FINAL REPORT

WASTE MANAGEMENT OF CANADA CORPORATION

WATFORD, ONTARIO

TWIN CREEKS ENVIRONMENTAL CENTRE: 2023 FOURTH QUARTER & ANNUAL MONITORING REPORT VOLUME 1 OF 5 – COMPLIANCE MONITORING

RWDI #2303459.01

February 28, 2024

SUBMITTED TO

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February 28, 2024

Ms. Angela McLachlan
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Re: Waste Management of Canada Corporation
2023 Fourth Quarter and Annual Monitoring Report
Twin Creeks Environmental Centre, Warwick Township, County of Lambton, Ontario
Volumes 1 and 2 - Text, Figures, Tables, and Appendices

Dear Ms. McLachlan,

RWDI AIR Inc. (RWDI) is pleased to provide the 2023 Fourth Quarter and Annual Monitoring Report**, Volumes 1** and **2:** Compliance Monitoring and Operations Program, for the Twin Creeks Environmental Centre. **Volume 1** includes the text, figures, and tables. **Volume 2** includes the appendices, which contain the technical information and supporting documentation for the Compliance Monitoring and Operations Program and is provided in two (2) bound sections. **Volume 3** – Poplar System Monitoring Program, **Volume 4** – Ambient Air Quality Monitoring Program, and **Volume 5** – Noise Monitoring Program, are provided under separate covers.

In November 2010, the Ministry of the Environment (MOE) issued the Technical Guidance Document entitled "*Monitoring and Reporting for Waste Disposal Sites, Groundwater and Surface Water*" (MOE, 2010). Appended to this report is a completed Monitoring and Screening Checklist from the above Technical Guidance Document, which provides certification of the Competent Environmental Practitioner (CEP). The Monitoring and Screening Checklist is provided in **Appendix S**.

Volumes 1 and 2 of the 2023 Fourth Quarter and Annual Monitoring Report have been prepared in consideration of Conditions 15.4 through 15.7 of amended Environmental Compliance Approval (ECA) No. A032203 dated December 19, 2020, then as amended on February 4, 2023, and then as further amended on December 16, 2023 (Waste ECA), and provides a detailed interpretive analysis of the 2023 findings for the compliance monitoring at the Twin Creeks Environmental Centre and a summary of its operations in 2023.

We trust that this report satisfies your requirements. Please contact us if you have any questions.

Yours truly,

RWDI

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1 INTRODUCTION

1.1 Purpose & Scope

The purpose of the 2023 Compliance Monitoring and Operations Program for Waste Management of Canada Corporation's (WM) Twin Creeks Environmental Centre (Site) is as follows.

- To report compliance with the terms and conditions of the relevant Environmental Compliance Approvals (ECAs) (waste, sewage, and air) and regulatory permits (PTTW) for the Site, the landfill gas flare systems, and stormwater management facilities for the reporting period of January 1 to December 31, 2023.
- To satisfy Conditions 5, 6, and 7 of the Environmental Assessment Act approval, dated January 15, 2007.
- To assess potential effects of the landfill on groundwater and surface water quality.
- To evaluate the monitoring program(s) on an annual basis and to recommend improvements as operations at the Site mature.
- To determine the need for the implementation of contingency measures.

Volumes 1 and 2 of the 2023 Fourth Quarter and Annual Monitoring Report (2023 Annual Report) satisfy the reporting requirements for both the fourth quarter (Q4) of 2023 (October 1 to December 31) and the 2023 compliance monitoring and operations calendar year monitoring period. Reporting involves a data collection component and a comprehensive analysis and interpretation component. The 2023 data were collected by WM and RWDI AIR Inc. (RWDI), while the data compiled for **Volumes 1 and 2** of the 2023 Annual Report were collated and analyzed by RWDI. The following presents a summary of the data collection responsibilities for the Compliance Monitoring Program in 2023.

Waste Management of Canada Corporation:

- Operations Logs (Dust and Litter)
- Leachate Volume Tracking
- Tonnage Tracking Information (Waste & Recyclables)
- Water Taking Information
- Complaint Logs
- Collection of Daily Liquid Levels from Expansion Landfill PDL Pumping Stations

RWDI AIR Inc.:

- Liquid Level Monitoring (Leachate and Groundwater)
- Groundwater Quality Monitoring
- Surface Water Quality Monitoring
- Contaminated Soil & ASR Quality Monitoring
- Leachate Quality Monitoring
- Monthly Collection of Liquid levels from Expansion Landfill SDL Pumping Stations
- Monthly Site Inspections
- Overall Data Collation and Reporting

Air quality, noise, total suspended particulate and Poplar System monitoring, and reporting were also completed by RWDI in 2023. The monitoring results, analysis, and interpretation for the Poplar System Monitoring Program are presented in **Volume 3** of the 2023 Annual Report. Approval to discontinue the monitoring of the Poplar Plantation was received on February 20, 2013, per Notice No. 1 of the Sewage ECA. Therefore, a relevant volume is not included in this Annual Report.

1.2 Site Regulatory Framework

The Site is owned and is operated by WM in conformance with the regulatory approvals noted below. Copies of the relevant ECAs and their amendments, as well as the PTTW, are provided in **Appendix A**.

- Amended Environmental Compliance Approval (ECA) No. A032203, dated December 16, 2023. It is noted that during the 2023 calendar year, WM was required to conform to the Amended ECA dated December 19, 2020, then as amended on February 4, 2023, and then further amended on December 16, 2023 (Waste ECA).
- Amended ECA for Industrial Sewage Works No. 2403-BE6LZ4, dated August 21, 2019 (Sewage ECA).
- Amended ECA for Air No. 6318-CX4NFX, dated December 13, 2023. It is noted that during the 2023 calendar year, WM was required to conform to Amended ECA for Air No. 4155-BMCLZ8, dated March 3, 2020 and then the Amended ECA for Air No. 6318-CX4NFX, dated December 13, 2023 (Air ECA).
- Permit-To-Take-Water (PTTW) No. 4682-BLJRYJ, dated November 8, 2021, for the removal of surface water from four (4) Sedimentation Ponds and the dewatering of the Secondary Drainage Layer (SDL) for the Expansion Landfill.
- MECP Letter entitled "Request for Modification to Surface Water Monitoring/Assessment Process at Twin Creeks Landfill", dated February 27, 2014 (2014 MECP Letter).

Throughout 2023, quarterly monitoring reports were submitted to relevant stakeholders in accordance with Condition 15.4 of the Waste ECA. **Volumes 1 and 2** of the 2023 Annual Report have been prepared in consideration of Conditions 15.4 through 15.7 of the Waste ECA and Condition 12(3) of the Sewage ECA. **Volumes 1 and 2** provide a detailed analysis of the 2023 findings for the compliance monitoring at the Site and its operation in 2023.

This 2023 Annual Report is also prepared in accordance with Conditions 5, 6, and 7 of the Notice of Approval to Proceed with the Undertaking, dated January 15, 2007, in regard to the Environmental Assessment Act (EAA) approval of the Warwick Landfill Expansion (renamed Twin Creeks Landfill and subsequently to Twin Creeks Environmental Centre).

1.3 Site Description & Background

The Site is a solid, non-hazardous waste landfill site that contains an old landfill (Existing Landfill) and an area approved for expansion (Expansion Landfill). The Site is located on Part of Lots 19 and 20, Concession 3, south of Egremont Road (SER), and part of Lots 20 to 22, Concession 4 SER, in the Township of Warwick, County of Lambton, Ontario. The Site occupies an area of 301 hectares (ha) with 101.8 ha permitted for landfilling. A Site Location Map is presented on **Figure 1**.

Landfill waste at the Site has two (2) distinct waste disposal areas: 1) the Existing Landfill; and 2) the Expansion Landfill. The Existing Landfill is divided into waste cells as presented on **Figure 2**. The progression of construction of the Expansion Landfill is summarized below and presented on **Figure 2**.

Expansion Landfill Cell	Date of First Waste Tonnage Deposited
Cell 1A Stage I	November 16, 2009
Cell 1A Stage II	September 21, 2010
Cell 1B Stage I	August 18, 2011
Cell 1B Stage II	June 20, 2012
Cell 2A	November 18, 2013
Cell 2B	September 25, 2014
Cell 2C	September 10, 2015
Cell 2D	August 19, 2016
Cell 2E	September 8, 2017
Cell 4A Stage 1	September 25, 2019
Cell 4A Stage 2	November 14, 2019
Cell 4B Stage 1	September 22, 2020
Cell 4B Stage 2	November 23, 2020
Cell 4C	August 10, 2021
Cell 6A	September 14, 2022

The South Cell (formerly South Fill Area) of the Existing Landfill consists of historical waste landfilled into trenches of various widths and depths excavated into the clayey soil. There are three (3) finger drains that transect through the trenches to provide gravity drainage toward the perimeter maintenance holes (MH16, MH17, and MH18) for leachate collection. The remainder of the waste footprint of the Existing Landfill contains older waste cells that are completed with waste trenches, but also includes newer waste cells constructed with re-compacted clayey liners with waste underdrains.

Waste within the Expansion Landfill will extend to an average design depth of 15 m below existing grade. Leachate is managed with a liner system that directs leachate toward dedicated leachate pumping stations. The liner system consists of a primary drainage layer (PDL) below the waste to convey leachate, an underlying re-compacted clayey liner (primary liner), then a secondary drainage layer (SDL) for leak detection and contingency use, which is all underlain by a thick natural barrier of clayey soil. Design specifications are provided under Items 66 to 68 in Schedule A of the Waste ECA, namely, the report titled "*Development and Operations Plans – Warwick Landfill Expansion (Volumes 1 to 3)*", as prepared by Henderson Paddon & Associates and dated March 2008 (D&O Report).

Leachate generated at the Site can be managed either on-Site through irrigation for poplar trees to be treated by phytoremediation or by transport for off-Site treatment and disposal. The Poplar System was decommissioned in June 2014 as part of the construction activities to expand the footprint from the previous 3.3 ha to 9 ha. Leachate phytoremediation is approved for the expanded Poplar System located within the waste footprint of the Existing Landfill, as shown on **Figure 2**. In 2023, irrigation liquid was applied to the poplar trees intermittently from May 2 to October 12. It should be noted that the Poplar System pertains to a plot of poplar trees planted on the landfill cap of the Existing Landfill, whereas the Poplar Plantation refers to the plot of trees planted on native soil and is located south of the Existing Landfill. Details pertaining to the Poplar System Monitoring Program completed in 2023, including surface water monitoring in response to precipitation events of ≥ 10 millimetres (mm) in 24 hours, are provided in **Volume 3** of the 2023 Annual Report.

Surface water flow is ephemeral, with flow that typically occurs after snowmelt or prolonged periods of precipitation. Details on the surface water quality system are provided in **Section 2.4**. In summary, surface water is managed through a network of on-Site ditches, a Temporary Water Storage Area, and four (4) on-Site Sedimentation Ponds. Surface water runoff from the Site flows toward: 1) Kersey Drain (Brown Creek) to the east, and 2) to drains and ditches associated with Bear Creek to the west.

Assessments of local groundwater and surface water have continued to achieve acceptable quality at the Site compliance boundaries. A list of historical monitoring reports is provided in **Table B-1**, **Appendix B**.

For reference to the Site construction design details, **Appendix L** contains construction details of the Existing and Expansion Landfills, with the breakdown as outlined below.

Existing Landfill:

The construction details: *"Laidlaw Waste Systems (Warwick) Limited, Warwick Township Landfill Site, Development and Operations Plan"* from the Development & Operations Report, Canadian Waste Services Inc., Warwick Landfill, Warwick Township (Henderson, Paddon Environmental Inc., October 1997), which is Item 37 of Schedule A of the Waste ECA (included as **Appendix L-1**, **Appendix L**).

Expansion Landfill:

The construction details: *"Drawings 111 – 120, 125, and 127"* from the Development & Operations Plans, Warwick Landfill Expansion, Volume 1 of 3, which is Item 66 of Schedule A of the Waste ECA (included as **Appendix L-2**, **Appendix L**).

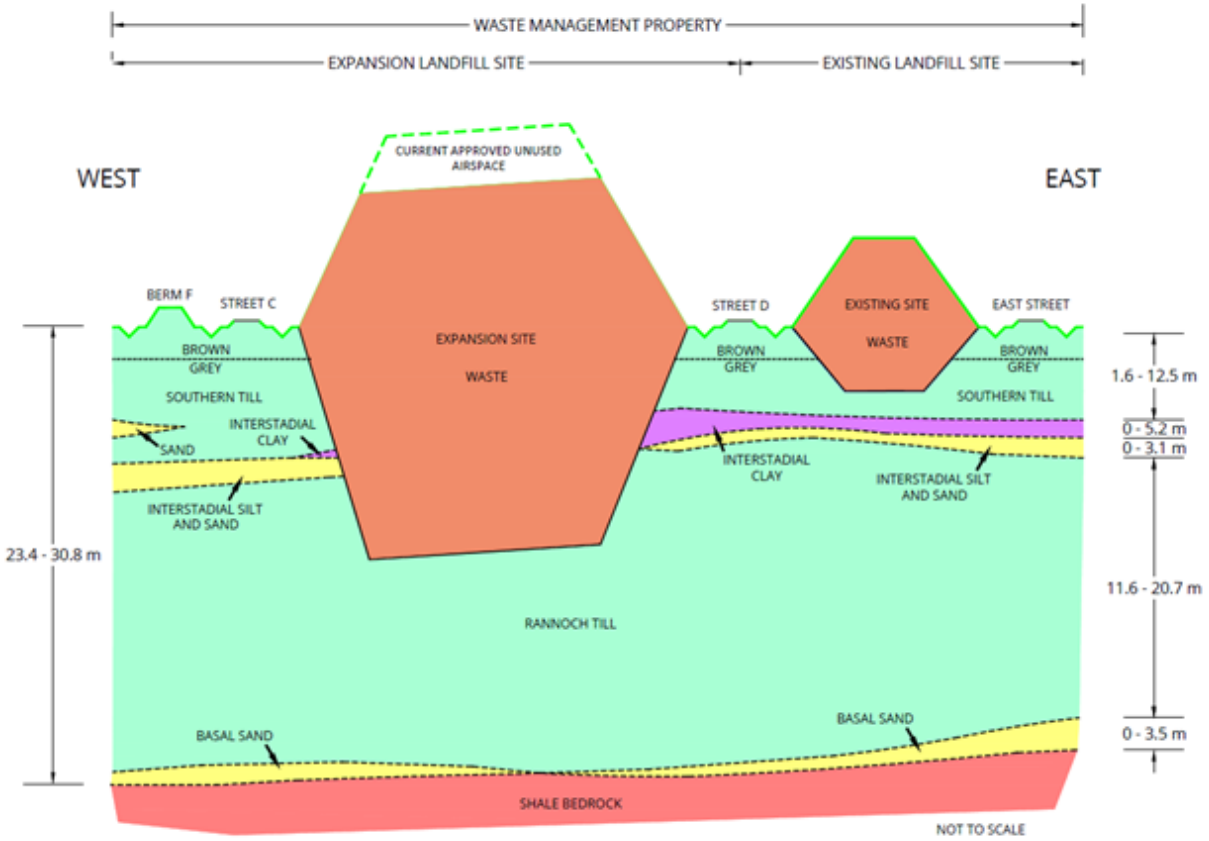
As-built Information for Waste Cells Constructed in 2023:

The liner system for Cell 6B is approximately 95% complete. It is expected to be completed in 2024. The CQA/CQC Liner System Summary Report (Cell 6B) will be submitted following the completion of the liner system.

1.4 Site Hydrogeologic Setting

The landfill is located in southwestern Ontario within the southeastern portion of the Horseshoe Moraines physiographic region (Chapman and Putnam, 1984). The Horseshoe Moraines consist of a large horseshoe-shaped landform that includes a series of moraines aligned roughly parallel to the Lake Huron shoreline. Bear Creek to the west and Brown Creek to the east provide a slightly rolling topography around the Site. This rolling topography is further enhanced by the local tributaries and drainage swales.

For the purpose of this report, the local stratigraphy is subdivided into the following main units: 1) the Southern Till; 2) interstadial deposits; 3) the Rannoch Till; and 4) bedrock and the overlying basal sand. Each unit is shown in the following cross-section and is briefly discussed below.



The **Southern Till** unit consists of silty clay to clayey silt with trace amounts of disseminated sand and gravel. Occasional discontinuous layers or lenses of sand were observed within this unit. At the Site, this unit ranges in thickness from approximately 1.6 m to 12.5 m. The upper 1.6 m to 5.0 m of the Southern Till is weathered and is generally identified by a brown colour. Soil fractures are numerous near ground surface and decrease in frequency with depth. The underlying unweathered Southern Till is grey in colour and contains occasional fractures.

The **interstadial deposits** generally consist of two (2) distinct deposits: 1) an upper deposit of silt and clay, often varved, that is up to 5.2 m in thickness; and 2) a lower deposit of silt to sand that is up to 3.1 m in thickness. At some borehole locations, one or both deposits were not detected which indicates that these deposits are not continuous below the Site. Below the Site, the interstadial silt and sand ranges from 4.0 m to 10.7 m below ground surface where detected.

At about 4.0 m to 10.3 m below ground surface is the **Rannoch Till**. This till is a gritty to moderately stony clayey silt to silt till, although some textural variations occur. At some borehole locations, layers or lenses of silt to sand were detected within the till. The Rannoch Till was up to about 21.4 m thick below the Site.

Occasional discontinuous layers of sand and gravel between the Rannoch Till and underlying bedrock constitute the **basal sand**. The **bedrock** was encountered at a depth of between 23.4 m and 30.8 m below ground surface at the landfill and consists of the black bituminous shale of the Kettle Point Formation. The upper fractured portion of the bedrock and the overlying basal sand form the local bedrock aquifer.

The two (2) creeks that influence the physiography of the regional study area include Bear Creek to the west and Brown Creek to the east. The watershed for Bear Creek includes most of the Site and the area to the west. The Drainage Divide for the Bear Creek watershed cuts through the northeastern corner of the Site. Bear Creek is a tributary of the North Sydenham River and flows southwesterly to join the Sydenham River at Wallaceburg.

Surface water flow is ephemeral, with flow that typically occurs after snowmelt or prolonged periods of precipitation. Runoff from most of the east half of the Existing Landfill flows to Sedimentation Pond 1 (SP1), while runoff from the northern portion of Cell 11 and the west half of the Existing Landfill from north of approximately Cell 8/6 boundary flows to Sedimentation Pond 4 (SP4), drainage from most of Cell 6 flows into a Temporary Water Storage Area, while runoff from the remainder the west half of the Existing Landfill is directed to Sedimentation Pond 2 (SP2).

Sedimentation Ponds 1 through 4 are four (4) on-Site Sedimentation Ponds constructed in 2009 to manage surface water for the Site. Sedimentation Pond 1 discharges onsite and ultimately flows through surface water monitoring station SS1 that in turn discharges into a tributary of Bear Creek on the east side of Lambton Road 79 (Nauvoo Road). Sedimentation Pond 2 discharges through culverts to the western Site boundary and into a tributary of Bear Creek on the east side of Nauvoo Road. It is noted that flow from SS1 and flow from SP2 both discharge to the east side of Nauvoo Road at the box culvert under the road. Sedimentation Pond 3 discharges to the east side of Nouvoo Road near the northwestern portion of the site. Sedimentation Pond 4 discharges onsite and ultimately flows through a culvert that discharges to the southern side of Zion line. The surface water system around the Site is presented on **Figure 3**.

Surface water runoff is managed through Sedimentation Ponds 1, 2, 3, and 4. Surface water runoff originating from areas south of the Existing Landfill flows toward: 1) Kersey Drain (Brown Creek) to the east; and 2) to the west toward the Van Kessel Drain where it enters a municipal drainage tile at a catch basin (surface water monitoring station SS1), which is situated 60 m east of the western Site boundary. The municipal drainage tile subsequently drains into the discharge ditch of Sedimentation Pond 2, which ultimately flows westward to the Gilliand-Geerts Drain 'A', beneath Lambton Road 79.

The Brown Creek watershed drains the area east of the Site, including the northeast corner of the Existing Landfill. Brown Creek is a southwesterly flowing headwater of the Sydenham River, which it intersects about 1.3 kilometres (km) northeast of Alvinston.

1.5 Water Budget

Water budgets are provided in **Tables C-1** through **C-7**, **Appendix C,** for the 30-year normals (1961-1990, 1971-2000, 1981-2010, and 1991-2020) and the 2021 through 2023 climatic data for the area around the Site. The water budget information is based on the Thornthwaite Analytical Method (1957). A summary of precipitation data for the 30-Year Normal (1961-1990, 1971-2000, 1981-2010, and 1991-2020) and the 1995 through 2023 annual climatic data for the area around the Site is provided in **Table C-9, Appendix C.** The 30-year normal and data to 1996 were collected at the Strathroy Climatological Station. Data from 1997 onward were collected from the Strathroy-Mullifarry Climatological Station, which is the nearest Environment Canada climatological station to the Site. Precipitation data collected from the on-Site climatological station from January 1 to December 31, 2023, is also provided in **Table C-8**, **Appendix C**. As presented in **Table C-9, Appendix C**, a total of about 906.2 mm of precipitation was recorded from the on-Site climatological station during 2023, while the Strathroy-Mullifarry Climatological Station recorded about 1,140.4 mm of precipitation in 2023.

Relative to the 30-Year Normal (1991-2020), 2023 was wetter than normal as recorded at the climatological station. The 2002 to 2023 on-Site precipitation data from January 1 to December 31 indicates that the yearly precipitation received at the Site was consistently less than the regional total. For example, the precipitation recorded from the on-Site climatological in 2023 was approximately 20.5% less than what was measured at the Strathroy-Mullifarry Climatological Station. This pattern of annually less precipitation recorded at the Site than recorded regionally, has typically been observed since on-Site precipitation monitoring began in 2003 (2003 was first full year of monitoring). Notwithstanding this observation, within the last five (5) years, 2023 was noted to have been the wettest year. 2023 experienced two kinds of precipitation occurrences that were of note that occurred multiple times throughout the year. The two different kinds of events were:

1) Multiple short duration, high magnitude events (i.e. August 23, 2023 where the site recorded 114.4 mm in 24 hours); and
2) Prolonged periods of precipitation over multiple weeks (i.e. it rained 20 of the 31 days in October 2023).

Based on the available historical data from the Environment Canada climatological stations year-to-year, there is typically a water deficit (evapotranspiration exceeds precipitation) from May through September. Therefore, there is a low potential for overland flow and an increase in infiltration rates during this period, which is beneficial for the operation of a Poplar System. For the period from October through April, typically there is a water surplus (precipitation exceeds evapotranspiration) results in a greater potential for overland flow and a decrease in infiltration rates.

1.6 Monitoring System & Schedule

The monitoring system and schedule for the site follows the requirements of the site regulatory framework as outlines in **Section 1.2**, as well as the environmental monitoring plan, as prepared by Jagger Hims Limited, dated December 6, 2007 (EMP).

Table 1 provides a schedule of the monitoring tasks completed in 2023. Also, provided in **Table 1** are rationales for monitoring requirements that were not completed in 2023. The annual monitoring program completed for the 2023 calendar year, including the relevant monitoring locations, parameters, and frequency, is outlined in **Table B-2**, **Appendix B**. **Table B-3**, **Appendix B**, provides a summary of changes to the EMP as approved by the Ministry of the Environment, Conservation and Parks (MECP). **Table B-4**, **Appendix B**, provides a summary of Compliance Point trigger concentration exceedances in 2023. Borehole logs and monitoring well information are provided in **Appendix D**. Monitoring well construction details are also summarized in tabular format as provided in **Table F-1**, **Appendix F**.

2 MONITORING METHODS

The 2023 Compliance Monitoring Program for groundwater, surface water, landfill gas, leachate, air quality and noise were completed by RWDI between January 1 and December 31, 2023. Liquid level monitoring of the PDL and SDL of the Expansion Landfill was recorded automatically with pressure transducers and recorded by a SCADA system. Monitoring locations included in the annual monitoring program are listed in **Table 1** and presented on **Figure 2.**

Copies of the Chain of Custody Forms, as it relates to water, leachate, and soil, for samples submitted to the laboratory in 2023 are provided in **Table B-5**, **Appendix B**. A quality assurance and quality control (QA/QC) program was followed for each of the routine monitoring tasks completed. This program consists of procedures for the sampling of monitoring wells, the collection of samples, and ancillary tasks. A copy of the field sampling protocols is provided in **Appendix E**.

Monitoring well construction details are provided in **Table F-1**, **Appendix F**. Monitoring wells, which were included in the 2023 annual monitoring program, are designated as 'Active'. Other monitoring wells not included in the annual monitoring program are designated as 'Inactive'. Some historical monitoring wells that were recently removed and/or replaced from the monitoring program may be designated as 'Decommissioned'.

2.1 Liquid Level Measurements

Groundwater and leachate levels were manually measured at accessible monitoring wells, leachate wells, and maintenance holes located on the Site on May 1 and November 1, 2023.

Daily, during landfill operations, liquid levels for the leachate within the PDL at PS1, PS3, PS5, and PS7, as well as monthly groundwater levels for the water in the SDL at PS2, PS4, PS6, and PS8. Groundwater and leachate elevations are discussed in **Section 4**.

2.2 Leachate Sampling

Leachate samples were collected using dedicated disposable bailers for the relevant monitoring locations. Leachate samples were collected from select maintenance holes and pumping stations on May 2 and 3, 2023.

Leachate from the Equalization Tank was conveyed into 20 litre (L) pails, which were rinsed with leachate prior to sample collection. The sampling point for the Equalization Tank is at the truck loading bay for PS10. The Equalization Tank is sampled on a quarterly basis. The leachate within the Equalization Tank represented leachate from: PS1 (Cell 1), PS3 (Cell 2), PS5 (Cell 4), PS7 (Cell 6A) most of the Existing Landfill, as well as partially derived from the condensate from the landfill gas collection systems installed in the Existing and Expansion Landfill. During 2017, each cell with a leachate collection system within the Existing Landfill was automated for leachate transfer to the Equalization Tank, with the exception of the eastern portion of Cell 3S (MH3SA and MH3SB), and the northern portion of Cell 4 (MH4B). In late 2022, MH3SB was automated for leachate transfer to the Equalization Tank. As such, leachate sampled from the Equalization Tank included leachate from the Existing Landfill throughout 2023.

Leachate was collected from PS1 (Cell 1), PS3 (Cell 2), PS5 (Cell 4), and PS7 (Cell 6A) via dedicated Waterra tubing equipped with a manual inertial-lift pump during the required annual sampling event in May. Leachate samples for soluble metals did not require field-filtering, but were preserved as required, while leachate samples for dissolved organic carbon (DOC) were field filtered and preserved.

Leachate chemical results for the aforementioned various sampling locations are discussed in **Section 5.1**.

2.3 Monitoring Well Sampling

Groundwater samples were collected from May 1 to 4, 2023 for the spring semi-annual monitoring event. During the fall semi-annual monitoring event, groundwater sampling was completed from November 1 to 3, and November 13, 2023.

Groundwater samples were collected using dedicated low flow bladder pumps.

The cemetery well is sampled annually in the spring by manually purging approximately 100 L using the cemetery well's existing manual inertial-lift pump. Although not evaluated as a drinking water source, as there is not restriction to how the water could be used from the cemetery well, metals sampling did not include field filtering because the water could potentially be utilized as drinking water.

As part of Site operations and to protect groundwater resources, some inactive monitoring wells were retained for potential future use as part of the monitoring program of the Expansion Landfill. This includes monitoring well OW59-10. Although monitoring well OW59-10 is considered an 'inactive' monitoring well, liquid levels are being assessed at OW59-10 to evaluate groundwater conditions near Cell 7 of the Existing Landfill. Idle monitoring wells OW39-6 and OW39-12 were decommissioned in 2017 during replacement activities related to damaged OW39-26. Monitoring locations OW61, OW62, OW75, OW76, OW77, OW78, and OW85 are currently inactive, as these monitoring wells are utilized to assess groundwater quality as it pertains to the operation of the Poplar Plantation. Since the Poplar Plantation has been inactive since its construction in 2009, groundwater quality assessment is not required to be completed in that location, which is also approved under Notice No.1 of the Sewage ECA.

Groundwater monitoring well nests OW82, OW83, and OW84 were sampled, as scheduled, for the first time in May 2023, following their installation in 2022.

Groundwater chemical results for the monitoring wells that were required to be sampled in 2023 are discussed in **Section 5.2**.

In consultation with the Landfill Engineer and Hydrogeologist Reviewers of the Technical Review Team (TRT), WM had agreed post-2016 to supplement the existing leachate level monitoring. The supplemental leachate level monitoring locations (LW1 through LW6) were installed within the Existing Landfill in late 2017. The locations of the select landfill gas extraction wells from within the Expansion Landfill were determined in 2018 [EV229 in Cell 1A (Stage 1), EV268 in Cell 1A (Stage 2), EV022 in Cell 2B, and EV226 in Cell 2D], as shown on **Figure 2**. These supplemental leachate level monitoring wells are proposed to be monitored semi-annually together with the already established semi-annual spring and fall monitoring events for the Site to provide further insight toward leachate patterns within select waste cells of the Existing Landfill, as well as the Expansion Landfill.

2.4 Surface Water Sampling

2.4.1 Surface Water Flow

Surface water flow at the monitoring stations is precipitation dependent. Adequate flowing conditions to conduct surface water sampling were noted during Q1, Q2, Q3 and Q4 of 2023. After some precipitation events, some of the sampling stations did not produce the required flow for sampling. The observation of no flowing conditions after rain events $\geq$ 10mm/24hrs is expected and has been identified since precipitation monitoring began in 2003 at the Site. Verification surface water sampling events were also conducted, where required, in 2023.

As approval to discontinue monitoring the Poplar Plantation was received from the MECP on February 20, 2013, the surface water monitoring program for SS17A/B and SS18A/B remained inactive during the 2023 monitoring period.

2.4.2 Mechanism for Response Routine Monitoring

In general, for the surface water monitoring program, the triggering mechanism for response monitoring is the receipt of ≥ 10 mm of precipitation in a 24-hour period from 08:00 to 08:00 hours. Flowing conditions permitting, the surface water stations are sampled within a 24-hour window following the receipt of ≥ 10 mm at the Site. Surface water is sampled once per quarter as part of the required routine monitoring for the Site. If a compliance monitoring station does not produce sufficient runoff to conduct sampling (or is dry), then the next precipitation event of ≥ 10 mm in a 24-hour period will trigger the assessment of those stations that were dry during the previous assessment. This response monitoring will continue throughout a quarterly monitoring period until the compliance stations have been sampled, or the quarter ends, in which monitoring of all the compliance stations will commence again for the next quarterly monitoring period.

2.4.3 Mechanism for Response Verification Monitoring

There are two (2) types of surface water monitoring stations at the Site. The first type of station consists of an open ditch where surface water flowing conditions heavily rely on precipitation. The second type of station consists of Sedimentation Ponds. When a Primary Leachate Indicator List (PLIL) parameter exceeds its trigger concentration at a surface water monitoring station, a verification monitoring response is triggered for that monitoring station per the regulatory documents.

For the 'ditch' type monitoring stations (e.g., SS1), verification monitoring can only occur after the receipt of ≥ 10 mm of precipitation in a 24-hour period where the precipitation was sufficient to generate flowing conditions to conduct sampling. Response monitoring continues throughout the quarter until a precipitation event is sufficient to conduct sampling. If insufficient flowing conditions continue at the ditch type station throughout a quarterly monitoring period, the verification event is postponed to the next quarterly monitoring period, and consequently, the postponed, monitoring event will consider both the routine quarterly monitoring event, as well as the verification monitoring event.

Similarly, for the Sedimentation Ponds, a verification monitoring event is triggered when one or more PLIL parameters exceed their relevant trigger concentrations following the routine quarterly sampling event. The verification monitoring for Sedimentation Ponds is completed within one (1) week of receipt of the routine monitoring event's chemical analytical results, independent of precipitation occurrences (Condition 5.4.) of the Sewage ECA).

2.4.4 Precipitation Summary for Monitoring Events

Monitoring Station Locations and Sampling Details:

The surface water monitoring stations that formed part of the 2023 Compliance and Poplar System Monitoring Programs are summarized below.

Task	Monitoring Station Designations	Monitoring Station Description
Surface Water Environmental Monitoring Program	SS1	Downstream of landfill on WM property, 60 m east of Lambton Road 79 (Nauvoo Road) – Compliance Point
	SS10	Off-Site flow into East Ditch of the Existing Landfill – Background Surface Water Quality
	SS16	Flow onto expansion lands from Township land located south of the Site – Background Surface Water Quality
	SP1	Outlet Weir of Sedimentation Pond 1 – Internal assessment location
	SP2	Outlet Weir of Sedimentation Pond 2 – Compliance Point
	SP3	Outlet Weir of Sedimentation Pond 3 – Compliance Point
	SP4	Outlet Weir of Sedimentation Pond 4 – Compliance Point
Surface Water Poplar System Monitoring Program	SS14A (former SS14)	On-Site flow within East Ditch of the Existing Landfill, upstream of Poplar System
	SS14B (former SS15)	On-Site flow within West Ditch of the Existing Landfill, downstream of Poplar System as of June 2011.
	SS15A	South Ditch of the Existing Landfill and inlet point to Sedimentation Pond 1. Downstream of Poplar System.

Note: Former surface water monitoring stations SS14 and SS15, and revised/new surface water stations SS14A, SS14B, and SS15A as noted above, are required under the Waste and Sewage ECA's as part of the Poplar System Monitoring Program.

Details of the findings for the 2023 Poplar System surface water monitoring stations (SS14A, SS14B, and SS15A) can be found in **Volume 3** of the 2023 Annual Report.

A summary of the precipitation that triggered the surface water monitoring events is provided below. The precipitation amounts for the five days preceding the monitoring event are also provided. The data presented in the summary reflects that collected from the on-Site climatological station in 2023.

Quarter	Previous 5 Days of Precipitation (mm)	Sampling Events
1	0.2, 0, 0, 7.2, 10.8	February 10, 2023 – Routine monitoring event for the February 9, 2023 precipitation event.
1	0, 0.6, 0, 0, 9.0	March 17, 2023 – Verification monitoring event for the February 10, 2023 routine precipitation event from Q1.
2	0, 0.4, 5.6, 43.8, 10.8	April 2, 2023 – Routine monitoring event for the April 1, 2023 precipitation event.
2	0, 0, 0, 5.0, 2.6	April 17, 2023 – Verification monitoring event for the April 2, 2023 routine precipitation monitoring event from Q2.
2	1.2, 1.4, 0, 5.2, 9.8	May 3, 2023 – Verification monitoring event for the April 2, 2023 routine precipitation monitoring event from Q2.
3	0.4. 5.0, 0, 3.4, 20.4	July 3, 2023 – Routine monitoring for the July 2, 2023 precipitation event.
3	0, 0, 0, 0, 29.0	July 7, 2023 – Routine monitoring for the July 6, 2023 precipitation event.
3	6.4, 0.4, 0, 7.8, 30.4	July 13, 2023 – Verification monitoring for the July 7, 2023 routine precipitation monitoring event from Q3.
4	1.8, 4.8, 0.2, 0.4, 14.0	November 2, 2023 – Routine monitoring for the November 1, 2023 precipitation event.

Summary of Stations Monitored:

A summary of the surface water stations that were sampled in 2023, including a brief explanation as to why a station was not sampled, is provided below.

Surface Water Monitoring Station	Routine Monitoring	Verification Monitoring	Rationale for No Samples Being Collected
SS1	Q1, Q2, Q3, Q4	Q1, Q2	
SS10	Q1, Q2, Q3, Q4		
SS16	Q1, Q2, Q4		No flow in Q3
SP1	Q1, Q2, Q3, Q4	Q3	
SP2	Q1, Q2, Q3, Q4	Q2, Q3	
SP3	Q1, Q2, Q3, Q4		
SP4	Q1, Q2, Q3, Q4		

Surface water chemical results for the aforementioned various sampling locations are discussed in **Section 5.3**.

Biological Monitoring:

The annual biomonitoring program was completed for the April 2, 2023, spring surface water monitoring event per the EMP. Surface water samples were collected at stations SS1, SS10, SS16, SP1, SP2, SP3, and SP4 for the annual biomonitoring program.

Verification biomonitoring was also conducted at monitoring stations SS1 on March 17 (for Q1), May 3 (for Q2), and July 13 (for Q3) 2023, and at SP2 on April 17 (for Q2), and July 13 (for Q3) 2023 in accordance with conditions approved in 2014 MECP Letter.

Details of the biological monitoring completed during the 2023 year are discussed in **Section 5.3.3** and **5.3.4**.

2.5 Landfill Gas Monitoring

Landfill gas monitoring was completed at gas probes GP1 to GP10 in January, February, March, April, July, November, and December 2023 per the EMP.

Methane gas monitoring findings are discussed in **Section 5.4**.

2.6 Automobile Shredder Residue Monitoring

Automobile Shredder Residue (ASR) may be used at the Site as daily cover in accordance with Condition 6.51 of the Waste ECA. ASR samples, when this material is utilized, are collected on a semi-annual basis during the spring and fall and submitted for analysis of Ontario Regulation 347 (O.Reg. 347) Schedule IV criteria in accordance with Condition 6.52 of the Waste ECA. Composite samples of stockpiled ASR material were collected on April 10 and October 3, 2023.

ASR monitoring findings are discussed in **Section 6.3**.

2.7 Contaminated Soil Monitoring

Contaminated soil may be managed on-Site in accordance with Conditions 6.53 to 6.61 of the Waste ECA. Quarterly sampling is completed for contaminated soil that is utilized as daily and/or intermediate cover for the Expansion Landfill per Conditions 6.56 and 6.57 of the Waste ECA, and is submitted for analysis of O.Reg. 347 Schedule IV. Composite samples of contaminated soil material were collected on January 18 (for Q1), April 10 (for Q2), July 11 (for Q3), and October 3 (for Q4) in 2023.

Contaminated soil monitoring findings are discussed in **Section 6.4**.

2.8 Field Sampling Parameters

Groundwater, leachate, and surface water field testing included the measurement of pH, electrical conductivity (EC), temperature, and turbidity (groundwater, surface water, and leachate), as well as dissolved oxygen (DO) (for surface water and leachate only). Surface water field parameters, including flow rates, were measured at each monitoring station, when water was present, during each monitoring event.

2.9 Laboratory Analytical Parameters

Analytical parameters are listed in **Table B-2**, **Appendix B**. In general, analyses were completed by Bureau Veritas Laboratories, a Canadian Association of Laboratory Accreditation (CALA) accredited laboratory.

2.10 Field QA/QC Sampling

The field sampling QA/QC program is outlined in the following table. No equipment rinse blanks were collected due to the use of dedicated sampling equipment.

Media	Monitoring Event	Field-prepared Duplicate (Original Sample)
Leachate	May 2, 2023	LDUP (MH18)
Groundwater	May 1 to 4, 2023	GWDUP1 (OW73-9)
		GWDUP2 (OW83-5)
		GWDUP3 (OW17-4)
		GWDUP4 (OW80-3)
	November 1 to 3, 2023	GWDUP1 (OW16-6)
		GWDUP2 (OW16-7)
		GWDUP3 (OW57-4)
Surface Water	February 10, 2023	SSDUP1 (SS1)
		SPDUP (SP4)
	April 2, 2023	SSDUP1 (SS1)
		SPDUP (SP4)
	July 3, 2023	SSDUP1 (SS1)
		SPDUP (SP2)
	November 2, 2023	SSDUP1 (SS1)
		SPDUP (SP2)

Notes: 1) Field and trip blanks were analyzed as part of the groundwater monitoring events during May and November 2023. Parameters are outlined in **Table B-2**, **Appendix B**.
2) Field prepared duplicate samples are not required for verification monitoring events.

3 QUALITY ASSURANCE & QUALITY CONTROL EVALUATION

The QA/QC program included field-prepared duplicate samples, field-prepared blanks, trip blanks, comparisons with field-determined analytical results, laboratory-prepared blanks, matrix spikes, duplicates, percent recoveries of analyses, and data review. Additionally, the QA/QC program consists of verifying that the correct parameters were assessed by the laboratory for each sampling event, and that they were assessed within their respective hold times (not beyond the sample expiration date). During 2023 the correct parameters were assessed within the allotted hold times.

The laboratory analyzed several control samples to verify that the analytical equipment was functioning properly and reporting results accurately at the time of analysis for the samples collected at the Site. The control samples had an expected target value, which was compared against pre-determined data quality objectives. For the laboratory control samples, the results were within acceptable laboratory data quality criteria.

For the field-prepared duplicate samples, the analytical results for the required parameters of analysis, completed as detailed in **Section 2.9**, were evaluated for the relative percent difference (RPD) of parameter concentrations using the United States Environmental Protection Agency (USEPA) National Functional Guidelines (US EPA 542-R-20-006 and US EPA 540-R-20-005) as a general QA/QC RPD screening mechanism. The RPD screening mechanism is such that for concentrations greater than five (5) times the laboratory reportable detection limit (RDL), a concentration difference of less than or equal to 20% is deemed acceptable. For concentrations less than or equal to five (5) times the RDL, a concentration difference of equal to or less than the RDL is deemed acceptable. Where an exceedance of the general QA/QC RPD screening mechanism is identified, the results for the required parameters of analysis are evaluated against the applicable performance standards for sample duplicates noted in Tables 5.1 to 5.15 of the *Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act*, as prepared by the Ministry of the Environment, Conservation, and Parks (MECP), dated March 9, 2004, and amended on February 19, 2021. For the results found to exceed the criteria of each QA/QC evaluation, a laboratory data quality review (DQR) of the results is completed by the laboratory to verify that the concentrations are accurate as presented and are within acceptable laboratory data quality criteria.

Laboratory chemical results for the leachate, groundwater, and surface water are provided in **Appendices G**, **H,** and **I**, respectively.

3.1 Leachate

For leachate samples collected for the 2023 Compliance Monitoring Program, the RPD were acceptable between original and duplicate samples. Therefore, the results for the leachate samples collected during the 2023 monitoring event were considered representative of actual leachate quality at the time of sample collection and were acceptable for inclusion into the database for interpretation.

The leachate field analytical results for temperature, pH, EC, turbidity, and DO, are provided for the Existing Landfill (CFA-Comp, Sump, and MH18), as well as the Expansion Landfill (PS1, PS3, PS5, PS7, and Equalization Tank) in **Table G-1**, **Appendix G**. Field leachate temperatures showed some variability reflective of the location the leachate is being stored/generated and the time of year the leachate was assessed. For example, generally the quarterly field temperature results for the Equalization Tank showed expected variability based on the time of year sampled with relatively lower temperatures for January and October, and relatively higher temperatures for May and July.

The field analytical values recorded for pH across the Site varied between 7.3 and 8.7 pH units. EC values also varied, with a range of 1,210 to 5,990 micro-Siemens per centimetre (µS/cm) at the Existing Landfill, and 10,510 to >20,000 µS/cm for the Expansion Landfill. Turbidity values also expectedly varied with values between 122 and 135 nephelometric turbidity units (NTU) for the Existing Landfill, and values between 230 and >1,000 NTU for the Expansion Landfill.

Ion balances were also calculated as a QA/QC procedure for the leachate. Considering major anions and cations, an ion balance difference of greater than 10% would initiate a more thorough review of the chemical results and laboratory procedures. The leachate chemical results obtained during the 2023 annual monitoring program satisfied the 10% ion balance target, except as noted in the summary below. The cause of the ion balance exceedances summarized below are reasonable for the noted parameters and the respective concentrations detected in the relevant samples.

Media	Station/Monitoring Well ID	Ion Balance Percentage and Date	Comments
Leachate	MH18	20.5 – May 2023	High anion concentrations
	CFA-COMP	25.8 – May 2023	High anion concentrations
	Equalization Tank	18.4 – May 2023	High anion concentrations
		23.4 – October 2023	High anion concentrations
	PS1	21.8 – May 2023	High anion concentrations
	PS3	19.5 – May 2023	High anion concentrations
	PS5	16.7 – May 2023	High anion concentrations

3.2 Groundwater

For the groundwater samples collected for the 2023 Compliance Monitoring Program, the RPD were acceptable between original and duplicate samples, with the exception of select parameters as summarized below.

Sampling Date	Original Sample (Duplicate)	Parameter with QA/QC Exception
May 2 to 4, 2023	OW83-5 (GWDUP2)	Dissolved Organic Carbon Dissolved Iron Dissolved Lead Dissolved Potassium Dissolved Sodium
	OW17-4 (GWDUP3)	Dissolved Boron Dissolved Magnesium Dissolved Potassium
	OW80-3 (GWDUP4)	Dissolved Barium Dissolved Iron
November 1 to 3, 2023	OW16-7 (GWDUP2)	Dissolved Organic Carbon
	OW57-4 (GWDUP3)	Dissolved Organic Carbon Nitrate

A laboratory DQR for each of the aforementioned results indicated that the concentrations for the above noted parameters were accurate as presented and within acceptable laboratory data quality criteria. Therefore, the results for the groundwater samples collected during the 2023 monitoring events were considered representative of actual groundwater at the time of sample collection and were acceptable for inclusion into the database for interpretation.

The groundwater field analytical results for temperature, pH, EC, and turbidity are provided for the active aquitard, the interstadial silt and sand, as well as the interface aquifer in **Tables H-1** to **H-3**, **Appendix H**, respectively. Shallow groundwater generally showed greater temperatures than the deeper groundwater during May and cooler temperatures compared to the deeper groundwater during November, indicative of seasonal influences on the shallower groundwater. The field analytical values recorded for pH varied between 6.4 and 8.1 pH units. As expected in clayey soil, both conductivity and turbidity values varied, with a range of 590 to 6,270 µS/cm for conductivity and 3.56 to >1,000 NTU for turbidity.

Ion balances were also calculated as a QA/QC procedure for the groundwater. Considering major anions and cations, an ion balance difference of greater than 10% would initiate a more thorough review of the chemical results and laboratory procedures. The groundwater chemical results obtained during the 2023 annual monitoring program satisfied the 10% ion balance target, except as noted in the summary below. The cause of the ion balance exceedances summarized below are reasonable for the noted parameters and the respective concentrations detected in the relevant samples.

Media	Station/Monitoring Well ID	Ion Balance Percentage and Date	Comments
Groundwater	OW17-4	24.0 – May 2023	High cation concentrations
		25.9 – November 2023	High cation concentrations
	OW39A-26	17.0 – May 2023	High cation concentrations
	OW56-4	13.1 – May 2023	High cation concentrations
	OW60-4	21.6 – May 2023	High cation concentrations
	OW68-5	10.5 – May 2023	High cation concentrations
		10.4 – November 2023	High cation concentrations
	OW79-7	10.8 – May 2023	High cation concentrations
	OW79-26	13.9 – May 2023	High cation concentrations
	OW80-3	14.3 – May 2023	High cation concentrations
	OW80-6	11.9 – May 2023	High cation concentrations
	OW80-27	10.7 – May 2023	High cation concentrations
	OW82-28	18.1 – May 2023	High cation concentrations
	Cemetery Well	11.2 – May 2023	High cation concentrations

3.3 Surface Water

For the surface water samples collected for the 2023 Compliance Monitoring Program, the RPD were acceptable between original and duplicate samples, with the exception of select parameters as summarized below.

Sampling Date	Original Sample (Duplicate)	Parameter with QA/QC Exception
April 2, 2023	SS1 (SSDUP1)	Chemical Oxygen Demand Total Suspended Solids
July 3, 2023	SS1 (SSDUP1)	Total Dissolved Solids
November 2, 2023	SP2 (SPDUP1)	Biochemical Oxygen Demand Total Iron

A laboratory DQR for each of the aforementioned results indicated that the concentrations for the above noted parameters with RPDs were accurate as presented and within acceptable laboratory data quality criteria. Therefore, results for the surface water samples collected during the 2023 monitoring events were considered representative of actual groundwater quality at the time of sample collection and were acceptable for inclusion into the database for interpretation.

Surface water field analytical results are provided in **Table I-1**, **Appendix I**. During the 2023 monitoring events, the surface water temperatures reflected the ambient air temperature during sampling. Field pH, EC, turbidity, and DO values fluctuated with no notable anomalies.

Ion balances were also calculated as a QA/QC procedure for surface water. Considering major anions and cations, an ion balance difference of greater than 10% would initiate a thorough review of the chemical results and laboratory procedures. The surface water chemical results obtained during the 2023 annual monitoring program satisfied the 10% ion balance target, except as noted in the summary below. The cause of the ion balance exceedances summarized below are reasonable for the noted parameters and the respective concentrations detected in the relevant samples.

Media	Surface Water Monitoring Station	Ion Balance Percentage and Date	Comments
Surface Water	SS1	43.5 – March 2023	Low anion concentrations
		40.7 – October 2023	Low anion concentrations
		37.4 – July 2023	Low anion concentrations
	SP1	20.5 – July 2023	Low anion concentrations

In summary, the 2023 field and laboratory QA/QC results indicated that the chemical results were representative of actual conditions at the time of sample collection.

4 GROUNDWATER & LEACHATE ELEVATION RESULTS

To define the local groundwater setting below the landfill, the stratigraphic sequence described in **Section 1.4** can be associated with hydrostratigraphic units, as summarized below.

Stratigraphic Unit	Hydrostratigraphic Unit	Approximate Depth to top of Unit (m)
Brown Zone in the Southern Till	Active Aquitard	0.0
Grey Zone in the Southern Till	Upper Aquitard	1.6 to 7.9
Interstadial Clay and Silt		
Interstadial Silt and Sand	Interstadial Sand	4.0 to 10.7
Rannoch Till	Lower Aquitard	4.5 to 12.5
Fractured Bedrock and Basal Sand	Interface Aquifer	22.8 to 29.3

Although each stratigraphic unit is identified as part of a hydrostratigraphic unit, each unit has a hydraulic influence on the others. Groundwater monitoring wells developed within each hydrostratigraphic unit are summarized below and monitoring well construction details provided in **Table F-1**, **Appendix F**.

Hydrostratigraphic Unit	Monitoring Wells
Active Aquitard	OW16-6, OW17-4, OW40D-4, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4, *OW61-4, OW62-5*, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5, OW72-6, OW73-6, *OW75-3, OW76-5, OW77-4, OW78-4,* OW79-5, OW80-3, OW81-5, OW82-5, OW83-5, OW84-6, *OW85-5*
Interstadial Silt and Sand	OW16-7, OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-17, OW60-8, *OW61-6, OW62-7*, OW67-11, OW72-10, OW73-9, *OW75-7, OW78-6,* OW79-7, OW80-6, OW81-7, OW82-14, OW83-9, OW84-11, *OW85-8*
Interface Aquifer	OW17-30, OW19-29, OW39A-26, OW40A-28, OW49-29, OW60-25, *OW61-26, OW62-30*, OW79-26, OW80-27, OW81-27, OW82-28, OW83-29, OW84-31, Cemetery Well

Note: *Italicized* denotes monitoring well is inactive as the monitoring well is to be used to evaluate the Poplar Plantation two (2) months prior to activation of the system.

4.1 Leachate Elevations

Leachate elevations measured at the Existing Landfill during the 2023 annual monitoring program are presented with historical data in **Tables F-2** and **F-3**, **Appendix F**. Leachate elevation data from the pumping stations of the Expansion Landfill are presented with historical data in **Table F-6**, **Appendix F**.

4.1.1 Leachate Elevation Assessment - Existing Landfill

Based on discussions below, no improvements to the Existing Landfill leachate elevation monitoring were proposed or identified in 2023.

Monitoring Details:

Leachate elevations are plotted on **Figure 4**. Flow valves between maintenance holes for each cell of the Existing Landfill are left in a normally open position to facilitate the automated pumping of leachate to the Equalization Tank, as necessary to keep leachate levels at an acceptable elevation.

Collection System(s) Background:

To provide background for the understanding of the design of the waste cells within the Existing Landfill, Cells 3S, 4, 5, 6, 7, 8, 9, 10, and 11, as well as Cell 12 (only the southern third is constructed) contain waste underdrains that direct leachate to a perimeter collector system. Cells 10 and 12 are hydraulically connected, with leachate extraction typically occurring from MH12. The South Cell is completed with finger drains that direct leachate to a perimeter collection system. The West Cell is completed with a collection "Sump" to collect leachate for extraction purposes. Cell 3 does not have a leachate collection system, however, based on historical liquid levels the leachate in this cell is understood to be managed by the adjacent cells. For cells with waste underdrains, when the valve is open and leachate flows freely between a cell's maintenance holes, the leachate elevation in the maintenance holes of that cell is expected to be similar, typically within 0.15 m.

Two (2) exceptions to this pattern can occur for cells with waste underdrains, which are for Cells 3S and 4. For Cell 3S, the leachate levels can be notably different in each maintenance hole. By the original design of the collection system MH3SA and MH3SB were not hydraulically connected with a pipe and are the upper end of the system, which drain to the low end at MH3SC. As of October 2022, for operational efficiencies, MH3SB was converted into a pumping station and MH3SA and MH3SB were hydraulically connected with a pipe. As such the leachate elevations in MH3SA and MH3SB will be expected to be similar, typically within 0.15 m. MH3SC is connected with a pipe to MH3SD but is constructed with a sump ~2m deeper than the base of MH3SD. For Cell 4, there are two distinct (north third and south two-thirds) waste underdrain systems, which independently gravitationally drain to their respective low ends, MH4A (south system) and MH4B (north system). MH4B gravity drains through a toe drain to MH4A.

By the fall of 2017 each of the downstream maintenance holes for the Existing Landfill were updated to be operated as pumping stations (MH3SB updated to be operated as a pumping station late in 2022). This pumping station conversion enables the leachate level in the maintenance hole to be automatically managed, year-round, via pumping leachate to either the equalization tank or to the Poplar System irrigation tanks.

Leachate Management:

As a general leachate best management practice, the extraction of leachate within the Existing Landfill is prioritized based on the leachate elevations for each individual waste cell to facilitate inward hydraulic gradients (as calculated considering the previous year's seasonally relevant groundwater elevations). Exceptions occur since 2019 for leachate management practices where leachate is stored in the waste during late winter to spring, for volume availability for irrigation application to the Poplar System in the subsequent growing season. From an environmental stewardship perspective, the leachate generated from within the waste mound of the Existing Landfill was determined to generally be of more suitable use as irrigation liquid during the growing season as opposed to dedicating efforts for off-Site disposal and treatment between late winter 2023 and spring 2023. It is noted that storing leachate in this manner is suitable as environmental compliance for the Existing Landfill relies on groundwater and surface water quality monitoring, which were acceptable.

Leachate Level Assessment Details:

The hydraulic assessment of leachate compared to nearby shallow groundwater is utilized as an additional guidance tool toward managing leachate volumes in the waste cells and preventing the potential for releases to local water resources, such as surface water and groundwater. The leachate target elevations updated in 2022 were used to assist in lowering the liquid elevation within the maintenance holes and Sump during 2023. Most of the waste cells of the Existing Landfill are completed with waste underdrains such that leachate will percolate vertically downward through the waste and into the collection lines and be directed gravitationally toward the perimeter maintenance holes. As the waste mound is not likely uniform in nature, some leachate could be perched within the waste mound. As such, the potential for leachate seeps exists. In 2023, RWDI did not observe any seeps on the landfill cap during their respective Site inspections.

4.1.1.1 Leachate Elevation Patterns – Existing Landfill

It is apparent that leachate elevations varied across the Site. A comparison of the May and November 2023 leachate elevations with ground surface and inferred groundwater elevations outside the waste footprint is provided in **Table 2**. Overall, leachate elevations generally increased from November 2022 to May 2023 and/or then decreased from May 2023 to November 2023. One (1) exception to the generalized pattern was noted in the western portion of Cell 3S (MH3SC and MH3SD), where leachate elevations slightly increased from May 2023 to November 2023. It is noted that the pump in MH3SC frequently cycles on and off in a given day, and therefore the timing of leachate level measurement can affect the overall leachate volume interpretations from this manhole. Therefore, conclusions drawn from the leachate levels from this manhole should be interpreted with caution.

Based on 2023 leachate elevations, the hydraulically connected maintenance holes in the Existing Landfill generally showed an elevation difference that was equal within the same cell or that differed by less than 0.15 m. Exceptions to this occurred during one or both monitoring events for Cell 3S (at MH3SC and MH3SD, and at MH3SE and MH3SF), Cell 6, and Cell 8 in 2023. The below summary outlines the noted differences, which are not a concern as the differences are either based on design or generally consistent with historical observations.

- Within Cell 3S, the leachate elevation at MH3SC for the November monitoring event was greater than the elevation at MH3SD by 0.37 m, which is generally consistent with historical observations.
- Within Cell 3S, the leachate elevation at MH3SE for the November monitoring event was greater than the elevation at MH3SF by 0.33 m, which has been observed occasionally based on historical observations.
- Within Cell 6, the leachate elevations at MH6A for the November monitoring event was less than the elevation at MH6B by 0.36 m, which is generally consistent with historical observations.
- Within Cell 8, the leachate elevations at MH8A for the May and November monitoring events were less than the elevations at MH8B by 0.31 and 0.33 m, respectively, which is generally consistent with historical elevations.

4.1.1.2 Leachate Levels Assessed Against Ground Surface

Leachate elevations/pressures that would have the potential to affect the groundwater systems are reflected by the leachate elevations within the associated maintenance holes of a given waste cell. As presented in **Table 2**, leachate elevations within the eastern and western waste cells were generally lower than the surrounding ground surface in May and November 2023. One (1) exception occurred in the West Cell (Sump) both during the May and

November 2023 monitoring events. Since the November 2015 monitoring event, the leachate elevation within the Sump has generally exhibited an increasing trend until November 2019, which then showed a significant decrease of 2.6 m as a result of leachate extraction. The leachate elevation within the Sump showed a further decrease from November 2019 to November 2020 of 1.51 m, also as a result of leachate extraction. Since 2020, the leachate elevation within the Sump generally exhibited an increasing trend, of which is interpreted to be a result of a combination of significant precipitation totals (in 2021 and 2023). In addition, in mid-June of 2023, the Sump's pump level sensor was not functioning properly, which was fixed at that time. Additionally, it was also determined that the Sump's pump was determined to be faulty and was removed for repair and was re-installed in late August. From late August through the remainder of the 2023 irrigation season, the leachate level in the Sump was gradually lowered as leachate was transferred to the Poplar System. Ongoing leachate level monitoring will continue, specifically with a focus of reducing leachate levels in this cell in the long-term.

Overall, however, based on the findings from the regulatory monitoring, acceptable groundwater and surface water quality was noted around the Existing Landfill in 2023. Additionally, leachate seeps were not observed along the waste side slopes of the Existing Landfill in 2023. Therefore, the noted leachate elevation within the West Cell does not represent an immediate concern. Continued leachate extraction from the West Cell as well as the South Cell via automated pumping is expected to reduce the leachate mound in these cells. Ongoing monitoring will evaluate these locations over time.

4.1.1.3 Leachate Levels Assessed Against the Shallow Groundwater Table

Spring 2023:

In May 2023, leachate elevations were lower than the local and inferred shallow groundwater table for Cells 3, 5, 7, 9, 11, 12, as well as the South Cell (eastern portion). This comparison shows that the groundwater was being induced toward the waste and that leachate was hydraulically contained within the waste at these locations.

- Within Cell 4 (at MH4A and MH4B), the leachate elevations were higher than the local shallow groundwater elevations to the east by 0.73 m and 0.07 m, respectively. For these locations, it is noted that the May 2023 leachate elevation within MH4A was slightly above its historical range, however, the May 2023 leachate elevation within MH4B was within the historical range.
- Within Cell 6 (at MH6A), the leachate elevation was higher than the historical (pre-2008) local shallow groundwater elevation by 2.83 m. It is noted that the May 2023 leachate elevation within MH6A is within the historical range for this location.
- Within Cell 8 (MH8B), the leachate elevation was higher than the historical (pre-2008) local shallow groundwater elevation by 1.90 m. For this location, it is noted that the May 2023 leachate elevation was slightly above its historical range, however, the leachate elevation was lower than the historical local shallow groundwater elevation to the west by November 2023.
- Within Cell 10 (MH10), the leachate elevation was higher than the historical (pre-2008) local shallow groundwater elevation by 0.59 m. It is noted that the May 2023 leachate elevation within MH10 is within the historical range for this location.

- Within the West Cell (Sump), the leachate elevation was higher than the historical (pre-2008) local shallow groundwater elevations by 8.29 m. The May 2023 leachate elevation within the SUMP is 0.31 m higher than the peak elevation observed in May 2019, however, a decrease of 1.37 m was observed between May and November 2023, as a result of gradually lowering the leachate level as discussed in **Section 4.1.1.2**.
- Within the South Cell (at OW22A-10 and OW53-10) the leachate elevations were higher than the historical (pre-2008) local shallow groundwater elevation to the west by 0.62 m, and 1.99 m, respectively. For these locations, it is noted that the May 2023 leachate elevation within OW53-10 is above its historical range whereas the May 2023 leachate elevation within OW22A-10 is within its historical range.

Fall 2023:

In November 2023, the leachate elevations throughout select cells of the Existing Landfill expectedly showed a decrease since May 2023, dominantly as a result of leachate extraction for irrigation onto the Poplar System. For a few waste cells, the leachate elevations remained elevated with respect to the historical shallow groundwater elevations to the west and south of the Existing Landfill. However, leachate elevations were lower than the local and inferred shallow groundwater table for Cells 3, 5, 7, 8, 9, 10, 11, 12, Cell 3S (eastern portion), as well as the south cell (eastern portion).

- The leachate elevations within Cell 4 (at MH4A andMH4B) were higher than the shallow groundwater elevations by 0.97 and 0.86 m, respectively. It is noted that the November 2023 leachate elevations are within their respective historical ranges for each location.
- The leachate elevation within Cell 6 (at MH6A) was higher than the historical (pre-2008) shallow groundwater elevation by 2.41 m. It is noted that the November 2023 leachate elevation within MH6A is within the historical range for this location.
- Within the West Cell (Sump), the leachate elevation was higher than the historical (pre-2008) local shallow groundwater elevations by 6.94 m. It is noted that the November 2023 leachate elevation within the West Cell (Sump) is within the historical range for this location. Efforts to further lower the leachate level within the West Cell will continue in 2024.
- Within the South Cell (at OW22A-10 and OW53-10) the leachate elevations were higher than the historical (pre-2008) local shallow groundwater elevation by 0.33 m, and 3.17 m, respectfully. It is noted that the November 2023 leachate elevations with OW22A-10 and OW53-10 are within the historical ranges for these locations. Efforts to further lower the leachate level within the South Cell will continue in 2024.

Overall, as discussed herein, based on the findings from the regulatory monitoring, acceptable groundwater and surface water quality was demonstrated at the compliance points during 2023. Also, leachate seeps were not observed along the waste side slopes of the Existing Landfill in 2023. Therefore, the noted leachate elevations that were higher in 2023 than the local groundwater elevations within select leachate monitoring wells and maintenance holes of the Existing Landfill did not represent a concern.

4.1.1.4 Leachate Elevation Trends – Existing Landfill

Hydrographs of leachate elevations are presented on **Figures F-1** through **F-12**, **Appendix F**. Long-term trends are summarized in **Table 3**. For the purpose of assessing elevation trends, a constant elevation trend is defined as having 0.1 m or less of seasonal variation.

Over past years, leachate elevations have mostly fluctuated with some exceptions, as noted in **Table 3**. The historically increasing leachate elevation trends that were noted in 2019 for Cell 3S (at MH3SC and MH3SD), Cell 6 (at MH6A and MH6B), and the West Cell (Sump) are noted to have generally been fluctuating below their historical highs. Efforts to further lower the leachate level within the West Cell and the South Cell will continue in 2024.

Over the long-term, leachate elevations are expected to continue to decrease and eventually stabilize since the Existing Landfill is capped and leachate is extracted from cells within the Existing Landfill for the operation of the Poplar System and for off-Site disposal. It should be noted that over time, the amount of leachate removed from storage will likely increase with the operation of the expanded Poplar System, as the system matures. The volume of leachate managed from the Site in 2023 is summarized in **Section 4.1.3.1**.

4.1.1.5 Supplemental Leachate Level Assessment

As discussed in **Section 2.3**, supplemental leachate level monitoring wells were installed in 2017 and were monitored semi-annually in 2023 together with the already established semi-annual spring and fall monitoring events at the Site. The leachate elevations for the leachate level monitoring wells (LW1 to LW6) are presented in **Table F-3**, **Appendix F.**

Existing Landfill:

The May and November 2023 data indicates that select waste cells have leachate stored within the waste that may not be directed to, or captured by, the cell's leachate collection system. As such, this leachate does not represent a hydraulic loading to the respective cell's floor/liner and therefore, does not have a direct influence on the groundwater system (i.e. potentiometric influences).

During 2023, the leachate elevations within select maintenance holes were generally drawn down throughout the majority of the application period and fluctuated significantly as a result of leachate extraction for irrigation to the Poplar System. With respect to draw down as a result of leachate extraction, the liquid elevations in leachate monitoring wells LW1 to LW6 did not definitively correlate to the elevations in their counterpart maintenance hole (within the same waste cell). This observation indicates that leachate within the waste mound that may not be directed to, or captured by the leachate underdrain collection system (i.e. perched, low hydraulic conductivity, or some other cause) is therefore, not having an effect to the groundwater system (i.e. potentiometric pressures). This effect is observed in waste cells that are both positioned under and not under the Poplar System, indicating that the operation of the Poplar System is not the cause of this leachate elevation differential effect.

There was no observable negative affect observed to the sideslope of the Existing Landfill, such as leachate seeps, soil staining, stress vegetation, soil slumping or erosion, as a result of this leachate elevation differential. At this time the exact cause of the leachate differential is unknown, but it is not causing a detrimental effect to the operation of the Poplar System, excluding limiting leachate volume availability from select waste cells, and is not causing visible stress to the landfill cap and as such does not represent an immediate concern. Ongoing leachate level monitoring will enable an evaluation if this leachate differential is a long-term (i.e. over 5 years) situation, or has the potential to represent a concern (i.e. increasing trends with time, or stress to the landfill cap, etc.).

In summary, the Existing Landfill requires the ongoing leachate level monitoring program to continue to enable input such that the leachate is managed environmentally effective in consideration of the destination target (e.g. off-Site vs. on-Site treatment).

4.1.1.6 Leachate Storage Volume – Existing Landfill

Overall, between May 2022 and May 2023 there was an increase in the calculated theoretical total leachate volume stored above the local groundwater table (108,309 m^3) and within the waste (167,881 m^3) of the Existing Landfill, as summarized in **Table 5**. Between November 2022 and November 2023 there was an increase in the calculated theoretical total leachate volume stored above the local groundwater table (41,590 m^3) and within the waste (40,830 m^3) of the Existing Landfill. It is noted that these volumes are only theoretical in nature and are used as guidance information for year over year overall performance evaluation. For example, the total leachate storage in the Existing Landfill decreased from May to November 2023 (a period of time approximately 2 weeks longer than the 24-week long irrigation season) by 155,623 m^3, however, during that time approximately 8,658.85 m^3 was measured to have been extracted from the Existing Landfill. During this timeframe, the pumping stations in many of the weaker strength leachate waste cells were routinely drawn down to elevations where the leachate elevation was too low to safely operate the pumps without damage to the pumps. Therefore, the reliance on these theoretical leachate volumes as actual empirical volumes should not be completed, and that tracking of these volumes be only used as a year over year performance evaluation with respect to leachate management.

As discussed, and as presented on **Figures F-1** to **F-12**, after the 2023 irrigation season in November 2023, the leachate elevations in a few of the cells of the Existing Landfill were determined to be slightly higher than the May 2023 elevations whereas, the leachate elevations in the majority of the cells were determined to be lower.

Over the long-term, leachate volumes within cells of the Existing Landfill are expected to continue to decrease as more leachate is extracted for the operation of the expanded Poplar System and off-Site disposal.

4.1.2 Leachate Elevation Assessment – Expansion Landfill

Leachate level monitoring within the Expansion Landfill is completed to assess leachate pressures on the liner and the effectiveness of the leachate management system. Leachate levels for PS1, PS3, PS5, and PS7, are tabulated in **Table F-6** and graphically represented on **Figures F-26 to F-29**.

Based on discussions below, no improvements to the Expansion Landfill leachate elevation monitoring were proposed or identified in 2023.

Collection System Background:

Leachate within each cell is directed to a sump where it is managed by pumping stations PS1, PS3, PS5, and PS7, (Cell 1, Cell 2, Cell 4, and Cell 6A, respectfully) for conveyance to the Equalization Tank. The operation of the pumps in the aforementioned pumping stations is SCADA-controlled (automated) with liquid level sensors that control pump 'on' and 'off' depending on the leachate level within the relevant sump. Leachate retrieval from the Equalization Tank is controlled by pump station PS10. Pumping station PS1 began operation on November 16, 2009. PS3 began operation on November 21, 2013. PS5 began operation on October 1, 2019. PS7 operation began on September 14, 2022.

Trigger Mechanism Assessment Process:

The trigger mechanism for implementation of groundwater contingency measures for the Expansion Landfill is the loss of hydraulic containment of the landfill waste footprint. The loss of hydraulic containment occurs when leachate levels within the PDL are higher than the surrounding groundwater elevation for the active aquitard and the groundwater pressures for the interface aquifer.

Leachate liquid levels for the pumping stations for the Expansion Landfill are evaluated against the Waste ECA Conditions 7.18 and 14.1.

- Condition 7.18 of the Waste ECA requires that a leachate head of 300 mm (or 0.30 metres (m)) on the landfill liner is not exceeded.
- Condition 14.1 of the Waste ECA requires that, for PS1, PS3, PS5, and PS7, the trigger leachate elevations for hydraulic containment for the protection of groundwater are 232.7 metres above sea level (m ASL), 232.6 m ASL, 232.8 m ASL, and 233.4 m ASL, respectively. These elevations represent a maximum leachate head of 6 m above the landfill liner of each respective cell.

Occasionally, after major storm events when a part of the active waste disposal area within the Expansion Landfill is not final capped, a large percentage of precipitation will move to the cell floor and the leachate pumping rates for PS1, PS3, PS5, and PS7 would be less than the incoming volume of liquid.

It is noted that periodic elevated leachate occurrences are described in the MECP-approved Development and Operations Report (D&O Report) (Henderson Paddon, 2008). A temporary increase of the leachate head under such circumstances is not considered a non-compliance issue with the Waste ECA. Notwithstanding this consideration, WM has implemented an Expansion Landfill Leachate Level Contingency Plan (RWDI, April 30, 2021). The aforementioned plan was implemented so that WM is aware of a leachate level elevation that could be indicative of a pending operating scenario that could cause the leachate head to exceed 300 mm. This notification process enables WM to be aware of a level of possible concern and enable WM to evaluate if the leachate level is a concern or not. If the level is of concern, then WM will be able to evaluate the leachate level operational system to identify the cause and implement the relevant remedial measure(s) to address the leachate level. The notifications are denoted below.

- Electronic issuance (email and/or text) to relevant WM operations personnel that a leachate level for a given waste cell of the Expansion Landfill is at 80% (240 mm) of the 300 mm leachate head limit.
- A visual notification (i.e., light) on the leachate pumping stations when the leachate level for the respective waste cell of the Expansion Landfill is at 80% (240 mm) of the 300 mm leachate head limit.

Condition 7.18

PS1

During 2023, the leachate elevations at PS1 satisfied condition 7.18 of the Waste ECA, which targets a leachate head less than 300 mm (or 0.3 m).

PS3

The leachate elevations at PS3 in Cell 2 during the time periods of November 17 to 29, December 2 to 3, December 9 to 10, December 17, December 24 to 26, and December 30 to 31, 2023, exceeded the 0.3 m of head target by values ranging from 0.02 to 0.26 m. As noted above, periodic elevated leachate occurrences are described in the D&O Report. Temporary increases of the leachate head under such circumstances are not considered a non-compliance issue with the Waste ECA. Within the last five (5) years, 2023 was noted to have been the wettest year, with a significant amount of the precipitation occurring within Q3 and Q4.

PS5

During 2023, the leachate elevations at PS5 satisfied the leachate head of less than 0.3 m.

PS7

The leachate elevations at PS7 in Cell 6A during the time periods of April 4 to May 23, and July 8 to December 31, 2023 exceeded the 0.3 m of head target by values ranging from 0.08 m to 1.24 m. Specific to Cell 6A, the duration of 0.3 m head target exceedance during 2023 is caused by two dominant factors: 1) infiltration potential (e.g. large flat top area relate to sloped cap area; and 2) precipitation volume in 2023.

Infiltration Potential:
The waste mound in Cell 6A is still lower in elevation than the surrounding ground surface, and the clay covered waste mound has a large flat top surface area compared to sideslope area (note WM routinely slopes the 'flat top areas of large cell tops) that is completed with the required 0.3 m thick interim clayey soil cover. The sideslope area compared to the flat top area would preferentially shed stormwater away from the waste mound. The sideslopes and top of the waste mounds of Cell 1, Cell 2, and Cell 4 are clay capped with greater than the minimum 0.3 m thick interim cap, except where WM has an open landfill workface. Thus, Cell 6A is exposed to a greater volume of precipitation infiltration potential to the PDL of Cell 6A than the PDLs of Cell 1, Cell 2, and Cell 4.

Precipitation Volume:
As discussed in **Section 1.5**, 2023 experienced both numerous short duration/high magnitude events as well as prolonged periods of precipitation. With respect to the time period of April 4 to May 23, 2023, it is noted that the Site received approximately 97 mm of precipitation within a period of 9 days leading up to April 4, 2023, which is a significant amount of precipitation for early spring. Also, from April 5 to May 23, 2023 the Site received a further approximately 72 mm of precipitation. With respect to the time period of July 8 to December 31, it is noted that the Site received approximately 410 mm of precipitation within Q3 and approximately 156 mm in Q4, which is a significant amount of precipitation for the summer and fall seasons, respectively.

It is expected that as landfilling of waste in Cell 6A progresses above ground surface level, the exposure to precipitation infiltrating will decrease as the large flat top will be reduced with increased height as sideslopes are developed.

Condition 14.1

During 2023, the leachate elevations at PS1, PS3, PS5, and PS7 remained well below their respective trigger leachate elevations, as outlined in Condition 14.1 in the Waste ECA.

In addition, the leachate elevations at PS1, PS3, PS5, and PS7 were below the historical groundwater elevation in the active aquitard and the interstadial silt and sand flow systems. Therefore, the leachate in Cells 1, 2, 4, and 6A was hydraulically contained from the afore-mentioned groundwater flow systems.

Further details are included in **Appendix Q.**

4.1.2.1 Leachate Elevation trends – Expansion Landfill

Leachate levels for PS1, PS3, PS5, and PS7, are presented in **Table F-6** and on **Figure F-26 to F-29**, **Appendix F**. As expected, leachate levels vary with time as a result of the gradual accumulation of leachate and pumping activities to maintain acceptable leachate levels at each pumping station.

4.1.2.2 Supplemental Leachate Level Assessment

Expansion Landfill:

The leachate elevations for the Expansion Landfill were collected from landfill gas extraction wells, otherwise known as early vertical gas wells (EVGW) [EV229 in Cell 1A (Stage 1), EV268 in Cell 1A (Stage 2), EV022 in Cell 2B, and EV226 in Cell 2D] are presented in **Table F-8, Appendix F**. The locations of these EVGWs are shown on the attached **Figure 2**.

Leachate elevations for the EV229, EV268, EV022, and EV226 were unable to be measured during 2023 semi-annual monitoring events. For the EVGW's that could not be measured for liquid levels, similar to the semi-annual monitoring events since May 2019, debris was encountered at elevations that were higher than the EVGW base, thus precluding access to deeper portions of the EVGW's. The obstructing debris could not be identified in the field. It is noted that during the November 2023 monitoring event, early vertical gas well EV022 was inaccessible during the monitoring event as this well was in the progress of being raised and was too tall to measure during the remainder of 2023. Efforts to monitor EV022 will be made during the semi-annual monitoring events in 2024. It is noted that in 2018 these same EVGWs were assessed to be dry to each of their respective bottom elevations (approximately 1.0 to 1.5 m above the liner floor). Also, up to the 2021 semi-annual monitoring events, EVGW EV268 was determined to be dry to its depth extent, which is within 1 m above the liner floor.

4.1.3 Leachate Management

4.1.3.1 Leachate Volume

Leachate Generation:

The primary leachate source is from precipitation infiltrating into and percolating through the waste. The groundwater contribution is negligible. Between January 1 and December 31, 2023, a total of 70,424.34 m^3 of leachate was managed, of which 61,765.49 m^3 of leachate was removed and transported off-Site for treatment and disposal at the Chatham Water Pollution Control Plant, while 8,658.85 m^3 was irrigated onto the Poplar system during the 2023 growing season. Details regarding the 2023 Poplar System irrigation activities are discussed in **Volume 3** of the 2023 Annual Report.

A breakdown of the leachate volumes treated in 2023 is presented below.

Area of Leachate Extraction	Treatment (m^3)
Off-Site Treatment Management	
Existing Landfill MHs	0
Pumping Station PS10 – From Expansion Landfill	54.882.64
Pumping Station PS10 – From Existing Landfill	6,882.85
Sub-Total	***61,765.49***
On-Site Treatment Management	
Poplar System – From Expansion Landfill	71.42
Poplar System – From Existing Landfill	8,587.43
Sub-Total	***8,658.85***
TOTAL	**70,424.34**

Note: 1) m^3 denotes cubic metre. 1 m^3 is equivalent to 1,000 L (litres).
2) Existing Landfill denotes leachate extracted by tanker truck directly from one of, or a combination of, Cell 3S, 4, 5, 6, 7, 8, 9, 10/12, 11, South Cell, &/or West Cell (Sump).
3) The source cell leachate make-up in the Equalizations Tank, as sampled from PS10, changes over time, as outlined in **Section 2.2**.

Of the 70,424.34 m^3 noted above, the approximate breakdown of leachate source location between the Existing Landfill and the Expansion Landfill is 22% (15,470.28 m^3) and 78% (54,954.06 m^3), respectively. This breakdown is based on the leachate source distribution which incorporates the separate approximate volumes of leachate extracted from the Existing Landfill (37% of area) and Expansion Landfill (63% of area) for either off-site disposal of stronger strength leachate (i.e. Expansion Landfill leachate) or storage of weaker strength leachate (i.e. Existing Landfill leachate) for use as irrigation liquid to the Poplar System during the 2023 growing season.

No improvements to the leachate management were proposed or identified in 2023.

4.1.4 Leachate Seeps & Stains

Leachate seeps or potentially ponded water within waste that were noted by WM during daily inspections were generally limited to areas adjacent to the active landfilling working area (e.g. waste mound, haul roads) of the Expansion Landfill in 2023. Although select observed occurrences may have been ponded water within waste,

WM treated them as seeps and they were generally repaired the same day. Generally, no significant leachate seeps or stains were noted by the MECP, RWDI, or WM for the Expansion Landfill throughout the 2023 monitoring period. WM did note a leachate seep on the transition zone between Cell 3 and 4 of the Expansion Landfill and reported it to the MECP during their inspection on March 24, 2023, of which WM repaired the previous day. WM reported a series of leachate seeps along the Cell 4A access ramp in early April 2023. The leachate seeps were attributed to rain events during this time period and were repaired by WM. WM noted two leachate seeps on the eastern haul road and reported them to the MECP during their inspection on April 12, 2023, of which WM repaired. No leachate seeps from the Existing Landfill were observed for the during 2023.

4.2 Secondary Drainage Layer Hydraulic Containment

Liquid levels were recorded monthly for the SDL of Cell 1, Cell 2, Cell 4, and Cell 6A in 2023. Liquid elevations from the SDL are provided in **Table F-7** and graphically represented on **Figure F-25**, **Appendix F**.

Hydraulic Containment Assessment:

Water levels within the SDL of Cell 1, Cell 2, Cell 4, and Cell 6A continued to be below surrounding groundwater levels and pressures (provided in **Table 2** and **Table F-4**) and therefore, groundwater was induced to flow toward the SDL of Cell 1, Cell 2, Cell 4, and Cell 6A. As the water elevations in the SDL for Cell 1, Cell 2, Cell 4, and Cell 6A, (PS2, PS4, PS6, and PS8, respectively) are typically greater than the leachate elevations within the PDL of Cell 1, Cell 2, Cell 4, and Cell 6A, the leachate in the PDLs are hydraulically contained within the PDLs from the SDLs. Exceptions occurred in Cell 6A in June and late August through mid-December of 2023 as a result of water taking activities from the SDL of Cell 6 that occurred in May, late October, and early November of 2023 for Cell 6B liner system construction activities, which resulted in the temporary SDL water elevation decreases. The water elevations within the SDL of Cell 6A (PS8) increased throughout most of Q3 and again following mid-November in Q4 as the SDL water was not used for construction purposes during these time periods.

Historical SDL Elevation Trends of Note:

The initial slow increase over time in the SDL elevation within Cell 1 since its installation is a result of the large pore volume for water to accumulate within the 0.3 m thick granular layer that comprises the SDL within the western half of Cell 1. The rapid increases in SDL elevation within Cell 2, Cell 4, and Cell 6A are reflective of the very small pore volume within the 0.01 m thick Geonet that is installed as the SDL for Cell 2, Cell 4, and Cell 6A (and the eastern portion of Cell 1). It is noted that the historical periodic short duration decreasing pattern in the SDL for Cell 1, Cell 2, Cell 4, and Cell 6A represents water taking activities for cell-to-cell connection activities and/or soil moisture conditioning of the clayey soil liner material used in the construction of the cell liner system. These periodic SDL level decreases are expected during the Expansion Landfill construction and as discussed, do not represent a concern as once a cell is excavated, groundwater movement is toward the cell excavation, thereby hydraulically containing any liquid (both in SDL and PDL) in the cell.

No improvements to the secondary drainage layer monitoring were proposed or identified in 2023.

4.3 Active Aquitard Groundwater Movement

The active aquitard represents a shallow groundwater flow system whereby precipitation infiltrates into soil fractures, root casts, and other weathering features and moves in a dominantly lateral direction. The low permeability of the surrounding silty clay to clayey silt matrix reduces the volume of groundwater movement through the active aquitard. The low volume of water within the active aquitard is also evident by the slow recovery of monitoring wells after purging and sampling.

Groundwater elevations measured during the 2023 annual monitoring program are presented with historical data in **Table F-4**, **Appendix F**.

4.3.1 Groundwater Elevation Patterns

Groundwater elevations measured for the Active Aquitard on May 1, 2023, are presented on **Figure 4**. Considering the north-south flow divide through the Poplar Plantation and historical patterns of groundwater movement, an easterly and westerly direction of groundwater movement is inferred. Surficial features such as ditches, waste cells, excavations, ponds, berms, and the leachate management systems, as well as precipitation amounts, will locally influence the groundwater flow direction.

4.3.2 Groundwater Elevation Trends

Groundwater elevation hydrographs for the active aquitard are presented on **Figures F-13** through **F-18**, **Appendix F**. Long-term trends are summarized in **Table 4**. For the purpose of assessing elevation trends, a constant elevation trend is defined as having 0.1 m or less seasonal variation.

In the long-term within the active aquitard, groundwater elevations have continued to fluctuate. Overall, fluctuating patterns in groundwater elevation were noted across the Site in the Active Aquitard, which are attributed to seasonal effects from precipitation and snowmelt. Overall, groundwater elevations were generally noted to be within their historical ranges. The groundwater elevations at OW70B-5, OW71A-5, OW73-6 were noted to have increased to new highs in May 2023.

No improvements to the monitoring of the active aquitard groundwater movement was proposed or identified in 2023.

4.4 Interstadial Silt & Sand Groundwater Movement

The interstadial silt and sand hydrostratigraphic unit consists of silt and sand layers or lenses within the interstadial deposit that overlies the Rannoch Till. Groundwater movement within the interstadial silt and sand will be controlled by hydraulic gradients and the soil texture. For the purpose of the landfill compliance assessment, it is assumed that the silt and sand layers or lenses are hydraulically connected and that groundwater movement is in the direction of the inferred hydraulic gradient.

Groundwater elevations measured during the 2023 annual monitoring program are presented with historical data in **Table F-4**, **Appendix F**. Hydrographs for the interstadial silt and sand are provided on **Figures F-19** through **F-22**, **Appendix F**.

4.4.1 Groundwater Elevation Patterns

Groundwater elevations measured for the Interstadial Silt and Sand on May 1, 2023 are presented on **Figure 5**. Groundwater pressures suggest a consistent pattern to the historical interpretation of an easterly and westerly groundwater flow direction from a north-south groundwater divide that extends from Confederation Line to Zion Line (Jagger Hims Limited, 2005). However, the excavation of Cell 1, Cell 2, Cell 4, and Cell 6A has reduced the groundwater potentiometric pressures within the interstadial silt in these areas and locally induces groundwater to move toward and into the SDL of the cells. These lowered groundwater pressures are expected to return to pre-existing conditions as the soil mass is replaced with waste mass. Higher groundwater pressure elevations relative to other areas may occur below the Central Fill Area (defined as waste cells: Cell 3S, Cell 3 through Cell 7, as well as Cell 9 and Cell 11) of the Existing Landfill due to the mass of the overlying waste and leachate, thereby hydraulic gradients are expected to be upward toward the waste.

4.4.2 Groundwater Elevation Trends

Long-term elevation trends are summarized in **Table 4**. For the purpose of assessing elevation trends, a constant elevation trend is defined as having 0.1 m or less seasonal variation.

Groundwater elevations within the interstadial silt and sand have generally fluctuated in the long-term, with the elevations at OW54-10, OW67-11, OW72-10, and OW73-9 exhibiting generally decreasing and fluctuating trends over time. As of recent years, it is noted that the groundwater elevations at the aforementioned monitoring wells appear to be stabilizing and beginning to slightly increase. Ongoing monitoring will evaluate the noted trends over time.

For the monitoring wells where seasonal fluctuations in the groundwater elevation have historically been observed, this trend generally continued in 2023. For these wells, the November 2023 groundwater elevations within the interstadial silt and sand were generally lower or similar compared to those observed in May 2023. Within the interstadial silt and sand flow system, the overlying waste and leachate levels, as well as the Cell 1, Cell 2, Cell 4, and Cell 6A excavations, induced localized potentiometric pressure increases and decreases, which also resulted in variations in the local flow direction. Overall, with the exception of where decreasing trends continued to be observed in 2023, groundwater elevations were generally noted to be within their historical ranges.

4.4.3 Vertical Hydraulic Gradients

Vertical hydraulic gradients below the Site in the active aquitard to the interstadial silt and sand hydrostratigraphic unit were calculated for the May 1 and November 1, 2023, data.

The hydraulic gradients that were calculated are presented in **Table F-5**, **Appendix F**. In summary, vertical hydraulic gradients continued to be dominantly downward toward the interface aquifer around the waste footprints and below the Existing Landfill. However, localized upward hydraulic gradients occurred from the active aquitard to the interstadial silt and sand at the monitoring well locations summarized in the table below. Ongoing monitoring will continue to evaluate these trends over time.

May 2023	November 2023
OW80-3/OW80-6 OW81-5/OW81-7	OW40D-4/OW40A-7 OW79-5/OW9-7

No improvements to the monitoring of the interstadial silt and sand groundwater movement were proposed or identified in 2023.

4.5 Interface Aquifer Groundwater Movement

Occasional discontinuous layers of sand and gravel between the Rannoch Till and underlying bedrock constitute the basal sand. For the purpose of the landfill compliance assessment, it is assumed that groundwater movement is in the direction of the inferred hydraulic gradient. The upper fractured portion of the bedrock and the overlying basal sand form the local bedrock aquifer and are generally referred to as the interface aquifer.

Groundwater elevations measured during the 2023 annual monitoring program are presented with historical data in **Table F-4**, **Appendix F**. Hydrographs are provided on **Figures F-23** to **F-24**, **Appendix F**.

4.5.1 Groundwater Elevation Patterns

Groundwater elevations measured for the Interface Aquifer on May 1, 2023, are presented on **Figure 6**. Overall, a southwesterly groundwater flow direction was apparent below the Existing Landfill and the Expansion Landfill. This flow direction is consistent with the historical inferred direction of groundwater movement within the interface aquifer (Jagger Hims Limited, 2005). Of note, as more overburden soil is removed during landfill cell construction, interface aquifer pressures are expected to decrease temporarily. As more waste is deposited within the waste cells of the Expansion Landfill, the increase in overlying mass will increase the groundwater pressures of the bedrock aquifer.

4.5.2 Groundwater Elevation Trends

Long-term elevation trends are summarized in **Table 4**. For the purpose of assessing elevation trends, a constant elevation trend is defined as having 0.1 m or less seasonal variation. Groundwater pressure elevation trends and patterns for the interface aquifer continue to be generally consistent with historical findings with a fluctuating trend with time. Additionally, the majority of monitoring wells in the interface aquifer were showing a fluctuating and decreasing trend from about 2010 to 2018. This pattern at these locations was expected as it indicates a response to depressurization from the removal of overlying soil within the Expansion Landfill waste footprint. It is anticipated that these decreasing elevation trends will be temporary, and pressures will begin to increase once a sufficient waste mass is landfilled to replace the excavated clayey soil mass. As expected, monitoring wells OW39A-26, OW79-26, OW80-27, and OW81-27 are showing a fluctuating and increasing trend since about 2018 as a significant waste mass has been progressively landfilled into the southern half of the Expansion Landfill. Overall, with the exception of where a more dominant fluctuating trend continued to be observed in 2023, groundwater liquid levels were generally noted to be within their historical ranges.

4.5.3 Vertical Hydraulic Gradients

Vertical hydraulic gradients below the Site in the interstadial silt and sand to the interface aquifer hydrostratigraphic unit were calculated for the May 1 and November 1, 2023 data. The hydraulic gradients that were calculated are presented in **Table F-5**, **Appendix F**. In summary, vertical hydraulic gradients were noted to be downward during both the May and November 2023 monitoring events from the Interstadial Silt and Sand layer to the Interface Aquifer owing to the low leachate and groundwater levels within Cells 1, 2, 4 and 6A. Ongoing monitoring will continue to evaluate these trends over time.

No improvements to the monitoring of the interface aquifer groundwater movement were proposed or identified in 2023.

5 CHEMICAL & GAS MONITORING RESULTS

5.1 Leachate

In accordance with the landfill EMP, leachate sampling from within select maintenance holes across the Existing Landfill was completed on May 3, 2023, as part of the annual monitoring requirement. A leachate sample was obtained from the Sump that is located within the West Cell. A second leachate sample designated CFA-Comp consisted of the collection of a composite sample obtained from MH3SA-F, MH4B, MH5A, MH6A, MH7A, MH9A, and MH11A to represent leachate within the Central Fill Area. Leachate is also sampled from MH18 to represent leachate from the South Cell.

Samples were also collected from PS1, PS3, PS5, and PS7 during the spring monitoring event on May 2, 2023. PS1, PS3, PS5, and PS7 samples were collected directly from the pumping station sump. Chemical results are summarized in **Appendix G**.

Table 6 provides a chemical summary of the long-term leachate characteristics for the Existing Landfill and the Expansion Landfill to November 2023. The 2023 leachate chemical results were generally within the respective historical ranges for the parameters analyzed.

As shown on **Figure G-1**, **Appendix G**, the chloride concentrations in leachate from the Equalization Tank show a fluctuating trend since 2013. Concentration fluctuations over time are expected due to the nature of leachate, as well as to the variations in the relative contribution of weaker leachate from new waste (i.e., new waste in Cell 6A) or from the monofill cells (i.e., Cells 10/12) of the Existing Landfill to stronger leachate from the aging waste (i.e., waste in Cell 1) or from the West Cell (Sump) of the Existing Landfill. Chloride concentrations in leachate from the Equalization Tank will continue to be monitored during future sampling events.

5.1.1 Leachate Indicator List

In general, leachate concentrations vary across the Site, with stronger leachate within Cell 6 and the West Cell compared to other cells of the Existing Landfill. Leachate constituent concentrations for the Expansion Landfill are generally within the low range for concentrations detected in the Existing Landfill. This difference is attributed to the relatively young age of the waste (compared to waste in the Existing Landfill) and the onset of

waste decomposition. The 2023 and historical ranges in chemical concentrations for the leachate, as well as the background groundwater and surface water, are presented in **Table 6**. Based on a comparison of the leachate concentrations to the background groundwater and surface water concentrations, the following parameters have had notably elevated concentrations within the leachate.

- EC
- Alkalinity
- Calcium
- Magnesium
- Sodium
- Potassium
- Chloride
- Dissolved Organic Carbon
- Ammonia
- Total Kjeldahl Nitrogen
- Boron
- BTEX Compounds (Benzene, Toluene, Ethylbenzene, and Xylenes)

A landfill leachate effect on groundwater or surface water quality is defined as leachate mixing with the water and migrating in the direction of water movement beyond the Site boundary. To differentiate landfill leachate effects from natural water quality variability, a group of parameters indicative of landfill leachate was selected based on the following items.

- Elevated concentrations in leachate.
- Mobility and stability in groundwater and surface water.
- Representative of a larger chemical group (e.g., boron for metals).
- Applicable Ontario Drinking Water Standard (ODWS) or PWQO.

A group of indicator parameters selected for this landfill, termed the Primary Leachate Indicator List (PLIL), are summarized below.

Primary Leachate Indicator List (PLIL)	
PLIL – Groundwater	**PLIL – Surface Water**
Chloride, Nitrate (as N), Boron	Chloride, Ammonia (unionized), Phenols, Boron, Nickel, Chromium (total), Zinc

A supplemental group of parameters, termed the Secondary Leachate Indicator List (SLIL), is selected based on elevated concentrations within the leachate. The SLIL is used for quality assurance of the chemical database, for input to establish trigger concentrations, and for further data analyses in the event of trigger concentration exceedances. The SLIL parameters are summarized below.

Secondary Leachate Indicator List (SLIL)			
SLIL – Groundwater		**SLIL – Surface Water**	
Alkalinity, Sulphate, Calcium Magnesium, Potassium, Sodium, Barium, Iron, DOC, TDS	Ammonia (total), TKN, pH, Conductivity, Cadmium, Lead, Benzene, Toluene, Ethylbenzene, Xylenes	Alkalinity, Sulphate, Calcium, Magnesium, Potassium, Sodium, Iron, Nitrate, TKN, Phosphorus (total)	TDS, pH, Conductivity, Turbidity, Dissolved Oxygen

The concentrations of leachate constituents will vary with time. Leachate quality monitoring will continue at the Existing Landfill and the Expansion Landfill to assess the changing leachate characteristics for a landfill impact assessment and for leachate management.

No improvements to the leachate monitoring were proposed or identified in 2023.

5.2 Groundwater

Field groundwater chemical results for the May, November, and supplemental monitoring events are presented in **Tables H-1** to **H-3**, **Appendix H**. The 2023 laboratory chemical results are presented in **Tables H-4** and **H-5**, **Appendix H**. Historical data are provided for comparison. Laboratory reports of analysis and QA/QC documentation are included as **Table H-6**, **Appendix H**.

Groundwater quality monitoring occurred at the required monitoring locations in consideration of the groundwater monitoring schedule within the approved landfill EMP. An updated monitoring schedule is presented within **Table B-2**, **Appendix B**, which shows the monitoring wells required for sampling, the sampling frequency, and the parameters for analytical testing. Monitoring well designations and locations are presented on **Figure 2**. Monitoring well nests OW82, OW83, and OW84 were installed in June 2022; with monitoring of groundwater quality beginning in May 2023.

Based on discussions below, no improvements to the groundwater monitoring were proposed or identified in 2023.

5.2.1 General Chemical Trends

To assess long-term chemical trends with time, time-concentration graphs for chloride, nitrate, and boron were prepared. Based on the background concentrations presented in **Table 6**, concentrations were considered constant where results varied by less than 15 milligrams per litre (mg/L) for chloride, 0.5 mg/L for nitrate, and 0.2 mg/L for boron. Concentration trends that varied by greater than these concentration ranges were interpreted as increasing, decreasing, or fluctuating.

Concentration trends for the time-concentration graphs on **Figures H-1** to **H-14**, **Appendix H**, are summarized in **Table 7**. Typically, the long-term concentration trends indicate constant or fluctuating concentrations with time, with some exceptions, which are discussed below. It is noted that the below observations do not represent immediate concerns, but as a matter of diligence will be evaluated over time to verify that a trend of concern does not develop or corrective measures, if required can be implemented.

Active Aquitard:

- At monitoring well OW16-6, the chloride concentrations have been generally stable after the short-term historical high concentration of 77 mg/L noted in May 2015, which subsequently decreased to an approximate average of 45 mg/L since then. It is noted that the chloride concentrations discussed are notably less than the trigger concentration of 106 mg/L.
- At monitoring well OW17-4, the chloride concentrations have been generally stable after the short-term historical high concentration of 71 mg/L noted in May 2016, which subsequently decreased to an approximate average of 30 mg/L since then. It is noted that the chloride concentrations discussed are notably less than the trigger concentration of 106 mg/L.
- At monitoring well OW54A-4, chloride concentrations have been increasing and fluctuating since late 2014. It is noted that the aforementioned chloride concentrations have shown an approximate stabilization at 25 mg/L since 2018 and are notably less than the trigger concentration of 106 mg/L.
- At monitoring well OW56-4, the boron concentrations have generally been fluctuating below 0.5 mg/L. During the November 2023, a new historical high of 0.99 mg/L was noted at monitoring well OW56-4. It is noted that the aforementioned boron concentration is well below the trigger concentration of 2.1 mg/L. The noted boron concentrations are not a concern as it would be expected that the more mobile PLIL parameter chloride would also be present at elevated concentrations if the boron concentrations were landfill leachate related. Ongoing monitoring will evaluate if the boron concentrations represent a corrective measure (i.e. monitoring well replacement as a result of well seal moving into the sand filter pack for the well's screened interval) is required or not.
- At monitoring well OW56-4, nitrate concentrations have generally been low and constant, however, isolated elevated concentrations have been detected over time; with the most recent event occurring in 2018. It is likely that the nitrate concentrations are a result of effects resulting from fertilizer application to the adjacent field. Nitrate concentrations have continued to be low and constant since 2018.
- At monitoring well OW58-6, nitrate concentrations have been low and constant, however, an isolated event with a concentration that was a new historic high was detected in May 2022. It is noted that the aforementioned nitrate concentration of 0.47 mg/L is well below the trigger concentration of 2.3 mg/L. It is likely that the nitrate concentration detected in May 2022, was a result of effects resulting from fertilizer application to the adjacent field. The May 2022 nitrate concentration is not a concern as concentrations subsequently decreased back to historically low and constant values.
- At monitoring well OW67-4, the concentrations of chloride, nitrate, and boron have exhibited generally decreasing and fluctuating trends over time. Periodic increases in concentrations for each parameter have occurred over time, including chloride in November 2022. However, the overall trend for each parameter has generally been decreasing and fluctuating since monitoring began at OW67-4. It is noted that the concentrations of chloride, nitrate, and boron were below their respective trigger concentrations in 2023.
- At monitoring well OW69-5, boron concentrations continue to show a generally constant but slightly fluctuating trend with concentrations hovering around the shallow groundwater trigger concentration of 1.1 mg/L. At this time the boron concentrations at OW69-5 are not a concern as it is expected the more mobile parameter chloride would be observed first if the source of the boron were leachate. It is likely that, similar to observations for monitoring well OW58-14, that was decommissioned in 2016, the monitoring well's bentonite seal is moving into the filter screen material of the monitoring well, and as such may require decommissioning and replacement in the future depending on chemical results.

- At monitoring well OW71A-5, the chloride concentrations are showing an increasing trend to a historical high of 32 mg/L in November 2022. In 2023, chloride concentrations were lower than the historical high observed in November 2022. The chloride concentrations are notably less than the Active Aquitard trigger concentration of 106 mg/L. It is noted that monitoring well OW71A-5 is not a compliance monitoring well for the Site but was added to supplement historically dry conditions at OW67-4. The recent chloride concentrations at OW71A-5 and OW67-4 are generally similar and the concentrations of the other PLIL parameters are not showing a similar trend.

Interstadial Silt and Sand:

- At monitoring well OW46-7, the concentration of boron has been observed to have been fluctuating and increasing since November 2019, which is similar to the short-term increase in 2015. However, the boron concentrations are notably less than the historical concentrations prior to 2003. The boron concentrations remain below the trigger concentration of 2.1 mg/L. The other PLIL parameters are not elevated or showing an increasing trend. It is likely that the observed periodic increases in boron concentrations is an effect from the bentonite seal moving into the filter pack of the monitoring well. At historical monitoring well OW58-14, the observed boron concentrations were proven to be related to bentonite seal impacts from the monitoring well seal moving into the sand filter pack. Consequently, per MECP approval, OW58-14 was decommissioned and replaced as OW58-17, which has shown constant and acceptable concentrations of boron since its installation in 2014.
- At monitoring well OW47-6, the concentrations of chloride have been constant and low since data has been recorded. During the May 2022 monitoring event, a new historical high was recorded at monitoring well OW47-6, of which the chloride concentration (14 mg/L) was well below the trigger concentration of 116 mg/L. The May 2022 nitrate concentration is not a concern as concentrations subsequently decreased back to historically low and constant values.
- At monitoring well OW67-11, chloride concentrations showed an increasing trend between about 2009 and 2013 and have since showed a generally fluctuating trend. Nitrate concentrations have continued to fluctuate since monitoring began. Boron concentrations have fluctuated and decreased since about 2011. The chloride concentrations are notably below the trigger concentration of 116 mg/L for the interstadial silt and sand hydrostratigraphic unit.
- At monitoring well OW80-6, the concentrations of chloride, nitrate, and boron detected in May 2022 were noted to be anomalous due to overall groundwater quality showing significant deviations (typically lesser) from historical concentrations. Further monitoring will evaluate these parameter concentrations over time. In 2023, the relevant parameters returned to their historical ranges.

5.2.2 Organic Chemistry

The 2023 and historical organic chemical results are provided in **Table H-5**, **Appendix H**. Tested organic chemical constituents at each monitoring location were not detected at concentrations greater than their respective laboratory RDL during 2023.

5.2.3 Trigger Mechanisms

Groundwater compliance is assessed based on criteria calculated with respect to the Ministry of the Environment and Energy's (MOEE) Guideline B-7 Reasonable Use Concept (Guideline B-7) and evaluated at the Site boundaries (Points of Compliance). Trigger concentrations are used to assess potential sources of concentration changes. The groundwater trigger concentrations are based on 80% of the calculated Guideline B-7 criteria for the reasonable use of groundwater (MOE, 1994), in accordance with Condition 14.2 of the ECA. When background groundwater quality satisfies the ODWS, background groundwater quality cannot be degraded by more than 25% of the ODWS for health-related parameters (e.g., nitrate) or by more than 50% of the ODWS for aesthetic-related parameters (e.g., sodium). Where background concentrations naturally exceed the ODWS, background groundwater quality becomes the criteria.

Historical background groundwater quality for local monitoring wells was used to calculate the trigger concentrations at the Site. As a screening process, trigger concentrations for the PLIL were calculated and assessed as provided in Table 3 of the landfill EMP.

5.2.3.1 Points of Compliance

An assessment of potential landfill leachate effects on groundwater quality is completed at the Site boundary to encompass the Expansion Landfill footprint and operations, as well as to consider potential effects of the Existing Landfill on groundwater quality. Monitoring wells are used at strategic locations around the Site to obtain an acceptable representation of groundwater quality moving beyond the Site boundary. These strategic locations are called the Points of Compliance and are assessed in accordance with Guideline B-7.

To account for the natural groundwater quality variability, the trigger concentrations consider the PLIL parameters discussed in **Section 5.1.1**. Exceedance of the trigger concentrations at the monitoring wells initiates the assessment process, which is detailed within Figure 3 of the landfill EMP. **Tables 8** to **10** provide the groundwater trigger concentration comparison and the 2023 chemical concentrations for the PLIL parameters.

Verification groundwater monitoring at the Site adheres to Condition 14.4 of the Waste ECA, which references the landfill EMP. Groundwater verification is required to be completed for two (2) subsequent events separated by six months with the first verification monitoring event taking place within one month of the initial sampling event.

5.2.3.2 Trigger Concentration Assessment

Primary Leachate Indicator List Assessment:

Based on the chemical analytical results for the 2023 monitoring events, the concentrations of the PLIL parameters at the groundwater monitoring wells, including the Points of Compliance, within the active aquitard, the interstadial silt and sand, as well as the interface aquifer generally satisfied the relevant trigger concentrations. Where exceptions were noted, a summary of the trigger concentration evaluation is presented in the following table.

Sample ID	Parameter	Trigger Concentration (mg/L)	May 2023 Analytical Result (mg/L)	Comments
OW67-4	Nitrate	2.3	**<5.0**	The nitrate concentration at monitoring well OW67-4 is a "false" trigger concentration due to the elevated laboratory RDL. This reported concentration is not a concern as the other Primary Leachate Indicator List (PLIL) parameters (chloride and boron) were not detected at elevated concentrations. Verification monitoring was completed as per the EMP.
OW84-31	Nitrate	2.3	**6.22**	The detected nitrate concentration at monitoring well OW84-31 is not attributable to a landfill leachate as this well is positioned upgradient (background) at the Site. The reported concentration is also not a concern as the other PLIL parameters (chloride and boron) were not detected at elevated concentrations. Verification monitoring was completed as per the EMP.

Assessment Monitoring OW67-4

The nitrate concentration at monitoring well OW67-4 was a 'non-detectable' value as it was below the laboratory RDL. The laboratory reported that due to the sample matrix interferences, the sample required dilution and the RDLs for various parameters, including nitrate, were adjusted accordingly. The visually identified turbid water for the groundwater at OW67-4 was confirmed through field measurements for turbidity (>999 nephelometric turbidity units (NTU)). The other PLIL parameters chloride and boron were not detected at elevated concentrations which would be more indicative of a landfill leachate effect. Therefore, the elevated nitrate RDL caused a "false" trigger concentration exceedance at monitoring well OW67-4 and is therefore interpreted to not be a result of a landfill leachate effect.

Assessment Monitoring OW84-31

The detected nitrate concentration at newly installed monitoring well OW84-31 is not attributable to a landfill leachate effect as groundwater movement within the interface aquifer is in a southwesterly direction and therefore, OW84-31 is positioned upgradient (background) at the Site. Furthermore, the other PLIL parameters chloride and boron were not detected at elevated concentrations which would be more indicative of a landfill leachate effect. Monitoring well OW84-31 was sampled for the first time during the spring 2023 monitoring event.

Verification Monitoring OW67-4 and OW84-31

Based on the noted nitrate concentrations at monitoring wells OW67-4 and OW84-31 in the EMP, a verification monitoring event for the primary and secondary leachate indicator list parameters, per the process outlined in Figure 3 of the EMP. Verification samples were collected at monitoring wells OW67-4 and OW84-31 on May 25 and May 23, 2023, respectively. The verification monitoring for OW67-4 indicated acceptable results, whereas the verification monitoring for OW84-31 indicated a similar nitrate concentration to that of the routine sample.

Again, per the process outlined in Figure 3 of the EMP, a second round of verification samples were collected at monitoring wells OW67-4 and OW84-31 on November 1 and November 3, 2023, respectively. Results for the second verification sampling confirmed the first verification sampling findings.

As the nitrate concentrations were not confirmed during the verification monitoring process at OW67-4, no further assessment action was required, and routine monitoring can resume.

Per Figure 3 of the EMP, since the trigger concentration exceedance for monitoring well OW84-31 was confirmed, an Alternate Source Evaluation was completed, which is outlined below along with the associated findings.

- **Confirm QAQC data** – Laboratory review of QAQC data confirms initial result reported.
- **Confirm chemical trends of primary and secondary leachate indicator list parameters** – Monitoring well OW84-31 was sampled for the first time during the spring 2023 monitoring event and therefore, there is not enough data to determine a trend. The nitrate concentration for initial spring routine sample was 6.22 mg/L (May 3, 2023), the first verification sample was 6.45 mg/L (May 23, 2023), and the second verification sample was 5.08 mg/L (November 3, 2023).
- **Inspect condition of monitoring wells** – An assessment of the monitoring well OW84-31 denoted that it is in good condition. Of note, OW84-31 is approximately 10 m south of Zion Line, just north of the exterior sideslope of the Site's northern screening berm.
- **Inspect Chain-of-Custody Forms** – The field information form and chain of custody was reviewed, both of which are satisfactory and included the required information.

On going monitoring at this background groundwater monitoring well will continue.

Secondary Leachate Indicator List Assessment:

Based on the chemical analytical results for the 2023 monitoring events, the concentrations of the SLIL parameters at the groundwater monitoring wells, including the Points of Compliance, within the active aquitard, the interstadial silt and sand, as well as the interface aquifer satisfied the relevant trigger concentrations. Where exceptions were noted, a summary of the trigger concentration evaluation is presented in the following table.

Sample ID	Parameter	Trigger Concentration (mg/L)	May 2023 Analytical Result (mg/L)	Comments
OW83-5	Lead	0.002	**0.019**	The detected lead concentration at monitoring well OW83-5 is not a concern as lead is a Secondary Leachate Indicator List (SLIL) parameter, and the PLIL parameters (chloride, boron, and nitrate) were not detected at elevated concentrations.
OW84-6	Lead	0.002	**0.01**	The detected lead concentration at monitoring well OW84-6 is not a concern as lead is a SLIL parameter, and the PLIL parameters (chloride, boron, and nitrate) were not detected at elevated concentrations.

The detected lead concentrations at newly installed monitoring wells OW83-5 and OW84-6 are not a concern as lead is a SLIL parameter, and the PLIL parameters (chloride, boron, and nitrate) were not detected at elevated concentrations, and as such are not interpreted to be leachate related. Monitoring wells OW83-5 and OW84-6 were sampled for the first time during the spring 2023 monitoring event and were not required to be sampled during the fall 2023 monitoring event. Future monitoring events will evaluate if there is a trend of concern, or not, in the concentrations of lead.

During the 2023 monitoring events, VOCs tested within the groundwater at the monitoring well locations satisfied their respective trigger concentrations.

In summary, based on the chemical analytical results for the 2023 monitoring events, the concentrations of the PLIL and SLIL parameters at the groundwater monitoring wells, including the Points of Compliance, within the active aquitard, the interstadial silt and sand, as well as the interface aquifer generally satisfied the relevant trigger concentrations.

5.3 Surface Water

Surface water chemical results are summarized in **Tables I-1** to **I-4**, **Appendix I**. Laboratory reports and documentation of quality control are provided in **Table I-5**, **Appendix I**.

5.3.1 General Chemical Trends

As discussed in **Section 5.1.1,** there are seven (7) surface water PLIL parameters that represent effective indicators of landfill leachate effects on surface water quality for the Site. To assess chemical trends with time, time-concentration graphs for chloride, un-ionized ammonia, boron, and zinc were prepared.

Data were analyzed for long-term trends, which considered the historical data. Concentrations were considered constant where results varied by less than 15 mg/L for chloride, 0.02 mg/L for un-ionized ammonia, 0.2 mg/L for boron, and 0.02 mg/L for zinc. Concentrations trends that varied by greater than these concentration ranges were interpreted as increasing, decreasing, or fluctuating. A minimum of three (3) to five (5) data points are required to determine a chemical trend with time. Concentration trends are summarized in **Table 11**. Time-concentration graphs are presented on **Figures I-1** to **I-4**, **Appendix I**.

Long-term concentration trends indicate both constant and fluctuating concentrations with time. Fluctuating concentrations generally showed a seasonal pattern for boron and chloride concentrations at stations SS1 and SP1. Chloride concentrations at SP2 and SP4 appear to have a fluctuating pattern in the long-term. Additionally, in the long-term, unionized ammonia concentrations continued a constant trend of being below their respective laboratory RDL and/or less than the respective PWQO (0.02 mg/L), with occasional historical exceedances at SS1, SP1, and SP2.

In 2023, concentrations of the PLIL parameters in surface water within the Sedimentation Ponds and at compliance point SS1 were typically similar to each other, with some exceptions where elevated and fluctuating concentrations of boron, nickel, chromium, and zinc have generally been noted at SS1 and boron at SP2. The noted boron, nickel, chromium, and zinc concentrations at SS1 and boron concentrations at SP2 are not a concern as they are not landfill leachate related but are interpreted to be a result of short-term general erosional effects on the watercourse upstream of SS1 and SP2. Further details pertaining to individual surface water monitoring events conducted in 2023 are provided in **Section 0**.

5.3.2 Organic Chemistry

Organic chemical results are provided in **Table I-3**, **Appendix I**. Tested organic chemical constituents at the downstream compliance monitoring stations SS1, SP2, SP3, and SP4, as well as the internal compliance monitoring station SP1, were not detected at concentrations greater than their respective laboratory RDL.

5.3.3 Biomonitoring Program – Annual Spring Routine Event

The laboratory results for the biomonitoring monitoring events completed in 2023 are provided within **Table I-6, Appendix I**. The sample aliquots collected to assess biological conditions were assessed for surface water quality toxicity to *daphnia magna* and rainbow trout. The biological testing results showed that there was not a potential for detrimental effects to aquatic life in the discharge water.

5.3.4 Biomonitoring Program – Verification Events

Surface water verification sampling included the collection of a grab sample for analysis of the toxicity to rainbow trout and *daphnia magna* associated with verification surface water monitoring events for compliance monitoring discussed in **Section 2.4.3**.

During the verification sampling events, the verification biological results indicated that the surface water was of acceptable quality for continued discharge.

5.3.5 Trigger Concentration Assessment

Table 12 provides the Post 2022 trigger concentrations utilized to assess surface water quality during 2023, as well as the Post 2023 trigger concentrations that will be utilized in 2024 to assess the chemical quality of surface water.

A comparison of the 2023 surface water quality with the Post 2022 trigger concentrations is provided in **Table I–4**, **Appendix I**. Outlined below is a detailed discussion of the trigger concentration assessments for each surface water monitoring event, by calendar quarter for 2023. A quality comparison for background stations SS10 and SS16 is also provided where applicable.

First Quarter – January 1 to March 31, 2023

February 10, 2023:

Surface water samples were collected at compliance monitoring stations SS1, SP2, SP3, and SP4, as well as internal assessment monitoring location SP1, and background monitoring stations SS10 and SS16. The surface water quality at the required monitoring stations satisfied the relevant trigger concentrations, with one (1) exception at monitoring station SS1. For the surface water sample collected at compliance monitoring station SS1, the concentration of total boron (0.29 mg/L) was greater than its respective trigger concentration (0.20 mg/L). As such, verification monitoring at compliance monitoring station SS1 was required. The verification monitoring was completed for SS1 on March 17, 2023, and is discussed below.

The elevated total boron concentration noted at the location of monitoring station SS1 was interpreted to be as a result of the discharge water quality from within Sedimentation Pond 1, as well as erosional effects with flow in the ditch from SP1 to SS1. The erosional effects observed at SS1 were, in part, due to sediment buildup removal activities along select lengths of the surface water drainage ditch upstream of SS1 and downstream of SP1, which occurred in the late fall 2022.

Though elevated, total boron concentration at monitoring station SS1, was noted to be within the historical range. Overall, it is interpreted that the total boron concentration at monitoring station SS1 was not as a result of a landfill leachate effect, but rather from a combination of water quality discharging from Sedimentation Pond 1 as well as from soil erosional effects with flow through the recently cleaned (fall 2022) ditch towards SS1.

March 17, 2023:

Based on the aforementioned chemical findings, per Figure 4 of the EMP a verification surface water sample was collected at monitoring station SS1 on March 17, 2023. The verification monitoring also indicated an exceedance of the trigger concentration for boron, as well as total nickel, chromium, and zinc. However, the biological results indicated that the surface water quality does not pose a detrimental effect to aquatic life and that the surface water was of acceptable quality for continued discharge and that no further verification monitoring was required (refer to **Section 5.3.4**).

Second Quarter – April 1 to June 30, 2023

April 2, 2023:

Surface water samples were collected at compliance monitoring stations SS1, SP2, SP3, and SP4, as well as internal assessment monitoring location SP1, and background monitoring stations SS10 and SS16. The surface water quality at the required monitoring stations satisfied the relevant trigger concentrations with two (2) exceptions. For the surface water samples collected at compliance monitoring stations SS1 and SP2, the concentrations of boron (0.25 mg/L and 0.21 mg/L, respectively) were greater than their respective trigger concentration (0.20 mg/L). As such, verification monitoring was required, and as discussed below was completed on April 17, 2023 at monitoring station SP2, and on May 3, 2023 at monitoring station SS1.

The elevated total boron concentration noted at the location of surface water monitoring station SS1 was interpreted to be a result of the discharge water quality from within Sedimentation Pond 1, as well as erosional effects with flow in the ditch from SP1 to SS1. The elevated total boron concentration noted at the location of surface water monitoring station SP2 was interpreted to be a result of erosional effects with flow in the ditch upstream of SP2. The erosional effects observed at SS1 and SP2 were, in part, due to precipitation of varying intensity totaling approximately 55 millimeters (mm), within 48 hours prior to sample collection, as well as sediment buildup removal activities along select lengths of the surface water drainage ditch upstream of SS1 and downstream of SP1, as well as upstream of SP2, respectively, which occurred in the fall of 2022.

Though elevated, the total boron concentrations at monitoring stations SS1 and SP2, were noted to be within the historical range. Overall, it was interpreted that the total boron concentrations at monitoring stations SS1 and SP2 were not a result of a landfill leachate effect, but rather from a combination of water quality discharging from Sedimentation Pond 1, as well as from soil erosional effects with precipitation runoff through the recently cleaned ditches upstream of SS1 and SP2.

April 17, 2023:

Based on the aforementioned chemical findings, per Figure 4 of the EMP a verification surface water sample was collected at monitoring station SP2 on April 17, 2023. The verification monitoring also indicated an exceedance of the trigger concentration for boron. However, the verification monitoring for SP2 denoted acceptable biological results indicating that the surface water quality does not pose a detrimental effect to aquatic life and that the surface water was of acceptable quality for continued discharge and that no further verification monitoring was required (refer to **Section 5.3.4**).

May 3, 2023:

Based on the aforementioned chemical findings, a verification surface water sample was collected at monitoring station SS1 on May 3, 2023. The verification monitoring also indicated an exceedance of the trigger concentration of boron, as well as exceedances of total chromium, nickel, and zinc. However, the biological results indicated that the surface water quality at compliance monitoring station SS1 does not pose a detrimental effect to aquatic life and that the surface water was of acceptable quality for continued discharge, and that no further verification monitoring was required (refer to **Section 5.3.4**).

Third Quarter – July 1 to September 30, 2023

July 3, 2023:

Surface water samples were collected at compliance monitoring stations SS1, SP2, and SP3, as well as internal assessment monitoring location SP1, and background monitoring station SS10. Samples were not collected at surface water monitoring stations SS16 and SP4 due to there not being flowing conditions to initiate sample collection. The surface water quality at the required monitoring stations satisfied the relevant trigger concentrations with two (2) exceptions at monitoring stations SS1 and SP2. For the surface water sample collected at compliance monitoring station SS1, the concentrations of total boron (0.3 mg/L), total nickel (0.25 mg/L), total chromium (0.17 mg/L), and total zinc (0.4 mg/L), were greater than their respective trigger concentrations of 0.20 mg/L, 0.027 mg/L, 0.024 mg/L, and 0.06 mg/L, respectively. For the surface water sample collected at compliance monitoring station SP2, the concentration of total boron (0.26 mg/L) was greater than its respective trigger concentration (0.20 mg/L). Therefore, per Figure 4 of the EMP verification monitoring was required for SS1 and SP2, as discussed below was completed on July 13, 2023.

The noted total boron, nickel, chromium, and zinc concentrations noted at the location of surface water monitoring station SS1 are interpreted to not be landfill leachate related and are interpreted to be a result of the discharge water quality from within Sedimentation Pond 1, as well as erosional effects within the ditch from SP1 to SS1. The erosional effects observed at SS1 are, were part, due to precipitation of varying intensity totaling approximately 25 millimeters (mm), within 25 hours (most of which was observed within 5 hours) prior to sample collection. The visually identified turbid water for the surface water at SS1 was confirmed through field measurements for turbidity (>999 nephelometric turbidity units (NTU)). In addition, notwithstanding the ditch cleaning in the fall of 2022, since Q2 of 2023 along select lengths of the surface water drainage ditch upstream of SS1 and downstream of SP1, sediment build up was observed in the bottom of the ditch as well as built-up in front of a number of the straw-bale check dams. It is noted that this sediment was identified to be required for removal, and was completed as soon as scheduling of a contractor could be initiated in November 2023. Though elevated, the total boron, nickel, chromium, and zinc concentrations at monitoring station SS1 were noted to be within the historical range.

The noted total boron concentration noted at the location of surface water monitoring station SP2 was interpreted to not be landfill leachate related as neither chloride, un-ionized ammonia, nor phenols were detected at elevated concentrations which would be more indicative of a landfill leachate effect. Though elevated, the total boron concentration at monitoring station SP2 was noted to be within the historical range. As it was only boron that was elevated, it does not present an immediate concern.

July 7, 2023:

A surface water sample was collected at monitoring station SP4. A sample was not collected at surface water monitoring station SS16 on July 7, 2023 due to there not being flowing conditions to initiate sample collection. The surface water quality at monitoring station SP4 satisfied the relevant trigger concentrations.

July 13, 2023:

Per Figure 4 of the EMP verification surface water samples were collected at monitoring stations SS1 and SP2 on July 13, 2023. The verification monitoring also indicated an exceedance of the trigger concentration of boron at both monitoring locations SS1 and SP2. However, the biological results indicated that the surface water quality does not pose a detrimental effect to aquatic life and that the surface water was of acceptable quality for continued discharge, and that no further verification monitoring was required (refer to **Section 5.3.4**).

Fourth Quarter – October 1 to December 31, 2023

November 2, 2023:

Surface water samples were collected at compliance monitoring stations SS1, SP2, SP3, and SP4, as well as internal assessment monitoring location SP1, and background monitoring stations SS10 and SS16. The surface water quality at the required monitoring stations satisfied the relevant trigger concentrations.

VOC constituent concentrations were below their relevant laboratory RDLs for the surface water samples collected in 2023.

5.3.6 Surface Water Drainage Network Evaluation

The surface water that discharged from the Sedimentation (Stormwater Management) Ponds 1 to 4 was generally of acceptable quality during 2023 based on the assessment and verification monitoring completed.

During the 2023 calendar year, maintenance was completed on portions of the surface water drainage ditches listed below (upstream of SS1 an SP2).

Expansion Landfill

- Landfill side ditches along Street C (adjacent to the western limit of Cells 1, 2, and 4, as well as the southern limit of Cell 1).
- Landfill side ditch along Street D (adjacent to the eastern limit of Cells 1, 2, and 4).

Existing Landfill

- Landfill side ditch along Street D (western side of the Existing Landfill).

Other

- Ditch leading from the outflow of Sedimentation Pond 1, along the southern side of Steet C (south of the Expansion Landfill) almost to the eastern boundary of Sedimentation Pond 2.

The above-noted ditch maintenance included the removal of sediment build-up within the surface water drainage ditches as well as the repair/install of straw bale check dams.

Additional straw bale check dams are installed or replaced at various locations in the surface water drainage network in an effort to reduce sediment loading of runoff water into the sedimentation ponds at the site.

Also, in conformance with Condition 5.7. of the Sewage ECA, the sedimentation ponds were inspected in 2023 for the presence of excessive sediment/vegetation build-up. Based on the 2023 inspection, it was assessed that Sedimentation Pond 3 required sediment removal from the forebay and the main portion of the pond. This work was completed in January 2024. It is noted, despite the presence of sediment build-up assessed by RWDI to be required to be removed, the water quality discharge from Sedimentation Pond 3 during 2023 was of acceptable quality per the surface water evaluation criteria. Additionally, the total suspended solids were very low, and commonly less than 10 mg/L, which indicates that the pond still effectively worked to reduce sediment loading in discharge water despite the sediment build-up that required removal.

5.4 Landfill Gas Monitoring

Consistent with historical observations, methane gas was not detected within the gas probes in 2023. This observation indicates that landfill gas is not migrating in the subsurface beyond the waste footprint and is therefore, being effectively captured by the landfill gas collection system. Therefore, mitigation measures that would address a potential landfill gas migration in the shallow subsurface beyond the waste footprint are not required. The 2023 landfill gas monitoring results are presented in **Table J-1**, **Appendix J**.

Gas monitoring probes GP1A to GP10 were noted to be in acceptable condition for the monitoring of LFG and therefore, no additional monitoring or corrective actions were required. In addition, no improvements to the landfill gas monitoring were proposed or identified in 2023.

6 SITE OPERATIONS SUPPLEMENTAL TESTING & MONITORING

6.1 Construction Activities

6.1.1 Existing Landfill

On May 18, 2023, one (1) landfill cap repair was completed on the Existing Landfill to address Total Hydrocarbon (THC) survey findings from the spring monitoring event. On October 24, 2023, eight (8) landfill cap repairs were completed on the Existing Landfill to address THC survey findings from the fall monitoring event. The nine (9) repairs were all located along the eastern sideslope. These repairs were completed with a geosynthetic bentonite composite layer placed approximately 0.3 m below final cap surface that was then hydrated, and subsequently the clayey soil cap material was replaced and re-compacted. Validation of the ground level THC (as methane) level was completed for the repair locations following the spring and fall monitoring events on May 18 and November 5, 2023, respectively. The ground level THC concentrations were less than 500 ppm indicating that the repairs were successful. Refer to **Volume 4** of the 2023 Annual Report for details regarding the THC Survey monitoring.

On May 5, 2023, it was identified by RWDI and the MECP that an area up the sideslope of the Existing Landfill near MH3SA and MH3SB was saturated with no flowing water, but had water ponded in some erosion rills. This area was remediated the same day by WM by placing additional clayey soil to fill the rills and covering with topsoil and seeding. Follow up inspections completed through the remainder of 2023 indicated that this area no longer exhibited the saturated conditions.

6.1.2 Expansion Landfill

The Site was formally approved for expansion on August 5, 2008. During 2023, waste disposal occurred in Cell 4 and Cell 6A of the Expansion Landfill. Upon completion of the landfill liner system of Cell 6B, waste disposal is scheduled to also occur Cell 6B in 2024. A portion of Cell 6C pre-excavation activities related to the future construction of the Cell 6C landfill liner system of the Expansion Landfill occurred in late 2023.

Interim cover was placed on portions of the northern, eastern, and western side slopes of Cell 4 during 2023. Portions of Cell 1, Cell 2, and Cell 4 also had interim cover placed on the relative "flat-top". In addition, topsoil and seeding was placed on portions of the southern, eastern, and western side slopes of Cell 1 and portions of the eastern and western side slopes of Cell 2.

6.1.3 Groundwater Monitoring Wells

In 2023, there were no new groundwater monitoring wells or gas probes installed at the Site. There were also no groundwater monitoring wells or gas probes decommissioned and/or replaced in 2023.

The 2023 monitoring well and gas probe installation/decommissioning status summary is provided in **Appendix M**.

6.1.4 On-Site Surface Water Management

Upon completion of cell construction and filling in the Expansion Landfill, surface water runoff will be managed through Sedimentation Ponds 1, 2, 3, and 4. Surface water runoff originating from areas south of the Existing Landfill flows toward: 1) Kersey Drain (Brown Creek) to the east; and 2) to the west toward the Van Kessel Drain and enters a municipal drainage tile at a catch basin (SS1), which is situated 60 m east of the western Site boundary. The municipal drainage tile subsequently drains into the discharge ditch for SP2, which ultimately flows to the Gilliand-Geerts Drain 'A', beneath Lambton Road 79.

During the 2023 operating period, maintenance to the on-Site surface water flow system was required, which is detailed in **Appendix R**.

Only water that satisfied the Criteria for On-Site Surface Water Management (D&O, 2008) was used on-Site for dust control and road cleaning purposes in 2023.

6.2 MECP Site Inspection Reports

A MECP Inspector provided inspection summary reports on a semi-annual basis in 2023. The MECP Site inspections were conducted to assess Site operation compliance with the applicable approval documentation. Findings from the MECP semi-annual Inspection Reports for the MECP's Fiscal Year of October 1 (2022) to September 30 (2023), are summarized in **Appendix N** of Volume 2 of the 2023 Annual Report. Where action items were required, they were addressed by WM. It is noted that the semi-annual MECP inspection report for the timeframe of October 1, 2023 to March 31, 2024, is scheduled to be provided by the MECP to WM in April 2024.

6.3 Automobile Shredder Residue

Composite samples of stockpiled ASR material were collected in the spring and fall of 2023, for the TCLP parameters listed in Condition 6.52 of the Waste ECA. Testing results indicated that the ASR was classified as non-hazardous and could be either disposed of in the landfill or utilized as daily cover in accordance with the stipulations of the Waste ECA. Historical analytical data, as well as analytical data related to the 2023 semi-annual (spring and fall) assessments that were completed per Condition 6.52 of the Waste ECA, is presented in **Table K-1**, **Appendix K**. The relevant laboratory Certificates of Analysis, which detail the chemical analytical results for the ASR samples collected in 2023, are included in **Appendix K-2**.

No improvements to the ASR monitoring were proposed or identified in 2023.

6.4 Contaminated Soil

Composite samples of stockpiled contaminated soil were collected during each quarter of 2023 and were submitted for analytical testing of the TCLP parameters listed in Condition 6.57 of the Waste ECA. Testing results indicated that the contaminated soil was classified as non-hazardous and could be either disposed of in the landfill or utilized as daily cover in accordance with the stipulations of the Waste ECA. Historical analytical data, as well as analytical data related to the quarterly contaminated soil assessments that were completed per Condition 6.57 of the Waste ECA, is presented in **Table O-1**, **Appendix O**. The relevant laboratory Certificates of Analysis, which detail the chemical analytical results for the contaminated soil samples collected in 2023, are included in **Appendix O-2**.

No improvements to the contaminated soil monitoring were proposed or identified in 2023.

7 AMBIENT AIR QUALITY MONITORING PLAN

7.1 Total Suspended Particulate (TSP) Monitoring

Monitoring of Total Suspended Particulate (TSP) for the 2023 monitoring period was completed as required. Findings of the TSP monitoring program is detailed within **Volume 4** of the 2023 Annual Report.

7.2 Volatile Organic Compounds (VOCs) Monitoring

The ambient air volatile organic compound (VOC) monitoring is to be completed during the summer period, which begins on June 21 and ends September 21 of every year in accordance with the Ambient Air Quality Monitoring Plan. Findings of the VOC monitoring program, completed during the 2023 monitoring period, are detailed within **Volume 4** of the 2023 Annual Report.

7.3 Total Hydrocarbon (THC) Landfill Cap Surveys

The landfill final cap surface of the Existing Landfill is surveyed for Total Hydrocarbon (THC) vapour releases as part of the Ambient Air Quality Monitoring Plan twice annually in the spring and the fall. The landfill final cap surface of the Existing Landfill was surveyed by RWDI in the spring and fall of 2023 for Total Hydrocarbon (THC) vapour releases, as required. The THC Landfill Cap survey and associated details are presented within **Volume 4** of the 2023 Annual Report.

8 NOISE MONITORING PLAN

The Environmental Noise Monitoring Program (Aercoustics, 2007) was implemented in 2009. The survey is required under Condition 13.10 of the Waste ECA. The Noise Monitoring Plan (NMP) report as it relates to the 2023 monitoring period is presented within **Volume 5** of the 2023 Annual Report.

9 BEST MANAGEMENT PRACTICES

9.1 Dust

The Best Management Practices Plan (Dust) for the Site was utilized by WM for its operations during 2023. The Dust Inspection and Dispatch Log for each event as filled out by WM are maintained on file.

Complaints related to dust were not received by WM during the 2023 monitoring period.

Details of the Ambient Air Quality Monitoring Program for the Site are presented within **Volume 4** of the 2023 Annual Report.

9.2 Litter

WM operated the Site in accordance with its Best Management Practices Plan (Litter) during 2023. The Litter Inspection and Dispatch Logs for each event, as filled out by WM, are maintained on file.

Details related to litter complaints received and the associated response actions(s) by WM during the 2023 monitoring period are outlined in **Section 10, Appendix P**, and **Appendix Q**.

9.3 Odour

Odour control is achieved through the Best Management Practices Plan (Odour). The Odour Control Plan was implemented at the Site during 2023. Additionally, an odour suppression system is available to manage refuse odours during normal operating procedures as identified by WM.

Details related to odour complaints received during the 2023 monitoring period are outlined in **Section 10, Appendix P**, and **Appendix Q**.

Further explanation of odour as it relates to the Ambient Air Quality Monitoring Program for the Site is presented within **Volume 4** of the 2023 Annual Report.

10 COMPLAINTS

In 2023, WM received a total of 24 complaints. Of the complaints received by WM in 2023, one (1) of the complaints addressed two (2) topics (trackout and odour), one (1) of the complaints addressed litter, while the remaining complaints were related to odour. Of the odour complaints received, they represented a total of 20 complaint driven events, which each occurred on separate days. Of these odour events, 11 were documented from discrete physical locations such as a residence or commercial building. The remaining 9 odour events represented transient (drive-by) occurrences in which the complainant observed an odour while in transit along a road near to the Site. Further details on these complaints driven events are discussed in **Section Q1.17, Appendix Q, Volume 2.**

A summary of the complaints and the associated response action for each complaint is presented in **Appendix P**.

11 WATER TAKINGS

Reporting of 2023 water takings is required to be completed for Sedimentation Ponds 1 to 4 and the SDL per Ontario Regulation 387/04: Water Taking and Transfer (O. Reg. 387/04), and the Site's PTTW No. 4682-BLJRYJ, dated November 8, 2021. A report indicating water takings during 2023 from the Sedimentation Ponds and the SDL will be submitted to the MECP by March 31, 2024, in accordance with O. Reg. 387/04, and is provided under separate cover, and/or submitted using the online Water Taking Reporting System (WTRS).

In 2023, water was taken from Sedimentation Ponds 1, 2, 3, and 4, as well as pumping stations PS6 and PS8. Water that was taken from the aforementioned ponds was used mainly for dust control for landfill operations. Water was also taken from the aforementioned pumping stations for use as recompacted clayey liner soil conditioning. During 2023, the water taking activities were in compliance with the PTTW limits for the Site, as summarized next.

Pond 1		
PTTW Regulatory Components	**PTTW Value Limits**	**2023 Water Taking Values**
Max. Taken per Minute (L/min)	4,921	1,064
Max. Hours Taken per Day	24	10.1
Max. Litres Taken Per Day	7,085,520	642,000
Max. Days Taken per Year	105	7
Total Litres Taken in 2023	N/A	1,971,000
Pond 2		
PTTW Regulatory Components	**PTTW Value Limits**	**2023 Water Taking Values**
Max. Taken per Minute (L/min)	4,921	2,089
Max. Hours Taken per Day	24	1.7
Max. Litres Taken Per Day	7,085,520	211,981
Max. Days Taken per Year	105	2
Total Litres Taken in 2023	N/A	275,547
Pond 3		
PTTW Regulatory Components	**PTTW Value Limits**	**2023 Water Taking Values**
Max. Taken per Minute (L/min)	4,921	2,089
Max. Hours Taken per Day	24	4.8
Max. Litres Taken Per Day	7,085,520	605,660
Max. Days Taken per Year	105	44
Total Litres Taken in 2023	N/A	7,373,911
Pond 4		
PTTW Regulatory Components	**PTTW Value Limits**	**2023 Water Taking Values**
Max. Taken per Minute (L/min)	4,921	1,064
Max. Hours Taken per Day	24	12.2
Max. Litres Taken Per Day	7,085,520	774,000
Max. Days Taken per Year	105	3
Total Litres Taken in 2023	N/A	1,449,000

PS6		
PTTW Regulatory Components	**PTTW Value Limits**	**2023 Water Taking Values**
Max. Taken per Minute (L/min)	1,325	234
Max. Hours Taken per Day	24	17.5
Max. Litres Taken Per Day	1,907,640	246,000
Max. Days Taken per Year	365	7
Total Litres Taken in 2023	N/A	1,200,000
PS8		
PTTW Regulatory Components	**PTTW Value Limits**	**2023 Water Taking Values**
Max. Taken per Minute (L/min)	1,325	234
Max. Hours Taken per Day	24	15.2
Max. Litres Taken Per Day	1,907,640	213,000
Max. Days Taken per Year	365	10
Total Litres Taken in 2023	N/A	1,730,400

12 WASTE DISPOSAL INFORMATION

Waste disposal in 2023 occurred in Cell 4 and Cell 6A of the Expansion Landfill. In 2024, it is anticipated that landfilling of waste will continue to occur in Phase 3 (Cell 1 and Cell 2), Cell 4, and Cell 6A. Upon completion of the landfill liner system of Cell 6B, it is also anticipated that landfilling of waste will occur in this cell in 2024.

For reference, design drawings for the Existing and Expansion Landfills are presented in **Appendix L**.

13 EAA MONITORING & ANNUAL REPORTING

13.1 Mitigation Measures

No mitigation measures related to hydrogeology were required beyond the mitigation built into the Site design.

13.2 Monitoring Measures

Monitoring requirements at the landfill evolved in accordance with the EMP as construction progressed in 2023. No changes occurred in 2023 from the previous monitoring period.

13.3 Contingency Measures

Based on the groundwater and surface water quality results presented in **Sections 5.2** and **5.3**, the detailed development and implementation of contingency plans is not required.

13.4 Annual Reporting

Reporting requirements for the Site are addressed and detailed in **Appendix Q**, per the Waste and Sewage ECAs, as well as the amended PTTW.

14 2024 MONITORING PROGRAM

The 2024 Monitoring Program reflects the EMP approved for the Site and incorporates the requirements of the Waste ECA, Sewage ECA, Air ECA, as well as the PTTW. Details of the proposed 2024 Monitoring Program are presented in **Table 13**.

15 CONCLUSIONS

Based on the findings presented in this report, the following conclusions are provided.

- Overall, generally leachate elevations increased from November 2022 into May 2023 and then decreased from May 2023 to November 2024. This generalized pattern was expected for 2023 with the short-term increase of leachate levels in May 2023 resulting from utilizing the leachate volumes within the waste for irrigation application to the Poplar System beginning in May. From an environmental stewardship perspective, the leachate generated from within the waste mound of the Existing Landfill was determined to be of more suitable use as irrigation liquid during the growing season as opposed to dedicating efforts for off-Site disposal and treatment between late winter and spring. This storage practice began in 2019 and will continue into the future such that there is sufficient weak-strength leachate volume for irrigation purposes during the growing season. There was a short-term slight increase in leachate elevation noted at a number of the leachate maintenance holes from May 2023 to November 2023, however, the leachate elevations were generally noted to be within their historical ranges.
- Environmental compliance at the Site as it relates to the Existing Landfill relies on groundwater and surface water quality monitoring, which once again verified at the Site in 2023. As an additional guidance tool toward managing leachate volumes in the waste cells a hydraulic gradient assessment of leachate compared to nearby shallow groundwater is utilized to further protect local water resources. May 2023 leachate levels were reflective of leachate storage for utilization onto the Poplar. However, by November 2023, the leachate elevation data within the waste of the Existing Landfill indicated that groundwater flow was inward toward the waste at Cells 3S, 3, 5, 7, 8, 9, 10, 11, 12, as well as the southern and eastern portions of the South Cell.

- In 2023, leachate elevations within Cell 4, Cell 6, Cell 8, Cell 10, and the western portion of the South Cell (at OW22A-10 and OW53-10), and the West Cell (Sump) were higher in elevation compared to groundwater during the May monitoring event. Leachate elevations within Cell 4, Cell 6, the western portion of the South Cell (at OW22A-10 and OW53-10), and the West Cell (Sump) were higher in elevation compared to groundwater during the November monitoring event. However, acceptable water quality was demonstrated at the Site during 2023 and therefore, the elevated leachate elevations that showed the potential for outward migration were not negatively affecting the water resources at the Site. Also, leachate seeps were not observed along the waste side slopes of the Existing Landfill in 2023. Continued leachate management of the leachate via automated pumping is expected to continue to reduce the leachate mound in these cells over time.
- During May and November 2023, leachate elevation in the West Cell (Sump) was greater than the surrounding natural ground surface elevation. In May 2023, the leachate elevation in the West Cell (Sump) was higher than its historical high in May 2019 by 0.31 m, but then was lowered 1.37 m by November 2023, through leachate transfer to the Leachate Equalization Tank. The noted leachate elevation within the Sump does not represent an immediate concern based on acceptable surface water quality at compliance stations and no visible leachate seeps on the sideslope. Continued leachate extraction from the West Cell over time is expected to further reduce the potential for outward leachate seepage in this area. Efforts to further lower the leachate level within the West Cell will continue in 2024.
- Overall, between May 2022 and May 2023 there was an increase in the calculated theoretical total leachate volume stored above the local groundwater table (108,309 m^3) and within the waste (167,881 m^3) of the Existing Landfill. Between November 2022 and November 2023 there was an increase in the calculated theoretical total leachate volume stored above the local groundwater table (41,590 m^3) and within the waste (40,830 m^3) of the Existing Landfill. It is noted that these volumes are only theoretical in nature and are used as guidance information for year over year overall performance evaluation. For example, the total leachate storage in the Existing Landfill decreased from May to November 2023 (a period of time approximately 2 weeks longer than the irrigation season) by 155,623 m^3, however, during that time approximately 8,658.85 m^3 was measured to have been extracted from the Existing Landfill. During this timeframe, the pumping stations in many of the weaker strength leachate waste cells were routinely drawn down to elevations where the leachate elevation was too low to safely operate the pumps.
- The trigger mechanism for implementation of groundwater contingency measures for the Expansion Landfill is the loss of hydraulic containment of the landfill waste footprint. During 2023, the leachate target level for each pumping station of the Expansion Landfill as noted in Condition 14.1 of the Waste ECA was satisfied.
- The operation of the primary leachate collection system is designed to maintain a liquid level below a leachate head target of 300 mm (or 0.3 m) above the primary clay liner (bottom of the landfill). The leachate elevation in Cell 1 and Cell 4, as represented by PS1 and PS5 respectively, satisfied the 0.3 m head target, while there were occurrences at PS3 and PS7, which represent Cell 2 and Cell 6A respectively, had periods where the 0.3 m head target was exceeded. It is noted that periodic elevated leachate occurrences are described in the D&O Report after precipitation or snow melt events generate more leachate than the pumps can extract and a temporary increase of the leachate head under such circumstances is not considered a non-compliance issue with the Waste ECA. Where there were durations of the 0.3 m head target that were exceeded during 2023, a discussion provided in **Section 4.1.2**.

- Between January 1 and December 31, 2023, a total of 70,424.34 m^3 of leachate was managed, of which 61,765.49 m^3 of leachate was removed and transported off-Site for treatment and disposal at the Chatham Water Pollution Control Plant, while 8,658.85 m^3 was irrigated onto the Poplar System during the 2023 growing season.
- Of the 70,424.34 m^3 noted above, the approximate breakdown of leachate source location between the Existing Landfill and the Expansion Landfill is 22% (15,470.28 m^3) and 78% (54,954.06 m^3), respectively. This breakdown is based on the leachate source distribution which incorporates the separate approximate volumes of leachate extracted from the Existing Landfill (37% of area) and Expansion Landfill (63% of area) for either off-Site disposal of stronger strength leachate (i.e. Expansion Landfill leachate) or storage of weaker strength leachate (i.e. Existing Landfill leachate) for use as irrigation liquid to the Poplar System during the 2023 growing season.
- Considering a north-south groundwater drainage divide at the Site, shallow groundwater movement within the active aquitard was in an easterly and westerly direction away from the divide with local variations as a result of surficial feature influences, such as ditches, waste cells, excavations, ponds, berms, and the leachate management systems. Groundwater movement within the interstadial silt and sand also typically moves toward the east and west, away from the drainage divide. Influences from the excavation of the Expansion Landfill as well as landfilling of waste in the Expansion Landfill were noted to the south (at monitoring well nest OW79) where the groundwater in the active aquitard, as well as the interstadial silt and sand was induced toward the north. The groundwater pressures within the interface aquifer have also appeared to be affected by the removal of the overlying soil mass, whereby pressures were observed to be slightly decreasing in recent years, and are expected to return to pre-existing conditions as the soil mass is replaced with waste mass. As expected, monitoring wells OW39A-26, OW79-26, OW80-27, and OW81-27 are showing a fluctuating and increasing trend since about 2018 as a significant waste mass has been progressively landfilled into the southern half of the Expansion Landfill. Groundwater movement within the interface aquifer is in a southwesterly direction.
- The groundwater monitoring results for the active aquitard, the interstadial silt and sand, as well as the interface aquifer satisfied the relevant PLIL and SLIL trigger concentrations. Two (2) exceptions occurred during the spring monitoring event for the PLIL parameter nitrate at OW67-4 and OW84-31, which as discussed in **Section 5.2.3.2** is not landfill related.
- At monitoring wells OW69-5 (Active Aquitard), and OW46-7 (Interstadial Silt and Sand), the concentrations of boron show infrequent spikes, but concentrations are less than the respective trigger concentration at each location. At this time the boron concentrations are not a concern as it is expected the more mobile parameter chloride would be observed first if the source of the boron were leachate. It is likely that, similar to observations for monitoring well OW58-14, the bentonite seal for these locations is likely moving into the filter screen material of the monitoring well, and as such may require decommissioning and replacement in the future depending on chemical results. Overall, groundwater quality did not show an unacceptable landfill leachate or operations effect in 2023.
- The routine quarterly surface water monitoring results satisfied the relevant trigger concentrations, with five (5) exceptions. The exceptions are discussed in detail **in Section 0**, with verification results indicating acceptable chemical and biological results and no further verification monitoring was required. Overall, surface water quality did not show an unacceptable landfill leachate or operations effect in 2023.
- The annual spring biomonitoring showed that there was not a potential for detrimental effects to aquatic life in the discharge water and was acceptable for continued discharge.

- Water takings at the Site from the Sedimentation Ponds were used as a dust suppressant related to landfill operations. The water taking activities in 2023 satisfied the requirements of the Site's PTTW. Documentation will be submitted to the MECP, as required by the PTTW, under separate cover.
- No methane gas was detected within the gas probes in 2023. Therefore, mitigation measures that would address a potential landfill gas migration in the shallow subsurface beyond the waste footprint are not required.
- In 2023, WM received a total of 24 complaints. Of the complaints received by WM in 2023, one (1) of the complaints addressed two (2) topics (trackout and odour), one (1) of the complaints addressed litter, while the remaining complaints were related to odour. Of the odour complaints received, they represented a total of 20 complaint driven events, which each occurred on separate days. Of these odour events, 11 were documented from discrete physical locations such as a residence or commercial building. The remaining 9 odour events represented transient (drive-by) occurrences in which the complainant observed an odour while in transit along a road near to the Site.

16 CLOSURE

We trust that this 2023 Fourth Quarter and Annual Monitoring Report for the Twin Creeks Environmental Centre is satisfactory. Should there be any questions or comments, please contact us.

Yours very truly,

RWDI

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Scientist | Geoscience

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Senior Technical Director | Principal

JMH/JCL/BJL/klm

Attach.

17 STATEMENT OF QUALIFICATIONS AND LIMITATIONS

This Report has been prepared for a specific purpose and use, as outlined within the Report. The scope of the undertaking was initially provided in a proposal submitted by RWDI AIR, Inc. (RWDI) to Waste Management of Canada Corporation. The proposal (subject to any documented scope changes requested by Waste Management of Canada Corporation) constitutes an agreement between RWDI and Waste Management of Canada Corporation.

RWDI relied in part, upon the data, information, specifications, and documentation (Data) provided by Waste Management of Canada Corporation as well as third parties. It is assumed by RWDI that the Data provided are complete and accurate. RWDI was not retained to, nor has it conducted any independent verification of the accuracy, completeness or suitability of the Data. As such, RWDI assumes no liability for losses, damages, or claims of any nature arising from inaccurate, incomplete or unsuitable Data provided on this project. Waste Management of Canada Corporation by receipt of this Report agrees to indemnify and hold harmless RWDI with respect thereto.

It is important that the reader of this Report, recognize that subsurface, environmental and/or geotechnical conditions may vary geographically and temporally. This is a natural phenomenon, which is not fully accommodated in the limited testing conducted by RWDI. In addition, the analysis of the collected data, by necessity, incorporates simplifying assumptions of site conditions and analytical solutions that assume uniformity in site conditions. The opinions, conclusions, and recommendations contained within the Report therefore represent RWDI's professional judgment in-light of these limitations.

This Report is to be considered confidential and is for the sole use of Waste Management of Canada Corporation. As such, the Report shall not be relied upon by third parties, except where agreed in writing between RWDI and Waste Management of Canada Corporation; where required by law; or where used for governmental review. RWDI accepts no responsibility, and denies any liability whatsoever, to parties other than Waste Management of Canada Corporation who may obtain access to the Report, for any injury, loss, or damage suffered by such parties arising from their use of, reliance upon, decisions or actions based on the Report or any of its contents, except to the extent where those parties have obtained prior written consent of RWDI to use and rely upon the Report and its contents. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report are subject to the terms thereof.

TABLES

Table 1
Monitoring Schedule - 2023
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Task	Monitoring Locations	Monitoring Dates	Notes
First Quarter Monitoring Period (January 1 to March 31, 2023)			
Compliance Monitoring System			
Precipitation Event Surface Water Monitoring/Sampling	SS1, SS10, SS16, SS19 (new), SP1, SP2, SP3, SP4	February 10, 2023 - Routine monitoring for February 9, 2023, precipitation event.	SS19 not monitored since the compost facility is not yet constructed. SS10 not monitored due to no flow conditions.
	SS1	March 17, 2023 - Verification monitoring event based on the results for the February 10, 2023 routine monitoring event.	
Biomonitoring	SS1	March 17, 2023 - Verification monitoring event based on the results for the February 10, 2023 routine monitoring event.	
Leachate Liquid Level Measurements	PS1, PS3, PS5, PS7, MH3S, MH4, MH5, MH6, MH7, MH8, MH9, MH10, MH11, MH12, MH16, MH17, MH18, OW22A-10, OW51A-15, OW53-10, Sump	Semi-annually in May and November. Daily during operation for PS1, PS3, PS5, and PS7.	
Leachate Sampling	Equalization Tank	Quarterly, and Semi-Annually in May and November. A quarterly sample was collected on January 18, 2023.	
Secondary Drainage Layer (SDL) Liquid Levels	PS2, PS4, PS6, PS8	Monthly - January 10, February 2, and March 9, 2023 - PS2, PS4, PS6, PS8	
Gas Monitoring	GP1A, GP2, GP3, GP4, GP5, GP6, GP7, GP8, GP9, GP10	Monthly gas monitoring from November to April and in July. Perimeter gas probes were monitored on January 17, February 2, and March 15, 2023.	
Poplar System Monitoring Program			
Precipitation Event Surface Water Monitoring/Sampling	SS14A, SS14B, and SS15A	February 10, 2023 - Routine monitoring for February 9, 2023, precipitation event.	
Ambient Air Quality Monitoring Program			
Total Suspended Particulate - Dust	Stations West, Northeast, and Southeast	Every sixth day - NAPS Schedule (October 1 to May 31) Every third day - NAPS Schedule (June 1 to September 30)	
Noise Monitoring System			
Noise monitoring	Stations - M1, M2, M3, and M4	Ongoing - Quarterly Reporting	
Operational Monitoring			
Contaminated Soil	Landfill Daily Cover/Disposed Material	Quarterly, if utilized: January 18, 2023.	
Automobile Shredder Residue (ASR)	Landfill Daily Cover/Disposed Material	Semi-Annually (Spring and Fall) if utilized.	Monitoring not completed during the Q1 calendar period.

NOTES:
1) (new) denotes monitoring station/wells to be installed per the Environmental Monitoring Plan (EMP) dated December 20, 2007.
2) OW71A-5* denotes groundwater well monitored at the request of the Public Liaison Committee.

Table 1
Monitoring Schedule - 2023
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Task	Monitoring Locations	Monitoring Dates	Notes
Second Quarter Monitoring Period (April 1 to June 30, 2023)			
Compliance Monitoring System			
Precipitation Event Surface Water Monitoring/Sampling	SS1, SS10, SS16, SS19 (new), SP1, SP2, SP3, SP4	April 2, 2023 - Routine monitoring for April 1, 2023 precipitation event.	SS19 not monitored since the compost facility is not yet constructed.
	SP2	April 17, 2023 - Verification monitoring event based on the results for the April 2, 2023 routine monitoring event.	
	SS1	May 3, 2023 - Verification monitoring event based on the results for the April 2, 2023 routine monitoring event.	
Biomonitoring	SS1, SS10, SS16, SS19 (new), SP1, SP2, SP3, SP4	April 2, 2023 - Routine monitoring for April 1, 2023 precipitation event.	SS19 not monitored since the compost facility is not yet constructed.
	SP2	April 17, 2023 - Verification monitoring event based on the results for the April 2, 2023 routine monitoring event.	
	SS1	May 3 , 2023 - Verification monitoring event based on the results for the April 2, 2023 routine monitoring event.	
Leachate Liquid Level Measurements	PS1, PS3, PS5, PS7, MH3S, MH4, MH5, MH6, MH7, MH8, MH9, MH10, MH11, MH12, MH16, MH17, MH18, OW22A-10, OW51A-15, OW53-10, Sump	Semi-annually in May and November: May 1, 2023. Daily during operation for PS1, PS3, PS5, and PS7.	
Leachate Sampling	PS1, PS3, PS5, PS7, South Fill Area (MH18), West Central Fill Area (Sump), Central Fill Area (Composite of MH3S, MH4, MH5, MH6, MH7, MH8, MH9, MH10, MH11, MH12)	Annually in May: May 2 and 3, 2023.	
	Equalization Tank	Semi-Annually sampled in May and November: May 5, 2023.	
Secondary Drainage Layer (SDL) Liquid Levels	PS2, PS4, PS6, PS8	Monthly - April 5, May 8, June 2, 2023 - PS2, PS4, PS6, and PS8	
Groundwater Liquid Level Measurements	ACTIVE AQUITARD OW16-6, OW17-4, OW40D-4, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5*, OW72-6, OW73-6, OW79-5, OW80-3, OW81-5, OW82, OW83, OW84 INTERSTADIAL SILT AND SAND OW16-7, OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-17, OW60-8, OW67-11, OW72-10, OW73-9, OW79-7, OW80-6, OW81-7, OW82, OW83, OW84 INTERFACE AQUIFER OW17-30, OW19-29, OW39-26, OW40A-28, OW49-29, OW60-25, OW79-26, OW80-27, OW81-27, OW82, OW83, OW84	Semi-annually in May and November: May 1, 2023.	
Piezometer Liquid Level Measurements	P1, P2, P3	Semi-annually in May and November: May 1, 2023.	
Groundwater Sampling	ACTIVE AQUITARD OW16-6, OW17-4, OW40B-4r, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5*, OW72-6, OW73-6, OW79-5, OW80-3, OW81-5, OW82(new), OW83(new), OW84(new) INTERSTADIAL SILT AND SAND OW16-7, OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-14, OW60-8, OW67-11, OW72-10, OW73-9, OW79-7, OW80-6, OW81-7, OW82(new), OW83(new), OW84(new) INTERFACE AQUIFER OW19-29, OW39-26, OW49-29, OW79-26, OW80-27, OW81-27, OW82(new), OW83(new), OW84(new), Cemetery Well	Semi-annually in May and November: May 1, 2, 3, and 4, 2023.	
		OW84-31 verification monitoring - May 23, 2023	
		OW67- 4 verification monitoring - May 25, 2023	
Gas Monitoring	GP1A, GP2, GP3, GP4, GP5, GP6, GP7, GP8, GP9, GP10	Monthly gas monitoring from November to April and in July. Perimeter gas probes were monitored on April 21, 2023.	

Table 1
Monitoring Schedule - 2023
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Task	Monitoring Locations	Monitoring Dates	Notes
Poplar System Monitoring Program			
Precipitation Event Surface Water Monitoring/Sampling	SS14A, SS14B, and SS15A	April 4, 2023 - Routine monitoring for April 3, 2023 precipitation event.	
Ambient Air Quality Monitoring Program			
Total Suspended Particulate - Dust	Stations West, Northeast, and Southeast	Every sixth day - NAPS Schedule (October 1 to May 31) Every third day - NAPS Schedule (June 1 to September 30)	
Volatile Organic Compounds	Upwind/downwind Monitoring	June 21 to September (5 sets): Not required.	Ambient VOC monitoring could not be completed within the 9-day window of June 21 to 30, 2023 in the second quarter monitoring period as climatic conditions were unfavourable to conduct the survey.
Total Hydrocarbon Landfill Cap Survey	Final Capped Areas	Between the Spring and Fall: May 15, 2023	
Noise Monitoring Program			
Noise Monitoring	Stations - M1, M2, M3, and M4	Ongoing - Quarterly Reporting.	
Operational Monitoring			
Contaminated Soil	Landfill Daily Cover/Disposed Material	Semi-Annually (Spring and Fall), if utilized: April 10, 2023.	
Automobile Shredder Residue	Landfill Daily Cover/Disposed Material	Quarterly, if utilized: April, 10 2023.	

NOTES:
1) (new) denotes monitoring station/wells to be installed per the Environmental Monitoring Plan (EMP) dated December 20, 2007.
2) OW71A-5* denotes groundwater well monitored at the request of the Public Liaison Committee.

Table 1
Monitoring Schedule - 2023
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Task	Monitoring Locations	Monitoring Dates	Notes
Third Quarter Monitoring Period (July 1 to September 30, 2023)			
Compliance Monitoring System			
Precipitation Event Surface Water Monitoring/Sampling	SS1, SS10, SS16, SS19(new), SP1, SP2, SP3, SP4	July 3, 2023 - Routine monitoring for July 2, 2023 precipitation event.	SS19 not monitored since the compost facility is not yet constructed. SS16 and SP4 not monitored due to no flow conditions.
	SP4	July 7, 2023 - Routine monitoring for July 6, 2023 precipitation event.	
	SS1	July 13, 2023 - Verification monitoring event based on the results for the July 12, 2023 routine monitoring event.	
	SP2	July 13, 2023 - Verification monitoring event based on the results for the July 12, 2023 routine monitoring event.	
Biomonitoring	SS1 and SP2	July 13, 2023 - Verification monitoring event based on the results for the July 12, 2023 routine monitoring event.	
Leachate Level Measurements	PS1, PS3, PS5, PS7, MH3S, MH4, MH5, MH6, MH7, MH8, MH9, MH10, MH11, MH12, MH16, MH17, MH18, OW22A-10, OW51A-15, OW53-10, Sump	Semi-annually in May and November. Daily during operation for PS1, PS3, PS5, and PS7.	
Leachate Sampling	Equalization Tank	Quarterly, and semi-annually in May and November. A quarterly sample was collected on July 12, 2023.	
Secondary Drainage Layer (SDL) Liquid Levels	PS2, PS4, PS6, PS8	Monthly - July 12, August 3, September 1 2023 - PS2, PS4, PS6, and PS8	
Gas Monitoring	GP1A, GP2, GP3, GP4, GP5, GP6, GP7, GP8, GP9, GP10	Monthly gas monitoring from November to April and in July. Perimeter gas probes were monitored on July 18, 2023.	
Poplar System Monitoring Program			
Precipitation Event Surface Water Monitoring/Sampling	SS14A, SS14B, and SS15A	July 3, 2023 - Routine monitoring for July 2, 2023 precipitation event.	SS14A not monitored due to no flow conditions.
	SS14A	July 7, 2023 - Routine monitoring for July 6, 2023 precipitation event.	
Ambient Air Quality Monitoring Program			
Total Suspended Particulate - Dust	Stations West, Northeast, and Southeast	Every sixth day - NAPS Schedule (October 1 to May 31) Every third day - NAPS Schedule (June 1 to September 30)	
Volatile Organic Compounds	Upwind/downwind Monitoring	June 21 to October (5 sets): July 18, August 1, August 22, and September 14, 2023.	
Total Hydrocarbon Landfill Cap Survey	Final Capped Areas	Between the Spring and Fall: September 22, 2023.	
Noise Monitoring System			
Noise Monitoring	Stations - M1, M2, M3, and M4	Ongoing - Quarterly Reporting	
Operational Monitoring			
Contaminated Soil	Landfill Daily Cover/Disposed Material	Quarterly, if utilized: July 11, 2023.	Monitoring not completed during the 2022 third quarter monitoring period.
Automobile Shredder Residue	Landfill Daily Cover/Disposed Material	Quarterly, if utilized:	

NOTES:
1) (new) denotes monitoring station/wells to be installed per the Environmental Monitoring Plan (EMP) dated December 20, 2007.
2) OW71A-5* denotes groundwater well monitored at the request of the Public Liaison Committee.

Table 1
Monitoring Schedule - 2023
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Task	Monitoring Locations	Monitoring Dates	Notes
Fourth Quarter Monitoring Period (October 1 to December 31, 2023)			
Compliance Monitoring System			
Precipitation Event Surface Water Monitoring/Sampling	SS1, SS10, SS16, SS19(new), SP1, SP2, SP3, SP4	Novemeber 2, 2023 - Routine monitoring for November 1, 2023 precipitation event.	SS19 not monitored since the compost facility is not yet constructed.
Leachate Liquid Level Measurements	PS1, PS3, PS5, PS7, MH3S, MH4, MH5, MH6, MH7, MH8, MH9, MH10, MH11, MH12, MH16, MH17, MH18, OW22A-10, OW51A-15, OW53-10, Sump	Semi-annually in May and November: November 1, 2023. Daily during operation for PS1, PS3, PS5 and PS7.	
Leachate Sampling	Equalization Tank	Quarterly, and semi-annually in May and November. A quarterly sample was collected on October 11, 2023.	
Secondary Drainage Layer (SDL) Liquid Levels	PS2, PS4, PS6, PS8	Monthly - October 10, November 14, and December 14, 2023	
Groundwater Liquid Level Measurements	ACTIVE AQUITARD OW16-6, OW17-4, OW40D-4, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5*, OW72-6, OW73-6,OW79-5, OW80-3, OW81-5, OW82-5, OW83-5, OW84-6 INTERSTADIAL SILT AND SAND OW16-7, OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-14, OW58-17, OW60-8, OW67-11, OW72-10, OW73-9, OW79-7, OW80-6, OW81-7, OW82-14, OW83-9, OW84-11 INTERFACE AQUIFER OW17-30, OW19-29, OW39A-26, OW40A-28, OW49-29, OW60-25, OW79-26, OW80-27, OW81-27, OW82-28, OW83-29, OW84-31	Semi-annually in May and November: November 1, 2023.	
Piezometer Liquid Level Measurements	P1, P2, P3	Semi-annually in May and November: November 1, 2023.	
Groundwater Sampling	ACTIVE AQUITARD OW16-6, OW17-4, OW40B-4r, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5*, OW72-6, OW73-6, OW79-5, OW80-3, OW81-5, OW82-5, OW83-5, OW84-6 INTERSTADIAL SILT AND SAND OW16-7, OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-14, OW60-8, OW67-11, OW72-10, OW73-9, OW79-7, OW80-6, OW81-7, OW82-14, OW83-9, OW84-11 INTERFACE AQUIFER OW19-29, OW39-26, OW49-29, OW79-26, OW80-27, OW81-27, OW82-28, OW83-29, OW84-31, Cemetery Well	Semi-annually in May and November: November 1 ,2, and 3, 2023.	
Gas Monitoring	GP1A, GP2, GP3, GP4, GP5, GP6, GP7, GP8, GP9, GP10	Perimeter gas probes monitored on November 28 and December 14, 2023	
Poplar System Monitoring Program			
Precipitation Event Surface Water Monitoring/Sampling	SS14A, SS14B, and SS15A	Novemeber 2, 2023 - Routine monitoring for November 1, 2023 precipitation event.	
Ambient Air Quality Monitoring Program			
Total Suspended Particulate - Dust	Stations West, Northeast, and Southeast	Every sixth day - NAPS Schedule (October 1 to May 31) Every third day - NAPS Schedule (June 1 to September 30)	
Noise Monitoring Program			
Noise Monitoring	Stations - M1, M2, M3, and M4	Ongoing - Quarterly Reporting	
Operational Monitoring			
Contaminated Soil	Landfill Daily Cover/Disposed Material	Quarterly (if utilized), October 3, 2023	
Automobile Shredder Residue	Landfill Daily Cover/Disposed Material	Semi-Annually (Spring and Fall), if utilized: October 3, 2023	

NOTES:
1) (new) denotes monitoring station/wells to be installed per the Environmental Monitoring Plan (EMP) dated December 20, 2007.
2) OW71A-5* denotes groundwater well monitored at the request of the Public Liaison Committee.

Table 2
Leachate Elevation Comparison
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitoring Location	Groundwater Monitoring Wells Compared	Existing Ground Surface Elevation (m ASL)	Exisiting Bottom of Ditch Elevation (m ASL)	Current Local Groundwater Elevation (m ASL)	Leachate Elevation (m ASL)	Leachate Elevation Compared to Ground Surface Elevation	Leachate Elevation Compared to Groundwater Elevation
May 1, 2023							
Cell 3S							
MH3SA	OW17-4 and OW56-4	240.71	240.68	239.52	239.45	LOWER	LOWER
MH3SB	OW17-4 and OW56-4	240.46	240.31	239.52	239.42	LOWER	LOWER
MH3SC	*OW7-5*	239.66	239.42	*236.85*	236.05	LOWER	LOWER
MH3SD	*OW7-5*	239.87	239.93	*236.85*	235.99	LOWER	LOWER
Central Fill Area							
Sump	*OW7-5 and OW8-5*	240.81	240.28	*237.14*	245.45	HIGHER	HIGHER
OW51A-15	OW17-4	240.24	239.68	239.58	237.67	LOWER	LOWER
MH4A	OW17-4 and OW69-5	240.33	239.71	239.38	240.11	LOWER	HIGHER
MH4B	OW57-4	240.95	240.17	240.13	240.20	LOWER	HIGHER
MH5A	OW58-6	241.51	240.78	240.55	240.20	LOWER	LOWER
MH6A	*OW65-4/OW65A-4*	241.90	241.20	*237.34*	240.17	LOWER	HIGHER
MH7A	OW73-6	242.07	241.34	241.21	238.00	LOWER	LOWER
MH8B	*OW74-6*	242.54	242.46	*239.33*	241.23	LOWER	HIGHER
MH9A	OW72-6	242.33	241.89	240.82	239.33	LOWER	LOWER
MH10	*OW74-6*	241.80	241.43	*239.33*	239.92	LOWER	HIGHER
MH11A	OW54A-4	242.34	241.94	241.69	241.02	LOWER	LOWER
MH12A	*OW66-4*	241.90	241.37	*241.79*	239.96	LOWER	LOWER
MH12B	*OW66-4*	241.90	241.37	*241.79*	239.93	LOWER	LOWER
South Cell							
MH16	*OW63A-6*	239.53	238.49	*238.12*	238.05	LOWER	LOWER
MH17	*OW63A-6*	239.12	238.07	*238.12*	238.02	LOWER	LOWER
MH18	*OW63A-6*	238.84	238.18	*238.12*	238.07	LOWER	LOWER
OW22A-10	*OW6-4*	239.38	238.76	*238.11*	238.73	LOWER	HIGHER
OW53-10	*OW44-5 and OW64-4/OW64A-4*	239.47	238.45	*236.77*	238.76	LOWER	HIGHER
Expansion Site Cell 1							
PS1	*OW38-6*	240.88		*236.73*	227.12	LOWER	LOWER
Expansion Site Cell 2							
PS3	*OW38-6*	240.18		*236.73*	227.48	LOWER	LOWER
Expansion Site Cell 4							
PS5	*OW38-6*	240.73		*236.73*	227.30	LOWER	LOWER
Expansion Site Cell 6							
PS7	*OW38-6*	239.41		*236.73*	228.39	LOWER	LOWER

Notes: 1) Leachate elevations from May 1, 2023
2) m ASL denotes meters above sea level.
3) *Italics* denotes historic information used to calculate data.
4) ***Bold and italics*** denotes elevation presented is the maintenance hole bottom elevation as it was dry at the time of monitoring.
5) For waste cells with two maintenance holes, the maintenance hole farthest into the waste cell was utilized for comparison.
6) Revised measuring point elevations for Existing Site manholes and leachate wells, as well as updated ground surface elevations reflect the findings of an updated survey (2016).
7) Existing Ground Surface Elevation and Existing Bottom of Ditch Elevation for MH16, MH17, and MH18 resurveyed on November 3, 2022.

Table 2
Leachate Elevation Comparison
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitoring Location	Groundwater Monitoring Wells Compared	Existing Ground Surface Elevation (m ASL)	Exisiting Bottom of Ditch Elevation (m ASL)	Current Local Groundwater Elevation (m ASL)	Leachate Elevation (m ASL)	Leachate Elevation Compared to Ground Surface Elevation	Leachate Elevation Compared to Groundwater Elevation
November 1, 2023							
Cell 3S							
MH3SA	OW17-4 and OW56-4	240.71	240.68	238.96	238.91	LOWER	LOWER
MH3SB	OW17-4 and OW56-4	240.46	240.31	238.96	238.84	LOWER	LOWER
MH3SC	*OW7-5*	239.66	239.42	*236.85*	236.45	LOWER	LOWER
MH3SD	*OW7-5*	239.87	239.93	*236.85*	236.08	LOWER	LOWER
Central Fill Area							
Sump	*OW7-5 and OW8-5*	240.81	240.28	*237.14*	244.08	HIGHER	HIGHER
OW51A-15	OW17-4	240.24	239.68	239.36	236.94	LOWER	LOWER
MH4A	OW17-4 and OW69-5	240.33	239.71	239.13	240.09	LOWER	HIGHER
MH4B	OW57-4	240.95	240.17	239.45	240.31	LOWER	HIGHER
MH5A	OW58-6	241.51	240.78	240.69	236.37	LOWER	LOWER
MH6A	*OW65-4/OW65A-4*	241.90	241.20	*237.34*	239.75	LOWER	HIGHER
MH7A	OW73-6	242.07	241.34	240.20	236.66	LOWER	LOWER
MH8B	*OW74-6*	242.54	242.46	*239.33*	238.14	LOWER	LOWER
MH9A	OW72-6	242.33	241.89	240.61	238.25	LOWER	LOWER
MH10	*OW74-6*	241.80	241.43	*239.33*	237.89	LOWER	LOWER
MH11A	OW54A-4	242.34	241.94	241.25	238.55	LOWER	LOWER
MH12A	*OW66-4*	241.90	241.37	*241.79*	237.76	LOWER	LOWER
MH12B	*OW66-4*	241.90	241.37	*241.79*	237.75	LOWER	LOWER
South Cell							
MH16	*OW63A-6*	239.53	238.49	*238.12*	238.10	LOWER	LOWER
MH17	*OW63A-6*	239.12	238.07	*238.12*	238.09	LOWER	LOWER
MH18	*OW63A-6*	238.84	238.18	*238.12*	238.06	LOWER	LOWER
OW22A-10	*OW6-4*	239.38	238.76	*238.24*	238.57	LOWER	HIGHER
OW53-10	*OW44-5 and OW64-4/OW64A-4*	239.47	238.45	*235.30*	238.47	LOWER	HIGHER
Expansion Site Cell 1							
PS1	*OW38-6*	240.88		*236.73*	227.08	LOWER	LOWER
Expansion Site Cell 2							
PS3	*OW38-6*	240.18		*236.73*	226.93	LOWER	LOWER
Expansion Site Cell 4							
PS5	*OW38-6*	240.73		*236.73*	227.48	LOWER	LOWER
Expansion Site Cell 6							
PS7	*OW38-6*	239.41		*236.73*	229.43	LOWER	LOWER

Notes: 1) Leachate elevations from November 1, 2023.
2) m ASL denotes meters above sea level.
3) *Italics* denotes historic information used to calculate data.
4) ***Bold and italics*** denotes elevation presented is the maintenance hole bottom elevation as it was dry at the time of utilized for monitoring.
5) For waste cells with two maintenance holes, the maintenance hole farthest into the waste cell was monitored.
6) Revised measuring point elevations for Existing Site manholes and leachate wells, as well as updated ground surface elevations reflect the findings of an updated survey (2016).
7) Existing Ground Surface Elevation and Existing Bottom of Ditch Elevation for MH16, MH17, and MH18 resurveyed on November 3, 2022.

Table 3
Leachate Elevation Trends
Twin Creeks Environmenal Centre - 2023 Annual Monitoring Report

Monitor Designation	Long-Term Trend (Includes Historical Data)				
	Constant	Decreasing	Increasing	Fluctuating	Comments
Cell 3S					
MH3SA				X	Increasing to 2018 and since fluctuating
MH3SB				X	Decreasing to 2017 and since fluctuating.
MH3SC				X	Fluctuating since 2017.
MH3SD				X	Fluctuating since 2017.
MH3SE	X			X	Increasing to 2017 and since constant to fluctuating.
MH3SF	X			X	Decreasing to 2017 and since constant to fluctuating.
Central Fill Area					
OW51A-15	X			X	Constant to fluctuating since 2005.
MH4A			X	X	Fluctuating to increasing since 2011.
MH4B			X	X	Fluctuating to increasing since 2011.
MH5				X	Fluctuating since 2007.
MH6			X	X	Decreasing to 2017 and since fluctuating/increasing.
MH7		X		X	Fluctuating to decreasing since 2009.
MH8				X	Fluctuating since 2005.
MH9				X	Decreasing to 2012 and since fluctuating.
MH10				X	Fluctuating since 2010.
MH11				X	Decreasing to 2011 and since fluctuating.
MH12				X	Fluctuating since 2010.
SUMP			X	X	Fluctuating to 2016 and since increasing to fluctuating.
South Fill Area					
OW22A-10				X	Fluctuating since 2005.
OW53-10				X	Increasing to 2014 and since fluctuating.
MH16				X	Increasing to 2010 and since fluctuating.
MH17				X	Increasing to 2010 and since fluctuating.
MH18				X	Increasing to 2010 and since fluctuating.

NOTES:

1) Elevations can show more than one trend.
2) For waste cells with two maintenance holes, the maintenance hole furthest within the waste was utilized for comparison.

Table 4
Groundwater Elevation Trends
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitor Designation	Long-Term Trend (Includes Historical Data)				
	Constant	Decreasing	Increasing	Fluctuating	Comments
Active Aquitard					
OW16-6*				X	Seasonal
OW17-4				X	Seasonal
OW40D-4*				X	Seasonal
OW54A-4*			X	X	Seasonal
OW56-4			X	X	Seasonal
OW57-4			X	X	Seasonal
OW58-6*			X	X	Seasonal
OW59-6*				X	Seasonal
OW60-4				X	Seasonal
OW67-4				X	
OW68-5				X	Seasonal
OW69-5			X	X	
OW70B-5*				X	Seasonal
OW71A-5*				X	Seasonal
OW72-6			X	X	Seasonal
OW73-6			X	X	Seasonal
OW79-5				X	Seasonal
OW80-3				X	
OW81-5				X	
OW82-5					Ins
OW83-5					Ins
OW84-6					Ins
Interstadial Silt and Sand					
OW16-7				X	Seasonal
OW40A-7*				X	Seasonal
OW46-7			X	X	
OW47-6				X	
OW54-10		X		X	Decreasing since 2009
OW57-15				X	
OW58-17				X	Installed April 2014
OW60-8				X	Seasonal
OW67-11				X	Fluctuating since 2018
OW72-10				X	Fluctuating since 2018
OW73-9				X	Fluctuating since 2018
OW79-7				X	Seasonal
OW80-6				X	Seasonal
OW81-7				X	
OW82-14					Ins
OW83-9					Ins
OW84-11					Ins
Interface Aquifier					
OW17-30		X		X	Decreasing since 2005
OW19-29		X		X	Decreasing since 2009
OW39A-26			X	X	Seasonal
OW40A-28*		X		X	Decreasing since 2015
OW49-29		X		X	Decreasing since 2009
OW60-25		X		X	
OW79-26			X	X	Increasing since 2018
OW80-27			X	X	Increasing since 2018
OW81-27			X	X	Increasing since 2020
OW82-28					Ins
OW83-29					Ins
OW84-31					Ins

Notes:

1) Seasonal - denotes a seasonal trend with elevated elevations during prolonged periods of precipitation, typically in the spring and summer months, and lower elevations during drier periods, typically the fall and winter months.
2) Water elevations can show more than one trend.
3) Ins - denotes insufficient data. At least three data points are required to establish a trend.
4) * denotes trends consider historical data from former monitoring wells at that location.
5) Monitoring well OW58-14 was decomissioned prior to the fall 2016 monitoring event.
6) Monitoring well OW39-26 was noted to have been damaged during the fall 2016 monitoring event and decomissioned April 2017.
7) OW82-5, OW82-14, OW82-28, OW83-5, OW83-9, OW83-29, OW84-6, OW84-11, and OW84-31 installed in June 2022.

Table 5
Estimated Leachate Storage Volumes
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Fill Area	Approximate Area (ha)	Approximate Original Ground Surface Elevation	Groundwater Reference Elevation	Estimated Average Base of Waste	May 2023 Average Leachate	Estimated Volume in Waste Cells (Measured from Cell Base) (m^3)													Change in Volume Within the Waste Cells From May 2022 to May 2023 (m^3)	Volume Above Groundwater Reference Level (m^3)												Change in Volume Above Groundwater Reference Level From May 2022 to May 2023 (m^3)
						MAY 2010	MAY 2011	MAY 2012	MAY 2013	MAY 2014	MAY 2015	MAY 2016	MAY 2017	MAY 2018	MAY 2019	MAY 2020	MAY 2021	MAY 2022	MAY 2023		MAY 2010	MAY 2011	MAY 2012	MAY 2013	MAY 2014	MAY 2015	MAY 2016	MAY 2017	MAY 2018	MAY 2019	MAY 2020	MAY 2021	MAY 2022	MAY 2023	
West Cell (Sump)	6.3	238.3	237.1	235.5	245.5	103,320	118,440	110,628	136,332	87,948	71,568	148,680	164,052	195,552	242,928	122,724	161,784	174,636	250,740	76,104	63,000	78,120	70,308	96,012	47,628	31,248	108,360	123,732	155,232	202,608	82,404	121,464	134,316	210,420	76,104
Cell 3 (OW51A-15)	1.5	239.9	239.2	235.2	237.7	4,200	4,980	5,220	5,100	7,800	6,180	4,800	4,920	5,100	6,360	5,640	7,620	6,600	14,820	8,220	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cell 4 (MH4B)	2.1	240.8	238.5	234.1	240.2	52,080	62,664	29,148	36,120	30,492	37,212	46,200	46,452	40,404	46,368	43,848	44,856	45,024	51,240	6,216	11,760	25,704	0	0	0	252	9,240	9,492	3,444	9,408	6,888	7,896	8,064	14,280	6,216
Cell 5 (MH5A)	2.2	241.2	237.0	236.5	240.2	7,040	0	7,832	28,776	22,264	0	14,520	28,160	0	28,512	27,984	17,600	28,424	32,736	4,312	0	0	3,432	24,376	17,864	0	10,120	23,760	0	24,112	23,584	13,200	24,024	28,336	4,312
Cell 6 (MH6A)	2.0	240.0	237.3	236.5	240.2	4,000	8,080	5,280	9,680	10,880	1,600	0	0	3,840	28,880	16,720	16,000	29,280	29,360	80	0	1,680	0	3,280	4,480	0	0	0	0	22,480	10,320	9,600	22,880	22,960	80
Cell 7 (MH7A)	1.9	240.7	238.8	236.5	238.0	15,960	10,564	19,076	2,736	5,548	17,784	9,576	18,848	12,920	23,484	13,984	10,792	4,940	11,400	6,460	1,520	0	1,596	0	0	304	0	1,368	0	6,004	0	0	0	0	0
Cell 8 (MH8B)	1.9	240.0	239.3	237.0	241.2	760	10,108	19,380	17,480	3,496	1,672	9,880	18,392	17,252	27,968	29,868	22,572	16,872	32,148	15,276	0	0	1,900	0	0	0	0	912	0	10,488	12,388	5,092	0	14,668	14,668
Cell 9 (MH9A)	1.9	241.2	239.0	237.5	239.3	15,200	17,936	8,816	7,296	7,296	8,968	5,700	13,072	1,064	19,456	14,440	12,692	13,224	13,908	684	6,080	6,536	0	0	0	0	0	1,672	0	8,056	3,040	1,292	1,824	2,508	684
Cell 10 (MH10)	1.9	241.5	239.3	236.5	239.9	7,600	22,496	21,280	5,320	5,092	8,588	28,500	34,200	28,120	34,276	4,636	4,788	1,368	25,992	24,624	0	1,216	0	0	0	0	7,220	12,920	6,840	12,996	0	0	0	4,712	4,712
Cell 11 (MH11A)	1.9	244.3	240.8	237.8	241.0	20,520	7,068	15,884	14,516	15,352	19,076	23,560	21,584	20,292	25,156	11,324	17,860	7,068	24,472	17,404	9,120	0	0	0	0	0	760	0	0	2,356	0	0	0	1,672	1,672
Cell 12 (MH12A)	0.6	242.5	241.8	236.5	240.0	2,400	7,152	6,768	4,008	1,512	2,640	8,880	10,800	8,856	11,016	1,488	1,488	456	8,304	7,848	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cell 3S (MH3SA/B/C/D/E/F)	1.1	238.6	238.3	235.2	239.8	7,964	16,060	13,640	16,588	5,412	10,340	14,520	4,752	16,368	21,831	17,431	21,120	20,460	20,321	-139	0	2,420	0	2,948	0	0	880	0	2,728	8,191	3,791	7,480	6,820	6,681	-139
South Cell (MH16/17/18)	5.4	239.4	238.1	235.0	238.0	54,000	62,640	62,640	67,176	55,296	60,912	49,680	46,224	55,296	70,992	65,304	60,912	65,016	65,808	792	0	0	0	0	0	0	0	0	0	4,032	0	0	0	0	0
					Total	**295,044**	**348,188**	**325,592**	**351,128**	**258,388**	**246,540**	**364,496**	**411,456**	**405,064**	**587,227**	**375,391**	**400,084**	**413,368**	**581,249**	167,881	**91,480**	**115,676**	**77,236**	**126,616**	**69,972**	**31,804**	**136,580**	**173,856**	**168,244**	**310,731**	**142,415**	**166,024**	**197,928**	**306,237**	108,309

Notes:

1) Average leachate elevations are from May 1, 2023.

2) Assumes a waste porosity of 40%.

3) NA indicates data not available, owing to date of manhole installation.

4) Revised original ground surface elevations reflect the findings of an updated survey in 2016.

5) Estimated Leachate Storage Volume (m^3) for Total in Waste Cell = Average Leachate Elevation (m) - (Estimated Average Base of Waste (ha) * 10,000 (m^2)) * 0.4 (assumed porosity).

6) Groundwater Reference Elevation is a fixed value as of 2011 based on historic (2003-2007) data.

7) Volume Above Groundwater Reference Level based on similar reference level for post-2010 volumes. Pre-2010 volumes based on spring average level.

Table 5
Estimated Leachate Storage Volumes
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Fill Area	Approximate Area (ha)	Approximate Original Ground Surface Elevation	Groundwater Reference Elevation	Estimated Average Base of Waste	Nov 2023 Average Leachate	Estimated Volume in Waste Cells (Measured from Cell Base)						Change in Volume Within the Waste Cells From Nov 2022 to Nov 2023 (m^3)	Volume Above Groundwater Reference Level (m3)						Change in Volume Above Groundwater Reference Level From Nov 2022 to Nov 2023 (m^3)
						NOV 2018	NOV 2019	NOV 2020	NOV 2021	NOV 2022	NOV 2023		NOV 2018	NOV 2019	NOV 2020	NOV 2021	NOV 2022	NOV 2023	
West Cell (Sump)	6.3	238.3	237.1	235.5	244.1	217,224	177,408	139,356	180,432	177,912	216,216	38,304	176,904	137,088	99,036	140,112	137,592	175,896	38,304
Cell 3 (OW51A-15)	1.5	239.9	239.2	235.2	236.9	5,040	6,000	6,840	6,540	8,280	10,440	2,160	0	0	0	0	0	0	0
Cell 4 (MH4B)	2.1	240.8	238.5	234.1	240.3	47,376	40,572	44,772	49,140	44,268	52,164	7,896	10,416	3,612	7,812	12,180	7,308	15,204	7,896
Cell 5 (MH5A)	2.2	241.2	237.0	236.5	236.4	26,136	0	0	30,360	2,552	0	-2,552	21,736	0	0	25,960	0	0	0
Cell 6 (MH6A)	2.0	240.0	237.3	236.5	239.8	2,560	30,640	11,360	31,520	29,840	26,000	-3,840	0	24,240	4,960	25,120	23,440	19,600	-3,840
Cell 7 (MH7A)	1.9	240.7	238.8	236.5	236.7	10,412	3,952	456	4,408	760	1,216	456	0	0	0	0	0	0	0
Cell 8 (MH8B)	1.9	240.0	239.3	237.0	238.1	17,556	6,992	6,308	15,580	14,440	8,664	-5,776	76	0	0	0	0	0	0
Cell 9 (MH9A)	1.9	241.2	239.0	237.5	238.3	4,712	7,752	1,596	9,728	1,900	5,700	3,800	0	0	0	0	0	0	0
Cell 10 (MH10)	1.9	241.5	239.3	236.5	237.9	33,668	0	0	1,900	2,356	10,564	8,208	12,388	0	0	0	0	0	0
Cell 11 (MH11A)	1.9	244.3	240.8	237.8	238.6	22,952	7,296	4,484	7,372	15,276	5,700	-9,576	152	0	0	0	0	0	0
Cell 12 (MH12A)	0.6	242.5	241.8	236.5	237.8	10,632	0	0	576	792	3,024	2,232	0	0	0	0	0	0	0
Cell 3S (MH3SA/B/C/D/E/F)	1.1	238.6	238.3	235.2	239.6	19,323	21,685	11,730	19,351	20,108	19,338	-770	5,683	8,045	0	5,711	6,468	5,698	-770
South Cell (MH16/17/18)	5.4	239.4	238.1	235.0	238.1	59,760	58,608	58,248	64,800	66,312	66,600	288	0	0	0	0	0	0	0
					Total	**477,351**	**360,905**	**285,150**	**421,707**	**384,796**	**425,626**	40,830	**227,355**	**172,985**	**111,808**	**209,083**	**174,808**	**216,398**	41,590

155,623

Notes:

1) Average leachate elevations are from November 1, 2023.

2) Assumes a waste porosity of 40%.

3) NA indicates data not available, owing to date of manhole installation.

4) Revised original ground surface elevations reflect the findings of an updated survey in 2016.

5) Estimated Leachate Storage Volume (m^3) for Total in Waste Cell = Average Leachate Elevation (m) - (Estimated Average Base of Waste (ha) * 10,000 (m^2)) * 0.4 (assumed porosity).

6) Groundwater Reference Elevation is a fixed value as of 2011 based on historic (2003-2007) data.

7) Volume Above Groundwater Reference Level based on similar reference level for post-2010 volumes. Pre-2010 volumes based on spring average level.

Table 6
Leachate Chemical Summary
Twin Creeks Environmental Centre – 2023 Annual Monitoring Report

Parameter	Leachate Concentrations			Background Concentrations		
	West Central Fill Area (Existing Site) (2008-2023)	Typical Waste Areas (Existing Site) (2008-2023)	Equalization Tank (Expansion Site) (2010-2023)	Groundwater (1984-2001)	Surface Water (2001-2023) SS10	Surface Water (2008-2023) SS16
pH (pH units)	**7.3 - 8.1**	**7.4 - 8.2**	**7.0 - 8.1**	7.0 – 8.3	6.7 - 8.7	7.4 - 8.4
Conductivity (µS/cm)	**880 - 16,400**	**501 – 31,100**	**2,000 - 26,000**	443 – 2,550	62 - 1,200	109 - 620
Alkalinity	**290 - 7,060**	**160 - 18,300**	**1,820 - 10,000**	100 - 581	22 - 203	45 - 230
Calcium	**72 - 150**	**19 - 380**	**79 - 1,400**	19 - 250	5.4 - 170	15 - 1,300
Magnesium	**22 - 390**	**19 - 450**	**130 - 530**	9 - 261	1.6 - 33	3.3 - 88
Sodium	**57 - 2,100**	**19 - 6,300**	**270 - 2,700**	48 - 199	0.49 - 20	1.4 - 18
Potassium	**12 - 620**	**6.7 - 1,100**	**81 - 900**	1 - 9	1 - 17	3.1 - 60
Chloride	**68 - 2,600**	**11 - 1,000**	**330 - 3,400**	1 - 15	1 - 46	1.2 - 20
Sulphate	**0.5 - 81**	**10 - 410**	**10 - 220**	100 – 1,330	0.5 - 220	<1 - 220
Iron	**2.2 - 54**	**<0.05 - 33**	**<1 - 120**	<0.1 - 3.3	0.25 - 79	0.3 - 540
DOC	**22 - 462**	**8.3 - 1,480**	**170 - 4,500**	0.7 - 9.8	<0.02 - 0.26	
Ammonia (total)	**11.1 - 857**	**8 - 3,540**	**57 - 2,000**	<0.05 – 7.1	<0.02 - 18.4	0.05 - 0.3
TKN	**3.1 - 930**	**11 - 3,500**	**26 - 2,700**	<0.1 – 10.9	0.41 - 33	<0.7 - 7.2
Nitrate	**<0.1 - <2.0**	**<0.1 - 6.7**	**<0.1 - <5.0**	<0.1 – 2.7	<0.01 - 102	<0.01 - 1.5
Boron	**1.3 - 70**	**0.67 - 560**	**1.3 - 41**	0.09 – 0.99	0.02 - 0.48	<0.02 - 0.4
Benzene (µg/L)	**<0.2 - 361**	**<0.1 - 12.0**	**<1 - <10**	<1.3		
Toluene (µg/L)	**<0.2 - 782**	**<0.2 - 550**	**4.2 - 2,400**	<1.5		
Ethylbenzene (µg/L)	**<0.2 - 318**	**<0.1 - 891**	**<0.5 - 30**	<1.6		
m/p - xylenes (µg/L)	**<0.2 - 1,990**	**<0.1 - 200**	**2.5 - 64**	<3.4		
o - xylene (µg/L)	**<0.2 - 1,140**	**<0.1 - 97.4**	**<0.5 - 28**	<2.7		

Notes:

1) Background concentrations for groundwater are established from 1984 to 2001 for monitoring wells 250 metres or greater to the west of the Existing Site: OW1-5, OW5-6, OW38-6, OW38-10, OW39-6, OW39-12, OW42-6, OW42-9.
2) Background concentrations for surface water (SS10 and SS16) are established for 2001-2023 data, where available.
3) All data are mg/L unless otherwise specified.
4) Blank denotes parameter not tested.

Table 7
Indicator Parameter Concentration Trend Summary - Groundwater
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitor Designation	Long-Term Trend (Includes Historic Data)		
	Chloride	Nitrate	Boron
Active Aquitard			
OW16-6*	C	C	C
OW17-4	F	C	C
OW40D-4	C	C	D/F
OW54A-4*	I/F	C	C
OW56-4	C	F	F
OW57-4	C	C	C
OW58-6	C	C	F
OW59-6	C	C	F
OW60-4	C	C	C
OW67-4	F	F	F/D
OW68-5	C	C	C
OW69-5	C	C	F
OW70B-5*	C	C	C
OW71A-5*	I	C	C
OW72-6	C	C	F
OW73-6	C	C	F
OW79-5	F	C	C
OW80-3	D/F	C	C
OW81-5	C	C	C
OW82-5	ID	ID	ID
OW83-5	ID	ID	ID
OW84-6	ID	ID	ID
Interstadial Silt and Sand			
OW16-7	C	C	C
OW40A-7	C	C	C
OW46-7	C	C	F/I
OW47-6	C	F	F
OW54-10	C	C	C
OW57-15	C	C	C
OW58-17*	C	C	C
OW60-8	C	C	F
OW67-11	F	F	F
OW72-10	C	C	C
OW73-9	C	C	F
OW79-7	F	C	C
OW80-6	F	C	C
OW81-7	F	C	C
OW82-14	ID	ID	ID
OW83-9	ID	ID	ID
OW84-11	ID	ID	ID
Interface Aquifer			
OW19-29	C	C	F
OW39A-26*	F	C	F
OW49-29	C	C	F
OW79-26	C	F	C
OW80-27	C	C	F
OW81-27	F	C	F
OW82-28	ID	ID	ID
OW83-29	ID	ID	ID
OW84-31	ID	ID	ID
Cemetery Well	C	F	C

Notes:
1) C denotes constant trend.
2) D denotes decreasing trend.
3) I denotes increasing trend.
4) F denotes fluctuating trend.
5) S denotes seasonal pattern.
6) ID denotes insufficient data for interpretation.
7) Data are presented in Table H-4 Appendix H .
8) Historic data trends assume nitrate+nitrite represents nitrate.
9) Concentrations can show more than one trend.
10) * denotes considers historic data from decommissioned monitoring well.

Table 8
Groundwater Trigger Concentration / Comparison Summary - Active Aquitard
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitor Designation		Chloride	Nitrate	Boron
Active Aquitard				
	Trigger Concentration (mg/L)	**106**	**2.3**	**1.1**
OW16-6	May-23	44	0.22	0.16
	Nov-23	39	0.23	0.18
OW17-4	May-23	21	<0.10	0.25
	Nov-23	24	0.10	0.20
OW40D-4	May-23	5.2	0.13	0.22
OW54A-4	May-23	23	<0.10	0.20
	Nov-23	21	0.30	0.22
OW56-4	May-23	5.4	0.37	0.42
	Nov-23	5.1	0.36	0.99
OW57-4	May-23	4.0	<0.10	0.37
	Nov-23	2.8	0.45	0.34
OW58-6	May-23	5.6	<0.10	0.65
	Nov-23	2.2	<0.10	0.69
OW59-6	May-23	4.5	<0.10	0.75
	Nov-23	3.5	<0.10	0.80
OW60-4	May-23	4.9	<0.10	0.04
OW67-4	May-23	13	***<5.0***	0.05
	May-23 - Verification	18	0.10	0.09
	Nov-23	<50	<1.0	0.14
OW68-5	May-23	7.6	<0.10	0.09
	Nov-23	6.1	<0.10	0.10
OW69-5	May-23	8.9	<0.10	0.90
	Nov-23	6.9	0.12	0.99
OW70B-5	May-23	6.0	<0.10	0.39
	Nov-23	5.5	<0.10	0.42
OW71A-5	May-23	30	<0.10	0.11
	Nov-23	25	0.27	0.14
OW72-6	May-23	3.9	<0.10	0.68
	Nov-23	3.1	<0.10	0.77
OW73-6	May-23	7.6	<0.10	0.75
	Nov-23	5.1	<0.10	0.84
OW79-5	May-23	24	0.11	0.07
OW80-3	May-23	46	0.25	<0.02
OW81-5	May-23	19	<0.10	0.54
OW82-5	May-23	8	<0.10	0.53
OW83-5	May-23	59	<0.10	0.21
OW84-6	May-23	59	0.45	0.41

NOTES:

1) Trigger Concentrations based on Table 4 of the 2007 Landfill EMP.

2) Bolded text and shading denotes concentration exceeds trigger concentration.

3) Italics denotes parameter concentration was below the laboratory reportable detection limit (RDL), where the RDL exceeds the relevant trigger concentration.

4) Monitoring well nest OW82, OW83, and OW84 installed in the summer of 2022.

Table 9
Groundwater Trigger Concentration Comparison Summary - Interstadial Silt and Sand
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitor Designation		Chloride	Nitrate	Boron
Interstadial Silt and Sand				
	Trigger Concentration (mg/L)	**116**	**2.3**	**2.1**
OW16-7	May-23	4.5	0.37	0.27
	Nov-23	3.8	0.18	0.28
OW40A-7	May-23	5.2	0.32	0.61
OW46-7	May-23	12	0.14	0.56
	Nov-23	9.5	0.17	0.59
OW47-6	May-23	4	0.38	1.00
	Nov-23	4.1	<0.10	0.4
OW54-10	May-23	6.5	0.45	0.95
	Nov-23	7.4	0.41	0.97
OW57-15	May-23	7.5	0.40	1.1
	Nov-23	5.5	0.79	1.4
OW58-17	May-23	7.7	0.25	1.3
	Nov-23	6.1	0.36	1.3
OW60-8	May-23	6.6	<0.10	0.80
OW67-11	May-23	29	0.43	0.43
	Nov-23	27	0.31	0.44
OW72-10	May-23	4.4	0.13	1.1
	Nov-23	3.4	0.4	1.1
OW73-9	May-23	6.4	0.57	1.1
	Nov-23	7.1	0.72	1.1
OW79-7	May-23	*140*	<0.10	0.20
OW80-6	May-23	*160*	<0.10	0.19
OW81-7	May-23	*200*	0.16	0.55
OW82-14	May-23	28	1.12	1.2
OW83-9	May-23	15	<0.10	0.41
OW84-11	May-23	22	<0.10	0.94

Notes:

1) Trigger Concentrations based on Table 4 of the 2007 Landfill EMP.

2) Bolded text and shading denotes concentration exceeds trigger concentration.

3) Italics denotes that per MECP approval the parameter's concentration is not evaluated against the trigger concertation.

4) Chloride trigger concentration of 116mg/L is not applicable to OW79-7, OW80-6, and OW81-7

5) Monitoring well nest OW82, OW83, and OW84 installed in the summer of 2022.

Table 10
Groundwater Trigger Concentration Comparison Summary - Interface Aquifer
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitor Designation		Chloride	Nitrate	Boron
Interface Aquifer				
	Trigger Concentration (mg/L)	**134**	**2.3**	**2.6**
OW19-29	May-23	26	<0.10	2.1
OW39A-26	May-23	38	<0.10	1.7
OW49-29	May-23	26	<0.10	1.5
OW79-26	May-23	20	<0.10	1.5
OW80-27	May-23	45	<0.10	1.7
OW81-27	May-23	16	<0.10	1.3
OW82-28	May-23	38	<0.10	1.0
OW83-29	May-23	25	<0.10	0.93
OW84-31	May-23	34	**6.22**	1.9
	May-23 - Verification	21	**6.45**	0.52
	Nov-23 - Verification	19	**5.08**	1.1
Cemetery Well	May-23	2.6	0.25	0.06

Notes:

1) Trigger Concentrations based on Table 4 of the 2007 Landfill EMP.

2) Bolded text and shading denotes concentration exceeds trigger concentration.

3) Monitoring well nest OW82, OW83, and OW84 installed in the summer of 2022.

Table 11
Indicator Parameter Concentration Trend Summary - Surface Water
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitoring Station	Long-Term Trend (Includes Historic Data)			
	Chloride	Ammonia	Boron	Zinc
SS1	F	C	F	F
SS10	F	C	C	C
SS16	C	C	C	C
SP1	F	F	F	C
SP2	F	F	F	C
SP3	F	F	C	C
SP4	F	C	C	C

Notes:

1) C denotes constant trend.
2) D denotes decreasing trend.
3) I denotes increasing trend.
4) F denotes fluctuating trend.
5) S denotes seasonal pattern.
6) Data are presented in Table I-2, Appendix I.
7) INS - denotes there is insufficient data available for interpretation.
8) NC denotes sampling station not yet constructed.

Table 12
Surface Water Trigger Concentrations
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Parameter	Units	PWQO	Background Station SS10 and SS16 90% Trigger Concentration	Number of Samples for Background Station SS10	Number of Samples for Background Station SS16	Post 2022 Trigger Concentration	Post 2023 Trigger Concentration
Trigger Concentrations/Levels for Compliance Points							
Chloride	mg/L	210*	20.0	68	50	210	210
Ammonia (unionized)	mg/L	0.020	0.010	68	50	0.020	0.020
Phenols	mg/L	0.001	0.003	68	50	0.004	0.003
Boron	mg/L	0.20	0.17	68	50	0.20**	0.20**
Nickel	mg/L	0.025	0.026	68	50	0.027	0.026
Chromium (total)	mg/L	0.0089	0.021	68	50	0.024	0.021
Zinc	mg/L	0.02	0.05	68	50	0.06	0.05

Notes:

1) PWQO denotes Provincial Water Quality Objectives (1994) with updates.

2) * denotes recommended concentration by Environment Canada.

3) ** It is noted that the boron trigger concentration for SP1 is 0.39 mg/L, per the MOECC letter dated May 18, 2012.

4) Trigger concentrations are calculated annually from SS10 and SS16, per MOECC letter dated February 27, 2014.

Table 13
2024 Monitoring Program
Twin Creeks Environmental Centre - 2023 Annual Monitoring Report

Monitoring Locations	Parameters	Frequency
Leachate		
PS1, PS3, PS5, PS7, MH3S, MH4, MH5, MH6, MH7, MH8, MH9, MH10, MH11, MH12, MH16, MH17, MH18, OW22A-10, OW51A-15, OW53-10, Sump, LW1, LW2, LW3, LW4, LW5, LW6	Leachate Levels	May and November
PS1, PS3, PS5, PS7	Leachate Levels	Daily
PS1, PS3, PS5, PS7, South Fill Area (MH18), West Central Fill Area (Sump), Central Fill Area (Composite of MH3, MH4, MH5, MH6, MH7, MH9, MH11)	PLIL-GW, SLIL-GW, PLIL-SW, SLIL-SW, LS	May
Equalization Tank	BOD_5, DOC, phosphorus (total), TKN, BTEX, pH	Quarterly
	PLIL-SW, SLIL-SW, LS	May and November
Treated Leachate Effluent		
Treatment Plant Effluent	Discharge Rates, COD, pH, turbidity	Daily
	Chloride, $CBOD_5$, BOD_5, DOC, BTEX, ammonia, pH	Weekly
	PLIL-GW, SLIL-GW, PLIL-SW, SLIL-SW, LS	Monthly
	PCB, organochlorines	May and November
Treated Leachate Temporary Storage Cells : Cells 1 and 2	Discharge Rates	Daily
Cell 1 Inlet, Cells 1 and 2	Chloride, $CBOD_5$, BOD_5, DOC, BTEX, ammonia, pH	Weekly
Cells 1 and 2	DO, pH, alkalinity, DOC	Weekly
Cells 1 and 2	PLIL-GW, SLIL-GW, PLIL-SW, SLIL-SW, LS	Monthly
Cell 1	Biomonitoring	May and November
Secondary Drainage Layer		
PS2, PS4, PS6, PS8	Groundwater Levels	Monthly
Active Aquitard		
OW16-6, OW17-4, OW40D-4, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4**, OW61-4, OW62-5**, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5[†], OW72-6, OW73-6, **OW75-3, OW76-5, OW77-4, OW78-4**, OW79-5, OW80-3, OW81-5, OW82-5, OW83-5, OW84-6, **OW85-5,** P1, P2, P3	Groundwater Levels	May and November
OW16-6, OW17-4, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, **OW61-4, OW62-5**, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5*, OW72-6, OW73-6, **OW75-3, OW76-5, OW77-4, OW78-4**	PLIL-GW, SLIL-GW	May and November
OW40D-4, OW60-4, OW79-5, OW80-3, OW81-5, OW82-5, OW83-5, OW84-6, **OW85-5**	PLIL-GW, SLIL-GW	May
OW16-6, **OW61-4, OW62-5, OW75-3, OW78-4**	Volatiles	May and November
OW17-4, OW40D-4, OW54A-4, OW56-4, OW57-4, OW58-6, OW59-6, OW60-4, OW67-4, OW68-5, OW69-5, OW70B-5, OW71A-5*, OW72-6, OW73-6, **OW76-5, OW77-4**, OW79-5, OW80-3, OW81-5, OW82-5, OW83-5, OW84-6, **OW85-5**	Volatiles	May
Interstadial Silt and Sand		
OW16-7, OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-17, OW60-8, **OW61-6, OW62-7**, OW67-11, OW72-10, OW73-9, **OW75-7, OW78-6**, OW79-7, OW80-6, OW81-7, OW82-14, OW83-9, OW84-11, **OW85-8**	Groundwater Levels	May and November
OW46-7, OW47-6, OW54-10, OW57-15, OW58-17, OW67-11, OW72-10, OW73-9	PLIL-GW, SLIL-GW	May and November
OW16-7, **OW61-6, OW62-7, OW75-7, OW78-6**	PLIL-GW, SLIL-GW, volatiles	May and November
OW40A-7 OW60-8, OW79-7, OW80-6, OW81-7, OW82-14, OW83-9, OW84-11, **OW85-8**	PLIL-GW, SLIL-GW	May
OW40A-7, OW46-7, OW47-6, OW54-10, OW57-15, OW58-17, OW60-8, OW67-11, OW72-10, OW73-9, OW79-7, OW80-6, OW81-7, OW82-14, OW83-9, OW84-11, **OW85-8**	Volatiles	May
Interface Aquifer		
OW17-30, OW19-29, OW39A-26, OW40A-28, OW49-29, OW60-25, **OW61-26, OW62-30**, OW79-26, OW80-27, OW81-27, OW82-28, OW83-29, OW84-31	Groundwater Levels	May and November
OW19-29, OW39A-26, OW49-29, OW79-26, OW80-27, OW81-27, OW82-28, OW83-29, OW84-31, Cemetery Well	PLIL-GW, SLIL-GW	May
OW19-29, OW39A-26, OW49-29, OW79-26, OW80-27, OW81-27, OW82-28, OW83-29, OW84-31, Cemetery Well	Volatiles	Biennial - May 2024
Background Station		
SS10, SS16	Flow Rates	Quarterly after 10 mm precipitation events. Greater than 1 month intervals between sampling.
	PLIL-SW, SLIL-SW, nitrite	
	LS-SW	Spring Precipitation Event
	Biomonitoring	Spring Precipitation Event
Sedimentation Ponds (Discharge Points)		
SP1, SP2, SP3, SP4	Flow Rates	Quarterly after 10 mm precipitation events. Greater than 1 month intervals between sampling.
	PLIL-SW, SLIL-SW, nitrite	
	LS-SW, volatiles, semi-volatiles	Quarterly after 10 mm precipitation events. Greater than 1 month intervals between sampling.
	Biomonitoring	Spring Precipitation Event
Western Site Boundary Compliance Point		
SS1	Flow Rates	Quarterly after 10 mm precipitation events. Greater than 1 month intervals between sampling.
	PLIL-SW, SLIL-SW, nitrite	
	LS-SW, volatiles, semi-volatiles	Quarterly after 10 mm precipitation events. Greater than 1 month intervals between sampling.
	Biomonitoring	Spring Precipitation Event
Poplar Tree Plantation Land Application Area		
SS17A, SS17B, SS18A, SS18B	Flow Rates	Quarterly after 10 mm precipitation events. Greater than 1 month intervals between sampling.
	PLIL-SW, SLIL-SW, nitrite	
	LS-SW, volatiles, semi-volatiles	Quarterly after 10 mm precipitation events. Greater than 1 month intervals between sampling.
	Biomonitoring	Spring Precipitation Event
Compost Facility (if constructed)		
SS19	PLIL-SW, SLIL-SW, nitrite, BOD_5, TSS, Total Coliform, Fecal Coliform, E. Coli	Prior to water use

Monitoring Locations	Parameters	Frequency
Landfill Gas Monitoring		
Landfill Cap	Inspections	Monthly (April to November)
GP1A, GP2, GP3, GP4, GP5, GP6, GP7, GP8, GP9, GP10	Methane Gas	January, February, March, April, July, November, December

Notes:

1) PLIL-GW indicates: chloride, nitrate, boron.

2) SLIL-GW indicates: alkalinity, sulphate, calcium, magnesium, potassium, sodium, barium, cadmium, iron, lead, DOC, TDS, ammonia (total), TKN, pH, conductivity. Field parameters of pH, conductivity, temperature, turbidity.

3) PLIL-SW indicates: chloride, ammonia (total and unionized), phenols, boron, nickel, chromium (total), zinc.

4) SLIL-SW indicates: alkalinity, sulphate, calcium, magnesium, potassium, sodium, total phosphorus, iron, nitrate, TKN, TDS, pH, conductivity. Field parameters of temperature, pH, conductivity, turbidity, DO.

5) LS indicates: arsenic, barium, cadmium, copper, lead, manganese, mercury, nitrite, TSS, volatiles, semi-volatiles, BOD_5, COD.

6) LS-SW indicates: arsenic, barium, cadmium, copper, lead, mercury, nitrite, TSS, BOD_5, COD.

7) Volatiles should include the following at a minimum: benzene, 1,4-dichlorobenzene, dichloromethane, toluene, ethylbenzene, xylenes, and vinyl chloride.

8) Semi-volatiles should include the following at a minimum: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, hexachlorobenzene, diethylphthalate, dimethylphthalate, di-n-butyl phthalate, phenol, benzo(a)pyrene, 2,4,6-trichlorophenol, 2,4-dichlorophenol, pentachlorophenol.

9) Organochlorines include herbicide and pesticide scan.

10) Biomonitoring indicates toxicity testing for Rainbow Trout and Daphnia Magna.

11) Biennial indicates every second year.

12) QA/QC includes one (1) blind duplicate for each 15 samples or once per event, whichever is greater.

13) Surface water samples shall be collected in a downstream to upstream sequence.

14) OW84(new) denotes monitoring wells to be installed per EMP dated December 20, 2007.

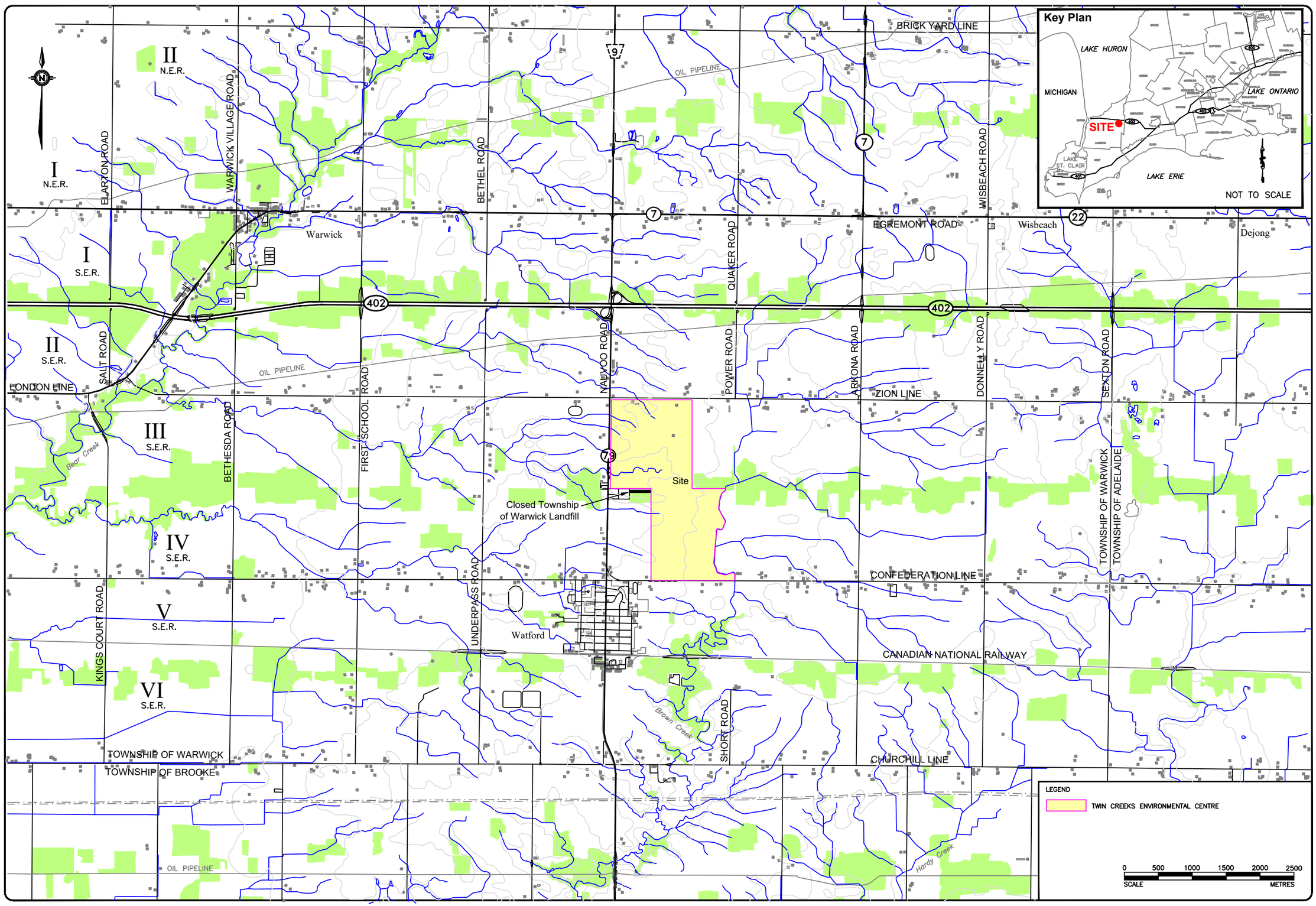
15) Spring denotes: April, May, and June.

16) † indicates that OW71A-5 is not required as part of the monitoring program, however, obtained data is interpolated for the monitoring well OW67-4, which used to show dry conditions.

17) Since the Poplar Plantation is not required to be utilized until a few months prior to the initiation of the treatment plant as operational, monitoring per the EMP and ECA, as well as the Waste and Sewage ECA's that is completed to evaluate the vigour of the Poplar Plantation, is not required. It is recognized that once the Poplar Plantation is initialized, then the required monitoring to evaluate the Poplar Plantation would be reinitiated.

18) Monitoring stations that are currently idle until 2 months prior to the leachate treatment plant being operational, include the following: 1) Surface water stations **SS17A, SS17B, SS18A, SS18B**; and 2) Groundwater monitoring locations **OW61, OW62, OW75, OW76, OW77, OW78, AND OW85.**

FIGURES



MAP SOURCE:
FIGURE PROVIDED BY GENIVAR INC., FIGURE 1, FILE REF NO. 111-53111-00-F1-LM 12CM Q4, DATED FEBRUARY 2013.

SITE LOCATION MAP
2023 COMPLIANCE MONITORING PROGRAM

TWIN CREEKS ENVIRONMENTAL CENTRE
TOWNSHIP OF WARWICK, ONTARIO

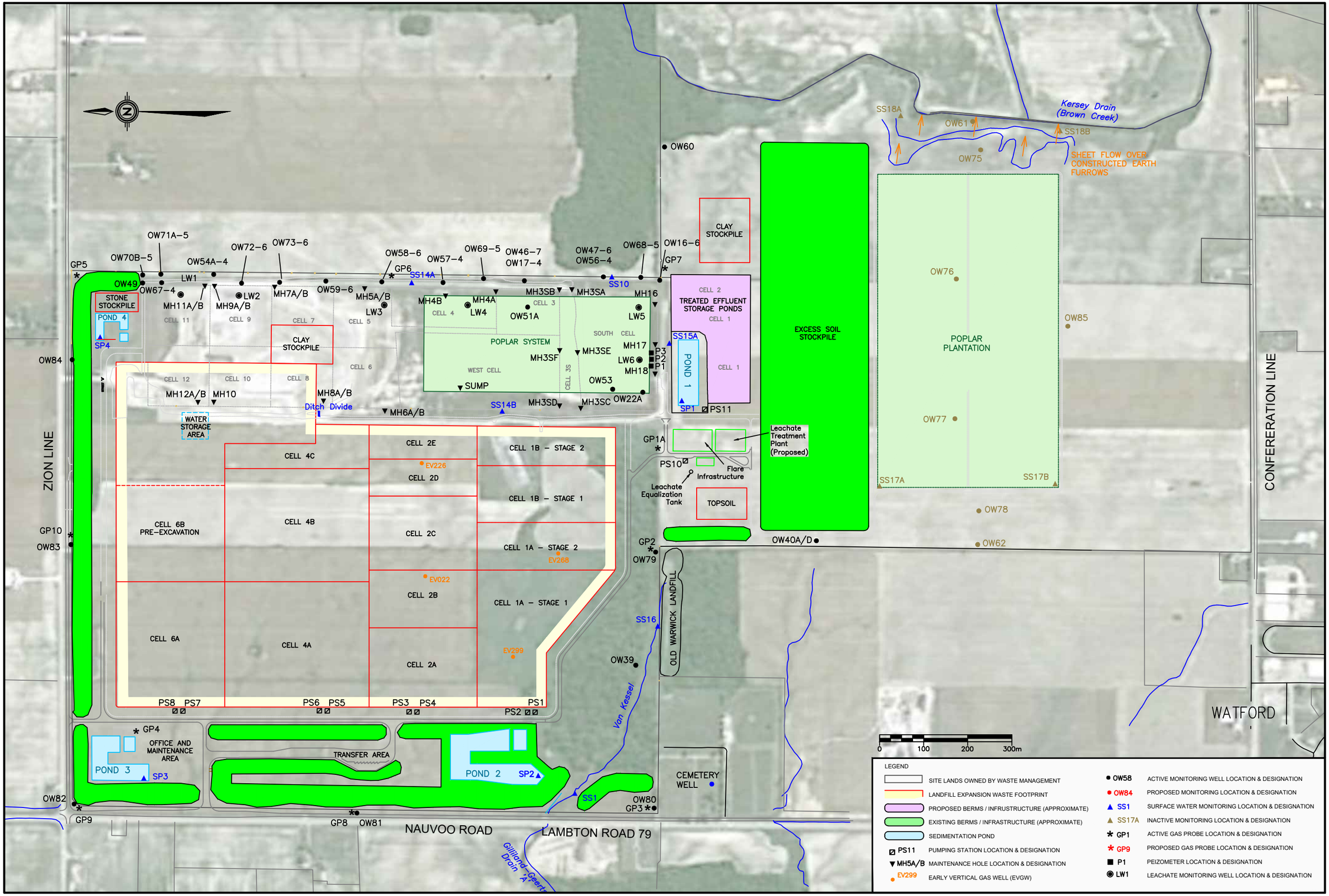
DWN BY: EW
CHK BY: PEJ
DATE: JANUARY 2024
SCALE: 1:50,000

WASTE MANAGEMENT OF CANADA CORP.

PROJECT FILE REF. NO.
2303459

FIGURE
1

WASTE MANAGEMENT



MAP SOURCE:
AERIAL PHOTO PROVIDED BY GOOGLE EARTH (2011), ACCESSED ON JANUARY 2014.
FIGURE PROVIDED BY GENIVAR INC., FIGURE 2, FILE REF NO. 111-53111-00-F2-SP 12CM Q4, DATED FEBRUARY 2013.

NOTE: LOCATION OF CONSTRUCTION SEDIMENTATION PONDS, BERMS, POPLAR PLANTATION, TREATMENT PLANT, & EFFLUENT LAGOONS FROM NOVEMBER 2010 SURVEY PLAN.

SITE PLAN

2023 COMPLIANCE MONITORING PROGRAM

TWIN CREEKS ENVIRONMENTAL CENTRE
TOWNSHIP OF WARWICK, ONTARIO

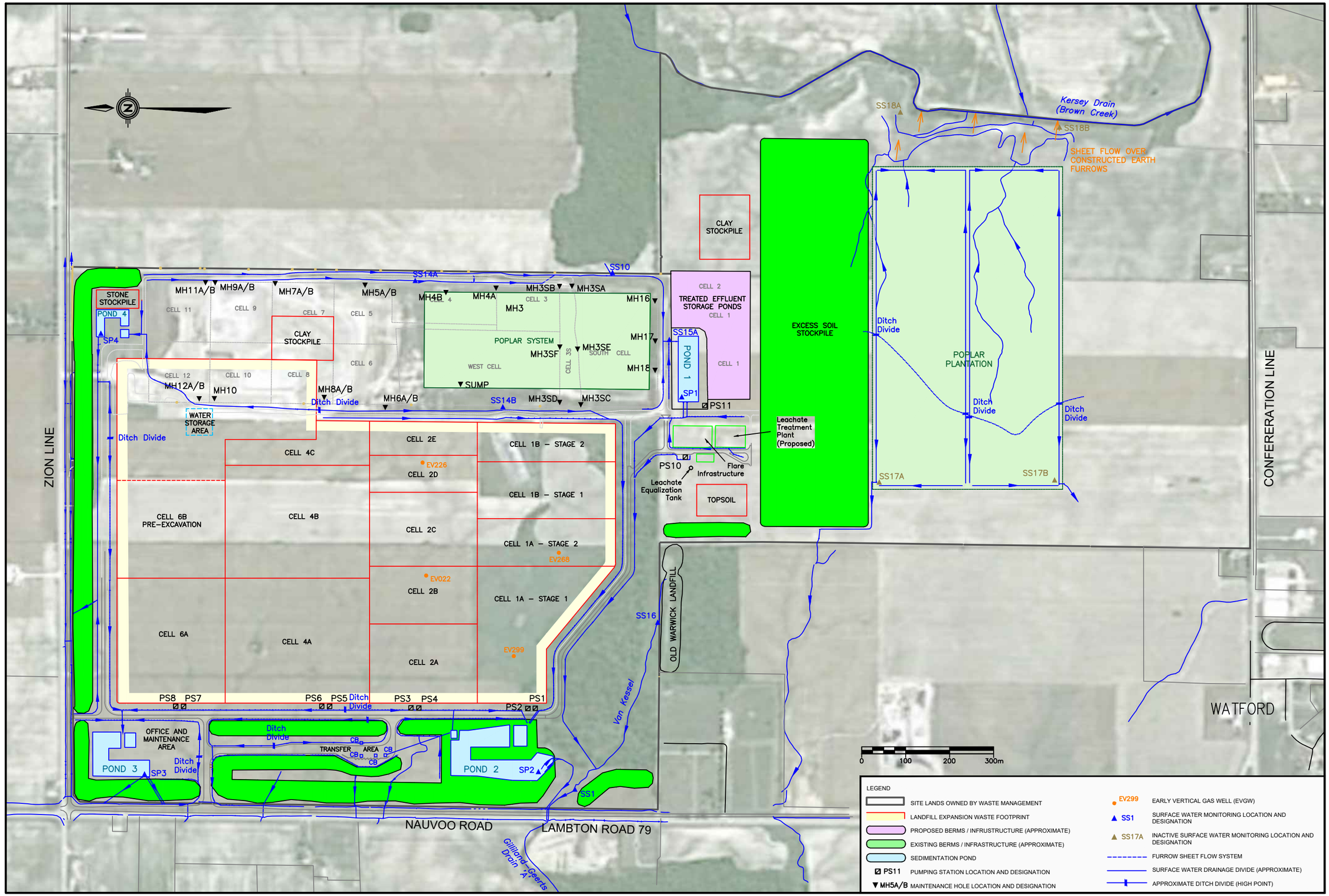
WASTE MANAGEMENT OF CANADA CORP.

DWN BY: EW
CHK BY: JCL

DATE: FEBRUARY 2024
SCALE: 1:8,000

PROJECT FILE REF. NO. 2303459

FIGURE 2



MAP SOURCE:
AERIAL PHOTO PROVIDED BY GOOGLE EARTH (2011), ACCESSED ON JANUARY 2014.
FIGURE PROVIDED BY GENIVAR INC., FIGURE 3, FILE REF NO. 111-53111-00-F3-SP 12CM Q4, DATED JANUARY 2013.

NOTE:
LOCATION OF CONSTRUCTION SEDIMENTATION PONDS, BERMS, POPLAR PLANTATION, TREATMENT PLANT, & EFFLUENT LAGOONS FROM NOVEMBER 2010 SURVEY PLAN.

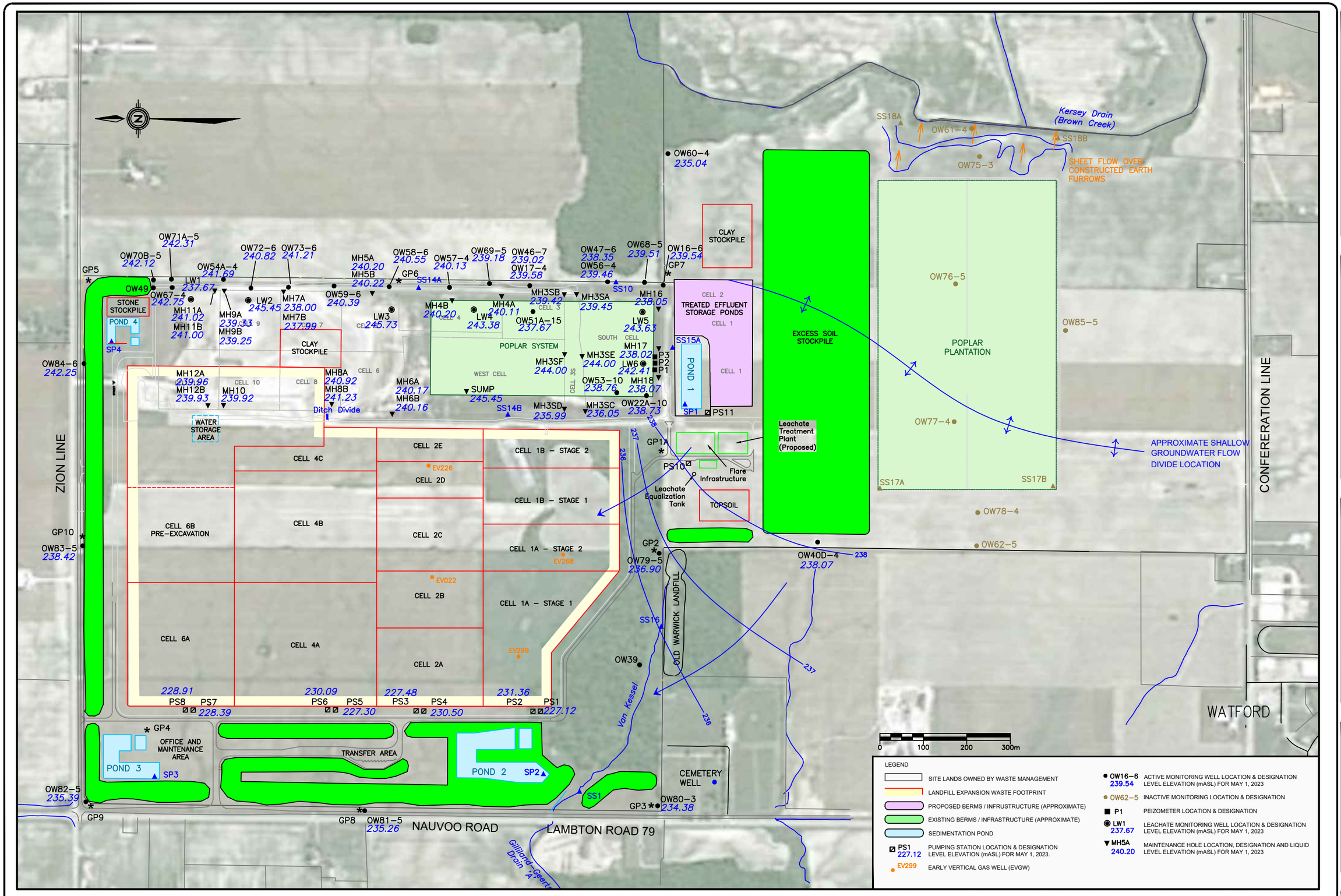
WASTE MANAGEMENT

SURFACE WATER SYSTEM
2023 COMPLIANCE MONITORING PROGRAM

TWIN CREEKS ENVIRONMENTAL CENTRE
TOWNSHIP OF WARWICK, ONTARIO

DWN BY: EW
CHK BY: JCL
DATE: FEBRUARY 2024
SCALE: 1:8,000
WASTE MANAGEMENT OF CANADA CORP.
PROJECT FILE REF. NO. 2303459

FIGURE 3



MAP SOURCE:
AERIAL PHOTO PROVIDED BY GOOGLE EARTH (2011), ACCESSED ON JANUARY 2014.
FIGURE PROVIDED BY GENIVAR INC., FIGURE 2, FILE REF NO. 111-53111-00-F2-SP 12CM Q4, DATED FEBRUARY 2013.

NOTE: LOCATION OF CONSTRUCTION SEDIMENTATION PONDS, BERMS, POPLAR PLANTATION, TREATMENT PLANT, & EFFLUENT LAGOONS FROM NOVEMBER 2010 SURVEY PLAN.

RWDI

WASTE MANAGEMENT

LEACHATE & SHALLOW GROUNDWATER ELEVATIONS
2023 COMPLIANCE MONITORING PROGRAM

TWIN CREEKS ENVIRONMENTAL CENTRE
TOWNSHIP OF WARWICK, ONTARIO

DWN. BY: EW
CHK. BY: JCL

DATE: FEBRUARY 2024
SCALE: 1:8,000

WASTE MANAGEMENT OF CANADA CORP.

PROJECT FILE REF. NO. 2303459

FIGURE 4

I:\2303459\04Deliverables\41WasteManagement\Phase 1000\Q4\2023 Annual Report\02Figures\F4-F6 Working Files - do not include\20240117 RWDI 2303459 FIG Waste TCEEC2023ReportFig4LchShalGWElev.dwg

OW60–8
235.00

OW16–7
238.77

OW72–10
238.74

OW54–10
238.59

OW59–10
238.70

OW58–17
237.75

OW57–15
239.26

OW46–7
239.02

OW47–6
238.35

OW67–11
238.25

OW73–9
239.04

OW84–11
239.41

OW83–9
235.93

OW82–14
234.39

OW81–7
235.26

OW80–6
235.38

OW79–7
236.16

OW40A–7
237.18

OW61

OW75

OW78–6

OW62–7

Kersey Drain
(Brown Creek)

SHEET FLOW OVER
CONSTRUCTED EARTH
FURROWS

CLAY
STOCKPILE

STONE
STOCKPILE

POND 4

CELL 11

CELL 9

CELL 7

CELL 5

CELL 6

CELL 12

CELL 10

CELL 8

CELL 4

CELL 3

POPLAR SYSTEM

WEST CELL

SOUTH CELL

CELL 3S

CELL 2
TREATED EFFLUENT
STORAGE PONDS

CELL 1

POND 1

CELL 1

PS11

EXCESS SOIL
STOCKPILE

POPLAR
PLANTATION

WATER
STORAGE
AREA

CELL 4C

CELL 2E

EV226

CELL 2D

CELL 1B – STAGE 2

CELL 1B – STAGE 1

CELL 6B
PRE–EXCAVATION

CELL 4B

CELL 2C

CELL 1A – STAGE 2

EV268

EV022

CELL 2B

CELL 1A – STAGE 1

CELL 6A

CELL 4A

CELL 2A

EV299

Leachate
Treatment
Plant
(Proposed)

PS10

Flare
Infrastructure

Leachate
Equalization
Tank

TOPSOIL

OLD WARWICK LANDFILL

228.91
PS8
PS7
228.39

230.09
PS6
PS5
227.30

227.48
PS3
PS4
230.50

231.36
PS2
PS1
227.12

OFFICE AND
MAINTENANCE
AREA

POND 3

TRANSFER AREA

POND 2

CEMETERY
WELL

NAUVOO ROAD

LAMBTON ROAD 79

Gilliland Geerts
Drain 'A'

Van Kessel

APPROXIMATE SHALLOW
GROUNDWATER FLOW
DIVIDE LOCATION

CONFERERATION LINE

ZION LINE

WATFORD

0 100 200 300m

LEGEND

- SITE LANDS OWNED BY WASTE MANAGEMENT
- LANDFILL EXPANSION WASTE FOOTPRINT
- PROPOSED BERMS / INFRUSTRUCTURE (APPROXIMATE)
- EXISTING BERMS / INFRASTRUCTURE (APPROXIMATE)
- SEDIMENTATION POND
- PS11 227.12 — PUMPING STATION LOCATION & DESIGNATION LEVEL ELEVATION (mASL) FOR MAY 1, 2023
- EV299 — EARLY VERTICAL GAS WELL (EVGW)
- OW40A–7 237.18 — ACTIVE MONITORING WELL LOCATION & DESIGNATION LEVEL ELEVATION (mASL) FOR MAY 1, 2023
- OW62–7 — INACTIVE MONITORING WELL LOCATION, DESIGNATION
- OW58–14 — DECOMMISSIONED MONITORING WELL LOCATION AND DESIGNATION

MAP SOURCE:
AERIAL PHOTO PROVIDED BY GOOGLE EARTH (2011), ACCESSED ON JANUARY 2014.
FIGURE PROVIDED BY GENIVAR INC., FIGURE 2, FILE REF NO. 111–53111–00–F2–SP 12CM Q4, DATED FEBRUARY 2013.

NOTE: LOCATION OF CONSTRUCTION SEDIMENTATION PONDS, BERMS, POPLAR PLANTATION, TREATMENT PLANT, & EFFLUENT LAGOONS FROM NOVEMBER 2010 SURVEY PLAN.

WASTE MANAGEMENT

INTERSTADIAL SILT AND SAND GROUNDWATER ELEVATIONS
2023 COMPLIANCE MONITORING PROGRAM

TWIN CREEKS ENVIRONMENTAL CENTRE
TOWNSHIP OF WARWICK, ONTARIO

DWN. BY: EW
CHK. BY: JCL

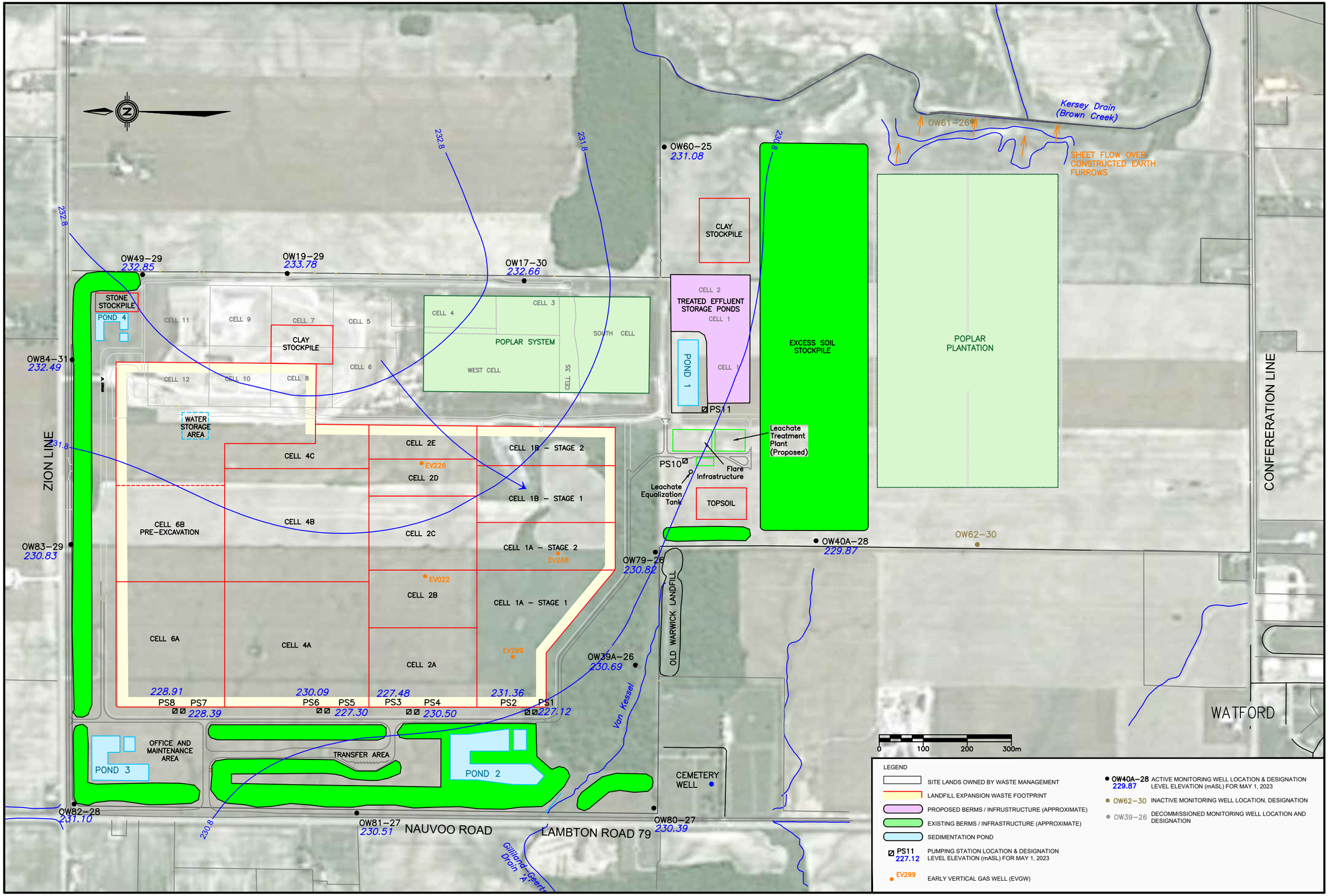
DATE: FEBRUARY 2024
SCALE: 1:8,000

WASTE MANAGEMENT OF CANADA CORP.

PROJECT FILE REF. NO. 2303459

FIGURE
5

I:\2303459\04Deliverables\41WasteManagement\Phase 1000\Q4\2023 Annual Report\02Figures\F4-F6 Working Files - do not include\20240117 RWDI 2303459 FIG Waste TCEC2023ReportFigSSIISandGWElev.dwg



MAP SOURCE:
AERIAL PHOTO PROVIDED BY GOOGLE EARTH (2011), ACCESSED ON JANUARY 2014.
FIGURE PROVIDED BY GENIVAR INC., FIGURE 2, FILE REF NO. 111–53111–00–F2–SP 12CM Q4, DATED FEBRUARY 2013.

NOTE: LOCATION OF CONSTRUCTION SEDIMENTATION PONDS, BERMS, POPLAR PLANTATION, TREATMENT PLANT, & EFFLUENT LAGOONS FROM NOVEMBER 2010 SURVEY PLAN.

WASTE MANAGEMENT

INTERFACE AQUIFER
GROUNDWATER ELEVATIONS
2023 COMPLIANCE MONITORING PROGRAM

TWIN CREEKS ENVIRONMENTAL CENTRE
TOWNSHIP OF WARWICK, ONTARIO

DWN BY: EW
CHK BY: JCL

DATE: FEBRUARY 2024
SCALE: 1:8,000

WASTE MANAGEMENT OF CANADA CORP.

PROJECT FILE REF. NO. 2303459

FIGURE
6