



2022 ANNUAL REPORT FOR THE VANCOUVER LANDFILL

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EXECUTIVE SUMMARY

The purpose of this report is to fulfill the annual reporting requirements defined in the Landfill's Operational Certificate (OC) MR-01611 (BC Ministry of Environment and Climate Change Strategy, formerly known as , BC Ministry of Environment Lands and Parks, hereafter MOE, 2001) and the BC *Landfill Criteria for Municipal Solid Waste, Second Edition* (MOE, 2016). The report covers the period of January 1 to December 31, 2022. The MOE annual status form is also included.

Background

The Vancouver Landfill opened in 1966 and is owned and operated by the City of Vancouver. It is located at 5400 72nd St. in Delta, in the southwest corner of Burns Bog, and is only accessible via Highway 99 Southbound. Further details on the site background and regulatory structure are included in the report.

The Landfill plays an integral role in the management of municipal solid waste (MSW) from commercial and residential sources within Metro Vancouver as part of Metro Vancouver's *Integrated Solid Waste and Resource Management Plan* (Metro Vancouver, 2010). Most of the waste received at the Landfill is first delivered to either the Vancouver South Transfer Station (VSTS) also owned and operated by the City of Vancouver, or one of Metro Vancouver's Recycling and Waste Centres.

Authorized waste discharge

The Landfill is authorized to accept up to 750,000 tonnes of MSW for disposal each year. Materials used beneficially, such as for cover, road building and closure, are not counted towards this annual discharge limit. In 2022, a combined total of 734,486 tonnes of waste were disposed at the Vancouver Landfill, of which 1,045 tonnes were Out-of-Region MSW under specific authorization by the MOE.

Leachate and stormwater management

In 2022, approximately 2.16 million cubic metres (cu. m) of combined leachate and surface runoff were delivered to Annacis Island Wastewater Treatment Plant for treatment at a cost of roughly \$3.6 million.

A total of 51 leachate, surface and groundwater monitoring stations are sampled quarterly as part of the Landfill's Water Quality Monitoring Program. An additional 12 monitoring stations were sampled during the winter (January to March) and fall (October to December) in 2022 to assess stormwater quality in closed areas and potential receiving water bodies. As an ongoing operational practice, clean stormwater is periodically released from the storage ponds to the Dredge Pond, diverting flow from the leachate collection and containment system and subsequently reducing leachate treatment and conveyance costs. Through surface evaporation from the storage ponds and controlled release to the Dredge Pond, approximately 340,000 cu. m of clean stormwater were diverted in 2022, saving approximately \$560,000.

Landfill gas control

In 2022, 10 new vertical gas wells were installed, as well as nine horizontal gas collectors and nine side-slope collectors. By the end of 2022, there were a total of 272 vertical gas wells, 136



horizontal gas collectors, seven DRAINTUBE (DT) gas collectors, 11 side slope gas collectors, and one pressure relief gas collector for a total of 427 gas collection points. The 20 year agreement that allowed for beneficial use of landfill gas (LFG) off-site to generate electricity for sale to BC Hydro and heat for Village Farms' (VFCE) greenhouses since 2003 was amended for an additional 20 years to allow VFCE to construct a system to convert LFG to renewable natural gas (RNG). Since May 2022, LFG has been diverted to the flares while the construction of VFCE's new facility is completed. Approximately 62 million cu. m of LFG (normalized to 50 per cent methane) were collected and destroyed in 2022, which is equivalent to the emissions of approximately 115,937 vehicles (City of Vancouver, 2023).

Closure capacity

In 2022, four hectares of the Landfill were closed in Phase 4. To date, a total of 126.8 ha have been closed, representing 73 per cent of the 173 ha waste footprint.

Recycling

Through the Zero Waste Centre, 1,500 tonnes of materials were recycled in 2022. A breakdown of the types and quantities of recycled materials is included in the report.

Compost

The City operates a composting facility to process yard trimmings dropped off at the VSTS and Landfill into finished compost for sale and donation. In 2022, approximately 16,900 tonnes of yard trimmings were composted and approximately 14,160 cu. m of finished compost were distributed. Approximately 1,600 cu. m of compost were used in LFG construction at the Landfill (to promote grass growth on the south header alignment).

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1. Introduction

This report covers the period from January 1 to December 31, 2022. It has been prepared to fulfill the requirements of the Landfill’s Operational Certificate MR-01611. This report is available online at vancouver.ca/landfill-annual-report, along with reports from previous years.

This report addresses the reporting requirements described in Section 3.5.2 of the OC with Table 1 summarizing where the required information is located in this report.

Table 1: Operational Certificate Reporting Requirements

Reporting Requirement	2022 Annual Report Section(s)
Updates to the design and operating plan	2. Design and operating plans
Revised closure/post closure costs	3. Closure and post closure costs
Planned improvements	4. Planned improvements
Records for waste, recyclable material and compost quantities	Table 5: Inbound Material Quantities for 2021 & 2022 Table 6: 2021 & 2022 Recycling Quantities Appendix 2: Annual waste quantities
An evaluation of recycling and composting programs, including waste diversion projections	5.2 Municipal Solid Waste disposal 6.1 Zero Waste Centre 6.3 Yard trimmings collection and composting
A review of receiving environmental monitoring data with interpretation, including leachate flow data and leachate/drainage ditch levels suitably tabulated	7.3 Water quality monitoring program & annual review Appendix 7: 2022 Water quality monitoring program review executive summary Appendix 8: 2022 Weekly leachate and drainage ditch water elevations
An evaluation of leachate generation control measures	7.2 Leachate generation control measures
An evaluation of the efficiency of the landfill gas management systems, including an estimation of the landfill gas generation rate, percent recovery and the actual rates/volumes of gas collected, utilized and flared	7.5 Landfill gas collection efficiency
A list of operating problems and corrective actions taken	8.5 Operating problems & corrective actions
A summary of the public complaint and resolution log	8.7 Public complaint & resolution log

This report also meets the reporting requirements as per Section 10.6 of the BC *Landfill Criteria for Municipal Solid Waste, Second Edition* (MOE, 2016) with Table 2 summarizing where the required information is located in this report.

Table 2: Additional Reporting Requirements as per the Landfill Criteria

Reporting Requirement	2022 Annual Report Section(s)
Total volume of waste discharged into the landfill for the year	Table 5: Inbound Material Quantities for 2021 & 2022 Appendix 2: Annual waste quantities
Operational plan for the next 12 months	2. Design & operating plans
Remaining site life and capacity	2.3 Remaining capacity
Closure works completed	2.1 Site plan & progressive closure status
Results of regular inspection for cover integrity, health of vegetation, undesirable plant species, burrowing animals, erosion, settlement, etc.	8.4 Site inspections
Any changes from approved reports, plans and specifications	2. Design & operating plans
Compaction, waste to cover ratio, waste to road ratio and airspace utilization factor	2.2 Operational efficiency
Operational and maintenance expenditures	8.6 Operational and maintenance expenditures

As of January 1, 2016, annual reports for high priority authorizations must include the MOE Annual Status Form. The form for the Vancouver Landfill lists all OC conditions, all of which were met in 2022, and is included in Appendix 10.

2. Design and operating plans

Golder Associates Ltd. (Golder) completed the Design Plan (Golder, 2019a) and Operating Plan (Golder, 2019b) in early 2019. The Design Plan is a reference for landfill design and progressive closure, while the Operating Plan is a guide for day-to-day operation of the Landfill.

The Design Plan was updated in September 2019. Figures in the Operating Plan that referenced the final contours and filling sequence of Phases 4 and 5 were updated in April 2020 and August 2021, respectively. The MOE was notified of the updates in a letter issued in October 2021, and details were provided in the 2021 Annual Report for the Vancouver Landfill. No changes were made to the Design or Operating Plans in 2022.

In August 2022, the City retained Sperling Hansen to complete an updated Design, Operations and Progressive Closure Plan by the end of 2023 per the OC (Section 2.18) and Section 10.3 of the Landfill Criteria.

2.1. Site plan & progressive closure status

The Landfill property is 320 ha in size, which contains the operational area (within the perimeter ditches) at 225 ha, a 16.7 ha pond historically used for dredging cover material and perimeter buffer zones. Approximately 320 ha of undeveloped land that were part of the original Landfill property were transferred back to the City of Delta as shown in Figure 1. The site plan for the Landfill property is shown in Figure 2.

Progressive closure phases and a profile view of the engineered fill plan are shown in Figure 3.



Figure 1: 2022 Vancouver Landfill Property and Footprint



Figure 2: 2022 Vancouver Landfill Site Plan

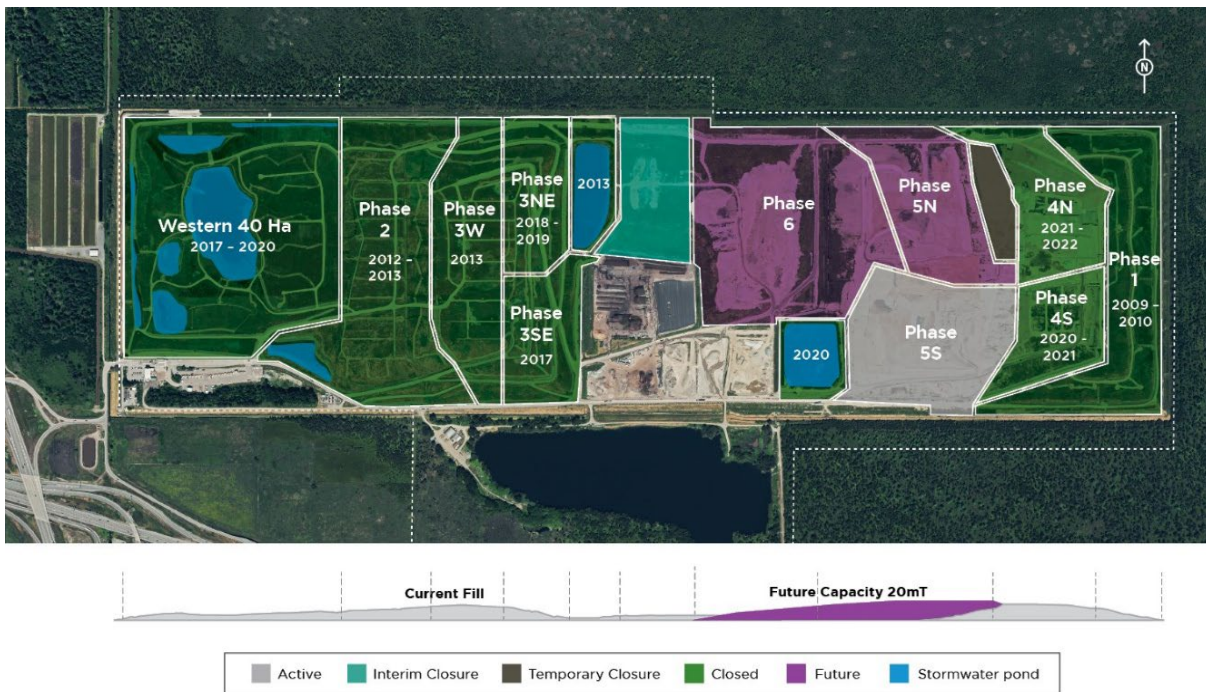


Figure 2: 2022 Landfill Fill and Progressive Closure Plan

In 2022, MSW filling occurred in Phase 5 South. Asbestos waste was disposed of in Phase 5S as well.

A summary of the operational plan for the next 12 months is as follows:

- Disposal of MSW in Phase 5;
- Expanding the landfill gas collection system in Phase 5; and,
- Litter fencing on every lift.

As of the end of 2022, several phases have been closed with engineered cover systems, including the Western 40 Hectares, Phases 1, 2, 3 and 4. In 2022, four ha of liner completed the Phase 4N closure. Closure of Phase 4N incurred a cost of \$10.2 million and was completed by Sperling Hansen Associates Inc. (SHA), SCS Engineers (SCS) and King Hoe Excavating Ltd. (King Hoe).

A breakdown of the progressive closure status up to and including 2022 is available in Appendix 1.

2.2. Operational efficiency

Aerial mapping and analysis has been completed at the Landfill annually since 2000. The flight to generate contour data occurs around the beginning of April when weather permits, and the data are typically available within three months. SHA is under contract to the City to complete the annual data analysis from 2022 to 2024.

The purpose of the aerial mapping and analysis is to utilize the contour data from the previous and current years coupled with the tonnages of materials disposed and beneficially used to assess the following parameters:

- Landfill settlement
- Compaction density
- Air space consumption
- Waste to cover ratio and waste to road¹ materials ratio
- Remaining capacity
- Lifespan analysis

As per SHA's *Vancouver Landfill 2021 to 2022 Aerial Mapping Report* (SHA, 2023), the following operational efficiencies were achieved from April 13, 2021 to May 22, 2022, for the Phase 4 and Phase 5 active areas:

- Compaction density of 0.86 tonnes per cu. m for waste in Phases 4 and 5. This value, also known as the effective density, is back-calculated using assumed densities from various geotechnical sources and survey volumes after accounting for settlement. The

¹Road materials include beneficial use materials such as clean wood waste, demo hog and crushed concrete/rubble.

calculated compaction density is lower than previous years, which is a result of the co-disposal of construction and demolition materials with MSW, which were managed separately in the Western 40 Hectares prior to 2020.

- Airspace utilization factor of 0.48 cu. m per tonne in Phase 4 and 0.85 cu. m per tonne in Phase 5. This represents an increase in available airspace from 2021, caused by settlement. The airspace utilization factor is larger in Phase 5 because filling in this phase only began in 2021; there is much less weight above the waste to drive settlement compared to Phase 4.
- Waste to cover ratio by volume of 4.98:1 was achieved in Phase 4, and a ratio of 5.78:1 was achieved in Phase 5. This represents a slight improvement over 2021 and is dependent on multiple factors, including estimated settlement and the amount of cover materials coming to the site.
- Waste to road materials ratio by volume of 7.51:1 was achieved in Phase 4, and a ratio of 3.36:1 was achieved in Phase 5. Waste to road materials ratio represents the volume of waste divided by the volume of all materials used for construction of roads, including recycled crushed rock, wood waste and demo hog.

2.3. Remaining capacity

Per the 1999 agreement between the City of Vancouver and City of Delta (City of Vancouver and the Corporation of Delta, 1999), the current waste capacity of the Landfill is defined as 20 million tonnes of MSW as of October 1, 1997. The remaining capacity as of December 31, 2022 is 5,716,355 tonnes. Based on the current airspace utilization factor, a volume of 6.6 million cu. m is required. The volume is derived from taking the difference between the latest aerial contours (May 2022 in this case) and the final design contours in the 2021 update to the Design Plan (SHA, 2021).

The remaining volumetric capacity is slightly higher than that reported in 2021 due to a refinement in calculations associated with the increased detail in the updated filling plans compared to the 2019 Design Plan. The final design contours were updated in the *2021 VLF Capacity Analysis* (SHA, 2021b).

3. Closure and post closure costs

The OC requires the City to maintain a dedicated reserve fund sufficient to finance closure, post-closure and environmental contingencies related to the Landfill. The Solid Waste Capital Reserve (SWCR) was established to address these costs. In 2001, Council set the minimum balance of the SWCR at \$30 million and directed that the requirements for the SWCR be reviewed every five years. At the end of 2022, the closing balance of the SWCR was approximately \$70.9 million. This reflects a net increase of \$2.9 million from 2021, which is due to the transfer of surplus tipping fees exceeding progressive closure costs in 2022.

Every year, closure and post-closure costs are reviewed and updated with current available information. For the 2022 Landfill liability calculation, the updated 2019 Design Plan was used as the primary resource. The net present value for closure and post-closure costs is \$128.1 million, up from \$112.7 million from 2021 as a result of higher forecast closure costs and interim post closure costs based on the 2023 - 2026 Capital Plan.

According to the 1989 Tripartite Agreement (Greater Vancouver Sewerage and Drainage District, City of Vancouver and City of Delta (formerly Corporation), 1989), Metro Vancouver is responsible for closure and post-closure costs based on the proportion of regional waste in place at the Landfill. The City of Vancouver is responsible to pay for closure and post-closure costs for Vancouver and Delta waste. These percentages are reviewed and adjusted annually. At the end of 2022, 36.6 per cent of the total waste in place at the Landfill was regional waste, with the remaining 63.4 per cent originating from Vancouver and Delta. This represents an increase of 0.9 percent in the proportion of regional waste since 2021, and corresponds to a current liability for the City of Vancouver of \$66.6 million (\$4.3M less than what is currently available in the closure reserve).

4. Planned improvements

4.1. Leachate, surface water runoff and stormwater management

As filling progressed in Phase 5S, one leachate collector was extended on the east side of lift 3 between September and November 2022. In 2023, one leachate collector is planned for installation on the east side of lift 5 of Phase 5S.

In 2022, the City was winding down the 2017-2021 Water Quality Consulting & Stormwater Management Planning Project and was preparing for the procurement of the next five-year service agreement. In October 2022, the City awarded the 2022-2027 Water Quality Consulting and Stormwater Management Planning Project to AECOM Canada Ltd. Key tasks that will be completed under this new contract include:

- 2022-2026 Annual Water Quality Monitoring Reviews
- 2023 Hydrogeology Review (five-year update)
- 2023 Geotechnical Settlement Analysis
- Stormwater Management Plan Update and Continued Implementation
- Perimeter Stormwater Management Strategy and Conceptual Design

The *Stormwater Management Plan* (AECOM, 2020) for the Vancouver Landfill was finalized in July 2020. Recommendations of the *Stormwater Management Plan* that were undertaken in 2022 included routine stormwater monitoring and completion of the *Landfill Leachate Pump Station Assessment* (AECOM, 2022). The City is planning to initiate Phase 2 of the pump station assessment in 2023.

4.2. Landfill gas collection

Implemented modifications and system upgrades undertaken in 2022 are summarized in Table 3. Planned modifications and upgrades to the LFG collection system scheduled for 2023 are summarized in Table 4.

Table 3: Implemented Modifications and System Upgrades in 2022

Landfill Sub Area	Activity	Description
Phase 3	Commission	5 vertical gas wells
Phase 4 South	Drilled	2 new wells to increase coverage and 2 replacements for kinked wells
Phase 4 North	Install	4.0 ha of closure liner
	Install	3.0 ha of liner for temporary closure on west bank of Northwest slope
Phase 5 South	Install and Commission	9 lift 2 horizontal gas collectors (P05H201-09E)
	Install	9 side-slope gas collectors (P05-S501-S09)
	Commission	3 temporary vertical gas wells (P05-TV01 to TV03)
	Install and Commission	Lift 3 leachate collector
South Header	Install and Commission	Replace 1100-metre section of the south header, including 10 condensate drain traps
Wellfield Upgrade	Install and Commission	50 remote monitoring and auto-tuning devices on vertical gas wells and horizontal gas collectors

Table 4: Planned Modifications and Upgrades in 2023

Landfill Sub Area	Activity	Description
Phase 5 South	Install and Commission	9 Lift 4 horizontal gas collectors
	Install and Commission	5 Lift 6 horizontal gas collectors
	Install and Commission	1 Lift 5 leachate collector sample port
Phase 5 North	Install and Commission	8 Lift 2 horizontal gas collectors
	Install and Commission	1 Lift 5 leachate collectors
Phase 4 North	Install and Commission	1 Leachate collector sample port connection

4.3. Progressive landfill closure

Construction of the Phase 4 Closure and Gas Upgrades Project was awarded to King Hoe in early 2020 as a two-year project. As planned, the final four ha of Phase 4N closure were

completed in 2022, including a 3.0 ha temporary closure on the west bank in an attempt to increase gas collection in Phase 4N.

In December 2022, a Request for Proposals was publicly posted for the design and construction supervision of Phase 5 Closure, including Phase 5S and 5N. The contract was awarded to SHA in March 2023.

4.4. Landfill facilities

The following works at Landfill facilities were completed in 2022:

- Paving remaining 1.3 ha of the Composting Facility
- Upgrades to Landfill main entrance gate to allow remote control
- Installation of a new trailer for Landfill garage staff

RAM Engineering Ltd. was retained in 2021 to provide project management and engineering design to undertake site improvements in the Zero Waste Centre as part of the Landfill Civil Works Project. Conceptual design for the following was completed in 2022:

- A new household hazardous waste area cover
- Two bin canopies for the drop-off bays to support new diversion opportunities
- Additional storage

A review of options for a site wheelwash is also underway. Planned work in 2023 includes completing the detailed design and initiating construction.

4.5. Material diversion

In 2022, City staff began studying the potential for aggregate recovery from excavated soils sourced from City sewers, streets, and water operations. The investigation will analyze different scenarios for recovery of aggregates from soil that is typically sent to the Landfill for cover.

4.6. Landfill end use

As per the terms of the 1999 Vancouver – Delta Agreement, City of Vancouver and City of Delta shall work together to establish the end use of the site for the post-closure period. In 2021, Compass Resource Management Ltd. was retained to assist the City of Vancouver and City of Delta to develop suitable end use options for the site supported by stakeholder engagement and technical feasibility analysis as a first step in end use planning. The following reports were submitted to Delta in early 2023:

- *Part I: Site Overview and Initial Opportunities Report*
- *Part II: Coarse-Level Evaluation of Initial End Use Opportunities Report*
- *Part III: Preliminary Assessment Report*

These three reports detail the technical assessment of 35 possible options for end use at the Landfill, including preliminary costs. They provide a structure to assess new options and also outline potential next steps in stakeholder consultation.

5. Waste disposal

The Landfill is authorized to accept up to 750,000 tonnes of waste each year. The annual totals for 2021 and 2022 for municipal solid waste, demolition waste, cover, road construction and closure materials are provided in Table 5. The historical quantities are shown in Figure A1.

Table 5: Inbound Material Quantities for 2021 & 2022

Material	2022 Quantity (tonnes)	2021 Quantity (tonnes)
Waste Discharge		
Municipal Solid Waste	643,190	685,417
Bottom Ash	37,281	35,326
Demolition Material	52,969	29,635
Out-of-Region Flood Relief*	1,045	6,095
Cover Soil	437,493	357,783
Road Construction & Other Beneficial Use Materials		
Demo hog	91,295	103,542
Wood waste	3,515	3,980
Crushed concrete	38,767	78,793
Purchased concrete & rock	52,997	30,229
Sand	399	79
Closure Materials		
Aggregate	44,662	55,367
Sand & Soil	147,676	494,335
Total	1,551,289**	1,835,579**
Note:		
* Authorized by MOE in 2021.		
** Totals may vary due to rounding errors.		

In 2022, the total waste discharge was 734,486 tonnes, reflecting a decrease of approximately 3% from 2021. It should be noted that in November 2021, the MOE granted a temporary increase to the maximum annual discharge rate to 825,000 tonnes for the calendar year due to the flooding that occurred in the Fraser Valley (see section 5.3.5 for more details).

5.1. Waste composition

Metro Vancouver publishes waste composition study reports for the region, and the City of Vancouver contributes as a partner by coordinating waste audits at the VSTS. The data is combined with data gathered at other regional facilities.

Metro Vancouver published two waste composition studies in 2022, one focused on multi-family waste, and the other on all sectors.

The 2021 Multi-Family Waste Composition Study (MTE, 2022) was completed by Metro Testing and examined garbage, recycling and organics in multi-family residences throughout the region.

The 2021 Full-Scale Waste Composition Study (Dillon, 2022), was completed by Dillon Consulting and provided composition for the following sectors:

- Single-family Residential
- Multi-family Residential
- Commercial/Institutional
- Small Loads

These studies, as well as those completed in previous years, are available on Metro Vancouver's website: <http://www.metrovancouver.org/services/solid-waste/about/reports-resources/Pages/default.aspx>

5.2. Municipal Solid Waste disposal

Waste disposed of at the Vancouver Landfill is either hauled directly to the Landfill, or transferred through the VSTS or one of Metro Vancouver's Transfer Stations.

In 2022, a total of 734,486 tonnes of waste (MSW, bottom ash, demolition material and out-of-region flood relief waste) were disposed of at the Landfill, primarily in Phase 5S. Of this, 136,151 tonnes were transferred through the VSTS and 326,019 tonnes were transferred from the regional transfer stations.

Table A1 in Appendix 2 provides a breakdown of material type, origin and disposal location for 2022. Table A2 provides a breakdown of material type, origin and disposal location for 2021. Table A3 shows the breakdown by month of material types for 2022. Details on some of these materials are included in the following sections.

5.2.1 Asbestos waste

Commercial asbestos waste is received Monday to Friday from 8 am to 2 pm for direct burial, while residential asbestos waste is received during regular operating hours in a dedicated bin at the Zero Waste Centre. Burials occur a minimum of 20 metres away from all other active areas, and include the placement of a minimum of 0.5 m of material on the waste. An exposure control plan is in place that includes periodic exposure monitoring to confirm the risk of asbestos exposure to Staff is low. The definition of asbestos waste used in the Landfill's Asbestos Policy (City of Vancouver, 2019) follows the *Occupational Health & Safety Regulation* (BC Ministry of

Labour, 1998). Commercial loads of asbestos waste must meet the *Transportation of Dangerous Goods Regulation* (Transport Canada, 1985).

A total of 14,018 tonnes of asbestos waste was disposed of in 2022 from commercial and residential customers, up from 12,752 tonnes in 2021.

A total of 668 tonnes of used residential drywall (suspect asbestos containing material) was received at the Vancouver Landfill in 2022, down from 768 tonnes in 2021. Used drywall from commercial customers is not accepted due to the availability of alternative disposal options within the commercial sector.

5.2.2 Construction and demolition processing residual waste

The Landfill receives construction and demolition processing residual waste from around the region. This waste stream is composed of the materials that remain after construction and demolition waste has been processed to remove recyclable materials. In 2022, a total of 96,173 tonnes of this material was received from licensed transfer stations and material recovery facilities in the region, up from 86,981 tonnes in 2021.

5.2.3 Bottom ash

The regional Waste-To-Energy Facility (WTEF) opened in 1988 in Burnaby, and bottom ash was initially managed at the Coquitlam landfill. In 2001, bottom ash was first accepted as subgrade material for an expansion of the Vancouver Landfill's Composting Facility and has since been accepted at the Landfill. A total of 37,281 tonnes of bottom ash was disposed of in 2022, slightly more than 35,326 tonnes in 2021.

5.3. Other authorized waste

In early 2022, the Landfill continued to receive out-of-region MSW associated with the provincial state of emergency caused by the widespread flooding in November, 2021. The provincial authorization for discharge of out-of-region waste was in effect until March 2022 (MOE, 2021a). The City also received authorization in May 2022 to discharge Avian Influenza materials for a period of 90 days (MOE, 2022a).

Other ongoing discharges authorized by the MOE are those for Non-Recyclable Wastewater Treatment Plant (WWTP) Residuals and Non-Recyclable Drinking Water Treatment Plant (WTP) Residuals, each of which are generated by regional facilities. In 2018, the City received temporary authorization to accept Iona Grit Dump Solids for disposal until November 30, 2024 (MOE, 2018). In 2021, the City received temporary authorization to accept up to 120 tonnes of non-recyclable marine debris from the Haida Gwaii Marine Debris Clean-up Project (MOE, 2021b), which was extended in 2022 (MOE, 2022b).

5.3.1. Non-Recyclable Wastewater Treatment Plant Residuals

Details on the historical receipt of WWTP residuals is as follows:

- Since 1998, the Landfill has been accepting grit from the Annacis Island and Lions Gate WWTPs, and since 2000 from Lulu Island and Iona WWTPs. Grit is primarily composed of materials that are denser than water and may include sand, pebbles, cinders, coffee grounds, seeds, cigarette filters and organic matter.
- In 2005, the Landfill began accepting sludge and scum screenings from Annacis Island WWTP on a trial basis. Sludge screenings are solids composed of hair, plastic debris, paper fibers and other finer materials. Scum screenings are floating materials such as toilet paper, waste paper products, plastics and other buoyant materials, which are generally combined with fat and grease.
- In October 2008, the MOE authorized disposal of WWTP residuals from the Annacis Island WWTP at the Landfill (MOE, 2008a).
- In 2012, the MOE consolidated the authorizations for the disposal of non-recyclable WWTP residuals from any of the five regional WWTPs (MOE, 2012).
- In 2020, the City received a letter amendment to include 2,500 tonnes of digester solids originating from Metro's WWTPs in the 2012 authorization provided certain conditions are met. Digester solids are grit that has not been captured in upstream preliminary treatment system, and sludge generated during secondary treatment, which is mixed with sawdust prior to hauling to absorb excess liquid. As stipulated in the MOE amendment letter (MOE, 2020), the disposal of digester solids counts towards the allowable annual tonnage, and is reported as a separate line item in Table A1 in the Appendix.

As part of the 2012 authorization, the City and Metro Vancouver were required to develop a sampling and reporting program. Metro Vancouver completes a Waste Assessment Form for the Landfill on an annual basis and confirms that WWTP residuals are not Hazardous Waste. Further, Metro Vancouver completes characterization sampling and reporting on a biennial basis.

The most recent *Grit and Screenings Characterization Study Sub-Report* was completed for Metro Vancouver in November, 2022. (WSP, 2022). This report summarizes the 2022 sampling program results of the non-recyclable WWTP residuals disposed of at the Vancouver Landfill. In 2022, grit bin samples from all WWTPs met the applicable guidelines. The next report is expected in 2024.

In 2022, 2,811 tonnes of grit were buried as nuisance waste in Phase 5. Additionally, 48 tonnes of digester solids and no sludge and scum were received. The tonnage of grit, sludge and scum screenings and digester solids received is reported as a separate line item (Sewage Treatment Plant Residuals) in Table A1 in Appendix 2.

5.3.2. *Non-Recyclable Drinking Water Treatment Plant Residuals*

In November 2009, the Landfill began accepting drinking WTP residuals from the Seymour Capilano Filtration Plant on a trial basis. The residuals consist of silt and sediment from the raw water reservoir and the coagulants added to bind the sediment together. In November 2011, the MOE authorized the ongoing disposal of WTP residuals as MSW at the Landfill (MOE, 2011). In 2022, 3,258 tonnes of WTP residuals were accepted at the Landfill.

5.3.3. *Iona Grit Dump Solids*

In August 2018, the MOE authorized the temporary disposal of Grit Dump Solids from a closed landfill on the Iona WWTP site until November 30, 2024 (MOE, 2018). It was initially estimated there were approximately 40,000 to 65,000 tonnes of Grit Dump Solids that required disposal.

The Landfill did not receive any Iona Grit Dump Solids in 2022 as the temporary disposal was completed. A cumulative total of 83,393 tonnes was received between 2018 and 2021.

5.3.4 *Refuse from Out-of-Region (Metro Vancouver Regional District)*

In November 2021, due to the heavy flooding in BC, the Landfill received refuse disposal requests from organizations outside the Metro Vancouver Regional District. The City received approval from the MOE in a letter (MOE, 2021a) dated November 18, 2021, to discharge refuse from out-of-region until the end of March 2022. Under this approval, the Landfill received a cumulative total of approximately 6,800 tonnes of out-of-region refuse, including 1,045 tonnes in 2022. Refuse from sources outside the region and the quantity of material received is reported on a separate line item (Out-of-Region) in Table A1 in Appendix 2.

5.3.5 *Non-Recyclable Marine Debris*

In February 2021, the City received a disposal request for the disposal of up to 120 tonnes of non-recyclable marine debris from the Haida Gwaii Marine Debris Clean-up Project. The debris included crab traps, tires, chains, rope, bricks, blocks and old docks. The City received an initial authorization letter from the MOE (MOE, 2021b), dated August 17, 2021, to allow for disposal before the end of March 2022. A second authorization to accept 25 tonnes of debris until March 31, 2023 was received at the City's request for the same project on August 15, 2022 (MOE, 2022b).

The authorization letter requires that the annual report include the following:

- Tonnage: 14.73 tonnes in 2022
- Discharge location: Phase 5
- Dates of discharge: February 2 and 22, March 11 and October 13, 2022

The tonnage of non-recyclable marine debris received is reported as a separate line item (Non-Recyclable Marine Debris) in Table A1 in Appendix 2. Signed, redacted copies of the waste assessment forms (as required under the MOE authorization letter) are included in Appendix 9.

5.3.6 *Avian Influenza Material*

In response to an outbreak of Avian Influenza Disease (AI) in April 2022, the City received a letter from the MOE on May 4, 2022 (MOE, 2022a) authorizing disposal of AI contaminated carcasses and associated waste for 90 days, which expired on July 2, 2022. The authorization letter states that the waste materials must be double bagged in 6 mil plastic bags and sealed, then immediately buried within a minimum of 0.5 m of cover material. The landfill received 8.52 tonnes of AI contaminated waste under this authorization in 2022.

5.3.7 Demolition Material

Demolition material is mainly wood waste with small amounts of soft construction material, which has to meet the minimum criteria for wood content of 80 per cent. In 2022, a total of 52,969 tonnes of demolition material was received at the Landfill. This represents a significant increase from the 29,365 tonnes received in 2021, due to a surge in demolition activities in the region. Most was used for preparation of roads, drainage and gas collection layers in Phase 5; the remaining material was landfilled.

5.4 Cover materials

Cover soil for Landfill operations is excavation material generated by sewer, water and street construction activities in the Metro Vancouver region.

In 2022, the Landfill received a total of approximately 433,700 tonnes of soil. The material was distributed on site as follows:

- 57 per cent was directed to the soil stockpile area (see Figure 2); and,
- 43 percent was direct hauled to Phase 5 for cover.

The soil stockpile area is managed by the on-site contractor, Poschner Construction 88 Ltd. (Poschner), who must maintain a minimum of 30,000 cu. m of soil in the area at all times. Articulated ('Yuke') dump trucks are used to deliver soil to the active face on an as needed basis. Soil usage data by location is considered for Annual Aerial Mapping.

5.5 Road construction & other beneficial use materials

Road construction materials for temporary access roads on the active areas at the Landfill include purchased and recycled concrete, demolition (demo) hog and wood waste.

The City regularly brings in a contractor for processing clean concrete and asphalt received at the Landfill. Crushed material is used in closure works and for Landfill operations. In 2022, there was one crushing event in March. Approximately 39,000 tonnes of recycled crushed concrete and asphalt and 53,000 tonnes of purchased aggregate were received for road construction in 2022.

Demo hog is ground construction wood waste received at a reduced fee from local wood waste processors for use as top dressing on tipping pads as approved by the MOE in February 2008 (MOE, 2008b). Demo hog is classified as a beneficial use material and not counted towards the annual authorized discharge. Approximately 91,300 tonnes of demo hog were received in 2022.

Since January 1, 2011, residential quantities of clean wood waste have been accepted at the Landfill at a reduced fee to encourage diversion. Wood waste is ground onsite and then used as road base. Approximately 3,515 tonnes of wood waste were received in 2022.

5.6 Closure materials

Materials used for the construction of engineered cover systems in completed areas of the Landfill include (refer to Figure 6):

- soil to contour the areas to achieve design elevations;
- a geomembrane liner as an impermeable barrier;
- aggregate to convey landfill gas and stormwater to collection systems below and above the liner, respectively; and,
- topsoil to support the growth of grass and future vegetation.

In 2022, closure contractors sourced approximately 44,662 tonnes of aggregate and 147,676 tonnes of sand and soil for the Phase 4 Closure project.

6. Waste reduction & recycling initiatives

6.1 Zero Waste Centre

The Zero Waste Centre (ZWC) offers a recycling area for large items not typically included in curbside collection programs (mattresses, scrap metal, white goods) and a number of Product Stewardship Program materials (household batteries, lead acid batteries, smoke alarms, tires, thermostats, used oil, used oil filters). In May 2014, the City expanded collection to include all forms of packaging and printed paper covered by the provincial Product Stewardship Program and under contract to Recycle BC.

Recycled quantities received are provided in Table 6. The total amount of materials recycled in 2022, including the tonnes associated with materials measured in litres and units, was 1,500 tonnes compared to 2,062 tonnes in 2021. The reduction in total recycled quantities from the previous year can largely be attributed to fewer/less mattresses, propane tanks, scrap metal and loads of paper in 2022.

Table 6: Recycling Quantities for 2021 & 2022

Item	2022	2021	Units
Books	7.14	1.81	tonnes
Clothing	12.8	12.4	tonnes
Containers (Plastic, Metal, Paper) ¹	6.4	3.9	tonnes
Cooking Oil	0.8	1.8	tonnes
Drywall, new scraps only	90	88	tonnes
Electronics & Small Appliances ¹	121	159	tonnes
Fire Extinguishers	0.73	1.57	tonnes
	322	692	units
Glass Bottles & Jars ¹	8.3	4.0	tonnes
Household Batteries & Cell Phones ^{1,2}	0.5	1.2	tonnes
Lead Acid Batteries ¹	12.9	18.7	tonnes
Light Bulbs ^{1,3}	1.25	2.65	tonnes
Mattresses	239	315	tonnes
	9,581	12,636	pieces
Mixed Paper & Cardboard, Residential ¹	33	260	tonnes
Other Flexible Plastic Packaging ⁴	0	6.7	tonnes
Plastics Bags & Overwrap ^{1,4}	6.2	1.8	tonnes
Plastic Foam Packaging ¹	7.2	7.9	tonnes
Product Care Items (Paint, Aerosol, Pesticide, Solvent) ^{1,3}	51	49	tonnes
Propane Tanks	4435	9,643	units
	5.3	9.2	tonnes
Refrigerators, Freezers & Air Conditioners	178	230	tonnes
	3,155	3,711	units
Scrap Metal (excluding Refrigerators, Freezers & Air Conditioners)	687	821	tonnes
Smoke Alarms ¹	1	3	boxes
Tires ¹	20.7	35.4	tonnes
	2,070	3,350	units
Waste Antifreeze ¹	0.7	2.9	tonnes
	701	2910	litres
Waste Oil ¹	10.2	26.8	tonnes
	11,441	30,150	litres
Waste Oil Filters ¹	0.3	1.7	tonnes
Total⁵	1,500	2,062	tonnes

Note:

¹ Product Stewardship Program material

² Household batteries and cell phones were collected under the same program by Call2Recycle. However; cell phone total weights were not tracked by the vendor in 2022.

³ Abandoned or recovered from waste stream

⁴ Other Flexible Plastic Packaging and Plastic Bags & Overwraps were combined into one category by Recycle BC beginning January 2023. Combined totals for 2022 are reported under Plastic Bags & Overwrap due to changes in data collection.

⁵ Includes tonnes calculated for items measured in units, pieces, and litres. Conversion factors are provided by Metro Vancouver and Product Stewards.

6.2 Disposal bans

Since 2008, the City of Vancouver has implemented disposal bans in alignment with Metro Vancouver to reduce the amount of material being landfilled that could instead be recycled and follow BC's *Recycling Regulation* (MOE, 2004b) (defines materials to be managed under provincial Extended Producer Responsibility Programs).

Materials banned from disposal as garbage at the Landfill are defined in the appendices of the City's *Solid Waste By-law No. 8417* (City of Vancouver, 2022) and mirror those which are banned in Metro Vancouver's *Tipping Fee Bylaw* (GVS&DD, 2022) as much as possible.

The disposal bans are enforced by Metro Vancouver's inspection officers that routinely visit the City's disposal facilities. Disposal ban violation notices and surcharges are issued to those customers that dispose of banned materials in excess of the defined thresholds. Appendix 3 contains a complete list of materials that are accepted for recycling at the Landfill and those that are banned from disposal as garbage.

6.3 Yard trimmings collection and composting

In 2022, approximately 16,900 tonnes of yard trimmings were received, down from approximately 21,600 tonnes in 2021 mainly due to the discontinuation of yard trimmings receipt from two transfer stations in the region.

The Composting Facility includes a 4.2 ha paved surface, of which 1.3 ha was paved in 2022. Equipment includes a dual-shaft shredder, excavator, two front-end loaders, star screener and windrow turner.

The static windrow composting method is used to process yard trimmings into finished compost. The feedstock is ground up and placed in windrows (piles) using front end loaders, then turned regularly to maintain optimal oxygen and temperature levels. After a minimum of six months in windrows, the material is screened and stockpiled for curing and subsequent sale or donation.

Approximately 14,160 cu. m of finished compost were distributed in 2022, compared to 19,900 cu. m in 2021. Compost sales totaled 12,320 cu. m and the remaining 1,840 cu. m were donated to City of Delta and City of Vancouver residents during free compost campaigns. Approximately 1,600 cu. m of compost were used to replace costly topsoil covering the new south LFG header alignment.

Compost quality is compared to standards set out in the MOE's *Organic Matter Recycling Regulation* (MOE, 2002) based on the feedstock and composting method used. In 2021 and 2022, the compost met the standards for unrestricted distribution for all parameters listed in the Regulation. A summary of the compost quality in 2021 and 2022, and the standards for unrestricted use are provided in Table 7.

Table 7: Compost Quality for 2021 & 2022

Parameter	BC Standard mg/kg unless stated	2022 Mean Value mg/kg unless stated	2021 Mean Value mg/kg unless stated
Arsenic	13	1.08	5.4
Cadmium	3	0.25	0.5
Chromium	100	8.3	21.5
Cobalt	34	2.83	4.5
Copper	400	33.3	61.5
Lead	150	12.5	27.5
Mercury	2	0.17	0.1
Molybdenum	5	0.42	1.5
Nickel	62	5.2	15.2
Selenium	2	<0.50	<0.50
Zinc	500	42	171.5
Foreign Matter (%)	1	<0.1	0.02

6.4 Diversion projections

The *Integrated Solid Waste and Resource Management Plan* (ISWRMP, Metro Vancouver, 2010) established future diversion targets. The ISWRMP outlines initiatives for achieving these rates which include diverting demolition, landfill clearing and construction waste for recycling as well as food waste to composting and energy recovery.

As per the *2021 ISWRMP Biennial Report* (Metro Vancouver, 2022) produced by Metro Vancouver, 65 per cent of the waste generated in the region in 2020 were recycled or diverted from disposal. This diversion rate is slightly higher than the rate determined in the previous period (2018) as reported in the *2019 ISWRMP Biennial Report* (Metro Vancouver, 2020). The next ISWRMP report is anticipated to be completed in 2023.

Metro Vancouver is currently updating its solid waste management plan which includes undertaking technical studies, indigenous and public engagement and consultation with stakeholders. The update process is expected to take 2-3 years.

7. Environmental protection programs

7.1 Leachate, surface runoff and stormwater management

Water management at the Landfill is described using the following terminology:

- **Leachate** - produced by rainwater percolating through waste.
- **Surface runoff** - rainwater that flows along the surface of areas of the Landfill (subject to the placement of daily or intermediate cover), and may be impacted by leachate.
- **Stormwater** - rainwater that is collected above the engineered cover system installed in closed areas of the Landfill. Stormwater is not impacted by leachate.

The Landfill site is underlain by compressed peat and a continuous layer of relatively impermeable clayey-silt, which is referred to as the natural soil barrier layer. Prior to the placement of waste in each landfill cell, a layer of demolition material was placed on top of the peat. This provides the conduit for leachate to flow laterally to the perimeter ditch system surrounding the Landfill footprint as shown in Figure 4. The layer of demolition material, natural soil barrier layer, and perimeter ditch system are collectively referred to as the leachate collection system. The inner ditch collects leachate, while the outer ditch, more commonly known as the drainage ditch, collects clean water that runs off adjacent land. The drainage ditch is maintained at a higher level than the inner ditch to contain leachate in the inner ditch as shown in Figure 5. The leachate is then conveyed from the pump station located in the southwest corner of the Landfill through force mains to the Annacis Island WWTP under *Waste Discharge Permit SC-100168-FSA* (GVS&DD, 2011).

In addition to leachate, surface runoff is routed to the inner ditch. An internal storage pond (linear pond 4) is used to reduce peak discharge to the sewer system. This pond has an approximate capacity of 22,000 cu. m and is located north of the Phase 4 stormwater retention pond (Figure 4).

The Phase 2 and Phase 3 closure areas each have a dedicated pond for stormwater retention, which have a combined capacity of 67,200 cu. m. Six retention ponds for clean stormwater in the Western 40 Hectares have a combined design storage capacity of approximately 87,700 cu. m. The Phase 4 retention pond has an estimated design capacity of approximately 100,000 cu. m.

Prior to October 2020, stormwater was directed to the retention ponds, then once the storm had passed, to the inner ditch. In late 2020, two stormwater discharge pilot tests were conducted (AECOM, 2021a). The two pilot tests demonstrated that discharging clean stormwater from the three retention ponds to the Dredge Pond did not appreciably affect its water quality or result in any downstream flooding events. As such, diverting clean stormwater became a continued operational practice. Through controlled release to the dredge pond and surface evaporation from the storage ponds, approximately 340,000 cu. m of clean stormwater were diverted in 2022, saving approximately \$560,000 in costs associated with leachate management.

The annual fees associated with leachate, surface runoff and stormwater management include a conveyance fee paid to Delta for the use of the sewer system, and an industrial discharge fee made up of capacity and usage components for the treatment of the leachate at the WWTP.

The capacity and usage charges account for biological oxygen demand, total suspended solids and flow. In 2022, the cost associated with leachate conveyance and treatment totaled \$3.57 million. Approximately 72 per cent of this cost was associated with conveyance, which is slightly lower than last year due to less precipitation.



Figure 4: Leachate, Surface Runoff and Stormwater Management

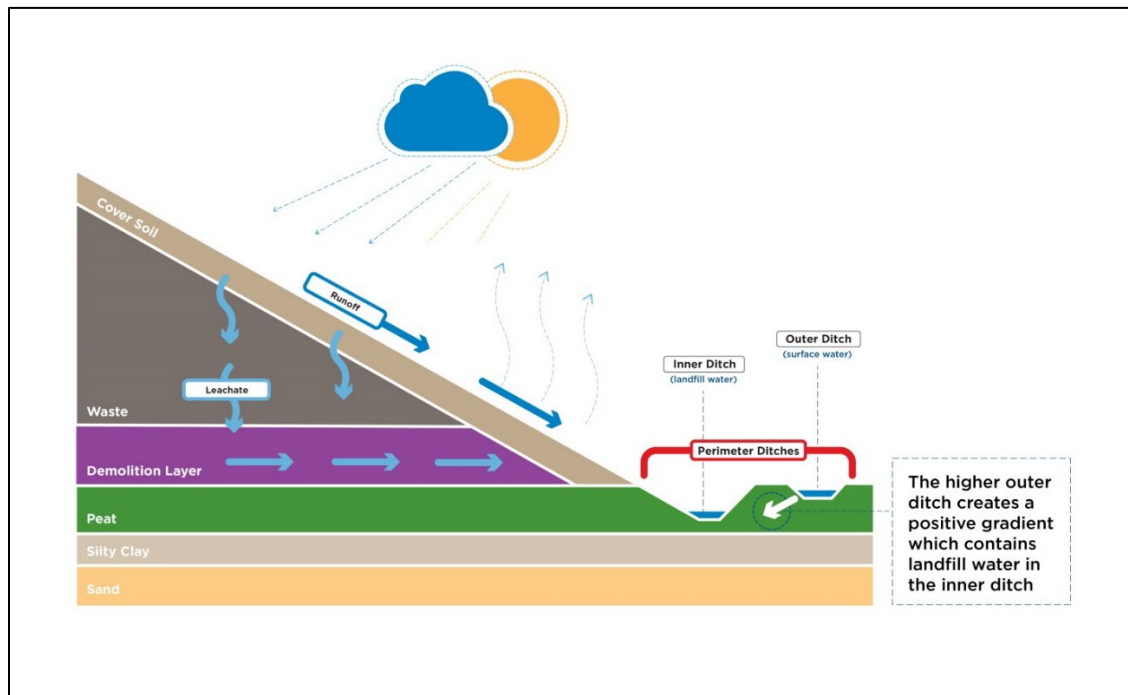


Figure 5: Leachate Collection System Cross-Section

Monthly leachate flow and precipitation data for 2022 are provided in Table 8.

Table 8: 2022 Leachate Flow Volumes and Precipitation

Month	Leachate Flow (m ³)	Precipitation ² (mm)	Precipitation Volume (m ³)	Ratio of Leachate Flow to Precipitation Volume
January ¹	458,231	147	331,425	138%
February ¹	193,309	60	134,325	144%
March ¹	387,335	153	344,250	113%
April	193,121	95	212,850	91%
May	127,602	92	207,225	62%
June	102,324	70	156,825	65%
July	46,100	28	62,775	73%
August ¹	40,501	6	14,400	281%
September ¹	34,722	7	15,750	220%
October	63,803	89	199,575	32%
November	186,459	104	233,550	80%
December	323,602	188	422,325	77%
Total	2,157,109	1,038	2,335,275	92%

Notes:

¹ The high ratio of leachate flow to precipitation volume reported in select months can be due to the release of stored water that occurs when the Landfill becomes saturated and the controlled release of clean stormwater from storage ponds.

² Recorded at Delta Burns Bog Station 1102415.

A total of 2,157,109 cu. m of leachate, surface runoff and stormwater were pumped to Annacis Island WWTP in 2022. Leachate from the Vancouver Landfill is considered dilute compared to other MSW landfills because of the high volume of surface runoff and stormwater from the closed areas that have historically been treated as leachate. As closure activities progress, the volume of leachate generated is expected to decrease.

7.2 Leachate generation control measures

Leachate generation at the Landfill is controlled through a number of mechanisms, which include the following:

- Progressive closure of completed phases, with an impermeable geomembrane cover system installed to minimize infiltration and leachate generation. See Figure 6 for the cross-section of the typical final cover system.
- A dedicated linear pond for leachate and surface runoff to control flows to the leachate pump station as well as stormwater retention ponds to reduce flows from closed areas to the Dredge Pond during significant precipitation events. See Figure 5 for pond locations.
- Use of daily and intermediate cover at the active face and keeping the active face as small as possible to minimize infiltration from precipitation.

- Erosion control measures on side slopes, such as swales and downchutes, to convey water to internal ditches.

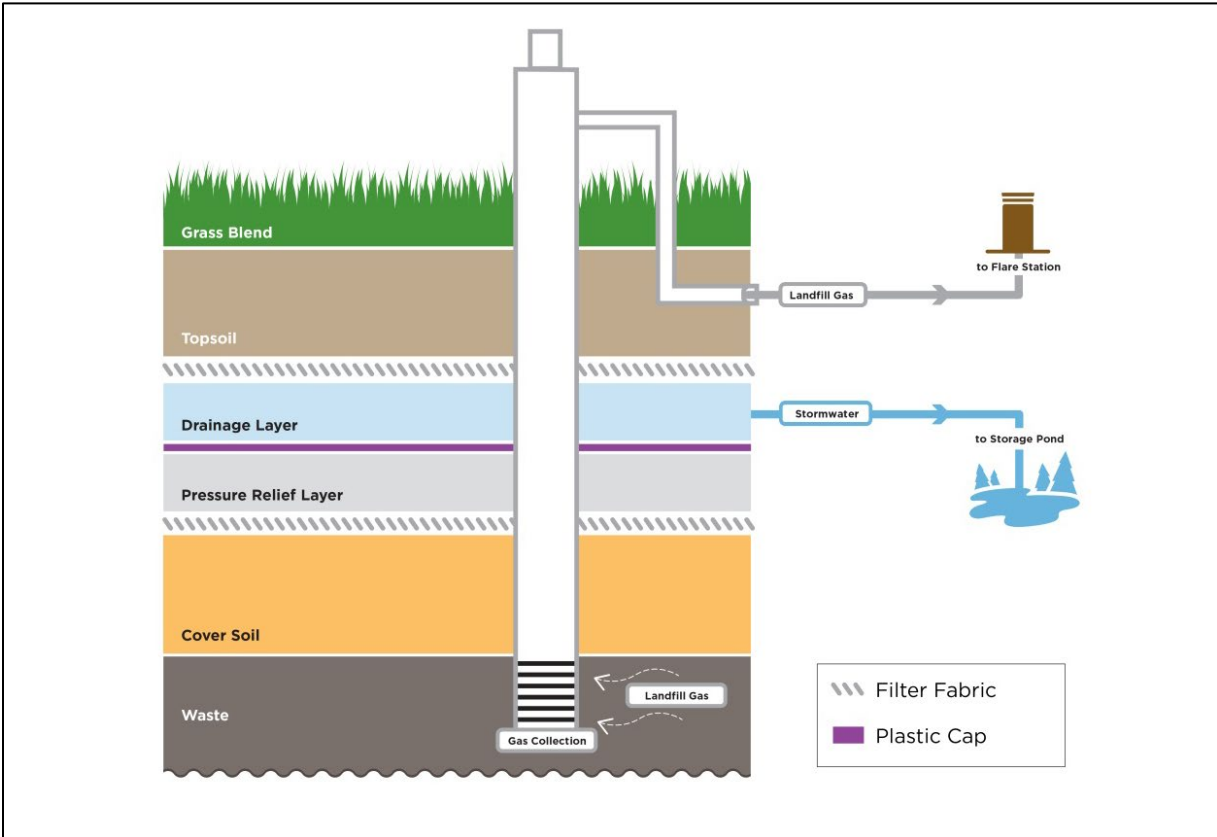


Figure 6: Final Cover System Cross-Section

7.3 Water quality monitoring program & annual review

The OC requires regular sampling and analysis of leachate, and surface and ground waters in the vicinity of the Landfill, for specific stations and parameters. Leachate flow measurement and leachate/drainage ditch water level measurements are also required. The Landfill's WDP also requires regular sampling and analysis of leachate, in addition to leachate flow measurement. The Landfill Water Quality Monitoring Program (WQM Program) is in place to meet the above requirements and includes stormwater sampling as well. Sampling and data collection is completed by Staff, according to the *Leachate, Groundwater, Surface Water and Stormwater Monitoring and Sampling Manual* (AECOM, 2021b).

In 2022, one leachate station, 13 surface water locations, 18 shallow groundwater wells and 20 deep groundwater wells were sampled quarterly by Landfill Staff. Shallow groundwater wells are screened in the peat aquifer and range in depth between 2.5 – 4 m, while deep groundwater wells are screened in the sand aquifer and range in depth between 6 – 9 m. Well and sampling locations are shown in Appendix 4. Additionally, a 24-hour composite sample representing the leachate pumped to Annacis Island WWTP was taken monthly. Samples were analyzed for the parameters listed in Appendix 5.

Consultants hired by the City have completed annual reviews of the WQM Program each year since 1999. The *City of Vancouver Landfill - 2022 Annual Water Quality Monitoring Report* (AECOM, 2023) confirms that the 2022 Landfill WQM Program meets or exceeds the requirements set out in the OC and WDP with respect to the number, type and locations of stations monitored, sampling frequency, water quality parameters, and detection limits with the exception of five surface water stations (Stations 43, 44, 45, 91 and 96) which were not sampled during dry ditch conditions in the third quarter. This is consistent with past years.

The December 2019 *City of Vancouver – 2018/19 Stormwater and Surface Water Monitoring Report* (AECOM, 2019) recommended that a regular monitoring program for stormwater be implemented, and include monthly sample collection from October to March each year. Sampling began in December 2019 and continued into 2022 at 12 stations. Results from the sampling events are included in the 2022 WQM Report.

The executive summary from the 2022 WQM Report, including recommendations, is included in Appendix 7. A tabulation of the leachate/drainage ditch levels is included in Appendix 8.

7.4 Landfill gas management system

The City began collecting and flaring LFG in 1991 to control odours and greenhouse gas emissions. From September 2003 to May 2022, the City sold LFG for beneficial use of LFG, initially to Maxim Power Corporation (Maxim), and then Village Farms International Inc. (VFI) in 2014 when they purchased Maxim's assets, for their combined heat and power cogeneration facility located off property, southeast of the Landfill's blower-flare station.

The amount of flared LFG has increased in recent years because VFCE's equipment was reaching end of life. In October 2020, VFCE finalized an amendment to their 20-year agreement with the City to extend the term for an additional 20 years. The agreement amendment allows VFCE to upgrade their equipment at the Landfill to produce RNG off site for sale to FortisBC and carbon dioxide for their greenhouses. The agreement amendment was subsequently assigned DeltaRNG, and the term extension commences upon start-up of commercial operations with an option to extend for an additional five year period. DeltaRNG decommissioned the combined heat and power system on May 16, 2022 to prepare for construction and commissioning of their new facility in the first half of 2023. All LFG is being flared until commissioning.

In 2018, FortisBC and the City reached an agreement for FortisBC to develop an upgrading plant at the Landfill to convert LFG to RNG for the FortisBC pipeline. The BC Utilities Commission approved this agreement in September 2019. In December 2021, FortisBC successfully selected their technical provider for the RNG facility project and awarded the balance of plant design work. In 2022, Fortis BC prepared their design-build package for release in early 2023. Construction of the facility is planned to start in 2023 with commissioning in 2023/24.

An overview of the Landfill's LFG control system is shown in Figure 7, with the distribution of the vertical gas wells and horizontal, side slope, pressure relief and DRAINTUBE² gas collectors across the footprint shown in Figure 8.

² DRAINTUBE is a geocomposite mat consisting of small diameter plastic pipes (<25mm in diameter) between layers of geocomposite material that is used for collecting landfill gas under the geomembrane cover and in the waste mass.

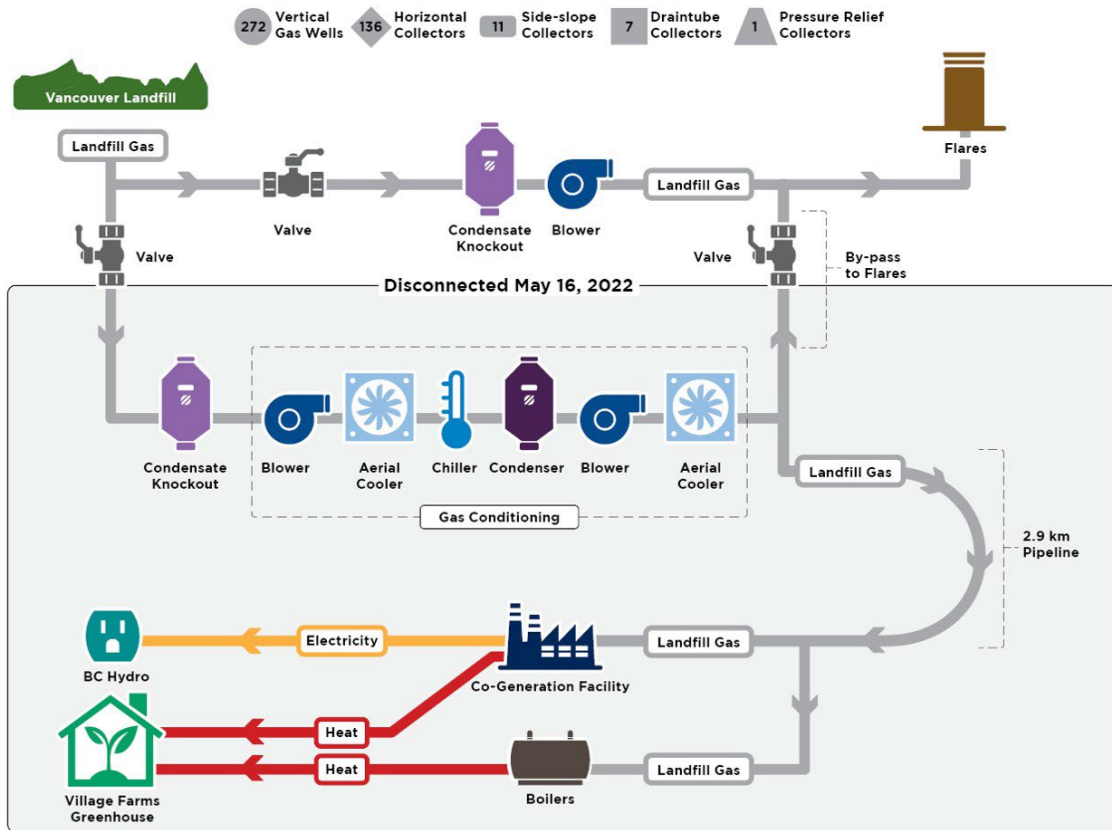


Figure 7: Landfill Gas Collection & Beneficial Use System

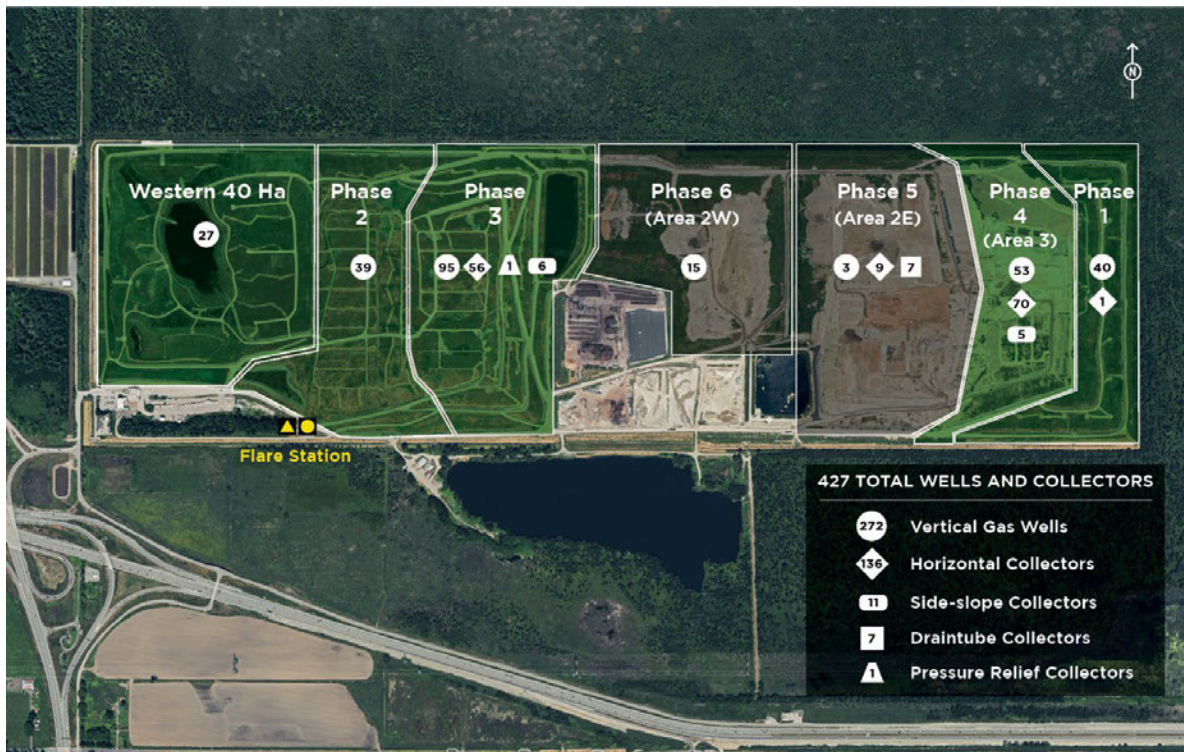


Figure 8: 2022 Landfill Gas Collection System

The total volume of LFG collected in 2022 is reported in two ways in this section and Table 9:

1. As measured by individual meters; and,
2. On a normalized basis (to 50 per cent methane by volume) as per the methodology used by the MOE in Section 3.2 of the 2010 *Landfill Gas Management Facilities Design Guidelines* (Conestoga-Rovers & Associates, 2010).

Table 9: 2022 Landfill Gas Collection and Beneficial Use

Date	Weighted Average Methane Content (% by vol.)	LFG to Utilization Facility (cu. m)	LFG to Flare (cu. m)	LFG Captured for Period (cu .m)
Total (metered)	50.5	5,721,246	56,675,360	62,396,606
Total (normalized to 50 percent methane)	50.0	5,774,176	51,199,689	62,973,865
Daily Average*	50.5	42,068	155,275	170,950
Daily Average (normalized to 50 percent methane)*	50.0	42,457	156,711	172,531

Note:

*LFG Utilization Facility daily average is based on 136 days, January 1 to May 16, 2022.

The total metered volume of LFG collected (62,396,606 cu. m) in 2022 equates to 20,646 tonnes of methane or 516,150 tonnes of carbon dioxide equivalents (CO₂e). It is equivalent to the emissions approximately of 115,937 vehicles over the period of a year. Landfill gas collection efficiency

The 2022 Collection Efficiency (CE) was 70 per cent as calculated by the site-specific LFG general model. The achieved CE was below the MOE target of 75 per cent. The decrease in CE in 2022 is mainly due to the shutdown of the VFCE system on May 16. Immediately after shutdown, City staff observed a decrease in the LFG flow rate of approximately 10 per cent with only the City’s blowers running compared to when VFCE’s blower was running in parallel, despite the same wellfield vacuum set point. Differences in flow have been attributed to different pairings of the City’s three blowers. The City’s flowmeter was sent offsite for annual calibration. The City worked with their consultant, Jacobs, to investigate the changes in total flow through 2022, and work will continue into 2023.

In 2022, the City continued its effort to increase LFG collection through an aggressive capital works program, including the installation of the following new works:

- 10 vertical gas extraction wells
- 9 horizontal gas collectors and seven DRAINTUBE collectors
- Replacement of the south header
- Installation of automated well tuning devices procured from Apis Innovations (Apis) called SmartWells. Fifty SmartWells were installed in 2022 to test the LFG at the well head and adjust the flow automatically. According to Apis, the devices increased the CE in the first ten wells by approximately 15 per cent. Work will continue in 2023 to further test and optimize this new technology.

Additional initiatives undertaken to improve LFG CE included:

- In 2020, the City began a regular, annual program to replace vertical gas wells compromised by flooding, fouling and kinking to continue to increase LFG CE. Two wells were replaced in Phase 4 in 2022.
- Installation of additional vertical gas wells in higher producing areas (decreasing well spacing). Two wells were installed in Phase 3 in 2022.
- Decreasing spacing between the horizontal gas collectors from 40 m to 30 m and vertical gas extraction wells from 60 m to 50 m.

In 2020 and 2021, the City was awarded \$5.73 million in funding through the CleanBC Industry Fund: Emissions Performance to advance several gas system expansion projects. These works, including funding proportion, are summarized below in Table 10.

Table 3 - Clean BC Industry Fund Awards

Scope	Stage	CleanBC 2020 (50% Funding)	CleanBC 2021 (90% Funding)
12 Vertical Gas Wells (five in Phase 3, two in Phase 1, five in Phase 5)	Stage II	✓	
11 Phase 5S Side Slope Gas Collectors	Stage II	✓	
9 Phase 5S L2* Horizontal Gas Collectors	Stage II	✓	
7 Vertical Gas Wells on Phase 4NW slope	Stage II	✓	
South Header Upgrade	Stage II	✓	
TVGWs in West bank of Phase 5S	Stage IIB		✓
DRAINTUBE blanket in Phase 5S between L1* and L2*	Stage IIB		✓
Ph5S Sample Cleanouts	Stage IIB		✓

PH5SL3 Leachate	Stage III	✓	
4 Vertical Gas Wells	Stage III	✓	

Note:

*L refers to Lift.

Construction of the various system components in 2022 contributed to a reduction in overall collection efficiency when portions of the system needed to be shut down and purged to allow connection to the main system. This was particularly an issue during the replacement of the South header.

Further details on LFG collection activities in 2022 can be found in the *2022 Annual Landfill Gas Report for the Vancouver Landfill* (City of Vancouver, 2023).

7.5 Landfill gas surface emissions monitoring program

No site-wide surface emissions monitoring was undertaken in 2022. Surface emissions monitoring for the site is deferred until 2023 to allow for completion of Phase 4 closure.

7.6 Subsurface soil landfill gas monitoring

The purpose of subsurface soil LFG monitoring is to monitor the potential subsurface migration of LFG beyond the wellfield (closed and active filling areas) into onsite buildings.

In 2020, 18 subsurface soil gas monitoring probes were installed near the perimeter of the site in between the waste mass and the property boundary. Monthly monitoring began in March 2020.

Of the 18 probes, eight were found to have exceeded the methane lower explosive limit (5 per cent) during the first year of monitoring. Attempts were made to reduce this soil gas migration by turning up the suction in vertical gas wells adjacent to the gas probes. Frequent readings were taken, before and after LFG flow adjustments were made in the field. On analysis, it was found that altering the suction on the gas wells had no apparent effect on subsurface gas migration. The main cause of changes in gas migration was found to be changes in atmospheric pressure. As a result of this analysis, monitoring frequency was reduced to quarterly as of March 2021.

To address the gas migration risk, the City’s consultants recommended the installation of two additional building methane monitors at the air compressor trailer and Poschner works yard (see Section 7.8). These two new building methane monitors were installed in 2022.

7.7 Building methane monitoring

In 2021, the City changed from Atlas Copco to Comcor to maintain the continuous combustible gas measurement equipment (building methane monitors) installed in 2016 throughout site buildings. Since then, the building methane monitors have been calibrated quarterly and replaced once they exceeded their service-life. As of December 2022, there were a total of 38 building methane monitors installed and operational at the Landfill. Propane monitors were also installed in buildings in 2021, after the building LFG supplied by VFCE/DeltaRNG ended. There were no alarms related to methane monitoring in 2022.

7.8 Landfill gas migration & emissions monitoring program

The City has had a perimeter ambient air monitoring program since 2001 to monitor potential nuisance odour sources at the property boundary. Ambient air is monitored for total organic carbon (TOC) as methane and hydrogen sulfide (H₂S) at each station at heights of 10 cm and 200 cm above ground elevation.

In 2022, there were 76 stations along the Landfill perimeter, and there were four measurements above the detection limit (50 ppm) for TOC (two in Q3 and two in Q4), compared to one in 2021. These occurred at two locations: the same location as last year on the western boundary and a new one on the southern boundary. For the repeat location, investigation revealed the emissions are from a leachate riser pipe, which cannot be retrofitted.

Additionally, there were seven detections above the detectable odour limit of 3ppb for H₂S in 2022. These were only detected in Q1, not at any other time in the year. Most odour limit detections were south of active filling areas where odour is expected.

8. Operational information

8.1. Nuisance waste

Nuisance waste is defined as material that requires special consideration, documentation, handling or disposal (such as direct burial). These materials typically originate from small businesses or light industry and are not classified as Hazardous Waste. The waste generator completes a Waste Assessment Form and submits it for review and approval by City staff.

Nuisance waste also includes materials ordered for destruction or burial by the Canadian Food Inspection Agency (CFIA). Deep burial is required to meet CFIA requirements and is often witnessed by a CFIA Officer. The Canadian Border Services Agency also periodically orders destruction of specific materials entering Canada.

Table 11 lists the types of nuisance wastes and quantities received at the Landfill in 2022. The tonnage of CFIA burials in 2022 was approximately 550 tonnes more than in 2021, mainly attributed to Japanese beetle soil (and its expanded regulated area). In addition, street sweepings decreased by approximately 500 tonnes compared to 2021 as the City of Surrey stopped sending street sweepings to the Landfill. Overall 2022 nuisance waste quantities increased by 3,308 tonnes when compared to 2021 quantities, which represents a 37 per cent increase.

Table 4: 2022 Nuisance Waste Quantities

Material	2022 Quantity (tonnes)
CFIA burials	7,731
Invasive Species	1,856
Plastic-Contaminated Green Waste	1,763
Non-Compostable Food	380
Fish and Shellfish Waste	164
Other*	137
Street Sweepings	67
Fish Nets	59
Rope	22
Marine Debris	15
Total	12,194

Note:

* Other includes ice paint, nylon web slings, pipe covering insulation, grain sweepings, mouldy apparel, rubber, hose assemblies, non-recyclable plastic waste, post sortation residue, straw, and expired COVID-19 test kits, first aid kits, toothbrushes and LED lights.

8.2. Bird control

Birds, particularly gulls, are a nuisance at landfill sites. In large numbers, they create a negative image of landfills and scatter litter onto surrounding areas. Birds are also a potential aviation hazard. A formal program using birds of prey started in July 2001. The program includes the use of trained raptors (hawks) near the active face as a primary control method. The raptors discourage gulls and other birds from approaching the waste. Secondary control methods are used when trained raptors are not an option, such as when traffic is heavy or during very windy or rainy conditions. These methods include noise deterrents (stock or bull whips, pyrotechnics, whistles), visual deterrents (aerial projectiles, laser pointers, kites), and positioning the bird control vehicle close to the active area.

Pacific Northwest Raptors has been providing bird control services since January 2016 and is based on Vancouver Island.

In early 2018, the City began supporting the Hancock Wildlife Foundation (HWF) in collaboration with Simon Fraser University for the Bald Eagle Tracking Alliance Project. The Project aims to better understand the movements of bald eagles using tracking devices. In February 2022, the City sent a letter to HWF outlining terms and conditions for their periodic visits to the Landfill for the purpose of plotting, baiting and catching bald eagles for banding and GPS tracking between February 25, 2022 and July 31, 2023.

8.3. Household hazardous waste

Household hazardous wastes (HHW), such as paints, used oil, flammable liquids and pesticides, are banned from disposal at the Landfill. However, residents periodically abandon or discard HHW in loads of refuse.

In 2022, 2.55 tonnes of hazardous wastes were collected at the HHW facility. The cost of contracted services for the removal and disposal of HHW not covered by stewardship programs was approximately \$17,800, compared to \$25,400 in 2021. Costs incurred in 2022 were approximately 30 per cent lower than 2021 due to Product Care covering more costs in 2022 despite higher public participation. Note that City staff time to segregate and pack the materials is not included in the costs above.

8.4. Site inspections

Formal site inspection activities beyond those conducted as part of environmental monitoring programs, are summarized in Table 12.

Table 5: 2022 Site Inspection Activities

Type of Inspection	Description	Findings & Action Taken (if applicable)
Site Tour	Conducted weekly by the Landfill Engineer, GPS Technician and Superintendent to assess progress of filling, cover integrity, erosion, and settlement in active areas.	Any signs of erosion on side slopes are addressed promptly by Operations Staff at the direction of the Superintendent.
Workplace Inspections	Conducted monthly by representatives from the OH&S Committee and exempt Staff to verify compliance with the Landfill's Safety Management Program and <i>OH&S Regulation</i> .	Any deficiencies identified are logged and addressed as soon as practical with discussion following in the monthly OH&S Committee Meetings.
Vegetation Inspection	Monthly inspections for invasive plants completed by the landscaping services contractor in established naturescaping areas.	Several different invasive plants are present in large numbers throughout the landfill closed areas. In the naturescaping areas, multiple invasive plants were removed by hand as part of regular monthly maintenance tasks, including: Himalayan Blackberries, Creeping Buttercup, Teasel, Common Mullein, Reed Canary Grass and Common Butterfly Bush.
Leachate Collection System Inspection	Conducted in advance of and during significant precipitation events by the Environmental Technician and/or Operations Staff to ensure ditches and culverts are not obstructed by debris, leachate flow is unobstructed, and freeboard exists between water levels in the leachate and drainage ditches and crest of the intermediate berm.	Any accumulation of debris is managed promptly by Operations Staff.
Property Boundary Inspection	Conducted quarterly by Environmental Technician to monitor for litter so crews can be deployed for collection.	Contractor engaged to remove litter bordering the active areas. Typically performed in the first, second and fourth quarter due to higher risk of fire in Burns Bog typically in Q3.

8.5. Operating problems and corrective actions

The operating problems and corrective actions taken in 2022 are detailed in Table 13.

Table 6: 2022 Operating Problems and Corrective Actions

Problem	Perimeter Ditch Berm Repairs
Description	In September 2022, three sections of the north berm settled under the weight of mowing equipment during annual vegetation clearing activities. The settlement appeared to be the result of burrowing animals creating voids within the berm which gave way under the mower. Subsequent observations revealed evidence of beaver activity along the outer ditch at the northwest corner of the site.
Corrective Action	The City notified the MOE and began implementing a contingency plan. SHA was retained to design and oversee construction of the recommended berm repairs. The water level in the adjacent ditches was low at that time of year which minimized the risk of cross-flow during repairs. The mitigation works consisted of excavating to expose the subsurface void, backfilling the void with hydrated bentonite, covering the sides and crest of the bentonite core with excavated peat soils and armouring the outer berm slopes to enhance integrity of the restored berm. The repairs were completed in October prior to the onset of the rainy winter season. Two beavers were subsequently relocated with the help of an environmental consultant.
Problem	Landfill Entrance Gate Upgrade
Description	The Landfill entrance gates were becoming increasingly difficult to open and close due to the deteriorating condition of the infrastructure. The exit portion was controlled with an automatic opener that was becoming increasingly unreliable. The entrance portion was manually operated but required two staff and such force that there was concern over physical injury.
Corrective Action	Work was initiated in the spring of 2022 to upgrade the Landfill entrance gates. The project involved clearing vegetation, installing higher quality rollers on both gate panels, extending the underground power supply beneath the entrance roadway, installing a second automatic opener for the entrance panel, replacing the motor of the existing automatic opener on the exit panel and dealing with other miscellaneous components that were in need of replacement. The work was completed in October of 2022 which was later than expected due to supply chain issues associated with certain components.

8.6. Operational and maintenance expenditures

The total spent in 2022 for operations and maintenance at the Landfill was approximately \$28 million, as detailed in Table 14. Total expenditures in 2022 were approximately 12 per cent higher than in 2021. The increase can be partially attributed to higher costs associated with vehicle and equipment maintenance, rental and replacement.

Table 7: Operational and Maintenance Expenditures for 2020 & 2021

Item¹	2022	2021
Salaries, Administration, Wages & Fringe Benefits	\$6,133,694	\$5,939,150
Vehicle & Equipment Rental	\$5,856,743	\$4,328,939
Insurance, Taxes, Loan Payments, Utilities, Building Maintenance, Permits & Landscaping	\$7,400,197	\$5,417,593
Recycling	\$380,814	\$437,401
Roads and Cover	\$1,765,750	\$1,754,044
Water Quality, Gas Management, Ditch Maintenance, Bird Control, Household Hazardous Waste Disposal, etc.	\$1,817,091	\$1,714,896
Consulting Projects (Leachate Upgrades, Gas, etc.)	\$116,025	\$179,810
Sewer and Soil Deposit Fees	\$3,856,844	\$4,437,908
Weighscales	\$788,042	\$797,985
Total	\$28,115,199	\$25,007,727

Note:

¹ Items do not include capital loan repayments and other cost allocations.

8.7. Public complaint and resolution log

In 2022, the Landfill logged 12 complaints, up from eight received in 2021. The Public Complaint and Resolution Log for 2022 is available in Appendix 6.

More than one complaint was received on the following items:

- Customer Feedback
 - Customers complained about the length of lines and wait times at the Landfill. At certain times of day, traffic can become very busy, and traffic control is deployed as needed.
 - Customers raised concerns about inconsistency between information presented on City of Vancouver website and what they are told on arrival at the Landfill. When this type of complaint is received, Staff review related information and make necessary changes to the website or clarify information with the customer.
- Customer Experience

- Customers raised concerns regarding communications by Staff, such that messaging could have been communicated in a friendlier and more understanding manner. When a customer experience complaint is received, a Superintendent contacts the customer to gather information and works with the Staff member to resolve the issue for the future.

8.8. Landfill tours

Landfill Staff typically provide tours of the Landfill for a variety of visitors, including school groups (kindergarten to university levels), special interest groups, industry associations & professionals, delegates from other countries and members of the public. Tours provide the opportunity to showcase how waste is responsibly managed to minimize environmental impacts, and how much work we still have to do as a society to reduce the amount of waste sent for disposal.

Due to the pandemic, Landfill tours were suspended on March 11, 2020 and in 2022, there were no formal Landfill tours. Planning is currently underway to restart tours in fall 2023 and host a 2024 Open House.

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Appendix 1: Progressive closure status

Area	Construction Timeframe	As of Dec 31, 2022			Completed by
		Area Closed	Additional Infrastructure Installed	Spend in year incurred	
Phase 1	2009-2010	14 ha	22 vertical gas wells and 1 horizontal gas collector; 9 stormwater discharge bridges	\$ 12M	CH2M Hill, SHA, Tyam Construction
	2012-2013	3.5 ha	Toe closure and ditch to divert stormwater to 2 southern discharge bridges only	Included with Phase 2 below	RF Binnie Civil Engineering Consultants (Binnie), SHA, SCS Engineers (SCS), King Hoe Excavating (King Hoe)
Phase 2	2012-2013	19 ha	89 vertical gas wells and 12 horizontal gas collectors; 1 stormwater retention pond with 11,500 m ³ design capacity	\$ 17.4M	Binnie, SHA, SCS, King Hoe
Phase 3W	2013	9.5 ha	13 vertical gas wells; 1 stormwater retention pond with 88,500 m ³ design capacity (to serve all of Phase 3)	\$ 15.3M	Binnie, SHA, SCS, BD Hall Constructors (Hall)
Phase 3SE	2017-2018	9.7 ha	11 vertical gas wells	\$ 10M	Binnie, Golder, Hall
Phase 3NE	2018-2019	15.2 ha	33 vertical gas wells and 7 horizontal gas collectors	\$ 19.9M	Binnie, SHA, SCS, M2K
W40Ha	2017-2020	36.4 ha	27 vertical gas wells, 32 DRAINTUBE gas collectors; 6 stormwater retention ponds with 87,700 m ³ design capacity	\$ 23.5M	Binnie, SHA, SCS, King Hoe
Phase 4S	2020	10.8 ha	19 vertical gas wells, 28 horizontal gas collectors; 1 stormwater retention pond with 100,000 m ³ design capacity	\$ 11.5M	SHA, SCS, King Hoe
Phase 4N	2021-2022	8.7 ha	27 vertical gas wells; 6 horizontal gas collectors; 7 temporary vertical gas wells	\$10.2M	SHA, SCS, King Hoe
Total (ha)		126.8			

ha = hectare (equal to 10,000 m² or 2.47 acres)

Appendix 2: Annual waste quantities

Table A1: 2022 Material Summary by Source

Source	Waste Discharge				Cover	Road Construction & Other Beneficial Use					Closure		VLF Composting	
	VSTS MSW	VLF MSW	Total MSW	Demo	Cover Soil	Sand	Demo hog	Wood Waste	Crushed Concrete & Asphalt Grindings	Purchased Aggregate	Aggregate	Sand & Soil	VSTS Yard Trimmings	VLF Yard Trimmings
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
By Municipality	136,151	175,934	312,085										11,231	5,666
Vancouver Residential Collection	34,945		34,945											
Vancouver Public Works	5,960	4,942	10,902		232,965			9	3,649	17,329	3,501		640	3,276
Vancouver Commercial & Residential Drop-Off	54,749	47,282	102,031	9,966	28,487		18,397	823	14,277	74		28,920	10,051	505
Delta Residential Contractor		15,135	15,135											
Delta Public Works		3,813	3,813		78,323			12	15,615					133
Delta Commercial	1,213	15,157	16,370	2,822	15,864	399		99	609	1,607	120	6	7	96
Delta Residential Drop-Off	22	4,607	4,629					1,582					5	1,159
Richmond	35,378	36,795	72,173	16,675			59,712	419	345	28,637	14,359	137	328	156
UEL	2,686	0	2,686										12	0
Surrey	48	38,443	38,491	10,168	27,849		13,186	379	3,276			33,172	27	242
White Rock	6	449	455	575				86	140				2	62
Other Municipalities*	1,144	8,265	9,409	12,763	54,004			105	855		225	85,441	160	36
Out of Region		1,045	1,045							5,350	26,457			
Regional Waste Transfer		326,019	326,019											
Coquitlam Resource Recovery Transfer		105,549	105,549											
North Shore Transfer Station Transfer		99,121	99,121											
Surrey Transfer Station Transfer		106,266	106,266											
Maple Ridge Transfer Station		8,788	8,788											
Langley Transfer Station		6,295	6,295											
Other Authorized Waste		43,413	43,413											
Bottom Ash		37,281	37,281											
Water Treatment Plant Residuals		3,258	3,258											
Sewage Treatment Plant Residuals		2,811	2,811											
Digester Solids		48	48											
Non-Recyclable Marine Debris		15	15											
Totals	136,151	545,366	681,516	52,969	437,493	399	91,295	3,515	38,767	52,997	44,662	147,676	11,231	5,666
Total Materials to Vancouver Landfill												1,551,288		16,896

* Burnaby, City of Langley, City of North Vancouver, Coquitlam, District of North Vancouver, District of West Vancouver, Langley Township, Maple Ridge, New Westminister, Pitt Meadows, Port Coquitlam, Port Moody.

Note: Totals may vary due to rounding errors.

Appendix 2: Annual waste quantities

Table A2: 2021 Material Summary by Source

Source	Waste Discharge				Cover	Road Construction & Other Beneficial Use					Closure		VLF Composting	
	VSTS MSW	VLF MSW	Total MSW	Demo	Cover Soil	Sand	Demo hog	Wood Waste	Crushed Concrete & Asphalt Grindings	Purchased Aggregate	Aggregate	Sand & Soil	VSTS Yard Trimmings	VLF Yard Trimmings
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
By Municipality	134,693	170,988	305,681										12,457	6,209
Vancouver Residential Collection	35,653	38	35,691											
Vancouver Public Works	5,494	12,475	17,969		253,442			10	916	12,386	4,718		1,186	3,730
Vancouver Commercial & Residential Drop-Off	59,341	35,245	94,586	9,284	14,069		23,054	756	15,848			36,427	10,799	564
Delta Residential Contractor		14,498	14,498											
Delta Public Works		5,426	5,426		50,332			7	8,089					89
Delta Commercial	376	12,909	13,285	2,960	14,993			123	999			15,096	11	55
Delta Residential Drop-Off	20	5,613	5,633					1,906					7	1,324
Richmond	30,436	36,139	66,575	1,389	17		66,460	429	1,093	10,680	16,366	68,364	282	142
UEL	2,261	84	2,345										19	2
Surrey	75	38,042	38,118	6,803	17,664	79	14,028	514	514	7,163		81,605	13	222
White Rock	4	420	424	233				109	189				2	56
Other Municipalities*	1,032	4,360	5,392	8,966	7,266			127	51,144		34,283	247,842	139	24
Out of Region		5,739	5,739										0.1	
Regional Waste Transfer		364,317	364,317											2,903
Coquitlam Resource Recovery Transfer		137,014	137,014											
North Shore Transfer Station Transfer		82,521	82,521											
Surrey Transfer Station Transfer		128,799	128,799											
Maple Ridge Transfer Station		9,076	9,076											1,507
Langley Transfer Station		6,907	6,907											1,396
Other Authorized Waste		56,839	56,839											
Bottom Ash		35,326	35,326											
Water Treatment Plant Residuals		1,812	1,812											
Sewage Treatment Plant Residuals		3,450	3,450											
Digester Solids														
Iona Grit Dump Residuals		15,889	15,889											
Non-Recyclable Marine Debris		6	6											
Agricultural Waste		356	356											
Totals	134,693	592,144	726,838	29,635	357,783	79	103,542	3,980	78,793	30,229	55,367	449,335	12,457	9,112
Total Materials to Vancouver Landfill												1,835,579		21,568

* Burnaby, City of Langley, City of North Vancouver, Coquitlam, District of North Vancouver, District of West Vancouver, Langley Township, Maple Ridge, New Westminster, Pitt Meadows, Port Coquitlam, Port Moody.

Note: Totals may vary due to rounding errors.

Appendix 2: Annual waste quantities

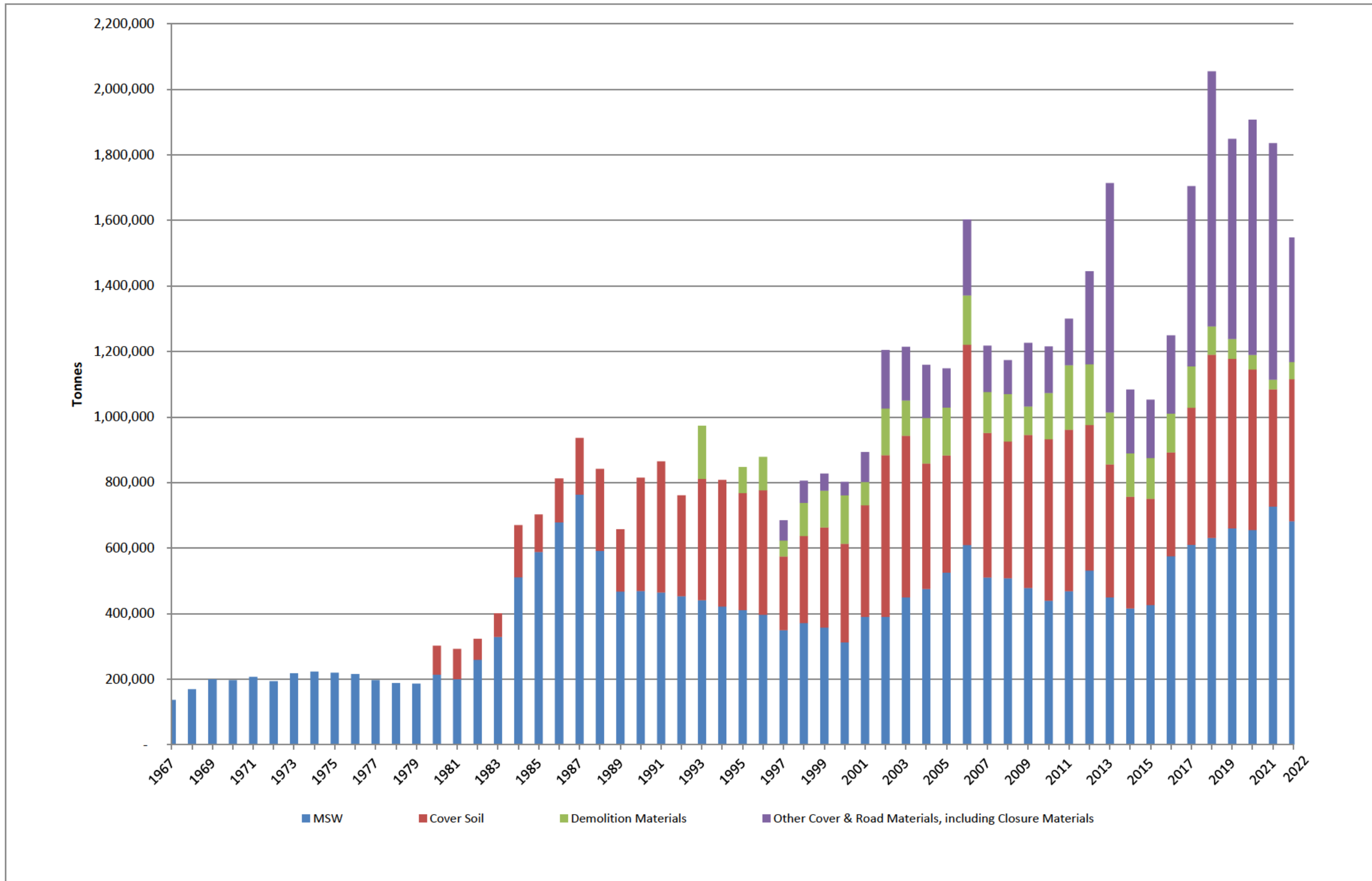
Table A3: 2022 Material Summary by Month

2022 Month	Waste Discharge					Cover, Road & Closure Materials			VLF Composting		
	VSTS tonnes	VLF tonnes	Total tonnes	Bottom Ash tonnes	Demolition Material tonnes	Cover Material tonnes	Road & Other Beneficial Use Materials tonnes	Closure Materials tonnes	VSTS Yard Trimming tonnes	VLF Yard Trimming tonnes	Yard Trimming Total tonnes
January	11,678	51,941	63,619	3,372	1,872	33,556	21,346	39,307	576	283	859
February	10,412	51,904	62,316	3,054	1,984	35,450	14,442	61,812	598	320	917
March	12,754	49,673	62,427	3,523	2,884	62,802	21,269	21,233	962	433	1,395
April	11,823	45,944	57,767	2,816	3,960	28,079	18,523	3,641	812	312	1,124
May	12,047	40,166	52,213	3,481	5,038	32,064	16,948	3,556	836	327	1,163
June	12,428	40,477	52,905	3,022	6,790	35,224	11,118	9,050	1,009	373	1,382
July	11,126	50,976	62,101	3,234	5,321	34,653	13,375	16,196	887	361	1,248
August	11,995	45,513	57,508	3,474	5,645	35,673	10,104	13,839	805	352	1,157
September	10,488	38,924	49,411	2,603	5,875	45,655	11,889	9,046	788	430	1,218
October	10,916	31,121	42,037	3,008	5,697	35,477	19,884	7,449	1,028	415	1,443
November	10,548	33,841	44,389	2,922	5,518	41,137	16,578	3,011	2,084	1,069	3,152
December	9,937	27,605	37,542	2,773	2,384	17,723	11,496	4,197	846	992	1,838
Totals	136,151	508,084	644,235	37,281	52,969	437,493	186,972	192,338	11,231	5,666	16,896
Total Materials to Vancouver Landfill									1,551,288		

Note: Totals may vary due to rounding errors.

Appendix 2: Annual waste quantities

Figure A1: Historical Regional Waste Quantities



Appendix 3: 2022 Recyclable and banned materials

Recyclable Materials – Accepted for FREE (Residential Only)

- ✓ Aerosol paint and empty containers
- ✓ Antifreeze and empty antifreeze containers
- ✓ Books
- ✓ Cardboard (flatten)
- ✓ Cell phones
- ✓ Clothing
- ✓ Cooking oil
- ✓ Electronics, small appliances and power tools (max 5 large items)
- ✓ Flammable liquids
- ✓ Fluorescent light bulbs and tubes
- ✓ Foam packaging (no foam peanuts)
- ✓ Glass bottles and jars
- ✓ Household batteries
- ✓ Large appliances (including refrigerators, freezers, air conditioners)
- ✓ Lawnmowers
- ✓ Lead acid car and truck batteries
- ✓ Metal containers (cans, tins, foil, empty aerosol cans excluding spray paint cans)
- ✓ Other flexible plastic packaging
- ✓ Paint and empty paint cans
- ✓ Paper containers (tetra-packs, coffee cups)
- ✓ Pesticides
- ✓ Plastic bags and overwrap
- ✓ Plastic containers (jars, jugs, bottles)
- ✓ Printed paper and paper packaging (newspaper, magazines, catalogues, writing paper, paper bags)
- ✓ Propane tanks (maximum 4 disposable and 2 refillable)
- ✓ Scrap metal
- ✓ Smoke and carbon monoxide alarms
- ✓ Thermostats
- ✓ Tires (passenger or light truck with or without rims; maximum of 10)
- ✓ Used oil (maximum 15 litres), oil filters (maximum 3) and empty oil containers

Recyclable Materials – Accepted for a FEE

- ✓ Gypsum drywall, new scraps only (maximum level pick-up truckload)
- ✓ Food scraps (maximum 130 kg)
- ✓ Mattresses and box springs (maximum 8 pieces)
- ✓ Wood waste (includes painted, stained and treated wood, residential quantities)
- ✓ Yard & garden trimmings

Banned Materials

The lists of Banned Materials that follow are taken from City of Vancouver *Solid Waste By-Law No. 8417*, in effect as of January 1, 2022.

Banned Hazardous and Operational Impact Materials (Schedule E)

The following wastes are prohibited from disposal at the Vancouver Landfill and Vancouver South Transfer Station:

1. Automobile bodies.
2. Refuse that is on fire, smoldering, flammable or explosive.

3. Hazardous Waste as defined in the *Hazardous Waste Regulation* (B.C. Reg. 63/88), with the exception of asbestos waste delivered to the Vancouver Landfill in accordance with the Asbestos Policy.
4. Propane tanks, with the exception of Propane Tanks delivered as recyclable materials;
5. Liquids or sludge.
6. Coated or uncoated wire and cable that exceeds either 1% of the total weight of the load or 1% of the total volume of the load.
7. Dead animals from personal or business activities.
8. Inert fill material including soil, sod, gravel, concrete and asphalt exceeding 0.5 cubic metres per load, with the exception of those materials meeting the City Engineer's specifications for landfill cover, road building, and closure.
9. Excrement, other than amounts of pet excrement that are double bagged and discarded with Municipal Solid Waste and that do not exceed either 5% of the total weight of the load or 5% of the total volume of the load.
10. Barrels, drums, pails or other large (205 litre or greater) liquid containers.
11. New or used gypsum (drywall), with the exception of residential used gypsum (drywall) delivered to the Vancouver Landfill in accordance with the Drywall Policy.
12. Mattresses, with the exception of Mattresses that are delivered in dedicated loads to the Vancouver Landfill for management as special handle waste requiring burial
13. Railroad ties or creosote treated wood.
14. Toxic Plants, with the exception of Toxic Plants that are double bagged and delivered in dedicated loads to the Vancouver Landfill for management as special handle waste requiring burial.
15. Personal hygiene products where the personal hygiene products make up more than 10% of the total weight of the load unless the personal hygiene products are double bagged in sealed plastic bags that are sufficiently durable to resist leaking or breaking during collection and disposal.
16. Any material that would cause undue risk of injury or occupational disease to any person at the Vancouver Landfill and Transfer Station or that would otherwise contravene the *Occupational Health and Safety Regulation* (B.C. Reg. 296/97) enacted pursuant to the *Workers Compensation Act*, as amended or replaced from time to time.
17. Any other material deemed by the City Engineer as unacceptable for disposal at the Vancouver Landfill or Vancouver South Transfer Station.

Banned Recyclable Materials (Schedule F)

1. Beverage containers identified in "Schedule 1 — Beverage Container Product Category" to the *Recycling Regulation* (B.C. Reg. 449/2004) of the *Environmental Management Act*.
2. Containers other than beverage containers made of:
 - i. Metal,
 - ii. Glass,
 - iii. Plastic identified by the SPI Code #1 (Polyethylene Terephthalate or PET) or SPI Code #2 (High Density Polyethylene or HDPE) or SPI Code #4 (Low Density Polyethylene or LDPE) or SPI Code #5 (Polypropylene or PP), or
 - iv. Composite materials to create rigid packaging consisting of paper and polyethylene (gable top cartons, frozen food boxes, ice cream cartons, and microwaveable dinner cartons) or paper, polyethylene and aluminum (aseptic cartons).
3. Recyclable Paper.
4. Corrugated Cardboard.

5. Yard Waste.
6. Food Waste.
7. Clean Wood Waste.
8. Expanded Polystyrene Packaging.

Banned Product Stewardship Materials (Schedule G)

The following materials included in the effective Product Stewardship Program product categories of the *Recycling Regulation* of the *Environmental Management Act*, are banned from garbage containers, and from disposal as garbage at the Vancouver South Transfer Station, and Vancouver Landfill:

1. The following materials pursuant to Schedule 2 – Residual Product Category to the *Recycling Regulation*:
 - Solvents and flammable liquids;
 - Pesticides;
 - Gasoline;
 - Pharmaceutical products and medications;
 - Oil, oil filters and oil containers;
 - Paint and paint containers;
 - Lead-acid batteries; and
 - Antifreeze and antifreeze containers;
2. Electronics and electrical products, including metal household and commercial appliance, as identified in Schedule 3 – Electronics and Electrical Products Category to the *Recycling Regulation*;
3. Tires pursuant to Schedule 4 – Tire Product Category to the *Recycling Regulation*.

Appendix 4: 2022 Water quality monitoring location plan



Appendix 5: 2022 Water quality monitoring program parameters

Surface Water

alkalinity as CaCO ₃	dissolved organic carbon	sodium, total & dissolved
aluminium, total	hardness as CaCO ₃	specific conductivity
ammonia	iron, total & dissolved	sulphate
arsenic, total	lead, total	zinc, total
cadmium, total	magnesium, total & dissolved	temperature*
calcium, total & dissolved	manganese, total & dissolved	turbidity
chloride	nickel, total	TSS
chromium, total	pH*	TOC
cobalt, total	true colour	VOCs
copper, total	phenols	
dissolved oxygen*	potassium, total & dissolved	

Groundwater

alkalinity as CaCO ₃	cobalt, dissolved	pH*
aluminium, dissolved	copper, dissolved	phenols
ammonia	hardness as CaCO ₃	potassium, dissolved
arsenic, dissolved	iron, dissolved	sodium, dissolved
cadmium, dissolved	lead, dissolved	specific conductivity
calcium, dissolved	magnesium, dissolved	sulphate
chloride	manganese, dissolved	temperature*
chromium, dissolved	nickel, dissolved	zinc, dissolved
		VOCs

Leachate Grab Samples

alkalinity as CaCO ₃	cyanide	potassium, total & dissolved
aluminium, total	dissolved oxygen*	sodium, total & dissolved
ammonia	hardness as CaCO ₃	specific conductivity
cadmium, total	iron, total & dissolved	sulphate
calcium, total & dissolved	lead, total	sulphide, total & dissolved
chloride	magnesium, total & dissolved	temperature*
chromium, total	manganese, total & dissolved	toxicity
cobalt, total	pH*	volatile organic compounds
copper, total	phenols, total**	zinc, total

Leachate Composite Samples

aluminium, total	copper, total	nickel, total
cadmium, total	iron, total	pH
chemical oxygen demand	lead, total	total suspended solids
chromium, total	manganese, total	zinc, total
cobalt, total	molybdenum, total	

Note:

* Field Data

** Total of 2,3,4,5 and 2,3,4,6 tetrachlorophenols and pentachlorophenols

Appendix 6: 2022 Public complaint and resolution log

No.	Issue	Resolution
1	A customer noted that there was mixed messaging on the website regarding glass and foam collection. The feedback stated that the website says collection is both suspended and resumed on different pages.	The customer did not request a response. The website was updated to reflect the correct information.
2	A customer expressed the line up at the landfill can be very long, stating that there are no washroom for the drivers of the cars/trucks to use while they are in line. The customer suggested a port-a-potty station near where the cars line up so patrons can have access to a washroom when needed.	The customer did not request a response. There are sufficient washrooms available for use by the public in Landfill buildings.
3	A customer went to the Landfill at 10:30am to drop off a small load of clean wood. The citizen dropped off the wood and was about 10 to 12 feet away from a guard-rail when it fell. Customer stated an employee accused them of backing into the gate. Customer works in metal industry and knows that the metal pin that would lock the gate was not locked and that caused the gate to fall without anything or anyone touching it. Customer was concerned that someone may have forgot to lock the pin and that the gate could have fallen onto a vehicle resulting in damage or injury.	Customer was called back after an incident investigation. Landfill staff reviewed relevant safety information.
4	A Citizen shared opinion that the Zero Waste Centre should start allowing recycling of baby car seats.	The customer did not request a response. The City does not currently facilitate recycling of car seats at this time. Additional recycling opportunities are being explored.
5	An email complaint forwarded from Metro Vancouver. A Customer noted confusing, bad customer service and complained that disposal fees were too high.	The customer did not request a response. The City's disposal fees align with the regional Transfer Station minimum charges.

No.	Issue	Resolution
6	<p>A citizen complained about difficulty to dispose of 2 litres of used motor oil. Citizen stated that they are a Vancouver resident and find it odd that one would have to drive to the Landfill for disposal and expressed that this may have the citizen take an alternative route by disposing this item in a non-environmentally-safe manner. The customer stated that there needs to be other options that just the one location in Delta.</p>	<p>The citizen did not request a response. Used motor oil can be dropped-off for free at multiple additional locations not operated by the City. Visit the BC Used Oil website for a map of locations.</p>
7	<p>A customer called to complain about interaction with scale house employee. Customer stated that the employee had an attitude, was rude and provided no customer service. Customer had fence panels and one bag of drywall. The customer complained that the employee used a harsh tone and asked if citizen has a business license. The customer advised that they had been to the dump 3 times in a year. The customer asked for employee's name and was ignored.</p>	<p>The customer was called back by a City employee for more information and explained the situation. The incident was reviewed, and the Superintendent spoke with staff to advise on how to better serve our customers.</p>
8	<p>A citizen provided complaint about the City's asbestos policy, specifically regarding the requirement to fit all drywall into 6 mil polybags. The citizen stated that the process of breaking down the drywall and snapping them into smaller pieces to fit into the bag creates a hazardous situation where workers are enveloped by plumes of asbestos and that aerosols can get blown towards neighboring properties. The citizen would like the City to review and improve on the existing asbestos policy.</p>	<p>The citizen did not request a response. The City is required to comply with section 40 of BC's Hazardous Waste Regulation, which specifies that waste asbestos (found in old drywall) must be confined to a double layer of sealed, 6 mil plastic bags during handling, storage and transportation before disposal in a landfill. The City cannot alter this part of the asbestos policy.</p>

No.	Issue	Resolution
9	A citizen called to express that they want the City to have additional drop-off locations for garbage disposal and recycling other than the Zero Waste Centre, Transfer Station and Landfill. The citizen feels that there should be more City owned and operated facilities in the event that other privately owned facilities stop accepting items.	The citizen did not request a response. Relevant information regarding alternative locations for waste disposal and recycling was shared in the initial call.
10	A citizen called to provide a complaint about purchasing compost at the Landfill. The citizen stated that the website indicated that a loader is available during specified hours to aid in collecting compost. When the citizen arrived at the landfill during those hours, they were told the loader was not available. The citizen shared what 3-1-1 mentioned and the employee at the weigh scale stated that they did not know about this. The citizen expressed that they had wasted a trip to the landfill and requested that the webpage be updated.	City staff contacted the citizen and offered for them to come back to the landfill for a free compost load to cover the expenses and inconvenience of the initial visit. Clarifications were made to landfill staff.
11	A citizen expressed confusion by conflicting messaging on the City website. Citizen stated that the webpage states asbestos waste can be brought in at any time during the day, but construction and demolition waste can only be disposed of Mon-Friday from 730am-3pm.	The citizen did not request a response. City staff confirmed that the website contained the correct information. Construction & demolition waste loads are handled differently than asbestos waste.
12	A citizen called to inform about conflicting information on the City website. Citizen stated that webpage for the Landfill Recycling Depot indicated that Glass bottles and Jars are accepted but the Waste Wizard does not presented this location an option for disposal.	The customer did not request a response. The website was updated to reflect the correct information.

Appendix 7: 2022 Annual water quality monitoring report executive summary

AECOM Canada Ltd. (AECOM) reviewed historical data and interpreted leachate, groundwater, surface water and stormwater quality data collected by City of Vancouver (CoV) and AECOM staff between January 1, 2022 and December 31, 2022. This annual monitoring report presents the findings of the monitoring program review in accordance with the landfill Operational Certificate MR-01611 (OC). The requirements of the monitoring program and subsequent interpretation and reporting are specified within the OC and Waste Discharge Permit SC-100168-FSA (WDP). Section 3.5.2 of the OC requires that the annual report include a review and interpretation of the analytical data from receiving environment monitoring for the preceding year, and leachate flow data and leachate/drainage ditch levels. The WDP governs the discharge of leachate from the Vancouver Landfill. Leachate discharged from the landfill is conveyed through City of Delta (CoD) and Metro Vancouver forcemains to the Annacis Island Wastewater Treatment Plant.

Monitoring data included measurements of leachate flows and leachate quality at the leachate pump station near the southwest corner of the landfill. Groundwater elevations and groundwater quality were measured in the shallow and deep aquifers using a monitoring well network that surrounds the footprint of the landfill and are located immediately outside the perimeter ditch leachate collection system. Surface water elevations and surface water quality were measured in the perimeter drainage ditch surrounding the landfill footprint, in downstream drainage ditches, and in the Delta Irrigation Enhancement Project (DIEP) irrigation canal that is connected to the Fraser River. A Remote Water Level Monitoring System was commissioned in 2021 and commenced operations in May 2022. The new system continuously monitors water levels at 13 stations in stormwater ponds and in the inner and outer ditch in support of stormwater management at the landfill.

A routine stormwater monitoring program commenced in December 2019. Stormwater monitoring is not a requirement of the OC or the WDP. The purpose of the program is to monitor the quality of the stormwater from closed areas of the landfill to support discharge of stormwater outside the leachate collection system. Two pilot stormwater discharge tests were carried out in October and November 2020, which discharged clean stormwater from select closed and lined landfill phases to the Dredge Pond. Since 2022, this approach has been implemented as a standard operating practice, and clean stormwater has continued to be discharged to the Dredge Pond.

The 2022 monitoring program met or exceeded the requirements of the OC and WDP with respect to the number of stations, media being monitored, and the parameters being analyzed, with the exception of a few surface water monitoring stations when ditches were dry which prohibited monitoring in late summer. The 2022 monitoring program included a quality assurance and quality control component that confirmed groundwater, surface water, leachate and stormwater quality data were acceptably precise and reliable. It also included a field sampling audit that confirmed the absence of issues that would materially affect the quality of data collected.

Flow Control System - Perimeter Ditch System

The perimeter ditch system consists of an inner leachate collection ditch and an outer surface water drainage ditch, which are separated by an intermediate soil berm. The outer drainage ditch diverts natural surface runoff and shallow groundwater flow from Burns Bog around the landfill footprint. The inner leachate ditch collects the following waters, which are collectively referred to as 'leachate' once they reach the inner ditch:

- Leachate – Rainwater that is contaminated after the water percolates through waste.
- Surface Runoff – Rainwater that flows along other surfaces at the landfill such as intermediate cover areas (temporarily closed) and operational areas (i.e., entrance area buildings and scales) that may be impacted by leachate.
- Stormwater – Rainwater that is collected above the impermeable geomembrane in closed areas of the landfill. It is not impacted by leachate.

Water collected in the leachate ditch flows to the landfill's pump station before being transported off-site through the municipal sanitary sewer system. Water in the sanitary line is transported to the Annacis Island Wastewater Treatment Plant.

The purpose of the perimeter ditch system is to maintain an inward hydraulic gradient around the landfill footprint to ensure leachate is collected and conveyed to the leachate pump station. To achieve this, water levels in the leachate ditch are actively maintained at a lower elevation than the drainage ditch through pump station control. Water levels in the drainage ditch are reflective of natural inputs from the surrounding lands; however, a system of weirs is in place to increase retention of natural runoff and maintain higher water elevations adjacent to Burns Bog.

Based on manual water level measurements and daily monitoring of the eight Remote Water Level Monitoring System stations installed throughout the perimeter ditch system, the overall efficiency of the system was 82.3% in 2022. This is lower than the overall containment efficiency in 2021 (90.6%) and the overall average efficiency from 1995 to 2021 (93.1%), which were estimated using manual water level measurements. The reduced efficiency can be partially attributed to periods of prolonged dry weather affecting outer ditch water levels to a greater extent than in previous years and the inclusion of three new staff gauge stations (SG6 to SG8) in the calculation methodology. Although outward gradients were observed at select monitoring locations following intense storm events, the duration of the gradient reversals were limited and estimated groundwater flow velocities through the berm are very slow. Therefore, it is highly unlikely that leachate migrated through the berm separating the leachate and drainage ditches as a result of temporary gradient reversals.

Leachate Flow

The CoV maintained suitable flow measuring devices for the purpose of recording the volume of leachate discharged to the sanitary sewer each month as required under Section 3.2.2 of the OC. The total leachate discharge volume was approximately 8.1% lower than in 2021, while total precipitation in 2022 was about 9.7% lower than in 2021. The leachate and precipitation ratio in 2022 was 86%, which is comparable to 2021 result (84%), but noticeably lower than the results observed between 2018 and 2020. The CoV estimated that the volume of stormwater diverted from leachate was 338,000 m³ in 2022. Although stormwater continues to comprise a

large proportion of the total leachate discharge, the reduced leachate to precipitation ratio indicates that on-going stormwater management works continue to be effective at decreasing the volume of leachate-impacted waters generated at the landfill that require discharge via the sanitary sewer. The monthly leachate flows in wet season (January-March and October-December) were 20.1% lower than those measured in 2021.

The highest daily leachate flow rate (37,112 m³/day) occurred on January 14, 2022. This is below the maximum (under review) daily limit of 45,000 m³/day. Leachate discharge volumes remained in compliance with OC and WDP requirements during 2022.

Groundwater Flow

Two groundwater flow systems are present beneath the site. The shallow aquifer consists primarily of organic peat that extends from ground surface to approximately six metres depth and is underlain by a thick permeable deep sand aquifer (known as the deep aquifer). The shallow and deep aquifers are separated by a low permeability silt/clay aquitard that varies in thickness from 1 to 7 metres. Water levels are monitored in both aquifers on a quarterly basis using a series of monitoring wells located around the perimeter of the landfill. The perimeter ditch system and Dredge Pond are important hydrologic features that influence groundwater levels and flow directions in both aquifers. Groundwater elevations fluctuated on the order of one metre seasonally. Groundwater levels were significantly lower than the historical range in the shallow aquifer during the dry season, likely because of reduced precipitation and recharge. Subsequently, stronger upward gradients than previous years were observed at the southwest corner of the landfill during the dry season. Groundwater flow directions were predominantly from northeast to southwest, which is consistent with previous years. Because topography is relatively flat, horizontal groundwater gradients and flow velocities in both the shallow and deep aquifers are relatively low.

Surface Water Flow

Regional surface water flows southwest from Burns Bog toward the perimeter ditch system. Surface water and shallow groundwater that enter the perimeter ditch system is carried around the landfill footprint and discharged into Crescent Slough from two connection points at the northwestern and southwestern corners of the landfill. Crescent Slough ultimately discharges to the Fraser River. The City of Delta intermittently opens a floodgate to allow river water to flow into the Delta Irrigation Enhancement Project canal for irrigation purposes on nearby agricultural lands. As a result, periodic surface water flow reversals have been observed under certain tidal, river discharge and operational scenarios. In late summer, portions of the perimeter ditch system on the north, east and southeast sides of the landfill cease to flow or become dry following prolonged periods of dry weather.

Leachate Quality Summary

Monthly leachate quality samples were collected from the approved sampling point at the leachate pump station in accordance with OC and WDP requirements. All samples were analyzed for the parameters stipulated in the OC and WDP. All leachate quality samples met applicable discharge criteria in 2022, except two (2) leachate grab samples that marginally exceeded HWR criteria for dissolved manganese. Exceedances are attributed to increased

concentrations caused by unusually extended dry summer conditions. Despite these marginal exceedances, overall leachate quality met the intent of the WDP because the annual mean manganese concentration was well below the HWR criteria.

Groundwater Quality

As per the OC, quarterly monitoring must be conducted on five shallow monitoring wells and seven deep monitoring wells. In 2022, the monitoring program included 18 shallow monitoring wells and 20 deep monitoring wells. Quarterly groundwater quality samples were collected from the monitoring stations required by the OC. The remaining monitoring wells were also sampled on a quarterly basis, with the exception of three wells that were only monitored for water levels and field parameters. All samples were analyzed for the parameters stipulated in the OC.

Groundwater quality in the shallow aquifer is strongly influenced by bog water chemistry. Upgradient groundwater flowing from Burns Bog toward the landfill is naturally acidic and contains elevated concentrations of several constituents that are readily mobilized under acidic conditions. Deep groundwater chemistry appears to have minimal influence from Burns Bog and represents a compilation of upgradient sources. Water chemistry in both shallow and deep aquifers naturally evolves along the flow path, particularly in the shallow aquifer, as groundwater travels away from the bog hydrologic system. Professional judgment was used to assess the nature and degree of any water quality impacts that may have occurred due to leachate, road salt, runoff from neighbouring lands, and brackish waters from tidal fluctuations and municipal floodgate operations.

Groundwater quality results were tabulated and compared against applicable *Contaminated Sites Regulation* (CSR) standards. The shallow aquifer is not considered to be a drinking water aquifer due to the presence of organic soils. Primary leachate indicator parameters are considered to be ammonia, conductivity, and chloride. Secondary leachate indicator parameters include alkalinity and hardness. All of these parameters were used to assess any leachate impacts in consideration of background concentrations of leachate indicator parameters and the results of statistical trend analysis.

Similar to previous years, leachate-impacted groundwater was contained within the landfill property.

Shallow Groundwater Quality

Background water quality in the shallow aquifer was similar to previous years and reflected natural water chemistry in Burns Bog. Shallow groundwater quality at all monitoring stations does not appear to be impacted by leachate, with one exception (54-2013).

Shallow groundwater quality at monitoring station 54-2013 (south of the landfill and northeast of the Dredge Pond) continued to exhibit dilute leachate impacts. Based on the results of the 2018 Hydrogeology Review, groundwater quality at this location, immediately south and up to 40 metres outside of the perimeter ditch system, is impacted by dilute leachate. The impacts are relatively minor and are contained within the landfill property boundary due to net inward hydraulic gradients from the bog towards the perimeter ditch system. Water quality at 54-2013 met all applicable CSR standards, but ammonia has exhibited an increasing trend over the past five years. Monitoring of newly installed drive-point piezometers in the vicinity of well 54-2013 will be conducted and data will be evaluated as part of the 2023 Hydrogeological Review.

The consistently elevated ammonia and conductivity in shallow groundwater wells along the southwestern corner of the property (wells 25-2019, 26-2013 and 50) are attributed to the upwelling and mixing of deep groundwater and not associated with leachate impacts due to low chloride concentrations. Exceptionally elevated concentrations observed in some wells in 2022 may be due to greater deep groundwater upwelling caused by lower shallow groundwater elevations during the dry season.

Shallow groundwater quality data met all applicable CSR Freshwater Aquatic Life (AW) and Irrigation Water Use (IW) standards in 2022.

Deep Groundwater Quality

In 2022, deep groundwater quality at all monitoring stations does not appear to be impacted by leachate. Background water quality in the deep aquifer was similar to previous years and reflected natural water chemistry. Concentrations of leachate indicator parameters and other dissolved minerals are higher than those observed in the overlying shallow aquifer. Concentrations of select leachate indicator parameters at downgradient monitoring wells are slightly higher than upgradient of the landfill, which may be the result of off-site sources (i.e., road salt and tidal influences).

Deep groundwater quality data met the applicable CSR Irrigation Water Use (IW) standards, with the exception of chloride at well 23 and well 124 (located at the southwest corner of the landfill) and chromium at well 57. Chloride concentrations at wells 23 and 123 are inferred to be the result of DIEP Canal construction in 2013. Chromium is not considered an accurate indicator of landfill leachate impacts at the site due to the low concentrations of chromium in leachate.

Deep groundwater quality data met CSR AW standards, except for chromium at well 57. As mentioned above, localized chromium impacts are not associated with leachate.

Deep groundwater quality data met applicable CSR Drinking Water Use (DW) standards, with the exception of dissolved vanadium at background well 121 and downgradient wells 57 and 55-2013. Vanadium impacts are not considered an indicator of landfill leachate due to relatively low concentrations of vanadium in leachate and high natural background concentrations.

Surface Water Quality

As per the OC, quarterly monitoring and sampling must be conducted at eight surface water monitoring stations. In 2022, 13 surface water monitoring stations were monitored and sampled to confirm compliance with the OC.

In 2022, the surface water monitoring program exceeded the requirements stipulated in the OC based on the number of stations and parameters monitored. The only exceptions were associated with locations that could not be sampled in the summer when the ditch was dry or stagnant, which is consistent with previous years.

Surface water quality at monitoring stations located north, northeast, northwest, and south of the landfill does not appear to be impacted by leachate. Water chemistry at these locations is strongly influenced by naturally acidic surface water runoff and groundwater seepage from Burns Bog. Similar to previous years, pH, turbidity, total suspended solids and select metals concentrations exceeded BCWQG AW and IW criteria. Exceedances at these stations are

consistent with background water quality and are attributed to the naturally acidic water quality associated with Burns Bog.

Surface water quality at monitoring stations located southwest of the landfill do not appear to be impacted by leachate. Temporary and localized impacts at stations 13 and 15 in November 2021 have been attenuated, and water quality at these locations was consistent with historical results throughout 2022. Similar to previous years, pH, turbidity, total suspended solids and select metals concentrations exceeded BCWQG AW and IW criteria. Water quality impacts at these locations are attributed to seasonal runoff from nearby agricultural fields and roadways and influences from the Fraser River.

Stormwater Quality

The purpose of the stormwater monitoring program is to characterize the quality of stormwater discharging from closed landfill phases to confirm if the water is suitable for discharge outside the leachate collection system.

Based on 2022 results, stormwater quality from the closed Phases 1, 2, 3, and Western 40 Pond 6 was similar to or better than water quality in nearby on-site and off-site receiving environments (e.g., Dredge Pond, Crescent Slough, and Centre Ditch). As such, stormwater from these locations were considered acceptable for discharge outside the leachate collection system. Stormwater from Phases 1, 2 and 3 were discharged to the Dredge Pond in 2022 and water quality in the Dredge Pond was not affected. Stormwater from Western 40 Pond 6 discharged into the leachate ditch because conveyance infrastructure capable of discharging stormwater beyond the leachate ditch was not yet available.

Stormwater quality from stations 107 (Western 40 Pond 4) and 144 (Phase 4) exhibit water quality that is not suitable for discharge outside the leachate collection system at this time. Water quality impacts are likely associated with recent closure activities and water quality is expected to continue improving with time. Stormwater from Phase 4 may be suitable for discharge outside of leachate collection system should favourable water quality results continue for one year.

Based on the findings of the 2022 Water Quality Monitoring Program Review, the following recommendations were made, and are presented with ongoing recommendations from previous years.

2022 - Water Quality Monitoring Program		Status
2022-1	Routine surface water sampling should be conducted at least 30 days after the previous sampling event to accurately evaluate quarterly variations. Stormwater sampling should be conducted at least three weeks after the previous sampling to assess monthly variations.	New
2022-2	Leachate, groundwater, surface water and stormwater monitoring (i.e., water level monitoring and sampling) should be conducted as per the recommended 2022 Water Monitoring Program as outlined in Appendix G of this report.	New
2022 – Monitoring Network		Status
2022-3	Further evaluation of the elevated chloride and conductivity along the southwest property boundary should be conducted during the next hydrogeology review (2023) to verify the hydraulic gradients and impacts associated with municipal ditch network and the Delta Irrigation Enhancement Project canal.	New
2021 - Water Quality Monitoring Program		Status
2021-2	Further evaluation of the elevated chloride and conductivity along the southwest property boundary should be conducted during the 2023 hydrogeology review to verify the hydraulic gradients and impacts associated with municipal ditch network and the Delta Irrigation Enhancement Project canal. The 2023 hydrogeology review work is currently ongoing.	On-going
2020 - Water Quality Monitoring Program		Status
2020-2	Water quality modelling should be conducted during the 2023 hydrogeology review to assess the effects on leachate quality as a result of diverting stormwater outside the leachate ditch and predict what parameters might have future Waste Discharge Permit compliance issues, if any. The 2023 hydrogeology review work is currently ongoing.	On-going
2019 – Monitoring Network		Status
2019-2	Inactive monitoring Wells 19 and 20 should be decommissioned once access to the property south of the landfill is granted. To date, the landowner has not responded to requests from the City.	On-going

Appendix 8: 2022 Weekly leachate and drainage ditch water elevations

Date	L1/D1		Flow Direction	L2/D2		Flow Direction	L3/D3		Flow Direction	L4/D4		Flow Direction	L5/D5		Flow Direction	L6/D6		Flow Direction	L7/D7		Flow Direction	L8/D8		Flow Direction
	L1 m	D1 m		L2 m	D2 m		L3 m	D3 m		L4 m	D4 m		L5 m	D5 m		L6 m	D6 m		L7 m	D7 m		L8 m	D8 m	
Summary Statistics - Manual Staff Gauge Measurements (Jan 1 - May 9, 2022)																								
Number of Manual Measurements			122			17			17			17			17			-			-			-
Number of Days with Outward or No Flow			1			2			0			0			2			-			-			-
Outward Flow Percentage			0.8%			11.8%			0.0%			0.0%			11.8%			-			-			-
Daily Data - Remote Water Level Monitoring System (May 10 - Dec 31, 2022)																								
2022-05-10	-0.397	-0.257	inward	-	-	-	0.109	0.941	inward	0.389	0.694	inward	0.085	0.629	inward	1.147	1.720	inward	1.382	1.676	inward	0.656	1.162	inward
2022-05-11	-0.396	-0.256	inward	-	-	-	0.108	0.908	inward	0.393	0.672	inward	0.034	0.599	inward	1.149	1.690	inward	1.382	1.699	inward	0.636	1.152	inward
2022-05-12	-0.392	-0.257	inward	-	-	-	0.108	0.905	inward	0.403	0.652	inward	-0.007	0.560	inward	1.161	1.696	inward	1.324	1.665	inward	0.653	1.134	inward
2022-05-13	-0.393	-0.260	inward	-	-	-	0.115	0.893	inward	0.402	0.661	inward	-0.005	0.571	inward	1.224	1.709	inward	1.375	1.545	inward	0.657	1.146	inward
2022-05-14	-0.410	-0.261	inward	-	-	-	0.121	0.877	inward	0.398	0.647	inward	0.010	0.601	inward	1.209	1.705	inward	1.374	1.689	inward	0.637	1.147	inward
2022-05-15	-0.399	-0.255	inward	-	-	-	0.142	0.892	inward	0.410	0.655	inward	0.053	0.616	inward	1.203	1.676	inward	1.363	1.686	inward	0.631	1.113	inward
2022-05-16	-0.380	-0.254	inward	-	-	-	0.130	0.926	inward	0.411	0.691	inward	-0.009	0.646	inward	1.258	1.694	inward	1.329	1.710	inward	0.645	1.134	inward
2022-05-17	-0.396	-0.259	inward	-	-	-	0.113	0.895	inward	0.392	0.703	inward	0.017	0.657	inward	1.209	1.727	inward	1.370	1.719	inward	0.647	1.148	inward
2022-05-18	-0.388	-0.258	inward	-	-	-	0.133	0.918	inward	0.411	0.675	inward	0.068	0.656	inward	1.246	1.727	inward	1.322	1.662	inward	0.648	1.158	inward
2022-05-19	-0.401	-0.261	inward	-	-	-	0.109	0.920	inward	0.404	0.693	inward	0.053	0.652	inward	1.219	1.717	inward	1.274	1.703	inward	0.633	1.166	inward
2022-05-20	-0.406	-0.261	inward	-	-	-	0.123	0.900	inward	0.401	0.671	inward	-0.012	0.564	inward	1.142	1.684	inward	1.347	1.717	inward	0.639	1.151	inward
2022-05-21	-0.410	-0.262	inward	-0.120	-0.016	inward	0.132	0.884	inward	0.395	0.679	inward	0.042	0.592	inward	1.240	1.673	inward	1.315	1.646	inward	0.616	1.153	inward
2022-05-22	-0.412	-0.264	inward	-0.131	-0.063	inward	0.136	0.870	inward	0.378	0.669	inward	0.036	0.649	inward	1.236	1.689	inward	1.364	1.676	inward	0.617	1.140	inward
2022-05-23	-0.428	-0.264	inward	-0.120	-0.063	inward	0.126	0.837	inward	0.393	0.638	inward	0.044	0.598	inward	1.236	1.676	inward	1.312	1.708	inward	0.627	1.140	inward
2022-05-24	-0.425	-0.262	inward	-0.122	-0.054	inward	0.104	0.823	inward	0.381	0.644	inward	0.034	0.624	inward	1.196	1.655	inward	1.328	1.552	inward	0.627	1.120	inward
2022-05-25	-0.431	-0.262	inward	-0.116	-0.067	inward	0.106	0.806	inward	0.375	0.594	inward	0.038	0.624	inward	1.236	1.644	inward	1.275	1.467	inward	0.645	1.148	inward
2022-05-26	-0.428	-0.262	inward	-0.120	-0.071	inward	0.119	0.819	inward	0.369	0.597	inward	0.027	0.631	inward	1.257	1.651	inward	1.318	1.603	inward	0.630	1.127	inward
2022-05-27	-0.352	-0.248	inward	-0.110	-0.046	inward	0.112	0.867	inward	0.391	0.663	inward	0.033	0.652	inward	1.232	1.670	inward	1.285	1.550	inward	0.636	1.159	inward
2022-05-28	-0.383	-0.263	inward	-0.095	-0.021	inward	0.111	0.878	inward	0.387	0.651	inward	0.023	0.656	inward	1.208	1.696	inward	1.323	1.685	inward	0.649	1.161	inward
2022-05-29	-0.407	-0.267	inward	-0.105	0.001	inward	0.087	0.870	inward	0.398	0.654	inward	0.034	0.649	inward	1.229	1.700	inward	1.357	1.569	inward	0.653	1.141	inward
2022-05-30	-0.448	-0.265	inward	-0.128	0.007	inward	0.079	0.857	inward	0.381	0.680	inward	0.036	0.638	inward	1.248	1.700	inward	1.357	1.702	inward	0.629	1.157	inward
2022-05-31	-0.445	-0.264	inward	-0.139	0.008	inward	0.090	0.853	inward	0.384	0.660	inward	-0.004	0.641	inward	1.249	1.695	inward	1.351	1.683	inward	0.644	1.145	inward
2022-06-01	-0.444	-0.267	inward	-0.119	0.015	inward	0.102	0.839	inward	0.396	0.639	inward	0.035	0.580	inward	1.252	1.673	inward	1.299	1.535	inward	0.617	1.140	inward
2022-06-02	-0.446	-0.260	inward	-0.142	0.012	inward	0.118	0.826	inward	0.385	0.654	inward	0.031	0.617	inward	1.270	1.675	inward	1.380	1.646	inward	0.651	1.143	inward
2022-06-03	-0.424	-0.258	inward	-0.163	0.021	inward	0.119	0.829	inward	0.395	0.653	inward	0.040	0.578	inward	1.274	1.671	inward	1.354	1.669	inward	0.644	1.122	inward
2022-06-04	-0.411	-0.264	inward	-0.142	0.014	inward	0.127	0.834	inward	0.390	0.652	inward	0.009	0.593	inward	1.273	1.679	inward	1.324	1.633	inward	0.622	1.131	inward
2022-06-05	-0.386	-0.259	inward	-0.107	0.041	inward	0.126	0.870	inward	0.396	0.655	inward	0.047	0.600	inward	1.264	1.703	inward	1.381	1.640	inward	0.625	1.125	inward
2022-06-06	-0.414	-0.261	inward	-0.166	0.034	inward	0.092	0.895	inward	0.377	0.671	inward	0.025	0.644	inward	1.245	1.695	inward	1.208	1.649	inward	0.628	1.139	inward
2022-06-07	-0.417	-0.260	inward	-0.156	0.085	inward	0.102	0.858	inward	0.391	0.664	inward	0.027	0.608	inward	1.254	1.700	inward	1.328	1.611	inward	0.628	1.139	inward
2022-06-08	-0.411	-0.262	inward	-0.149	0.090	inward	0.095	0.857	inward	0.389	0.677	inward	0.016	0.617	inward	1.256	1.687	inward	1.367	1.688	inward	0.618	1.124	inward
2022-06-09	-0.345	-0.249	inward	-0.091	0.083	inward	0.130	0.863	inward	0.405	0.674	inward	0.046	0.643	inward	1.289	1.694	inward	1.390	1.710	inward	0.651	1.139	inward
2022-06-10	-0.145	-0.241	outward	0.010	0.156	inward	0.124	0.976	inward	0.439	0.761	inward	0.129	0.682	inward	1.284	1.767	inward	1.387	1.786	inward	0.702	1.195	inward
2022-06-11	-0.204	-0.255	outward	-0.025	0.130	inward	0.126	0.979	inward	0.428	0.758	inward	0.109	0.695	inward	1.265	1.760	inward	1.393	1.620	inward	0.651	1.160	inward
2022-06-12	-0.275	-0.258	inward	-0.083	0.154	inward	0.136	0.950	inward	0.408	0.747	inward	0.084	0.658	inward	1.277	1.733	inward	1.384	1.753	inward	0.632	1.150	inward
2022-06-13	-0.365	-0.263	inward	-0.122	0.175	inward	0.113	0.959	inward	0.397	0.715	inward	0.035	0.653	inward	1.257	1.704	inward	1.360	1.729	inward	0.640	1.159	inward
2022-06-14	-0.380	-0.266	inward	-0.134	0.165	inward	0.104	0.943	inward	0.380	0.688	inward	0.039	0.638	inward	1.247	1.701	inward	1.377	1.727	inward	0.650	1.162	inward
2022-06-15	-0.376	-0.267	inward	-0.131	0.146	inward	0.115	0.945	inward	0.377	0.680	inward	0.032	0.592	inward	1.218	1.701	inward	1.396	1.725	inward	0.641	1.142	inward
2022-06-16	-0.381	-0.269	inward	-0.125	0.126	inward	0.150	0.885	inward	0.384	0.646	inward	0.039	0.620	inward	1.246	1.680	inward	1.350	1.680	inward	0.660	1.143	inward
2022-06-17	-0.373	-0.268	inward	-0.149	0.102	inward	0.135	0.892	inward	0.382	0.631	inward	0.012	0.629	inward	1.247	1.680	inward	1.331	1.689	inward	0.670	1.120	inward
2022-06-18	-0.395	-0.270	inward	-0.155	0.085	inward	0.152	0.904	inward	0.374	0.620	inward	0.007	0.634	inward	1.236	1.671	inward	1.342	1.589	inward	0.680	1.118	inward
2022-06-19	-0.425	-0.270	inward	-0.164	0.083	inward	0.152	0.898	inward	0.361	0.626	inward	-0.023	0.622	inward	1.229	1.659	inward	1.307	1.580	inward	0.649	1.096	inward
2022-06-20	-0.431	-0.271	inward	-0.157	0.054	inward	0.143	0.862	inward	0.360	0.611	inward	-0.035	0.603	inward	1.198	1.648	inward	1.356	1.580	inward	0.655	1.100	inward
2022-06-21	-0.432	-0.271	inward	-0.154	0.049	inward	0.149	0.844	inward	0.361	0.607	inward	-0.046	0.593	inward	1.238	1.622	inward	1.345	1.576	inward	0.652	1.084	inward
2022-06-22	-0.423	-0.272	inward	-0.127	0.040	inward	0.148	0.841	inward	0.372	0.604	inward	-0.044	0.578	inward	1.230	1.629	inward	1.390	1.614	inward	0.677	1.053	inward
2022-06-23	-0.424	-0.274	inward	-0.156	0.024	inward	0.133	0.809	inward	0.366	0.596	inward	-0.043	0.576	inward	1.245	1.609	inward	1.362	1.603	inward	0.649	1.065	inward

Date	L1/D1		Flow Direction	L2/D2		Flow Direction	L3/D3		Flow Direction	L4/D4		Flow Direction	L5/D5		Flow Direction	L6/D6		Flow Direction	L7/D7		Flow Direction	L8/D8		Flow Direction
	L1 m	D1 m		L2 m	D2 m		L3 m	D3 m		L4 m	D4 m		L5 m	D5 m		L6 m	D6 m		L7 m	D7 m		L8 m	D8 m	
2022-06-24	-0.424	-0.273	inward	-0.147	0.019	inward	0.119	0.798	inward	0.363	0.588	inward	-0.049	0.539	inward	1.240	1.805	inward	1.364	1.607	inward	0.690	1.089	inward
2022-06-25	-0.425	-0.274	inward	-0.136	0.009	inward	0.127	0.787	inward	0.362	0.575	inward	-0.069	0.561	inward	1.243	1.590	inward	1.374	1.502	inward	0.681	1.081	inward
2022-06-26	-0.427	-0.263	inward	-0.146	-0.017	inward	0.127	0.782	inward	0.362	0.557	inward	-0.069	0.549	inward	1.247	1.578	inward	1.309	1.389	inward	0.688	1.069	inward
2022-06-27	-0.421	-0.244	inward	-0.132	-0.032	inward	0.140	0.741	inward	0.368	0.535	inward	-0.079	0.541	inward	1.245	1.570	inward	1.241	1.519	inward	0.697	1.059	inward
2022-06-28	-0.428	-0.240	inward	-0.157	-0.031	inward	0.113	0.715	inward	0.364	0.507	inward	-0.124	0.526	inward	1.238	1.526	inward	1.303	1.451	inward	0.698	1.045	inward
2022-06-29	-0.432	-0.252	inward	-0.164	-0.038	inward	0.113	0.721	inward	0.351	0.499	inward	-0.127	0.526	inward	1.221	1.544	inward	1.282	1.475	inward	0.686	1.043	inward
2022-06-30	-0.432	-0.223	inward	-0.237	-0.030	inward	0.114	0.712	inward	0.351	0.507	inward	-0.122	0.502	inward	1.227	1.551	inward	1.358	1.479	inward	0.692	1.037	inward
2022-07-01	-0.430	-0.192	inward	-0.147	-0.044	inward	0.126	0.691	inward	0.360	0.483	inward	-0.121	0.512	inward	1.214	1.544	inward	1.301	1.441	inward	0.693	1.037	inward
2022-07-02	-0.442	-0.189	inward	-0.140	-0.079	inward	0.122	0.704	inward	0.361	0.487	inward	-0.113	0.487	inward	1.235	1.531	inward	1.363	1.488	inward	0.693	1.030	inward
2022-07-03	-0.447	-0.118	inward	-0.107	-0.052	inward	0.109	0.702	inward	0.357	0.488	inward	-0.113	0.489	inward	1.247	1.503	inward	1.385	1.483	inward	0.706	1.040	inward
2022-07-04	-0.431	-0.111	inward	-0.124	-0.057	inward	0.105	0.713	inward	0.371	0.510	inward	-0.098	0.523	inward	1.230	1.573	inward	1.323	1.497	inward	0.709	1.057	inward
2022-07-05	-0.439	-0.273	inward	-0.129	-0.040	inward	0.118	0.698	inward	0.368	0.525	inward	-0.112	0.479	inward	1.241	1.558	inward	1.358	1.443	inward	0.691	1.054	inward
2022-07-06	-0.444	-0.278	inward	-0.126	-0.048	inward	0.078	0.710	inward	0.365	0.499	inward	-0.106	0.511	inward	1.241	1.524	inward	1.388	1.493	inward	0.690	1.042	inward
2022-07-07	-0.446	-0.279	inward	-0.118	-0.047	inward	0.115	0.698	inward	0.366	0.488	inward	-0.120	0.483	inward	1.221	1.546	inward	1.316	1.504	inward	0.697	1.025	inward
2022-07-08	-0.451	-0.281	inward	-0.121	-0.035	inward	0.125	0.683	inward	0.366	0.491	inward	-0.132	0.485	inward	1.203	1.552	inward	1.332	1.506	inward	0.685	1.019	inward
2022-07-09	-0.450	-0.283	inward	-0.105	-0.031	inward	0.106	0.683	inward	0.362	0.473	inward	-0.156	0.421	inward	1.214	1.523	inward	1.311	1.479	inward	0.684	1.019	inward
2022-07-10	-0.458	-0.282	inward	-0.128	-0.038	inward	0.118	0.675	inward	0.352	0.465	inward	-0.181	0.475	inward	1.134	1.533	inward	1.230	1.390	inward	0.679	1.009	inward
2022-07-11	-0.449	-0.283	inward	-0.098	-0.033	inward	0.116	0.662	inward	0.366	0.461	inward	-0.150	0.468	inward	1.225	1.546	inward	1.194	1.450	inward	0.684	1.001	inward
2022-07-12	-0.439	-0.279	inward	-0.107	-0.032	inward	0.114	0.677	inward	0.363	0.445	inward	-0.142	0.442	inward	1.202	1.505	inward	1.328	1.455	inward	0.691	0.991	inward
2022-07-13	-0.448	-0.275	inward	-0.104	-0.042	inward	0.104	0.668	inward	0.365	0.436	inward	-0.133	0.428	inward	1.222	1.540	inward	1.362	1.407	inward	0.674	0.981	inward
2022-07-14	-0.445	-0.278	inward	-0.102	-0.034	inward	0.111	0.657	inward	0.355	0.429	inward	-0.149	0.428	inward	1.215	1.526	inward	1.293	1.231	outward	0.690	0.973	inward
2022-07-15	-0.451	-0.280	inward	-0.131	-0.033	inward	0.099	0.651	inward	0.363	0.431	inward	-0.156	0.374	inward	1.184	1.531	inward	1.307	1.423	inward	0.682	0.961	inward
2022-07-16	-0.450	-0.281	inward	-0.138	-0.028	inward	0.089	0.616	inward	0.358	0.413	inward	-0.148	0.414	inward	1.230	1.513	inward	1.248	1.400	inward	0.684	0.949	inward
2022-07-17	-0.447	-0.281	inward	-0.104	-0.048	inward	0.117	0.613	inward	0.345	0.411	inward	-0.168	0.407	inward	1.213	1.473	inward	1.254	1.395	inward	0.683	0.938	inward
2022-07-18	-0.454	-0.282	inward	-0.104	-0.032	inward	0.089	0.635	inward	0.343	0.392	inward	-0.171	0.410	inward	1.202	1.527	inward	1.249	1.395	inward	0.682	0.939	inward
2022-07-19	-0.451	-0.281	inward	-0.106	-0.043	inward	0.107	0.621	inward	0.361	0.401	inward	-0.149	0.393	inward	1.207	1.526	inward	1.262	1.333	inward	0.674	0.929	inward
2022-07-20	-0.448	-0.282	inward	-0.144	-0.025	inward	0.113	0.578	inward	0.339	0.404	inward	-0.149	0.398	inward	1.229	1.500	inward	1.322	1.286	outward	0.681	0.893	inward
2022-07-21	-0.443	-0.283	inward	-0.107	-0.028	inward	0.103	0.590	inward	0.309	0.388	inward	-0.197	0.361	inward	1.221	1.494	inward	1.291	1.371	inward	0.677	0.893	inward
2022-07-22	-0.440	-0.277	inward	-0.086	-0.033	inward	0.102	0.568	inward	0.303	0.395	inward	-0.180	0.372	inward	1.204	1.483	inward	1.316	1.352	inward	0.687	0.888	inward
2022-07-23	-0.448	-0.282	inward	-0.089	-0.035	inward	0.103	0.568	inward	0.305	0.392	inward	-0.215	0.365	inward	1.216	1.470	inward	1.267	1.333	inward	0.655	0.883	inward
2022-07-24	-0.448	-0.281	inward	-0.127	-0.026	inward	0.109	0.554	inward	0.355	0.390	inward	-0.181	0.364	inward	1.217	1.471	inward	1.231	1.269	inward	0.658	0.859	inward
2022-07-25	-0.445	-0.285	inward	-0.078	-0.034	inward	0.107	0.542	inward	0.352	0.373	inward	-0.169	0.345	inward	1.230	1.503	inward	1.147	1.341	inward	0.679	0.853	inward
2022-07-26	-0.441	-0.289	inward	-0.083	-0.056	inward	0.095	0.539	inward	0.356	0.372	inward	-0.172	0.340	inward	1.226	1.492	inward	1.240	1.349	inward	0.693	0.846	inward
2022-07-27	-0.447	-0.289	inward	-0.123	-0.028	inward	0.095	0.528	inward	0.360	0.363	inward	-0.226	0.334	inward	1.212	1.488	inward	1.286	1.298	inward	0.681	0.838	inward
2022-07-28	-0.441	-0.285	inward	-0.069	-0.042	inward	0.089	0.529	inward	0.370	0.367	outward	-0.232	0.322	inward	1.223	1.458	inward	1.214	1.288	inward	0.678	0.826	inward
2022-07-29	-0.431	-0.287	inward	-0.046	-0.030	inward	0.097	0.511	inward	0.364	0.356	outward	-0.165	0.326	inward	1.213	1.462	inward	1.238	1.247	inward	0.685	0.812	inward
2022-07-30	-0.426	-0.272	inward	-0.082	-0.026	inward	0.121	0.494	inward	0.359	0.334	outward	-0.152	0.322	inward	1.222	1.472	inward	1.251	1.265	inward	0.689	0.814	inward
2022-07-31	-0.436	-0.279	inward	-0.110	-0.023	inward	0.088	0.504	inward	0.367	0.339	outward	-0.202	0.319	inward	1.196	1.458	inward	1.183	1.203	inward	0.684	0.800	inward
2022-08-01	-0.434	-0.274	inward	-0.042	-0.020	inward	0.091	0.495	inward	0.360	0.324	outward	-0.176	0.308	inward	1.200	1.449	inward	1.189	1.083	outward	0.670	0.784	inward
2022-08-02	-0.438	-0.230	inward	-0.050	-0.023	inward	0.090	0.485	inward	0.352	0.309	outward	-0.168	0.289	inward	1.224	1.459	inward	1.205	1.149	outward	0.654	0.785	inward
2022-08-03	-0.423	-0.282	inward	-0.059	-0.022	inward	0.107	0.478	inward	0.349	0.321	outward	-0.154	0.275	inward	1.225	1.437	inward	1.222	1.229	inward	0.680	0.780	inward
2022-08-04	-0.422	-0.283	inward	-0.041	-0.005	inward	0.115	0.489	inward	0.361	0.329	outward	-0.168	0.281	inward	1.237	1.463	inward	1.222	1.236	inward	0.679	0.763	inward
2022-08-05	-0.430	-0.277	inward	-0.047	-0.015	inward	0.117	0.469	inward	0.370	0.315	outward	-0.171	0.251	inward	1.230	1.481	inward	1.163	1.188	inward	0.662	0.763	inward
2022-08-06	-0.431	-0.284	inward	-0.063	-0.027	inward	0.113	0.450	inward	0.363	0.305	outward	-0.164	0.266	inward	1.226	1.445	inward	1.191	1.206	inward	0.679	0.751	inward
2022-08-07	-0.426	-0.219	inward	-0.046	-0.030	inward	0.106	0.436	inward	0.363	0.297	outward	-0.169	0.281	inward	1.201	1.444	inward	1.156	1.137	outward	0.665	0.744	inward
2022-08-08	-0.420	-0.284	inward	-0.040	-0.025	inward	0.118	0.423	inward	0.370	0.273	outward	-0.163	0.280	inward	1.238	1.446	inward	1.199	1.176	outward	0.676	0.736	inward
2022-08-09	-0.425	-0.288	inward	-0.052	-0.027	inward	0.100	0.411	inward	0.362	0.265	outward	-0.160	0.278	inward	1.232	1.433	inward	1.136	1.157	inward	0.680	0.720	inward
2022-08-10	-0.436	-0.287	inward	-0.043	-0.029	inward	0.052	0.402	inward	0.374	0.282	outward	-0.156	0.241	inward	1.240	1.430	inward	1.124	1.191	inward	0.668	0.709	inward
2022-08-11	-0.439	-0.286	inward	-0.045	-0.031	inward	0.057	0.391	inward	0.368	0.276	outward	-0.171	0.245	inward	1.212	1.438	inward	1.135	1.200	inward	0.665	0.711	inward
2022-08-12	-0.433	-0.286	inward	-0.039	-0.023	inward	0.062	0.378	inward	0.374	0.249	outward	-0.192	0.257	inward	1.230	1.418	inward	1.107	1.201	inward	0.665	0.699	inward
2022-08-13	-0.447	-0.288	inward	-0.049	-0.032	inward	0.064	0.368	inward	0.366	0.255	outward												

Date	L1/D1		Flow Direction	L2/D2		Flow Direction	L3/D3		Flow Direction	L4/D4		Flow Direction	L5/D5		Flow Direction	L6/D6		Flow Direction	L7/D7		Flow Direction	L8/D8		Flow Direction
	L1 m	D1 m		L2 m	D2 m		L3 m	D3 m		L4 m	D4 m		L5 m	D5 m		L6 m	D6 m		L7 m	D7 m		L8 m	D8 m	
2022-08-18	-0.413	-0.290	inward	-0.020	-0.032	outward	0.106	0.315	inward	0.373	0.224	outward	-0.173	0.209	inward	1.230	1.403	inward	1.056	1.136	inward	0.688	0.660	outward
2022-08-19	-0.411	-0.290	inward	0.005	-0.030	outward	0.113	0.307	inward	0.382	0.216	outward	-0.196	0.216	inward	1.229	1.387	inward	1.108	1.145	inward	0.667	0.646	outward
2022-08-20	-0.418	-0.290	inward	0.005	-0.033	outward	0.115	0.297	inward	0.381	0.214	outward	-0.144	0.219	inward	1.225	1.371	inward	1.103	1.101	outward	0.677	0.632	outward
2022-08-21	-0.420	-0.292	inward	0.001	-0.050	outward	0.116	0.289	inward	0.374	0.225	outward	-0.165	0.217	inward	1.210	1.388	inward	1.089	1.104	inward	0.679	0.626	outward
2022-08-22	-0.420	-0.291	inward	0.019	-0.056	outward	0.115	0.282	inward	0.364	0.196	outward	-0.186	0.217	inward	1.224	1.372	inward	1.055	1.105	inward	0.659	0.623	outward
2022-08-23	-0.422	-0.292	inward	0.030	-0.043	outward	0.107	0.274	inward	0.374	0.168	outward	-0.174	0.205	inward	1.241	1.364	inward	1.061	1.100	inward	0.677	0.617	outward
2022-08-24	-0.410	-0.290	inward	-0.028	-0.050	outward	0.077	0.267	inward	0.383	0.155	outward	-0.160	0.190	inward	1.229	1.361	inward	1.037	1.068	inward	0.685	0.599	outward
2022-08-25	-0.409	-0.289	inward	-0.043	-0.050	outward	0.064	0.260	inward	0.377	0.180	outward	-0.185	0.205	inward	1.231	1.365	inward	1.014	1.039	inward	0.672	0.598	outward
2022-08-26	-0.405	-0.287	inward	-0.037	-0.047	outward	0.027	0.256	inward	0.373	0.171	outward	-0.172	0.206	inward	1.217	1.356	inward	1.058	1.086	inward	0.673	0.590	outward
2022-08-27	-0.404	-0.288	inward	-0.039	-0.056	outward	0.099	0.247	inward	0.364	0.175	outward	-0.177	0.203	inward	1.239	1.343	inward	1.036	1.068	inward	0.676	0.586	outward
2022-08-28	-0.412	-0.287	inward	-0.041	-0.065	outward	0.105	0.238	inward	0.367	0.163	outward	-0.227	0.193	inward	1.213	1.335	inward	1.034	1.029	outward	0.665	0.585	outward
2022-08-29	-0.415	-0.285	inward	-0.027	-0.055	outward	0.108	0.231	inward	0.361	0.166	outward	-0.178	0.176	inward	1.244	1.337	inward	1.019	1.063	inward	0.674	0.575	outward
2022-08-30	-0.402	-0.285	inward	-0.051	-0.060	outward	0.106	0.223	inward	0.382	0.148	outward	-0.204	0.158	inward	1.238	1.340	inward	1.043	1.084	inward	0.683	0.562	outward
2022-08-31	-0.390	-0.264	inward	-0.051	-0.057	outward	0.106	0.218	inward	0.380	0.163	outward	-0.164	0.170	inward	1.227	1.336	inward	1.022	1.043	inward	0.689	0.555	outward
2022-09-01	-0.395	-0.271	inward	-0.032	-0.078	outward	0.104	0.211	inward	0.363	0.154	outward	-0.177	0.162	inward	1.187	1.333	inward	1.009	0.993	outward	0.679	0.552	outward
2022-09-02	-0.374	-0.255	inward	-0.009	-0.061	outward	0.119	0.207	inward	0.378	0.153	outward	-0.184	0.169	inward	1.235	1.326	inward	1.030	1.012	outward	0.687	0.548	outward
2022-09-03	-0.393	-0.247	inward	-0.043	-0.064	outward	0.103	0.199	inward	0.373	0.145	outward	-0.181	0.128	inward	1.223	1.315	inward	1.012	1.031	inward	0.680	0.544	outward
2022-09-04	-0.392	-0.242	inward	-0.037	-0.076	outward	0.110	0.204	inward	0.366	0.146	outward	-0.204	0.154	inward	1.209	1.330	inward	0.988	1.037	inward	0.680	0.541	outward
2022-09-05	-0.416	-0.239	inward	-0.069	-0.080	outward	0.105	0.206	inward	0.372	0.144	outward	-0.206	0.159	inward	1.231	1.305	inward	0.992	1.025	inward	0.676	0.534	outward
2022-09-06	-0.400	-0.234	inward	-0.045	-0.076	outward	0.120	0.193	inward	0.374	0.154	outward	-0.210	0.128	inward	1.232	1.319	inward	1.010	0.962	outward	0.681	0.529	outward
2022-09-07	-0.413	-0.216	inward	-0.084	-0.089	outward	0.119	0.184	inward	0.375	0.130	outward	-0.233	0.139	inward	1.236	1.305	inward	0.934	0.993	inward	0.684	0.511	outward
2022-09-08	-0.421	-0.258	inward	-0.118	-0.112	inward	0.113	0.171	inward	0.379	0.122	outward	-0.209	0.136	inward	1.222	1.307	inward	0.978	0.986	inward	0.671	0.514	outward
2022-09-09	-0.411	-0.247	inward	-0.060	-0.101	outward	0.118	0.164	inward	0.365	0.133	outward	-0.197	0.129	inward	1.222	1.311	inward	0.983	0.950	outward	0.685	0.507	outward
2022-09-10	-0.406	-0.264	inward	-0.105	-0.141	outward	0.117	0.156	inward	0.391	0.135	outward	-0.168	0.115	inward	1.254	1.294	inward	0.986	0.961	outward	0.681	0.508	outward
2022-09-11	-0.416	-0.253	inward	-0.141	-0.182	outward	0.113	0.147	inward	0.378	0.103	outward	-0.185	0.088	inward	1.226	1.268	inward	0.971	0.957	outward	0.694	0.500	outward
2022-09-12	-0.414	-0.263	inward	-0.118	-0.161	outward	0.120	0.143	inward	0.372	0.142	outward	-0.188	0.135	inward	1.228	1.267	inward	0.943	0.969	inward	0.689	0.492	outward
2022-09-13	-0.406	-0.260	inward	-0.071	-0.178	outward	0.134	0.138	inward	0.374	0.126	outward	-0.204	0.135	inward	1.215	1.301	inward	0.942	0.990	inward	0.686	0.481	outward
2022-09-14	-0.412	-0.271	inward	-0.091	-0.169	outward	0.119	0.132	inward	0.384	0.134	outward	-0.210	0.123	inward	1.175	1.292	inward	0.939	0.983	inward	0.689	0.482	outward
2022-09-15	-0.410	-0.282	inward	-0.068	-0.189	outward	0.113	0.134	inward	0.367	0.130	outward	-0.212	0.114	inward	1.218	1.294	inward	0.949	0.955	inward	0.688	0.474	outward
2022-09-16	-0.392	-0.279	inward	-0.064	-0.176	outward	0.121	0.198	inward	0.380	0.196	outward	-0.305	0.095	inward	1.253	1.328	inward	0.966	1.002	inward	0.680	0.497	outward
2022-09-17	-0.372	-0.278	inward	-0.045	-0.171	outward	0.123	0.233	inward	0.366	0.181	outward	-0.221	0.100	inward	1.275	1.323	inward	0.968	0.979	inward	0.684	0.514	outward
2022-09-18	-0.361	-0.280	inward	-0.061	-0.221	outward	0.127	0.209	inward	0.377	0.168	outward	-0.207	0.138	inward	1.239	1.319	inward	0.962	0.922	outward	0.696	0.511	outward
2022-09-19	-0.370	-0.284	inward	-0.073	-0.170	outward	0.122	0.188	inward	0.383	0.185	outward	-0.219	0.121	inward	1.247	1.309	inward	0.938	0.976	inward	0.688	0.501	outward
2022-09-20	-0.371	-0.284	inward	-0.067	-0.184	outward	0.113	0.167	inward	0.372	0.174	outward	-0.230	0.124	inward	1.248	1.269	inward	0.931	0.949	inward	0.683	0.482	outward
2022-09-21	-0.354	-0.284	inward	-0.066	-0.179	outward	0.120	0.149	inward	0.383	0.150	outward	-0.225	0.124	inward	1.219	1.295	inward	0.822	0.940	inward	0.691	0.470	outward
2022-09-22	-0.365	-0.289	inward	-0.075	-0.174	outward	0.116	0.138	inward	0.382	0.134	outward	-0.247	0.121	inward	1.228	1.274	inward	0.895	0.951	inward	0.695	0.470	outward
2022-09-23	-0.369	-0.289	inward	-0.102	-0.193	outward	0.080	0.131	inward	0.365	0.123	outward	-0.298	0.117	inward	1.233	1.248	inward	0.917	0.932	inward	0.690	0.458	outward
2022-09-24	-0.371	-0.291	inward	-0.076	-0.176	outward	0.085	0.125	inward	0.375	0.132	outward	-0.294	0.096	inward	1.241	1.255	inward	0.929	0.933	inward	0.686	0.455	outward
2022-09-25	-0.365	-0.290	inward	-0.117	-0.170	outward	0.092	0.117	inward	0.366	0.118	outward	-0.289	0.120	inward	1.262	1.271	inward	0.923	0.920	outward	0.691	0.451	outward
2022-09-26	-0.351	-0.288	inward	-0.107	-0.180	outward	0.101	0.111	inward	0.374	0.142	outward	-0.246	0.116	inward	1.273	1.278	inward	0.888	0.949	inward	0.696	0.443	outward
2022-09-27	-0.341	-0.289	inward	-0.067	-0.176	outward	0.113	0.108	outward	0.381	0.134	outward	-0.227	0.107	inward	1.267	1.276	inward	0.853	0.952	inward	0.706	0.440	outward
2022-09-28	-0.343	-0.292	inward	-0.059	-0.188	outward	0.114	0.104	outward	0.377	0.140	outward	-0.242	0.094	inward	1.249	1.252	inward	0.903	0.925	inward	0.702	0.435	outward
2022-09-29	-0.353	-0.295	inward	-0.077	-0.179	outward	0.085	0.099	inward	0.378	0.137	outward	-0.261	0.088	inward	1.252	1.260	inward	0.866	0.918	inward	0.689	0.436	outward
2022-09-30	-0.349	-0.297	inward	-0.103	-0.180	outward	0.091	0.093	inward	0.376	0.148	outward	-0.299	0.079	inward	1.249	1.258	inward	0.906	0.936	inward	0.691	0.433	outward
2022-10-01	-0.339	-0.293	inward	-0.095	-0.181	outward	0.096	0.088	outward	0.372	0.143	outward	-0.258	0.107	inward	1.260	1.263	inward	0.893	0.917	inward	0.695	0.435	outward
2022-10-02	-0.335	-0.294	inward	-0.097	-0.170	outward	0.113	0.083	outward	0.382	0.149	outward	-0.248	0.109	inward	1.262	1.267	inward	0.881	0.925	inward	0.695	0.430	outward
2022-10-03	-0.338	-0.297	inward	-0.093	-0.187	outward	0.107	0.078	outward	0.381	0.145	outward	-0.239	0.099	inward	1.248	1.263	inward	0.894	0.882	outward	0.693	0.423	outward
2022-10-04	-0.338	-0.297	inward	-0.060	-0.187	outward	0.108	0.075	outward	0.376	0.140	outward	-0.244	0.083	inward	1.255	1.251	outward	0.881	0.898	inward	0.692	0.419	outward
2022-10-05	-0.348	-0.300	inward	-0.113	-0.185	outward	0.096	0.069	outward	0.372	0.147	outward	-0.255	0.070	inward	1.247	1.252	inward	0.854	0.888	inward	0.682	0.416	outward
2022-10-06	-0.342	-0.299	inward	-0.084	-0.181	outward	0.094	0.065	outward	0.372	0.139	outward	-0.276	0.088	inward	1.246	1.254	inward	0.856	0.898	inward	0.686	0.405	outward
2022-10-07	-0.342	-0.301	inward	-0.089	-0.178	outward	0.104	0.060	outward	0.374	0.135	outward												

Date	L1/D1		Flow Direction	L2/D2		Flow Direction	L3/D3		Flow Direction	L4/D4		Flow Direction	L5/D5		Flow Direction	L6/D6		Flow Direction	L7/D7		Flow Direction	L8/D8		Flow Direction
	L1 m	D1 m		L2 m	D2 m		L3 m	D3 m		L4 m	D4 m		L5 m	D5 m		L6 m	D6 m		L7 m	D7 m		L8 m	D8 m	
2022-10-12	-0.357	-0.307	inward	-0.114	-0.183	outward	0.109	0.037	outward	0.365	0.116	outward	-0.267	0.053	inward	1.233	1.237	inward	0.826	0.848	inward	0.688	0.394	outward
2022-10-13	-0.346	-0.307	inward	-0.097	-0.184	outward	0.120	0.034	outward	0.367	0.124	outward	-0.259	0.080	inward	1.235	1.228	outward	0.810	0.836	inward	0.692	0.388	outward
2022-10-14	-0.337	-0.305	inward	-0.081	-0.172	outward	0.120	0.032	outward	0.372	0.120	outward	-0.269	0.087	inward	1.238	1.244	inward	0.813	0.847	inward	0.677	0.390	outward
2022-10-15	-0.337	-0.306	inward	-0.099	-0.167	outward	0.124	0.029	outward	0.366	0.115	outward	-0.261	0.074	inward	1.246	1.249	inward	0.835	0.864	inward	0.689	0.391	outward
2022-10-16	-0.328	-0.306	inward	-0.098	-0.175	outward	0.127	0.025	outward	0.370	0.126	outward	-0.248	0.061	inward	1.247	1.232	outward	0.786	0.854	inward	0.705	0.387	outward
2022-10-17	-0.340	-0.314	inward	-0.112	-0.185	outward	0.119	0.021	outward	0.347	0.125	outward	-0.258	0.025	inward	1.237	1.215	outward	0.815	0.804	outward	0.695	0.379	outward
2022-10-18	-0.345	-0.316	inward	-0.104	-0.189	outward	0.112	0.019	outward	0.345	0.110	outward	-0.279	0.066	inward	1.240	1.231	outward	0.803	0.838	inward	0.690	0.371	outward
2022-10-19	-0.340	-0.317	inward	-0.099	-0.184	outward	0.110	0.016	outward	0.342	0.112	outward	-0.231	0.057	inward	1.249	1.217	outward	0.778	0.861	inward	0.690	0.366	outward
2022-10-20	-0.323	-0.315	inward	-0.078	-0.175	outward	0.131	0.016	outward	0.360	0.122	outward	-0.240	0.053	inward	1.244	1.233	outward	0.806	0.854	inward	0.713	0.361	outward
2022-10-21	-0.306	-0.310	outward	-0.062	-0.171	outward	0.140	0.025	outward	0.376	0.149	outward	-0.221	0.048	inward	1.201	1.260	inward	0.804	0.822	inward	0.724	0.369	outward
2022-10-22	-0.304	-0.310	outward	-0.084	-0.174	outward	0.132	0.058	outward	0.381	0.161	outward	-0.238	0.039	inward	1.274	1.262	outward	0.797	0.850	inward	0.729	0.389	outward
2022-10-23	-0.326	-0.315	inward	-0.109	-0.194	outward	0.108	0.055	outward	0.369	0.149	outward	-0.236	0.048	inward	1.200	1.242	inward	0.787	0.795	inward	0.704	0.369	outward
2022-10-24	-0.254	-0.292	outward	-0.011	-0.159	outward	0.158	0.257	inward	0.388	0.274	outward	-0.257	0.097	inward	1.242	1.352	inward	0.891	0.946	inward	0.726	0.471	outward
2022-10-25	-0.135	-0.279	outward	0.065	-0.100	outward	0.173	0.309	inward	0.385	0.277	outward	-0.229	0.108	inward	1.223	1.328	inward	0.924	0.933	inward	0.733	0.519	outward
2022-10-26	-0.137	-0.278	outward	0.032	-0.119	outward	0.145	0.341	inward	0.394	0.297	outward	-0.234	0.118	inward	1.160	1.387	inward	1.067	0.989	outward	0.739	0.530	outward
2022-10-27	-0.093	-0.257	outward	0.098	-0.078	outward	0.224	0.410	inward	0.411	0.325	outward	-0.211	0.128	inward	1.210	1.406	inward	1.119	1.040	outward	0.763	0.590	outward
2022-10-28	0.026	-0.239	outward	0.166	0.029	outward	0.270	0.536	inward	0.465	0.368	outward	-0.103	0.250	inward	1.358	1.448	inward	1.291	1.195	outward	0.803	0.678	outward
2022-10-29	-0.063	-0.273	outward	0.064	-0.104	outward	0.209	0.430	inward	0.407	0.349	outward	-0.194	0.189	inward	1.286	1.467	inward	1.342	1.146	outward	0.748	0.830	outward
2022-10-30	-0.036	-0.264	outward	0.116	-0.052	outward	0.275	0.474	inward	0.457	0.370	outward	-0.154	0.219	inward	1.334	1.492	inward	1.378	1.182	outward	0.775	0.686	outward
2022-10-31	0.069	-0.254	outward	0.214	0.056	outward	0.315	0.503	inward	0.498	0.389	outward	-0.058	0.271	inward	1.369	1.548	inward	1.401	1.276	outward	0.814	0.753	outward
2022-11-01	0.024	-0.258	outward	0.162	-0.020	outward	0.231	0.481	inward	0.460	0.382	outward	-0.136	0.283	inward	1.340	1.538	inward	1.393	1.282	outward	0.784	0.727	outward
2022-11-02	-0.027	-0.266	outward	0.093	-0.079	outward	0.174	0.462	inward	0.437	0.374	outward	-0.187	0.275	inward	1.324	1.521	inward	1.388	1.274	outward	0.757	0.700	outward
2022-11-03	-0.008	-0.248	outward	0.120	-0.056	outward	0.213	0.480	inward	0.462	0.381	outward	-0.182	0.280	inward	1.345	1.525	inward	1.400	1.285	outward	0.760	0.726	outward
2022-11-04	0.254	0.150	outward	0.486	0.304	outward	0.582	0.641	inward	0.705	0.562	outward	0.136	0.467	inward	1.597	1.649	inward	1.552	1.442	outward	0.966	0.999	inward
2022-11-05	0.202	-0.056	outward	0.379	0.231	outward	0.393	0.750	inward	0.548	0.695	inward	-0.016	0.579	inward	1.458	1.708	inward	1.428	1.446	inward	0.890	1.031	inward
2022-11-06	0.151	-0.117	outward	0.369	0.191	outward	0.416	0.780	inward	0.597	0.750	inward	0.016	0.622	inward	1.523	1.742	inward	1.477	1.476	outward	0.888	1.053	inward
2022-11-07	0.080	-0.148	outward	0.279	0.126	outward	0.366	0.816	inward	0.573	0.803	inward	0.052	0.654	inward	1.497	1.752	inward	1.452	1.513	inward	0.872	1.089	inward
2022-11-08	0.030	-0.242	outward	0.214	0.068	outward	0.302	0.836	inward	0.530	0.761	inward	0.014	0.639	inward	1.457	1.735	inward	1.426	1.497	inward	0.817	1.089	inward
2022-11-09	0.005	-0.251	outward	0.188	0.037	outward	0.277	0.840	inward	0.509	0.730	inward	-0.026	0.624	inward	1.436	1.723	inward	1.412	1.485	inward	0.795	1.076	inward
2022-11-10	-0.005	-0.256	outward	0.165	0.026	outward	0.254	0.829	inward	0.446	0.707	inward	-0.090	0.543	inward	1.415	1.715	inward	1.404	1.477	inward	0.779	1.061	inward
2022-11-11	-0.014	-0.256	outward	0.185	0.019	outward	0.254	0.821	inward	0.350	0.689	inward	-0.151	0.571	inward	1.413	1.709	inward	1.405	1.467	inward	0.782	1.051	inward
2022-11-12	-0.066	-0.260	outward	0.157	0.000	outward	0.243	0.813	inward	0.339	0.675	inward	-0.190	0.607	inward	1.402	1.702	inward	1.403	1.462	inward	0.777	1.041	inward
2022-11-13	-0.134	-0.262	outward	0.095	-0.047	outward	0.229	0.807	inward	0.328	0.664	inward	-0.217	0.613	inward	1.386	1.693	inward	1.399	1.455	inward	0.768	1.033	inward
2022-11-14	-0.216	-0.263	outward	0.049	-0.061	outward	0.223	0.801	inward	0.304	0.657	inward	-0.228	0.609	inward	1.375	1.684	inward	1.397	1.452	inward	0.766	1.028	inward
2022-11-15	-0.225	-0.265	outward	0.039	-0.060	outward	0.217	0.796	inward	0.284	0.646	inward	-0.235	0.605	inward	1.368	1.677	inward	1.397	1.449	inward	0.762	1.023	inward
2022-11-16	-0.219	-0.265	outward	0.049	-0.066	outward	0.219	0.791	inward	0.278	0.641	inward	-0.240	0.596	inward	1.360	1.672	inward	1.396	1.447	inward	0.760	1.020	inward
2022-11-17	-0.227	-0.266	outward	0.053	-0.077	outward	0.216	0.784	inward	0.276	0.634	inward	-0.243	0.587	inward	1.354	1.665	inward	1.395	1.444	inward	0.762	1.015	inward
2022-11-18	-0.227	-0.267	outward	0.051	-0.076	outward	0.217	0.777	inward	0.268	0.621	inward	-0.242	0.577	inward	1.349	1.659	inward	1.394	1.443	inward	0.762	1.010	inward
2022-11-19	-0.221	-0.266	outward	0.049	-0.064	outward	0.225	0.771	inward	0.273	0.612	inward	-0.235	0.570	inward	1.352	1.654	inward	1.395	1.442	inward	0.771	1.008	inward
2022-11-20	-0.211	-0.266	outward	0.041	-0.056	outward	0.224	0.765	inward	0.283	0.605	inward	-0.239	0.565	inward	1.349	1.649	inward	1.394	1.440	inward	0.772	1.007	inward
2022-11-21	-0.209	-0.264	outward	0.031	-0.054	outward	0.225	0.762	inward	0.287	0.600	inward	-0.236	0.558	inward	1.345	1.648	inward	1.396	1.439	inward	0.774	1.005	inward
2022-11-22	-0.135	-0.238	outward	0.128	0.030	outward	0.279	0.783	inward	0.348	0.639	inward	-0.183	0.586	inward	1.437	1.687	inward	1.419	1.462	inward	0.828	1.036	inward
2022-11-23	-0.094	-0.247	outward	0.154	0.093	outward	0.256	0.814	inward	0.299	0.692	inward	-0.199	0.635	inward	1.398	1.709	inward	1.404	1.479	inward	0.827	1.058	inward
2022-11-24	-0.099	-0.256	outward	0.168	0.096	outward	0.252	0.821	inward	0.274	0.687	inward	-0.242	0.643	inward	1.377	1.708	inward	1.404	1.477	inward	0.818	1.050	inward
2022-11-25	-0.062	-0.243	outward	0.226	0.140	outward	0.287	0.836	inward	0.318	0.709	inward	-0.182	0.653	inward	1.436	1.717	inward	1.417	1.467	inward	0.846	1.064	inward
2022-11-26	-0.061	-0.248	outward	0.226	0.208	outward	0.278	0.863	inward	0.294	0.723	inward	-0.177	0.669	inward	1.408	1.723	inward	1.410	1.462	inward	0.851	1.074	inward
2022-11-27	-0.082	-0.247	inward	0.238	0.199	outward	0.283	0.862	inward	0.288	0.714	inward	-0.206	0.672	inward	1.411	1.724	inward	1.411	1.468	inward	0.863	1.078	inward
2022-11-28	-0.125	-0.252	outward	0.165	0.096	outward	0.271	0.858	inward	0.276	0.697	inward	-0.240	0.640	inward	1.404	1.717	inward	1.409	1.466	inward	0.854	1.069	inward
2022-11-29	-0.170	-0.251	outward	0.082	0.020	outward	0.257	0.849	inward	0.270	0.686	inward	-0.251	0.605	inward	1.398	1.713	inward	1.411	1.481	inward	0.860	1.062	inward
2022-11-30	-0.146	-0.243	outward	0.148	0.041	outward	0.277	0.861	inward	0.306	0.698	inward	-0.220	0.633	inward	1.444	1.723	inward	1.420	1.488	inward	0.888	1.076	inward
2022-12-01	-0.105	-0.249	outward	0.190	0.089	outward	0.290	0.872	inward	0.283	0.692	inward												

Date	L1/D1		Flow Direction	L2/D2		Flow Direction	L3/D3		Flow Direction	L4/D4		Flow Direction	L5/D5		Flow Direction	L6/D6		Flow Direction	L7/D7		Flow Direction	L8/D8		Flow Direction
	L1 m	D1 m		L2 m	D2 m		L3 m	D3 m		L4 m	D4 m		L5 m	D5 m		L6 m	D6 m		L7 m	D7 m		L8 m	D8 m	
2022-12-06	-0.278	-0.259	inward	-0.100	-0.038	inward	0.196	0.824	inward	0.249	0.859	inward	-0.295	0.520	inward	1.361	1.693	inward	1.407	1.478	inward	0.823	1.045	inward
2022-12-07	-0.269	-0.256	inward	-0.111	-0.033	inward	0.206	0.829	inward	0.258	0.852	inward	-0.282	0.495	inward	1.371	1.698	inward	1.410	1.477	inward	0.835	1.048	inward
2022-12-08	-0.245	-0.251	outward	-0.097	-0.028	inward	0.218	0.843	inward	0.288	0.857	inward	-0.271	0.466	inward	1.394	1.703	inward	1.412	1.483	inward	0.853	1.053	inward
2022-12-09	-0.218	-0.246	outward	-0.085	-0.021	inward	0.226	0.852	inward	0.287	0.866	inward	-0.266	0.535	inward	1.398	1.712	inward	1.415	1.484	inward	0.855	1.058	inward
2022-12-10	-0.126	-0.192	outward	-0.010	0.012	inward	0.271	0.932	inward	0.362	0.733	inward	-0.194	0.620	inward	1.492	1.736	inward	1.434	1.513	inward	0.906	1.091	inward
2022-12-11	-0.185	-0.238	outward	-0.069	0.017	inward	0.240	0.977	inward	0.315	0.774	inward	-0.236	0.689	inward	1.445	1.735	inward	1.428	1.526	inward	0.884	1.106	inward
2022-12-12	-0.221	-0.246	outward	-0.109	0.012	inward	0.220	0.984	inward	0.262	0.752	inward	-0.264	0.675	inward	1.426	1.726	inward	1.416	1.519	inward	0.855	1.101	inward
2022-12-13	-0.224	-0.220	inward	-0.119	-0.011	inward	0.208	0.980	inward	0.267	0.729	inward	-0.287	0.619	inward	1.418	1.717	inward	1.410	1.510	inward	0.840	1.089	inward
2022-12-14	-0.221	-0.207	inward	-0.121	-0.022	inward	0.197	0.968	inward	0.260	0.715	inward	-0.296	0.632	inward	1.409	1.711	inward	1.408	1.504	inward	0.828	1.076	inward
2022-12-15	-0.215	-0.207	inward	-0.124	-0.040	inward	0.192	0.949	inward	0.255	0.698	inward	-0.304	0.594	inward	1.407	1.707	inward	1.408	1.499	inward	0.823	1.066	inward
2022-12-16	-0.209	-0.204	inward	-0.118	-0.051	inward	0.199	0.937	inward	0.262	0.707	inward	-0.307	0.555	inward	1.410	1.705	inward	1.407	1.494	inward	0.831	1.090	inward
2022-12-17	-0.246	-0.198	inward	-0.098	-0.054	inward	0.216	0.930	inward	0.273	0.692	inward	-0.295	0.565	inward	1.417	1.706	inward	1.414	1.494	inward	0.845	1.057	inward
2022-12-18	-0.320	-0.201	inward	-0.148	-0.057	inward	0.213	0.929	inward	0.280	0.673	inward	-0.294	0.597	inward	1.414	1.699	inward	1.410	1.493	inward	0.842	1.053	inward
2022-12-19	-0.324	-0.210	inward	-0.177	-0.065	inward	0.184	0.915	inward	0.267	0.662	inward	-0.311	0.581	inward	1.393	1.690	inward	1.408	1.490	inward	0.815	1.046	inward
2022-12-20	-0.285	-0.216	inward	-0.155	-0.057	inward	0.188	0.912	inward	0.280	0.665	inward	-0.269	0.559	inward	1.396	1.693	inward	1.408	1.498	inward	0.831	1.064	inward
2022-12-21	-0.299	-0.263	inward	-0.183	-0.065	inward	0.162	0.897	inward	0.270	0.659	inward	-0.299	0.569	inward	1.379	1.684	inward	1.406	1.490	inward	0.793	1.069	inward
2022-12-22	-0.284	-0.263	inward	-0.165	-0.066	inward	0.171	0.896	inward	0.275	0.651	inward	-0.270	0.576	inward	1.379	1.683	inward	1.405	1.489	inward	0.805	1.064	inward
2022-12-23	-0.267	-0.256	inward	-0.121	-0.051	inward	0.196	0.890	inward	0.295	0.660	inward	-0.220	0.590	inward	1.408	1.693	inward	1.399	1.496	inward	0.850	1.083	inward
2022-12-24	0.068	0.018	outward	0.212	0.157	outward	0.387	0.989	inward	0.478	0.804	inward	0.096	0.678	inward	1.620	1.749	inward	1.546	1.601	inward	0.995	1.177	inward
2022-12-25	0.151	0.285	inward	0.272	0.399	inward	0.382	1.103	inward	0.489	0.931	inward	0.148	0.738	inward	1.643	1.778	inward	1.565	1.697	inward	1.021	1.276	inward
2022-12-26	0.199	0.307	inward	0.321	0.472	inward	0.395	1.145	inward	0.628	0.988	inward	0.258	0.758	inward	1.652	1.815	inward	1.580	1.732	inward	1.029	1.311	inward
2022-12-27	0.258	0.311	inward	0.384	0.490	inward	0.516	1.170	inward	0.633	1.014	inward	0.446	0.773	inward	1.711	1.846	inward	1.630	1.756	inward	1.079	1.351	inward
2022-12-28	0.267	0.348	inward	0.325	0.510	inward	0.819	1.167	inward	0.681	1.009	inward	0.551	0.772	inward	1.691	1.835	inward	1.605	1.766	inward	1.091	1.355	inward
2022-12-29	0.094	0.159	inward	0.199	0.431	inward	0.378	1.137	inward	0.441	0.955	inward	0.243	0.747	inward	1.609	1.792	inward	1.526	1.726	inward	0.979	1.301	inward
2022-12-30	-0.014	0.112	inward	0.114	0.431	inward	0.321	1.136	inward	0.448	0.957	inward	0.208	0.736	inward	1.630	1.794	inward	1.544	1.724	inward	0.987	1.294	inward
2022-12-31	-0.063	0.062	inward	0.065	0.429	inward	0.299	1.129	inward	0.413	0.938	inward	0.160	0.727	inward	1.618	1.780	inward	1.531	1.718	inward	0.968	1.282	inward

Summary Statistics - Remote Water Level Monitoring System

Mean	-0.314	-0.247		-0.039	-0.027		0.155	0.580		0.370	0.453		-0.138	0.402		1.285	1.528		1.221	1.319		0.723	0.858	
Standard Deviation	0.162	0.097		0.123	0.128		0.092	0.326		0.064	0.243		0.135	0.224		0.104	0.179		0.214	0.285		0.090	0.282	
Number of Remote Measurements			236			225			236			236			236			236			236			236
Number of Days with Outward or No Flow			51			111			25			100			0			11			33			80
Outward Flow Percentage			21.6%			49.3%			10.6%			42.4%			0.0%			4.7%			14.0%			33.9%

2022 Summary Statistics

Total Number of Measurements			358			242			253			253			253			236			236			236
Total Number of Days with Outward or No Flow			52			113			25			100			2			11			33			80
Weighted Outward Flow Percentage			14.3%			36.1%			6.9%			27.4%			4.1%			4.7%			14.0%			33.9%
2022 Average Outward Flow															17.67%									

Notes:

1) All measured data are converted to geodetic elevations.

2) Data Source: Remote Water Level Monitoring System

Outward Flow Percentages are averaged to get the overall Average Outward Flow. The system efficiency is 100% - Average Outward Flow. This information is used in Table 6-4.

Indicates outward gradient flow direction

Appendix 9: 2022 Non-recyclable marine debris waste assessment forms

NP 6724 FEB 03 2022 #411

VANCOUVER LANDFILL WASTE ASSESSMENT FORM

2907

CITY OF VANCOUVER **Transfer & Landfill Operations**
PHONE: 604.606.2700 **EMAIL: landfilloperations@vancouver.ca**

Instructions: Note: The City of Vancouver reserves the right not to accept any waste material.
 1. Complete Section 1 of this form and return to the Landfill by email to landfilloperations@vancouver.ca.
 2. Landfill Staff will review the form and either: approve and return it by email, request additional information, or suggest other disposal options.
 3. If the form is approved, have the carrier complete Section 2 and bring a copy of the approved form with each shipment.

Section 1: Generator

Company Name: Misty Isles Economic development Society Phone: [REDACTED]
 Address: 138 Bay Street City & Postal Code: [REDACTED]
 Contact Person: [REDACTED] Phone: [REDACTED]
 Waste Description: Marine Debris Waste Weight: 9050
 Packaging type (e.g. box, bag): Super sacks within 40-yard containers Total No. Shipments: 4 container bins

Is this material under destruction orders from a government agency (CFIA, Agriculture Canada, etc.)? no
 * If YES, will an Inspector be accompanying the load for burial? no

Generator's Declaration: "I certify that the waste material is fully and accurately described above and is not a Hazardous Waste" as defined in the Hazardous Waste Regulations to the Environmental Management Act (or any successor legislation). I further certify that such waste material is not unacceptable waste, as defined on the City of Vancouver Prohibited Materials list and that it will be packed in proper condition for transport. I certify that to the best of my knowledge the waste material is suitable for disposal at a sanitary landfill, and I acknowledge that I remain responsible for ensuring compliance with all laws and by-laws applicable to the packaging, transport and disposal of the subject waste material. I hereby agree to indemnify and save harmless the City of Vancouver, its officials, officers and employees, from all claims liability, penalties, fines, judgements, costs and expenses of every kind, including as may arise from any finding of negligence on the part of the City of Vancouver, its officials, officers and employees, which may result in the disposal of the subject waste or from any failure to comply with all by-laws, statutes and regulations relating to the waste disposal in respect of which this application is made.

I represent that I am authorized to give the representations, assurances and indemnities set out above to the City of Vancouver."

Name: [REDACTED] Title: End of Life Coordinator
 Signature: [REDACTED] Application Date: 1/27/22

Section 2: Carrier (to be completed by hauler at time of shipment to Landfill)

Company Name: GFL
 Address: _____ City & Postal Code: Coquitlam BC
 Vehicle License: [REDACTED] Phone: _____
 Shipment Number (1, 2, 3, etc.): 1

Carrier's Declaration: "I declare that I have received the GOODS listed above for delivery in accordance with the Shipper's instructions."

Name: [REDACTED] Signature: [REDACTED]

Section 3: City of Vancouver (to be completed by Landfill Staff prior to shipment to Landfill)

Shipper to notify Landfill prior to shipping: no Database entry complete: no
 Special handling at Landfill: ACCEPT AT GARBAGE RATE
 No. of shipments to be accepted: N/A Shipments acceptable up to: JUNE 30 2022
 Approved by: [REDACTED] Phone: [REDACTED]
 Signature: [REDACTED] Date Approved: Jan 28 2022

Date Received at Landfill FEB 03 2022 **Net Weight of Load** 2190 kg

ENTERED

Version: January 7, 2020

NP.6709

VANCOUVER LANDFILL WASTE ASSESSMENT FORM

2907



Transfer & Landfill Operations
PHONE: 604.606.2700

EMAIL: landfilloperations@vancouver.ca

FEB 27 2022

Instructions:

Note: The City of Vancouver reserves the right not to accept any waste material.

1. Complete Section 1 of this form and return to the Landfill by email to landfilloperations@vancouver.ca.
2. Landfill Staff will review the form and either: approve and return it by email, request additional information, or suggest other disposal options.
3. If the form is approved, have the carrier complete Section 2 and bring a copy of the approved form with each shipment.

Section 1: Generator

Company Name: Misty Isles Economic development Society Phone: [REDACTED]
 Address: 138 Bay Street City & Postal Code: [REDACTED]
 Contact Person: [REDACTED] Phone: [REDACTED]
 Waste Description: Marine Debris Waste Weight: 9050
 Packaging type (e.g. box, bag): Super sacks within 40-yard containers Total No. Shipments: 4 container bins

Is this material under destruction orders from a government agency (CFIA, Agriculture Canada, etc.)? NO
 * If YES, will an Inspector be accompanying the load for burial? NO

Generator's Declaration: "I certify that the waste material is fully and accurately described above and is not a Hazardous Waste" as defined in the Hazardous Waste Regulations to the Environmental Management Act (or any successor legislation). I further certify that such waste material is not unacceptable waste, as defined on the City of Vancouver Prohibited Materials list and that it will be packed in proper condition for transport. I certify that to the best of my knowledge the waste material is suitable for disposal at a sanitary landfill, and I acknowledge that I remain responsible for ensuring compliance with all laws and by-laws applicable to the packaging, transport and disposal of the subject waste material. I hereby agree to indemnify and save harmless the City of Vancouver, its officials, officers and employees, from all claims liability, penalties, fines, judgments, costs and expenses of every kind, including as may arise from any finding of negligence on the part of the City of Vancouver, its officials, officers and employees, which may result in the disposal of the subject waste or from any failure to comply with all by-laws, statutes and regulations relating to the waste disposal in respect of which this application is made.

I represent that I am authorized to give the representations, assurances and indemnities set out above to the City of Vancouver *

Name: Gordon Clark Title: End of Life Coordinator
 Signature: Gordon Clark Application Date: 1/27/22

Section 2: Carrier (to be completed by hauler at time of shipment to Landfill)

Company Name: GFL
 Address: 70 Calder Dr City & Postal Code: Courville
 Vehicle License: [REDACTED] Phone: [REDACTED]
 Shipment Number (1, 2, 3, etc.): _____
Carrier's Declaration: "I declare that I have received the GOODS listed above for delivery in accordance with the Shipper's instructions."
 Name: [REDACTED] Signature: [REDACTED]

Section 3: City of Vancouver (to be completed by Landfill Staff prior to shipment to Landfill)

Shipper to notify Landfill prior to shipping: NO Database entry complete: NO
 Special handling at Landfill: ACCEPT of GARRAGE RATE
 No. of shipments to be accepted: N/A Shipments acceptable up to: JUNE 30 2022
 Approved by: [REDACTED] Phone: [REDACTED]
 Signature: [REDACTED] Date Approved: Jan 28 2022

Date Received at Landfill

FULL WILL

Net Weight of Load 2850 kg

ENTERED

VANCOUVER LANDFILL WASTE ASSESSMENT FORM

2907



Transfer & Landfill Operations
PHONE: 604.606.2700

EMAIL: landfilloperations@vancouver.ca

Instructions:

Note: The City of Vancouver reserves the right not to accept any waste material.

1. Complete Section 1 of this form and return to the Landfill by email to landfilloperations@vancouver.ca.
2. Landfill Staff will review the form and either: approve and return it by email, request additional information, or suggest other disposal options.
3. If the form is approved, have the carrier complete Section 2 and bring a copy of the approved form with each shipment.

Section 1: Generator

Company Name: Misty Isles Economic development Society Phone: [REDACTED]
 Address: 138 Bay Street City & Postal Code: [REDACTED]
 Contact Person: [REDACTED] Phone: [REDACTED]
 Waste Description: Marine Debris Waste Weight: 9050
 Packaging type (e.g. box, bag): Super sacks within 40-yard containers Total No. Shipments: 4 container bins

Is this material under destruction orders from a government agency (CFIA, Agriculture Canada, etc.)? no

* If YES, will an inspector be accompanying the load for burial? no

Generator's Declaration: "I certify that the waste material is fully and accurately described above and is not a Hazardous Waste" as defined in the Hazardous Waste Regulations to the Environmental Management Act (or any successor legislation). I further certify that such waste material is not unacceptable waste, as defined on the City of Vancouver Prohibited Materials list and that it will be packed in proper condition for transport. I certify that to the best of my knowledge the waste material is suitable for disposal at a sanitary landfill, and I acknowledge that I remain responsible for ensuring compliance with all laws and by-laws applicable to the packaging, transport and disposal of the subject waste material. I hereby agree to indemnify and save harmless the City of Vancouver, its officials, officers and employees, from all claims liability, penalties, fines, judgements, costs and expenses of every kind, including as may arise from any finding of negligence on the part of the City of Vancouver, its officials, officers and employees, which may result in the disposal of the subject waste or from any failure to comply with all by-laws, statutes and regulations relating to the waste disposal in respect of which this application is made.

I represent that I am authorized to give the representations, assurances and indemnities set out above to the City of Vancouver.*

Name: [REDACTED] Title: End of Life Coordinator
 Signature: [REDACTED] Application Date: 1/27/22

Section 2: Carrier (to be completed by hauler at time of shipment to Landfill)

Company Name: GFLS 1
 Address: [REDACTED] City & Postal Code: [REDACTED]
 Vehicle License: [REDACTED] Phone: [REDACTED]
 Shipment Number (1, 2, 3, etc.): [REDACTED]

Carrier's Declaration: "I declare that I have received the GOODS listed above for delivery in accordance with the Shipper's instructions."

Name: [REDACTED] Signature: [REDACTED]

Section 3: City of Vancouver (to be completed by Landfill Staff prior to shipment to Landfill)

Shipper to notify Landfill prior to shipping: no Database entry complete: no
 Special handling at Landfill: ACCEPT of GARBAGE RATE
 No. of shipments to be accepted: N/A Shipments acceptable up to: JUNE 30 2022
 Approved by: [REDACTED] Phone: [REDACTED]
 Signature: [REDACTED] Date Approved: Jan 28 2022

Date Received at Landfill: MAR 12 2022 Net Weight of Load: 2970 kg

ENTERED

PP 8631

2022-1-130

NOV 10 2022

VANCOUVER LANDFILL WASTE ASSESSMENT FORM

3060



Transfer & Landfill Operations
PHONE: 604.606.2700

EMAIL: landfilloperations@vancouver.ca

Instructions:

Note: The City of Vancouver reserves the right not to accept any waste material.

1. Complete Section 1 of this form and return to the Landfill by email to landfilloperations@vancouver.ca.
2. Landfill Staff will review the form and either: approve and return it by email, request additional information, or suggest other disposal options.
3. If the form is approved, have the carrier complete Section 2 and bring a copy of the approved form with each shipment.

Section 1: Generator

Company Name: K'you Enterprises Corp. Phone: [REDACTED]
 Address: PO Box 1535 City & Postal Code: [REDACTED]
 Contact Person: [REDACTED] Phone: [REDACTED]
 Waste Description: Marine Debris Waste Weight: 7771 kgs
 Packaging type (e.g. box, bag): 40yd Bags Total No. Shipments: 3-4

Is this material under destruction orders from a government agency (CFIA, Agriculture Canada, etc.)? no

* If YES, will an inspector be accompanying the load for burial? no

Generator's Declaration: "I certify that the waste material is fully and accurately described above and is not a Hazardous Waste" as defined in the Hazardous Waste Regulations to the Environmental Management Act (or any successor legislation). I further certify that such waste material is not unacceptable waste, as defined on the City of Vancouver Prohibited Materials list and that it will be packed in proper condition for transport. I certify that to the best of my knowledge the waste material is suitable for disposal at a sanitary landfill, and I acknowledge that I remain responsible for ensuring compliance with all laws and by-laws applicable to the packaging, transport and disposal of the subject waste material. I hereby agree to indemnify and save harmless the City of Vancouver, its officials, officers and employees, from all claims liability, penalties, fines, judgements, costs and expenses of every kind, including as may arise from any finding of negligence on the part of the City of Vancouver, its officials, officers and employees, which may result in the disposal of the subject waste or from any failure to comply with all by-laws, statutes and regulations relating to the waste disposal in respect of which this application is made.

I represent that I am authorized to give the representations, assurances and indemnities set out above to the City of Vancouver."

Name: [REDACTED] Title: Debris Mgmt Coordinator
 Signature: [REDACTED] Application Date: Sept 24/2022

Section 2: Carrier (to be completed by hauler at time of shipment to Landfill)

Company Name: Two Guys Disposal City & Postal Code: Polo V3C 1A7
 Address: 1970 Bow Hill Ave Phone: 604 970 8631
 Vehicle License: [REDACTED]
 Shipment Number (1, 2, 3, etc.): ①

Carrier's Declaration: "I declare that I have received the GOODS listed above for delivery in accordance with the Shipper's instructions."

Name: [REDACTED] Signature: [REDACTED]

Section 3: City of Vancouver (to be completed by Landfill Staff prior to shipment to Landfill)

Shipper to notify Landfill prior to shipping: no Database entry complete: no
 Special handling at Landfill: ok'd by George
 No. of shipments to be accepted: 2 Shipments acceptable up to: _____
 Approved by: _____ Phone: _____
 Signature: _____ Date Approved: _____

Date Received at Landfill OCT 13 2022

Net Weight of Load 2280

PP 8631

2022 C L 120
NOV 10 2022

VANCOUVER LANDFILL WASTE ASSESSMENT FORM

3060



Transfer & Landfill Operations
PHONE: 604.606.2700

EMAIL: landfilloperations@vancouver.ca

Instructions:

Note: The City of Vancouver reserves the right not to accept any waste material.

1. Complete Section 1 of this form and return to the Landfill by email to landfilloperations@vancouver.ca.
2. Landfill Staff will review the form and either: approve and return it by email, request additional information, or suggest other disposal options.
3. If the form is approved, have the carrier complete Section 2 and bring a copy of the approved form with each shipment.

Section 1: Generator

Company Name: K'you Enterprises Corp. Phone: [REDACTED]
 Address: PO Box 1535 City & Postal Code: [REDACTED]
 Contact Person: [REDACTED] Phone: [REDACTED]
 Waste Description: Marine Debris Waste Weight: 7171 kgs
 Packaging type (e.g. box, bag): Load Bags Total No. Shipments: 3-4

Is this material under destruction orders from a government agency (CFIA, Agriculture Canada, etc.)? no

* If YES, will an inspector be accompanying the load for burial? no

Generator's Declaration: "I certify that the waste material is fully and accurately described above and is not a Hazardous Waste" as defined in the Hazardous Waste Regulations to the Environmental Management Act (or any successor legislation). I further certify that such waste material is not unacceptable waste, as defined on the City of Vancouver Prohibited Materials list and that it will be packed in proper condition for transport. I certify that to the best of my knowledge the waste material is suitable for disposal at a sanitary landfill, and I acknowledge that I remain responsible for ensuring compliance with all laws and by-laws applicable to the packaging, transport and disposal of the subject waste material. I hereby agree to indemnify and save harmless the City of Vancouver, its officials, officers and employees, from all claims liability, penalties, fines, judgements, costs and expenses of every kind, including as may arise from any finding of negligence on the part of the City of Vancouver, its officials, officers and employees, which may result in the disposal of the subject waste or from any failure to comply with all by-laws, statutes and regulations relating to the waste disposal in respect of which this application is made.

I represent that I am authorized to give the representations, assurances and indemnities set out above to the City of Vancouver."

Name: [REDACTED] Title: Debris Mgmt Coordinator
 Signature: [REDACTED] Application Date: Sept 24/2022

Section 2: Carrier (to be completed by hauler at time of shipment to Landfill)

Company Name: Two Guys Disposal
 Address: 1970 Bow Hill Ave City & Postal Code: P06 0S0 1A7
 Vehicle License: [REDACTED] Phone: 604 970 8631
 Shipment Number (1, 2, 3, etc.): ①

Carrier's Declaration: "I declare that I have received the GOODS listed above for delivery in accordance with the Shipper's instructions."

Name: [REDACTED] Signature: [REDACTED]

Section 3: City of Vancouver (to be completed by Landfill Staff prior to shipment to Landfill)

Shipper to notify Landfill prior to shipping: no Database entry complete: no

Special handling at Landfill: ok'd by George

No. of shipments to be accepted: 2 Shipments acceptable up to: _____

Approved by: _____ Phone: _____

Signature: _____ Date Approved: _____

Date Received at Landfill OCT 13 2022

Net Weight of Load 44440

Appendix 10: 2022 Annual status form



Annual Compliance Status Form

AUTHORIZATION NUMBER: 1611
 AUTHORIZATION TYPE: Operational Certificate
 LEGAL AUTHORIZATION HOLDER NAME: City of Vancouver
 PERIOD OF COMPLIANCE STATUS ASSESSMENT: 2022-01-01 - 2022-12-31

AUTHORIZED PERSON NAME: Mike Buzik
 AUTHORIZED PERSON SIGNATURE: [Signature]
 SIGNATURE DATE: March 30, 2023

*I understand that it is an offense to mislead a government official, and I declare that all of the information presented is accurate and true.
 I have been given the authority by the authorization holder to sign this form.*

AUTHORIZATION CLAUSE NUMBER	AUTHORIZATION CLAUSE DESCRIPTION	COMPLIANT? (Yes/No/ND)	RATIONALE FOR YOUR COMPLIANCE DETERMINATION	LOCATION OF SUPPORTING INFORMATION IN ANNUAL REPORT
1.1.1	The discharge of refuse (to a sanitary landfill) from sources within the Greater Vancouver Regional District and other sources as specifically authorized by the Regional Waste Manager is authorized for the full term of the Greater Vancouver Regional District Solid Waste Management Plan, dated July 1995. The solid waste management plan must be amended to authorize the discharge beyond this term.	Yes	Discharging waste under authorizations.	Annual Report for the Vancouver Landfill (sections referenced herein), Executive Summary.
1.1.2	The maximum authorized rate of discharge is 750,000 tonnes per year. The characteristics of the discharge shall be typical municipal solid waste and other materials as specifically authorized by the Regional Waste Manager. Asbestos waste may be discharged in accordance with the	Yes	Discharged less than 750,000 tonnes in 2022.	Greater Regional District Solid Waste Management Plan (Metro Vancouver, 2010)
1.1.3	The characteristics of the discharge shall be typical municipal solid waste and other materials as specifically authorized by the Regional Waste Manager. Asbestos waste may be discharged in accordance with the <i>Special Waste Regulation</i> .	Yes	MSW and other specifically authorized waste only accepted for discharge. All other authorized wastes are listed as separate line items in annual report. Special Waste (other than asbestos) is not accepted for disposal in the landfill.	5. Waste disposal, Appendix 2 Table A1
1.1.4	Waste shall not be discharged within a buffer zone as identified in Section 2.9. Putrescible and household waste shall not be discharged into water. The burning of waste is prohibited.	Yes	Minimum 50 metres wide buffer is present along all boundaries except where 30 metres maximum is allowed on northern boundary.	2019 Operating Plan report (Golder 2021b), Site Layout Plan (first drawing after references)
1.1.5	The authorized works common to this section and Sections 1.2, 1.3 and 1.4 are a locking gate to control access by the public, a weigh scale and fire protection equipment, approximately located as shown on attached Site Plan A.	Yes	Locking gate and weigh scales operating near landfill entrance. Works laid out in accordance with Site Plan A from OC.	2. Design and operating plans, Figure 2
1.1.6	The authorized works specific to this section are those associated with a landfill operation and include berms, covering material, surface water diversionary works, environmental monitoring systems, leachate collection/pumping works and a landfill gas management system consisting of existing and future collection works, a blower/flare station and gas utilization works, approximately located as shown on attached Site Plan B.	Yes	Environmental controls in operation include perimeter ditch system for leachate (inner) and surface water (outer) collection, stormwater ponds, suitable daily and final cover, gas collection system including blower and flare station.	7. Environmental protection programs, 8. Operational information
1.1.7	The location of the point of discharge is Lot 9, Section 5 and 6, New Westminster District, Plan 38013. Discharge within the area identified as the "100 Acre Reserve", approximately as shown on Site Plan B, is restricted to construction and demolition waste in accordance with the approved closure plan required in Section 2.8.	Yes	Currently discharging within areas shown in Site Plan B. "100 Acre Reserve" is closed.	2. Design and operating Plans, Figure 3
1.2.1	The characteristics of the waste (at the landfill transfer station facility) are the same as set out in Section 1.1.3.	Yes	Waste accepted for discharge is typical MSW, all other materials accepted at this facility are for off-site recycling. (Recycling depot and household hazardous waste storage facility)	6. Waste reduction and recycling initiatives
1.2.2	The authorized works are those associated with a transfer station and include a paved access area and roll off bins, approximately located as shown on attached Site Plan C.	Yes	The facility has paved access and roll off bins, operating as shown in Site Plan C of OC.	6. Waste reduction and recycling initiatives, and 2. Design and operating plans, Figure 2
1.2.3	The location of the facilities is Lot 9, Section 5 and 6, New Westminster District, Plan 38013.	Yes	Location is as described.	2. Design and operating plans, Figure 2
1.3.1	The type of materials which may be managed at this facility (recycling depot and household hazardous waste storage facility) are typical recyclable materials and household hazardous waste.	Yes	Accepting recyclables and household hazardous waste at this facility. See complete list of accepted items.	6. Waste reduction and recycling initiatives
1.3.2	The authorized works are those associated with a recycling depot and household hazardous waste storage facility and include roll off bins, recycling containers, a secure (fenced) storage area and storage shed for household hazardous waste, approximately located as shown on attached Site Plan C.	Yes	Listed works are present at the facility, as shown on Site Plan C.	6. Waste reduction and recycling initiatives, 8. Operational information
1.3.3	The location of the facilities is the same location as set out in Section 1.2.3.	Yes	Same location.	2. Design and operating plans, Figure 2
1.4.1	The type of waste that may be composted is restricted to fruit and vegetable waste, typical yardwaste and Christmas trees.	Yes	Yard trimmings, wood and green waste only accepted for compost, no food scraps.	6. Waste reduction and recycling initiatives

Authorized Person Initial: MB

Date: Mar 30/23

AUTHORIZATION CLAUSE NUMBER	AUTHORIZATION CLAUSE DESCRIPTION	COMPLIANT? (Yes/No/ND)	RATIONALE FOR YOUR COMPLIANCE DETERMINATION	LOCATION OF SUPPORTING INFORMATION IN ANNUAL REPORT
1.4.2	The authorized works are those associated with a composting facility and include an impermeable pad, a stationary grinding plant, and windrow turning equipment, approximately located as shown on attached Site Plan A.	Yes	Facility is on paved pad, equipment include grinder, windrow turner and screener. Located in area shown in Site Plan A.	6. Waste reduction and recycling Initiatives
1.4.3	The location of the facilities [compost] is the same location as set out in Section 1.2.3.	Yes	Located as described.	2. Design and operating plans, Figure 2
2.1	In the event of an emergency which prevents compliance with a requirement of this operational certificate, that requirement will be suspended for such time as the emergency continues or until otherwise directed by the Regional Waste Manager.	Yes	N/A In 2022	N/A
2.2	The operational certificate holder shall inspect the authorized works regularly and maintain them in good working order. Notify the Regional Waste Manager of any malfunction of these works.	Yes	Landfill staff/contractors perform various regular inspection on works. Monitoring effects on surrounding area (Burns Bog) through regular inspection of perimeter ditch system. Issues noticed in inspection are brought to attention of staff.	8. Operational Information
2.3	The operational certificate holder shall inspect the property boundaries regularly and notify the Regional Waste Manager of any visual evidence of environmental impacts on adjacent properties.	Yes		8. Operational Information
2.4	Provision of fencing, site access, vehicle safety barriers, surface water diversionary works, firebreaks and site restoration as required, shall be carried out to the satisfaction of the Regional Waste Manager.	Yes	Site access limited to entrance. Vehicle safety barriers present on main roads. Surface water diversionary works include perimeter ditch system and ponds. Firebreaks used in filling of active areas.	Surface water diversionary works found in 7.0 Environmental protection programs. Other information not required in annual report by OC.
2.5	In preparation for the placement of putrescible waste, the operational certificate holder shall construct a base cell consisting of an approximate 3 metre lift of demolition and construction waste covered with a minimum 0.15 metre layer of suitable cover material. Firebreaks shall be incorporated into each cell in such quantity and manner as to prevent fires from becoming an environmental or safety hazard. Putrescible and household waste shall not be discharged in the base cell. Suitable cover consists of soil, utilized in accordance with Section 2.7 or other material as deemed acceptable by the Regional Waste Manager.	Yes	Base cell layer contains only construction and demolition waste. Firebreaks present throughout but not required by OC to be reported on in annual report.	7.0 Environmental protection programs. Detailed information available in 2019 Design Plan report (Golder, 2019a) section 6.0 Regulatory Design and Closure Requirements
2.6	All waste shall be placed in cells of a size acceptable to the Regional Waste Manager. The working face shall be confined to the smallest practical area. Waste shall be discharged in layers of 0.6 metres or less and compacted to the smallest practical volume. Intermediate cover, consisting of a minimum 0.30 metre of suitable cover material shall be applied as the filling proceeds. Side slopes shall be a maximum of 1:3 (vertical:horizontal). During non-discharge hours, the working face shall be covered with a tarp or other measures to the satisfaction of the manager to provide vector and litter control. The working face shall be covered with a minimum of 0.15 metres of suitable cover material once a week. The manager may vary the frequency of covering when fire prevention measures are used to affect normal operations. Urban park quality soil may be utilized for berm construction, intermediate and final cover, top dressing and landscaping. Soil with any substance with a concentration exceeding the lowest applicable numerical soil standard for urban park land may only be used for internal berms or intermediate cover. The utilization or discharge of special waste soil is prohibited.	Yes	Active face kept as small as possible per operating procedure. Daily cover - minimum 0.15 m used. Intermediate cover - typical 0.6 m used. Litter fencing installed.	2019 Operating Plan Report (Golder, 2019b), section 7.2 Operating Parameters (7.2.3 Active Face)
2.7	Urban park quality soil may only be used for internal berms or intermediate cover. The utilization or discharge of special waste soil is prohibited.	Yes	Urban Park quality soil used for landscaping, berms, intermediate and final cover. Stockpile of urban park soil kept separate from other soils used for daily cover.	2019 Operating Plan report, sections 3.0 Regulatory Operating Requirements and 6.2.4 Temporary Soil Stockpile Area
2.8	The operational certificate holder shall submit a closure plan for the area identified as the "100 acre reserve" to the Regional Waste Manager by December 31, 2001 for approval. For the remainder of the landfill, the operational certificate holder shall apply final cover to any area of the landfill, which will not receive any further waste. Final cover shall be applied within one (1) year of completing the subject area. Final cover shall consist of a minimum of 1.0 metre of low permeability (<1 x 10 ⁻⁵ emfs) compacted soil (or equivalent) cap plus a minimum of 0.15 metre of topsoil and suitable vegetative cover. Soil shall be utilized in accordance with Section 2.7. Final cover shall be sloped to promote surface water runoff. Surface water runoff shall be directed outside of the leachate collection system.	Yes	Final closure of "100 Acre reserve" referred to as Western 40 Hectares was completed in 2019.	2019 Operating Plan report, section 5.4 Filling Progression 2018 to 2024. Closure design available in the report.
2.9	The operational certificate holder shall maintain a buffer zone along the north, east and south perimeters of the site, approximately as shown on Site Plan B and as follows: a minimum of 50 metres wide along the west half of the northern boundary and 30 metres wide along the balance of the northern boundary; and a minimum of 50 metres wide along all remaining boundaries. The buffer zone along the southern boundary of the site shall include a minimum fifteen (15) metre wide natural or landscaped screen.	Yes	Minimum buffer zones maintained.	2019 Operating Plan report, Site Layout Plan (first drawing after references)
2.10	The operational certificate holder shall post a sign, to the satisfaction of the Regional Waste Manager, at the entrance of the landfill site with the following current information: site name, owner and operator, contact telephone number and address for owner or operator, telephone number in case of emergency, hours of operation, materials and wastes accepted for recycling and landfilling, prohibited materials and wastes, and tipping fees.	Yes	Sign posted behind gates at landfill entrance with required information.	Google Maps Street View: 5400 72nd St. Delta, BC.
2.11	The operational certificate holder shall take all reasonable measures necessary to prevent fires from occurring at the site. Provide and maintain fire fighting equipment and materials to the satisfaction of the Regional Waste Manager. The operational certificate holder is responsible for complying with all municipal fire safety requirements. In the event of a landfill fire, immediately notify the local fire department, the Provincial Emergency Program and the manager.	Yes	Fire prevention and control plans in place. Safe Operating Guidelines in place for staff use with respect to fire monitoring, prevention and response.	2019 Operating Plan report section 12.0 Fire Safety Plan
2.12	This operational certificate does not authorize the discharge of leachate to the environment. The operational certificate holder shall, to the satisfaction of the Regional Waste Manager, take measures to minimize leachate generation, including but not limited to, providing effective covering and surface water runoff. Measures taken, their effectiveness and any proposed measures shall be detailed in the annual report required in Section 3.5.2. The leachate collection works shall be maintained in accordance with sound engineering principles as supported by qualified personnel.	Yes	Leachate contained through perimeter ditch system and discharged to Annacis Island Waste Water Treatment Plant via sowers. Storm water runoff from closed areas of the landfill is collected in storage ponds. This water is discharged to the environment when proven to meet water quality criteria - otherwise it managed as leachate.	7. Environmental protection programs

Authorized Person Initial: MAA

Date: Mar 30/23

AUTHORIZATION CLAUSE NUMBER	AUTHORIZATION CLAUSE DESCRIPTION	COMPLIANT? (Yes/No/ND)	RATIONALE FOR YOUR COMPLIANCE DETERMINATION	LOCATION OF SUPPORTING INFORMATION IN ANNUAL REPORT
2.13	Submit a report to the Regional Waste Manager by April 30, 2001 detailing measures taken to minimize odours and greenhouse gas emissions and their effectiveness. The report shall also include a description of any planned measures, including energy recovery, and an implementation schedule. The annual report required by Section 3.5.2 shall include a description of measures taken and the beneficial results accomplished by those measures, any revisions to the implementation schedule and any new measures planned for the coming year.	Yes	Report submitted in 1999. LFG collection system reduces odours and greenhouse gas emissions by collecting LFG and conveying to flare plant. Gas conditioning plants to convert LFG to RNG currently in construction.	Final Report Vancouver Landfill Gas Management System Project I (Conestoga-Rovers & Associates, 1999) Annual Report section 7.4 Landfill gas management
2.14	The amount of compostable materials and finished compost accumulated at the facility authorized in Section 1.4 shall be limited to the maximum which can be properly managed at the site.	Yes	Compostable materials and compost produced reported in annual report. Amounts produced are manageable at the site.	6.5 Yard trimmings collection and composting
2.15	The amount of recyclable materials and household hazardous waste accumulated at the facility authorized in Section 1.3 shall be limited to the maximum which can be properly managed at the site.	Yes	Residential volumes only accepted for HHW and recyclable materials. Quantities and manageable and reported annually.	6.3 Zero Waste Centre, 8.3 Household hazardous waste
2.16	Conduct a hydrogeological assessment to determine the following: the hydrogeological impact of continuing extraction of sand and water from the dredge pond and its effect on leachate management; the natural attenuation properties of the peat and silt layers in the long term; the effect of additional height of waste on the horizontal hydraulic conductivity of the demolition layer (base cell); and the hydrogeological impact of current operating practices. The hydrogeological assessment shall be reviewed and updated every five (5) years. The first review shall occur prior to December 31, 2005.	Yes	Current Hydrogeological Review was completed in 2018. The 2023 Hydrogeological Review is being developed and will be submitted by Dec 31, 2023. Review completed every 5 years.	2019 Operating Plan report section 6.8 Reporting, Table 8
2.17	Register a covenant or other legal notification acceptable to the Regional Waste Manager, not later than 6 months following the subdivision of the property described in Section 1.1.7, that the property was used for the purpose of waste disposal as a charge against the title to the property. Notify the manager of the registration of the covenant or legal notification.	Yes	N/A in 2022	N/A
2.18	Operate the facilities authorized in Sections 1.1, 1.2, 1.3 and 1.4 in accordance with a design and operating plan certified by a qualified professional licensed to practice in the Province of British Columbia. The operational certificate holder shall review the plan on an annual basis. Any revisions to the plan shall be submitted to the Regional Waste Manager as part of the annual report.	Yes	Updates to Operating Plan available in annual report.	2. Design and operating plan. Full reports are 2019 Design Plan report and 2019 Operating plan report.
2.19	Accrue, during the life of the landfill, a dedicated reserve fund in a form acceptable to the Regional Waste Manager, sufficient to finance closure, post-closure and environmental contingencies related to the landfill. The estimated cost of carrying out closure and post-closure activities for a minimum post-closure period of twenty five (25) years and how the fund will be accrued shall be included in the design and operating plan. The estimated costs of closure and post-closure activities shall be updated annually and reported to the manager as part of the annual report. Should the estimated costs of closure and post-closure increase then the operational certificate holder shall increase the rate of accrual accordingly.	Yes	NPV for closure + post closure costs = \$128.1 million (\$112.7M end 2023) Capital reserve balance = \$70.9 million	3. Closure and post closure costs
2.20	The operational certificate holder shall submit a closure plan for the facilities at least six (6) months prior to the closure of the landfill to the Regional Waste Manager for approval. The plan shall incorporate details of the closure plan and include the required information.	ND	N/A in 2022	N/A
2.21	In accordance with the Waste Management Act and its regulations, the operational certificate holder shall submit a site profile to the Regional Waste Manager not less than 10 days prior to decommissioning the facilities authorized in Section 1.	ND	Not yet decommissioned.	N/A
3.1	Record the quantity, in tonnes, of waste received at the landfill, recycling and composting facilities. Also, the quantity and destination of recyclable materials and mature compost removed from these facilities shall be recorded.	Yes	Records kept for all materials received at landfill and for outbound recycled materials. Summaries available in annual report.	For waste: Appendix 2 Table A1 For recycling and compost: 6. Waste reduction and recycling initiatives, Table 6
3.2.1	Maintain leachate, surface water and groundwater monitoring stations, approximately located as shown on the attached Site Plan D, and as outlined in Table 1. Obtain grab samples at each station and analyze for each parameter at a frequency as indicated in Table 2. Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.	Yes	Currently exceeding the number of required monitoring stations. Samples taken at required frequency at all stations and best practices are used for sampling, storing and transporting including QA/QC.	7. Environmental protection programs, Appendix 4
3.2.2	Provide and maintain a suitable flow measuring device and record the volume of leachate discharged to sanitary sewer each month.	Yes	Monthly flows recorded and tabulated in annual report.	7. Environmental protection programs, Table 8
3.2.3	Establish and maintain a minimum of four (4) ditch water level monitoring stations and record once per month the water level elevation in the leachate and drainage ditches at each station.	Yes	Exceeding required monitoring in both number of stations and frequency of recordings. Using remote water level monitoring system at 8 stations in both ditches to record water level every 5 minutes.	7. Environmental protection programs
3.3.1	Sampling and flow measurement shall be carried out in accordance with the procedures described in "British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment and Biological Samples", 1996 Edition (Permittee), 312 pp., or by suitable alternative procedures as authorized by the Regional Waste Manager. Analyses are to be carried out in accordance with procedures described in the latest version of "British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials, [March 1994 Permittee Edition]", or by suitable alternative procedures as authorized by the Regional Waste Manager.	Yes	Sampling is periodically supervised by contracted qualified professionals to verify that best practices are used during sampling.	7. Environmental protection programs, Appendix 7
3.3.2	All data analyses required to be submitted by the permit shall be conducted by a laboratory acceptable to the Regional Waste Manager. At the request of the manager, the operational certificate holder shall provide the laboratory quality assurance data, associated field blanks, and duplicate analysis results along with the submission of data required.	Yes	Samples are only sent to laboratories certified to perform the analyses.	7. Environmental protection programs, Appendix 7
3.3.3		Yes	Same as 3.3.2.	Same as 3.3.2.

Authorized Person Initial: MB

Date: Mar 30/23

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3.4	The operational certificate holder shall maintain the following information and records, current and suitably tabulated, at the landfill office for inspection: a copy of Operational Certificate MR-01611; training procedures and personnel training records; contingency plans and notification procedures; the current design and operating plan; inspection records from staff and regulatory agencies; hydrogeological, geotechnical and landfill gas assessments; incoming waste, and soil records; records of recyclable materials shipped off site; environmental monitoring results and interpretations; and annual operating and monitoring reports for the previous year.	Yes	All required records are stored at the Landfill Technical Trailer and electronically.	N/A
3.5.1	Maintain data of analyses and records of waste and recyclable material quantities for inspection. Submit the data of analyses suitably tabulated, to the Regional Waste Manager for the previous three months. The reporting period ends March 31, June 30, September 30 and December 31. All reports shall be received by the manager within 31 days of the end of the reporting period.	Yes	Data maintained and reported in accordance with described schedule.	N/A
3.5.2	Prepare an annual report which shall include a compendium of data submitted under Section 3.5.1. In addition, the annual report shall include the following: a review and interpretation of the analytical data from receiving environment monitoring for the preceding year; waste, recyclable material and compost records; leachate flow data and leachate/drainage ditch levels suitably tabulated; an evaluation of leachate generation control measures; an evaluation of the efficiency of the landfill gas management system, including an estimation of the landfill gas generation rate, percent recovery and the actual rates/volumes of gas collected, utilized and flared; revised closure/post closure costs and amount of funds currently available; revised design and operating plan and planned improvements; identification of operating problems and corrective actions taken; an evaluation of the recycling and composting programs including waste diversion projections; and public complaint/resolution log for the landfill. The annual report shall be submitted to the Regional Waste Manager on or before March 31 of the following year.	Yes	2022 annual report submitted meeting requirements.	Annual Report for the Vancouver Landfill

Authorized Person Initial: MPB

Date: May 30/23