landfill development. The AECOM hydrogeological conceptual site model indicated that bedrock discontinuities (i.e., faults) contribute to large seasonal groundwater elevation fluctuations observed beneath the north ridge. The bedrock discontinuities and precipitation variations result in a weaker flow divide in summer and stronger more prominent divide during higher winter elevations. The 2017 Preliminary Water Budget Study conducted by SLR Consulting (Canada) Ltd., concluded that even with updated climate predictions and planned development in the area, the groundwater divide will continue to remain in place. Recommendations were provided regarding design, construction and management of aggregate in the area, to further assure the maintenance of the groundwater flow divide.

9.3 Domestic Well Monitoring Program

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. In 2017, water quality data was collected from 13 domestic wells located within a 2-km radius of the landfill on July 12, 2017. The sampling program included single samples and 2 replicate samples, which were analyzed for general water quality parameters and total metals.

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 and are bedrock wells drilled to depths of 30-120 m.

Laboratory analytical results were compared to the BC Approved Water Quality Guidelines (2010 edition) where available and Guidelines for Canadian Drinking Water Quality (2008) where they are more stringent.

9.3.1 Results

Overall, the 2017 domestic well water quality met the applicable guidelines. Similar to previous years, wells 53 and 38, had exceedances of the aesthetic objective for iron and manganese, respectively. The iron and manganese concentrations in excess of drinking water guidelines occur occasionally throughout the area and are not related to Hartland Landfill. Further, the iron and manganese guidelines are aesthetic targets and are not human health objectives. The domestic well results are consistent with background conditions and indicate that landfill leachate is not affecting any of the 13 domestic wells sampled.

9.4 Surface Water Monitoring Program

Hartland Landfill is located within the Tod Creek watershed. Drainage south of the landfill is directed toward Killarney and Prospect lakes, discharging to Tod Creek. Drainage north of the landfill flows northeasterly within Heal Creek to Durrance Creek, discharging to Tod Creek, and ultimately, to Tod Inlet. Surface water is monitored to ensure that it is not adversely affected by landfill operations.

The monitoring program includes approximately 23 sites within the landfill, at the property boundary and within each of the major off-site drainages. Five of these stations are considered boundary compliance monitoring stations. These stations are concentrated north and south of the landfill where creeks flow from the landfill property to off-site locations. Water quality results are compared to the BC Approved and Working Water Quality Guidelines (BC WQG) for Freshwater Aquatic Life.

9.4.1 Results

Surface water quality data collected in 2017-2018 confirmed that nearby surface water bodies, Tod Creek, Durrance Lake, Durrance Creek and Killarney Lake are not impacted by leachate and have not been for many years.

Surface water samples collected in this monitoring program typically met the BC WQG-MAC[4] and/or BC WQG 30-day average values. Occasional exceedances for select parameters were reported at 2 of the compliance locations. Elevated concentrations are considered related to seasonal impacts (rain events or dry low-flow conditions). Stable or improving trends were reported for the 5 compliance locations. The CRD has addressed sample variation during low flow stream conditions and has implemented increased leachate containment near the lower lagoon. These efforts are expected to improve surface water quality.

Table 9 Surface Water Quality Compliance Summary (2017-2018)

Location	Exceedances	# of Exceedances	Trend
SW-N-05	none	-	Stable
SW-N-16	Total & Dissolved Iron	1	Decreasing
SW-N-41s1	none	-	Decreasing conductivity, sulphate
SW-N-42s1	none	-	Decreasing conductivity, sulphate
SW-S-04	none	-	Decreasing conductivity, chloride

9.5 Leachate Management and Monitoring Program

Leachate is produced from the percolation of precipitation and groundwater through the decomposing refuse in the landfill. At Hartland Landfill, leachate is managed through landfill design, input monitoring, contaminant treatment, if required, and routine monitoring.

4 BC WQG MAC are the maximum allowable concentration of a parameter that should not be exceeded at any time.

During the reporting period, leachate continued to be managed in accordance with the Design, Operations and Closure Plan and its supporting documents. Leachate quality was closely monitored during special projects, which included the micro tunnel retrofit, leachate control verification of north purge well system, and leachate geochemical review as discussed below.

- A retrofit of the micro tunnel pump chamber was conducted in the fall 2017 to facilitate safe cleaning and inspection of the micro tunnel, which conveys leachate from the base of the landfill to the leachate lagoons. During the project, leachate collection and storage capacity was reduced. During this period, CRD frequently monitored leachate flow characteristics and continued routine monthly leachate quality monitoring. Leachate characteristics were as anticipated and leachate concentrations met the applicable standards and guidelines throughout the project.
- Since 2016, the CRD has conducted additional leachate control verification testing in the vicinity of the north purge well system in 2017. The test measures the influence pumping wells and supports analytical data that confirms leachate capture efficacy around the leachate lagoons. Early assessment of the 2017 data indicates that the north pumping wells have a small cone of influence and additional multi-season testing is warranted to confirm 2016/2017 data. If the results are confirmed, the CRD will initiate planning for augmentation of the north purge well as a precaution to ensure continued compliance at the north property line.
- Through 2017, AECOM assessed leachate geochemistry[5] to identify mechanisms contributing to increased biofouling in leachate conveyance infrastructure that has occurred since approximately 2010. AECOM confirmed the biological composition of the fouling and attributed the microbial action to increased aeration. CRD initiated aeration in the lagoons in 2014 to resolve sulphide concentrations that exceeded the RSCP waste discharge permit limit of 1 mg/L. Although the aeration successfully mitigated sulphide concentrations, AECOM hypothesized that it increased microbial decomposition, via aerobatic pathways, contributed to increased fouling. With the assessment, AECOM presented and ranked several mitigation options. The CRD has implemented select options (e.g., elimination of aeration) and is evaluating the potential for future implementation of others (e.g., leachate treatment).
- Later in 2017, AECOM commenced a similar evaluation of leachate fouling at the south purge well system. In pumping well P1, a precipitate began fouling pumps following installation of new pumping equipment. The following results in significant operational costs. The assessment continued into 2018, however, preliminary results indicated that this fouling is not microbial in nature, but is caused primarily by organic precipitation reactions. Based upon the preliminary recommendations, the CRD is rehabilitating this pumping well in winter 2018/2019, as part of the monitoring network upgrade capital project.

9.5.1 Leachate Monitoring

A routine leachate monitoring program is conducted to:

- document leachate discharge volumes and flow rates to the sanitary sewer;
- characterize the physical and chemical constituents in the leachate; and
- verify compliance with the CRD RSCP waste discharge permit at the point of discharge.

Automated monitoring of the volume of leachate discharged is maintained on the CRD SCADA system and provides a basis for measuring flow rates to the sanitary sewer and leak detection. Monthly leachate samples are collected to verify compliance with the RSCP waste discharge permit. Routine and annual leachate testing includes analysis of a variety of chemical parameters (e.g., nutrients, mineral oil and grease, organic compounds, metals and chlorinated compounds).

5 Leachate geochemistry Evaluation Report, AECOM, August 18, 2017.

9.5.1.1 Results

The total leachate discharged during the reporting period was 404,775 m^3. The average leachate flow over the period April 1, 2017-March 31, 2018 was 12.83 L/s, which is slightly less than the previous reporting year's average flow of 13.84 L/s. Leachate generation rates vary with annual precipitation rates and the precipitation values for 2017-2018 were greater than in 2016-2017.

Leachate quality at the point of discharge to the leachate pipeline was in compliance with the RSCP waste discharge permit throughout the reporting period. Monthly testing of emerging contaminants (per the CSR, see Section 3.2) was conducted in leachate commencing October 2017. Monitoring continues for these new parameters and results are being confirmed.

Hartland Landfill leachate continues to report low contaminant levels compared to other typical municipal waste landfills.

9.6 Summary and Recommendations

The environmental monitoring program at Hartland Landfill provides a valuable foundation to evaluate the effectiveness of the control measures, assess potential impacts of Hartland Landfill and support landfill management and operations by providing information to staff, managers and committees. Overall, the monitoring programs (landfill gas, groundwater, surface water, domestic wells and leachate) confirm that regulatory requirements are met.

- The continuous improvement program implemented at Hartland that evaluates data, sampling techniques and site quality should continue. The annual monitoring program must continue to be reviewed and interpreted by qualified professionals experienced in assessing the impacts of landfill leachate at large municipal landfills similar to Hartland Landfill.
- Landfill gas monitoring programs should continue (i.e., perimeter probes, building foundation probes, ambient grid, hot spot monitoring and speciation) to measure and ensure regulatory compliance. Landfill gas collection efficiency for 2017 was 67.7%. Continued monthly well field balancing is necessary to optimize gas collection. Gas speciation is recommended for 2019 to enable tracking of gas composition changes.
- The environmental monitoring program and data should be evaluated against the applicable standards in accordance with the Landfill Criteria and the BC CSR to continue meeting regulatory requirements and to determine if monitoring program changes are warranted.
- Operation of the north and south purge well systems effectively control and contain leachate and should be continued, including planned optimization and maintenance activities. 2017 optimization efforts have had beneficial results. The extent of the drawdown cone should continue to be verified routinely and additional optimization implemented, if warranted.
- Monitoring equipment in Phase 2 should be replaced by 2019 to allow for evaluation of leachate mounding in that area of the landfill.
- Aggregate management and airspace blasting activities should be conducted in accordance with recommendations regarding specialty blasting; aggregate storage design and aggregate runoff management to maintain the integrity of leachate containment and to protection downgradient water quality. Water quality downgradient of aggregate stockpile areas should continue to be closely monitored to confirm the effectiveness of cover systems.
- Leachate flow and chemistry should continue to be monitored to inform landfill management and operational decisions and to comply with the RSCP waste discharge permit.
- Future landfill planning should include a detailed hydrogeological evaluation to ensure that proposed works will not compromise the integrity of leachate containment.

10.0 CONCLUSIONS

The CRD Hartland Landfill facility provides recycling, household hazardous waste collection, a salvage area, yard and garden waste collection and processing, controlled waste disposal, and landfill services to commercial and residential customers. The facility operates under an approved SWMP and MOE Operational Certificate #12659. This report is intended for internal and external CRD stakeholders and regulators, including the MOE. The report compiles data regarding total waste tonnages, landfill lifespan, closure funding, operational and construction related activities in 2017 and environmental monitoring program results.

In 2017, the Hartland Landfill received a total of 156,875 tonnes of waste (including controlled waste) at the active landfilling location and a total of 3,236 tonnes at the asbestos location. The estimated remaining capacity[6] is 5,780,000 cubic metres, compared to 6,040,000 cubic metres in 2016 which corresponds to 31 years (i.e., 2048) of remaining capacity assuming current rates of waste deposit.

The Hartland Landfill monitoring programs assess the quality and quantity of landfill gas, leachate, groundwater and surface water. The program confirms that regulatory requirements are met and provide critical data that supports successful management of the landfill. Based upon the monitoring program, effective measures are in place to ensure environmental impacts are mitigated and leachate is effectively controlled and contained on site prior to discharge to the sanitary sewer.

6 Estimated capacities for 2017 and 2016 are rounded values to thousandths

11.0 REPORT SIGNOFF

Certified/Approved by: Korene Torney, P.Geo., PMP
Supervisor, GeoEnvironmental Programs

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA K. K. TORNEY # 43575 GEOSCIENTIST

2018 5 Sept, 19

(Qualified Professional)

Reviewed by:

Glenn Harris, Ph.D., R.P.Bio., Senior Manager, Environmental Protection

Chris Robins, Manager, Solid Waste Operations, Environmental Resource Management