Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

REPORT – VOLUME 1

2021 ANNUAL MONITORING REPORT

CITY OF BROCKVILLE LANDFILL SITE,

ECA NO. A440101

Former City Landfill,

Former Salvage Yard and

MOE Investigation Area

Submitted by:

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Jp2g Project No. 21-6149A

Submitted to:

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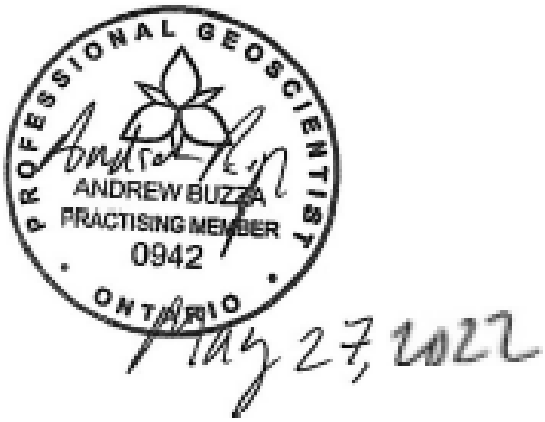

Report Reviewed By: _____

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City of Brockville Landfill Site

Former City Landfill, Former Salvage Yard and MOE Investigation Area

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PART A

Background Information, Hydrogeological and Hydrological Setting Monitoring

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REPORT – PART A

2021 Background Information, Hydrogeological and Hydrological Setting Monitoring

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May 2022

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1.0 INTRODUCTION

The Closed Brockville Landfill Site is located on Part of Lot 16 and 17, Concession 2 within the western limits of the City of Brockville on Parkdale Avenue as shown on **Figure A1**. A site plan of the Brockville Landfill Site and surrounding area is presented as **Figure A2**.

The Brockville Landfill was in operation from about 1964 until it closed on December 31, 2000. Golder Associates Ltd. (Golder) has carried out annual environmental monitoring at the City of Brockville Landfill Site since 1987. Jp2g Consultants Inc. conducted the environmental monitoring in 2021. For consistency in reporting, details previously provided by Golder (2021) have been repeated in part or in whole in the associated documents.

The monitoring program included surface water, groundwater and leachate collection system measurements and sampling at the Brockville Landfill Site, on the Contaminant Attenuation Zone (CAZ) and on lands south and west of the closed landfill. Surface water monitoring was completed twice during 2021 including elevations and flow measurements at selected locations. Jp2g conducted supplemental field survey to record the GPS locations of all surface water monitoring stations, and additional survey is required in 2022. Groundwater levels were measured twice in 2021 at all monitoring wells. Water quality sampling was conducted once for a majority of the groundwater monitors and twice at certain locations. The sampling of the leachate collection system is regularly monitored by City staff. Jp2g conducted sampling on two occasions in 2021. The 2021 monitoring program is similar to the 2006 to 2020 programs with minor changes.

In 2021, the City of Brockville managed and maintained the Brockville Landfill Site facilities. The City typically participates in Public Liaison Monitoring Group (PLMG) meetings, but there was no meetings in 2020 and 2021 due to the COVID-19 pandemic. Reporting on Brockville Landfill Site management and maintenance is included in Part B of this report.

The 2021 Annual Monitoring Report is organized into two volumes. **Volume 1** contains three parts (Parts A, B, and C) as follows:

- Part A: Background Information, Hydrogeological and Hydrological Setting
- Part B: City of Brockville Landfill Site - 2021 Monitoring and Site Maintenance
- Part C: Former City Landfill, Former Salvage Yard and the Area of the MOE Investigation - 2021 Monitoring

Parts A, B and C are structured as independent reports, each containing a table of contents, tables, and figures.The list of references for Parts A, B and C follow Part C. **Volume 2** contains all appendices for Parts A, B and C and is attached to **Volume 1** on a USB flash drive.

Although many of the monitoring locations discussed in Parts B and C are the same, and the 2021 monitoring programs as presented in Parts B and C are conducted simultaneously, the focus of each report (Part B and Part C)is different. The key difference between Part B (Brockville Landfill Site) and Part C (Former City Landfill, Former Salvage Yard and the Area of the MOE Investigation) is related to Ministry of the Environment, Conservation and Parks (MECP and or the Ministry) regulations concerning sources of groundwater and surface water impact. The Brockville Landfill Site is a “regulated” source of contamination (an approved facility) whereas the Former City Landfill, Former Salvage Yard and the Area of the MOE Investigation are “unregulated” sources of contamination. These areas are shown on **Figures A1 and A2**.

The 2021 management and maintenance of the Brockville Landfill Site and the associated monitoring program was completed in general accordance with the Environmental Compliance Approval (Provisional Certificate of Approval) No. A 440101 dated September 14, 2018 included in **Appendix 1**. Monitoring of the former City Landfill, the former salvage yard and the area of the MOE investigation is carried out by the City on a voluntary basis. The Ministry has recommended some changes to the monitoring program and conducts their own supplemental monitoring as detailed in correspondence included in **Appendix 1**.

1.1 Site Location

A detailed description of the site location is as follows:

- The site is located within Part Lot 16 and 17 Concession 2 geographic Township of Elizabethtown, now in the City of Brockville and part Lot 18, Concession 2 Elizabethtown-Kitley. The site is owned and managed by the City (the site is closed).
- The site comprises a 14.18 hectare closed landfilling area within a total site area of 36.2 ha.
- The site has a 18.5 ha +/- contaminant attenuation zone (CAZ) which extends southerly to Highway No. 401.
- The site coordinates are:
    - 45^0 35' 55.28" N 76^0 49' 56.93" W
    - NAD 83 - UTM 18N – easting 357,030 northing 5,051,060 +/- 50 metres

A site location map is provided as **Figure A1**. The landfill site and surrounding features are provided in **Figure A2**.

1.2 Site Ownership and Key Personnel

The site is closed and is owned by the City of Brockville. Contacts for the municipality and the Competent Environmental Practitioner for both the groundwater and surface water as defined by the Ministry (2010) are as follows:

Municipal Contacts
City of Brockville
Lyndsay d'Entremont
Solid Waste Officer
Tel: 613-342-8772 Ext. 3220
Email: *ldntremont@brockville.com*

City of Brockville
Peter Raabe
Director of Engineering and Infrastructure
Tel: 613-342-8772 Ext. 3257
Email: *praabe@brockville.com*

CEP Contact Ground and Surface Water
Jp2g Consultants Inc.
Andrew Buzza, P.Geo
Tel: 613 828-7800
Email: andrewb@jp2g.com

1.3 Description and Development of the Waste Disposal Site

This section provides a general description of the site.
Environmental Compliance Approval:
ECA No. A440101 issued September 14, 2018.
Site Status:
The site ceased receiving waste for landfilling in December 2000.

Site Capacity:
Total waste disposal volume is unknown.

Projected Site Life:
The site is closed.

Area of current waste cell footprint and approved footprint in hectares:
The waste cell footprint 14.18 ha.

Area of entire waste disposal site in hectares:
The entire WDS is 36.2 ha, excluding the CAZ.

Total property area in hectares:
The 36.2 ha site has a CAZ of approximately 18.5 ha.

Dates when waste disposal site opened, operated and closed as applicable:
The site reportedly opened in 1964 and was closed for operation on December 2000.

Information on final cover, slopes and engineering controls:
Detailed in the Closure and Post Closure Care, Final Report, March 2001.

Any Permits To Take Water associated with the site:
There is a Permit To Take Water associated with the leachate collection system for a taking of 1,501,610 m^3.

Other authorizing and or control instruments associated with the site:
In August 2012 the landfill gas management system operating under ECA No. 5172-58KQGH was shut down. To be decommissioned in 2022.

Description of any storm water management facilities:
A site perimeter sheet pile wall is around the Closed Brockville Landfill Site.

Description of any leachate collection systems; and any sewage works, including the ECA number of the works:
The system was installed in 1992 and includes a wet well/collection basin, leachate pumping station and forcemain to the City sewage collection system. The operation is monitored regularly by City staff including weekly sampling with results compared to the City Sewer Use By-law concentrations.

Any site developments, which occurred during the year of the monitoring report:
There were no new site developments during the reporting period.

Any new developments in the vicinity of the site of relevance from a monitoring perspective:
There were no new developments in the vicinity of the site.

Historical Site Overview

Environmental baseline investigations which were undertaken:
Historical monitoring has been completed at the Brockville Landfill Site. The earliest monitoring reported in this report is from the year 1985. Since this time, monitoring and monitoring well installations have been undertaken. A list of relevant studies is provided in the "References" at the end of the report.

Design and construction of the site:
Provided in the "Closure and Post Closure Care Report dated March 2001".

Development of environmental monitoring systems:
The development of environmental monitoring programs was initially provided in earlier reports and the Environmental Compliance Approval (formerly Certificate of Approval).

Conceptual Site Model:
Details that comprise the conceptual site model are provided in **Sections 2.0, 3.0 and 4.0** of this report.

Problems associated with the function or operation of the waste disposal site:
The site is closed, there have not been any reported issues.

Placement of final cover:
The placement of final cover was completed in a series of phases between 2002 and 2014

Date of site closure, actual or projected, including any closure plans:
The site was closed for use in December 2000.

1.4 MECP Review Comments and Recommendations

The MECP have not provided any review comments on the 2020 Annual Report.

The results of a June 11, 2020 sample at SW-5 indicated an exceedances of the trigger concentrations for total iron (1.0 mg/L) and dissolved iron (0.35 mg/L). Confirmation sampling on June 25, 2020 also reported exceedances. Golder recommended sampling at SW-5 over the next six months to be included coincidental with the City's leachate sampling. Correspondence and the results are included in **Appendix 1.**

Supplemental monitoring of domestic wells along Lyn Road were completed by the Ministry (i.e., sampling related to the former landfilling activities). Samples were collected and analyzed for selected VOCs. No VOCs were detected or have been detected. The Ministry recommends additional sampling at a frequency of every 3 years.

Similarly, domestic wells located along Old Red Road were sampled by the Ministry as part of their supplemental monitoring program. Samples were analyzed for VOCs, PFAS and 1,4-dioxane (the latter two were added to the program in 2021). VOCs were detected in all but one location, all generally within the range of historical concentrations; however, trichloroethylene exceeded the ODWS at one residence. The source of the VOCs is unknown. PFAS and 1,4-dioxane were detected but below the CDWQS of 0.05 mg/L and the Technical. Assessment and Standards Development Branch (TASDB) interim guidance value of 70 mg/L respectively.

1.5 Public Liaison & Monitoring Group Comments and Recommendations

Mr. Ruland, the consultant for the PLMG provided a letter dated December 1, 2021 as a review of the 2020 Annual Monitoring Report prepared by Golder, a copy is included in **Appendix 1**. The comments are reproduced in the following table, along with the responses by Golder (green), Jp2g (blue) and City (red).

2020 Annual Report Review
Recommendations and Responses

Recommendation, Question or Action from Review	City of Brockville/J2PG Response
Recommendation #1 (carried forward from 2017 to 2020) Any still-functional shallow wells in the area of the southwest corner of the Brockville Landfill should be sampled for TCE and vinyl chloride.	In the southwest corner of the Brockville Landfill property, groundwater flow is generally in a southeasterly direction. There are many monitoring wells located within the CAZ that are used for monitoring groundwater quality that may emanate from the southwest corner of the Brockville Landfill. There is also a significant distance between the southern boundary of the Brockville Landfill and the southern boundary of the CAZ (approximately 300m). Further, the Brockville Landfill Site is considered to be in compliance with MECP Reasonable Use Guideline B-7. Therefore, it is Golder's opinion that the current monitoring plan provides sufficient information regarding groundwater impacts from the Brockville Landfill Site and additional monitoring in the southwest corner of the Brockville Landfill Site is not warranted at this time. Jp2g agrees with this statement from the 2020 Annual Report
Recommendation #2 (carried forward from the years 2005 to 2020) Since the extent and fronts of the significant VOC plumes from the City's old and current landfills have not been defined in the bedrock groundwater flow system south of Highway 401, I recommend that sampling of downgradient domestic wells which are completed in the bedrock continue to be carried out on a regular basis (by either the City or the MOECC) as follows: - Domestic wells on Center Street should be tested biannually (every other year) for VOCs if possible. - Selected domestic wells on Lyn Road (south of Highway 401) which draw water from the bedrock groundwater flow system should be tested annually for VOCs on a precautionary basis.	Based on past monitoring results and the interpreted direction of groundwater flow, in Golder's opinion it is unlikely that the wells along Lyn Road and Centre Street would be impacted by the Brockville Landfill or the other sources of groundwater contamination that are the focus of the monitoring program. Therefore, the current frequency of the sampling by theMECP is considered to be sufficient and additional monitoring (by the City of Brockville) is not warranted at this time. The MECP sampled domestic wells on Lyn Road in the Fall of 2021, no elevated concentrations of VOCs were detected or have been historically detected. The Ministry recommends sampling every 3 years and have agreed to include some wells on Centre Street in the next event, Jp2g agrees with this program.
Recommendation #3 from December 1, 2021 letter) a) If the City receives adverse test results which indicate that a leachate breakout may have occurred from the Brockville Landfill, then both the MECP and the PLMG should be notified with forthwith and should be provided with all subsequent test results as these become available. b) When test results indicate that a leachate breakout may have occurred, then follow-up testing should be for the full surface water parameter list. c) When follow-up testing has confirmed that a leachate breakout may have occurred and that surface water quality limits have been exceeded, then toxicity testing of the impacted surface water should commence and should continue monthly until water quality testing has confirmed that the breakout has ended.	Upon detection of the June 2020 SW-5 exceedance of trigger values Golder and the City notified the MECP and proposed a monthly sampling program which was agreed to by the Ministry to include analysis of total and dissolved iron. Notification of the PLMG is provided in the Annual Reports. As no other parameters exceeded the trigger concentrations there was no need for additional analysis. The results of sampling SW-5 are provided in Appendix 1 which illustrates exceedances of both total and dissolved iron between August 24 to October 6, 2021 and then between June 7 and September 14, 2021, however at significantly lower concentrations than the June 2020 events. In addition, as there were no elevated VOCs detected at SW-5 which have been detected in the past, no additional analysis is merited. The 2021 SW-5 sampling by Jp2g didn't exhibit any exceedance of the trigger mechanism.

2020 Annual Report Review
Recommendations and Responses (continued)

Recommendation, Question or Action from Review	City of Brockville/J2PG Response
Recommendation #4 (carried forward from 2018 to 2020) a) The PLMG should request that the City enter into discussions regarding the end use of the City Landfill. b) These discussions should consider working with and building on the naturalization of the site which has occurred since it was closed in 2000. c) An End Use featuring a passive Naturalization Site in which the natural environment is enhanced and protected for the long term seems to offer a way forward.	The City of Brockville can prepare a written document to provide the PLMG an outline of the intended end use of the former landfill site. The City's current vision for the site includes encouraging the landscape's continuing natural growth to return to a state which can sustain wildlife and provide habitats.
Recommendation #5 (carried forward from 2019 to 2020) The City should decommission the landfill gas system (which is no longer functional) as soon as is practicable.	The former landfill gas collection system was originally installed for odour control purposes. The system was temporarily shut down in 2012 due to a lack of methane collected and no major odour concerns. Since that time, odours have remained a non-issue at the site and therefore, the City of Brockville acquired the technical services of Golder Associates Ltd. to draft a plan for decommissioning the system, which is no longer operable. This project is being further planned and prepared for later in 2022.

2.0 HYDROGEOLOGICAL SETTING

The following sections have been reproduced from the 2020 Background Information. Hydrogeological and Hydrological Setting Monitoring Report by Golder dated May 2021 (Golder, 2021)

2.1 Geology

2.1.1 Brockville Landfill Site and CAZ Lands

Subsurface conditions at the Brockville Landfill Site and CAZ lands were described in detail in several reports between 1990 and 1994 and in subsequent Annual Reports (see references following the text of Part C of this report). In summary, the northern and central portions of the Brockville Landfill Site consist of refuse placed over sandstone bedrock, while in the southern portion of the Brockville Landfill Site the refuse overlies a sequence of organic soils, silty clay and glacial till followed by Precambrian quartzite bedrock.

The Precambrian quartzite bedrock outcrops as a continuous elevated ridge along the south side of Parkdale Avenue opposite the Brockville Landfill Site within the CAZ lands. The Precambrian quartzite bedrock surface declines from this ridge northwards into the Brockville Landfill Site where, along a contact zone beneath the south-central portion of the site, it is overlain by the sandstone bedrock. The bedrock ridge also declines eastward and southward into the Grant's Creek valley in the CAZ lands. Precambrian quartzite bedrock underlies about 5 to 6 metres of overburden soil consisting mostly of silty clay and glacial till throughout nearly all of the Grant's Creek valley except where it rises to near the ground surface adjacent to Highway 401 along the southern boundary of the CAZ lands. South of Highway 401, at boreholes 99-7 through 99-11 and 00-1 and 00-2, bedrock is found at approximately 0.3 to 2.0 metres below ground surface.

2.1.2 Former City Landfill Site and Lands toward the West

Within the former City Landfill Site, Precambrian quartzite or granite bedrock is encountered beneath about 4 metres of refuse consisting mostly of silty sand mixed with glass, wood, metal, plastic, etc. The southern limit of the former City Landfill Site is generally adjacent to the continuous elevated ridge which continues from the northwest corner of the CAZ lands in an east-west direction.

The Precambrian quartzite bedrock is encountered beneath minimal overburden deposits on the west side of the former City Landfill Site (at boreholes 99-1 and 99-2) and south of the former City Landfill (at boreholes 99-3 and 99-5). At the Intera boreholes MW-1 through MW-4, to the west of the Brockville Landfill Site along Chemical Road, now called Old Red Road (the area of the 1990 MOE investigation), sandstone bedrock is also encountered beneath minimal overburden deposits. At 99-6, southwest of 99-1, 5.8 metres of glacial till overburden was encountered over Precambrian quartzite bedrock. At 00-2, which is southwest of 99-6, quartzite was encountered at about 1 metre below fill (in the former railroad right-of-way).

South of Highway 401, at 00-1 Precambrian quartzite bedrock was encountered below about 1.8 metres of topsoil and fill. Borehole 00-3, which is south of the former City Landfill and Highway 401 and just north of the C.N. rail line, encountered a significant depression in the bedrock surface that is in-filled with approximately 20 metres of silty clay above Precambrian bedrock.

2.2 Groundwater Flow Systems

Because significant depths of overburden deposits are generally confined to the southern part of the Brockville Landfill Site and within the Grant's Creek valley, off-site leachate impacted groundwater in the vicinity of the Brockville Landfill Site mostly occurs within the bedrock.

Monitoring wells in the CAZ lands and other areas west of the CAZ lands are generally between 5 and 25 metres in depth below the ground surface. Between these depths, three flow systems can be interpreted to be present: shallow, intermediate, and deep. The shallow bedrock groundwater flow system is defined as groundwater located within the upper 10 metres of the bedrock. All the monitoring wells in the vicinity of the Brockville Landfill Site which have screened intervals within the upper 10 metres of the bedrock are listed in **Table A1**, along with the ground surface elevations, casing elevations and approximate screened interval elevations. The shallow groundwater flow system generally follows the ground surface topography and is affected by site-specific groundwater recharge and discharge features including surface water systems, particularly the Grant's Creek valley. **Figure A3** illustrates the ground surface contours in the southern part of the Brockville Landfill Site, the CAZ lands, and the adjacent west property.

The deep groundwater flow system is assumed to be influenced regionally by the St. Lawrence River.

The deep bedrock groundwater flow system is generally defined by the monitoring wells that have screened intervals beneath the geodetic elevation of about 87 metres (see list of monitoring wells on Table A2). Monitoring wells 91-1D, MW-1D, MW-2D, MW-3D and MW-4D are included in the list of monitors within the deep flow system despite the fact that they each have screened intervals much higher than geodetic elevation 87 metres. At these monitoring wells, the ground surface is significantly higher and groundwater recharge to the deep groundwater flow system may occur, thus they are considered to be in the deep groundwater flow system. Between the shallow bedrock flow system and the deep bedrock groundwater flow system is the intermediate groundwater flow system.

3.0 GROUNDWATER AND SURFACE WATER CONTAMINANT SOURCES

The following sections have been reproduced from the 2020 Background Information Hydrogeological and Hydrological Setting Monitoring Report by Golder dated May 2021 (Golder 2021). The tables have been updated to include the 2021 data.

The multiple groundwater and surface water contaminant sources in the immediate vicinity of the Brockville Landfill Site have been discussed in the annual monitoring reports since 1997. Based on information obtained from a Phase I ESA and a groundwater investigation that was completed by Golder in 1998 (Golder, 1998b), it is known that the former City Landfill Site is a significant source of volatile organic compounds (VOCs), while the former salvage yard, the area of the MOE investigation and the Brockville Landfill Site are much less significant sources of VOCs.

In order to identify potential contaminant sources in the vicinity of the Brockville Landfill Site a number of interrelated factors were considered, including current/historical site use, physical hydrogeology and groundwater/surface water contaminant distributions. Additional information regarding identified sources of groundwater and surface water contamination can be found in Golder, 1998b.

3.1 Historical Land Uses

A review of current and historical site uses by Golder in 1998 revealed the following known historical and current land uses in the immediate vicinity of the Brockville Landfill Site:

1. Mining operations within the limits of the former City Landfill Site were carried out in the late 1800's/early 1900's. Iron sulphide (pyrite) ore was mined and processed to extract sulphur and to produce sulphuric acid. Mining operations may have also taken place outside of the limits of the former landfill. Waste rock and tailings (possibly containing iron sulphide) could have been disposed anywhere in the vicinity of the mining works. Near-surface deposits of iron sulphide that were not mined out could also be present in the general vicinity of the former landfill site. Iron sulphide reacts with molecular oxygen in water to produce dissolved sulphate and dissolved ferrous iron. Ferrous iron is highly soluble; however, in oxygenated waters ferrous iron converts to ferric iron, which is much less soluble, and thus it tends to precipitate out of solution (typically as a ferric hydroxide). This is typically the cause of the orangish-red iron precipitate colour observed on the bottom of surface water courses.
2. The presence of mine shaft(s) beneath the former City Landfill Site provide/s a conduit for deepgroundwater contamination from what would otherwise be surficial landfilling operations.
3. The recovery of metal and re-usable parts from old cars and farm machinery within the limits of the former salvage yard was carried out between about the mid 1950's and the early 1980's. It was reported that chemical use within the former salvage yard (i.e., parts cleaners, degreasers, etc.) was not common.
4. Landfilling operations in the former City Landfill Site were carried out between about the early 1950's and 1963/64. The former City Landfill Site had no waste type restrictions, and as such, an unknown amount of solid/liquid industrial waste from local companies was likely disposed along with domestic waste. Additionally, it is reported that waste may have been placed inside a former mine shaft(s) located within the landfill footprint.
5. Landfilling operations at the Brockville Landfill Site commenced in 1963/64. Early landfilling operations were not monitored closely, and the waste composition during the initial filling period was likely similar to that placed in the former City Landfill Site.
6. Road salt has been applied to Highway 401 during the winter months since the highway was constructed during the early 1960's.
7. Only a few single residential dwellings exist beyond the limits of the Brockville Landfill Site within about 500 metres. The Guy residence is the only residence located on the CAZ lands. The residential dwellings are not considered to be significant groundwater contaminant sources.
8. The Brockville Highlands Ltd. Golf Course is located on the south side of the Brockville Landfill Site.

In 1991, Intera Information Technologies (Canada) Ltd. (Intera) was commissioned by the Ministry to carry out a 'Soils and Hydrogeological Site Investigation' along Old Red Road, formerly Chemical Road, just west of the Brockville Landfill Site to define the extent of TCE contamination in the soil and groundwater within the affected area and to recommend measures for the remediation of the site.

The hydrogeological conditions of the site were assessed by installing four multi-level monitoring wells (the monitoring wells were installed in boreholes MW-1 to MW-4), each containing three screens, to a maximum depth of about 31 metres. A fifth monitoring well (MW-5) was installed after Intera reported the results of their investigation.

The report by Intera (Intera, 1992) states that: "The contaminant plume is a result of a source that is located upgradient of the Toohey residence, possibly at the rear of the Reynolds' or Thompson property". The Toohey, Reynolds and Thompson properties are all on the north side of Old Red Road, approximately 400 metres northwest of the former City landfill site.

3.2 Identified Sources of Groundwater and Surface Water Contamination

Based on the historical information collected by Golder (summarized above), and the groundwater and surface water monitoring data (discussed in Parts B and C), there are a number of known, and potential sources of inorganic and VOC contamination (groundwater and surface water) in the immediate vicinity of the Brockville Landfill Site. These sources and potential sources are summarized as follows:

Source of Contamination	Inorganics	VOCs
Brockville Landfill Site	✓	✓
Highway 401 road salt applications	✓	
Former City Landfill Site	✓	✓
Iron sulphide-rich rock (former mining operations)	✓	
Former salvage yard	*	✓
Area of the MOE (Ministry) investigation	**	✓

Notes:

* Possible elevated iron concentration due to the presence of buried scrap metal.

** The MECP investigated VOC impacts in the area north of Old Red Road and west of the Brockville Landfill Site. However, this area is likely an area of groundwater recharge, therefore activities such as road salting and septic disposal could also affect downgradient groundwater quality.

The approximate locations of the known inorganic and volatile organic contaminant sources are shown on **Figure A2**. As was previously described, mining operations are known to have taken place within the limits of the former landfill site and may have also taken place outside of the limits of the former landfill. Near surface deposits of iron sulphide that were not mined out could also be present outside of the limits of the former landfill.

Soil sampling undertaken by Golder in 2003 (Golder, 2004) identified three potential sources of iron in surface water in the wetland area west of the former landfill: peat, iron precipitate and mine tailings. Iron impacts due to buried scrap metal from the former salvage yard are also possible.

Parkedale Avenue (road salt) and possible impacts associated with the golf course (nutrients) are likely minor sources of contamination in comparison to the others listed above.

3.2.1 Sources of Inorganic Groundwater Contamination

A summary of selected inorganic groundwater quality indicator parameters together with historical concentrations is provided below, for the three most significant sources of inorganic groundwater contamination, along with the background groundwater quality for the Brockville Landfill Site.

Source of Contamination	Most Impacted Monitoring Well	Selected Groundwater Quality Indicator Parameters			
		Historical Range of Chloride (mg/L)	Historical Range of Sodium (mg/L)	Historical Range of Boron (mg/L)	Historical Range of Hardness (mg/L)
Brockville Landfill Site leachate	B-2M	235 - 810	63 - 370	<0.01 - 2.1	630 - 1,600
Highway 401 road salt applications	99-10D*	1,150	510	NA	552
Former landfill site leachate	98-6D	94 - 283	36 - 45	0.24 - 0.27	505 - 650
Background bedrock groundwater quality (see Part B)		3.8 - 36	<0.01 - 69	0.02 - 0.29	41 - 490

Notes:
Includes 2020 data
* Based on one-time sampling in 1999

The above table indicates the relative concentrations of the most significant sources of inorganic groundwater impacts. The inorganic impacts associated with the MOE area of investigation, road salt from Parkedale Avenue and the golf course are minor in comparison to the above listed sources.

3.2.2 Sources of Volatile Organic Groundwater Contamination

A summary of selected volatile organic groundwater quality indicator parameters together with historical concentrations is provided below for each of the four previously noted volatile organic sources.

Source of Contamination	Most Impacted Monitoring Well(s)	Selected Groundwater Quality Indicator Parameters		
		Historical Range of Trichloroethene (µg/L)	Historical Range of Cis-1,2-dichloroethene (µg/L)	Historical Range of Vinyl Chloride (µg/L)
Brockville Landfill Site leachate	91-2D	<0.1 - <2	<0.4 - 6.8	<0.5 - 186
Former City Landfill Site leachate	98-7M	0.6 - 2,100	635 - 8,500	370 - 1,600
Groundwater impact from former salvage yard	91-10M	<0.3 - 7.0	<0.4 - 2.8	<0.2 - 24.3
Area of the MOE investigation	MW-3M	<0.3 - 11.2	<0.4 - 3.1	<0.2 - <0.5

Notes: Includes 2020 data

The above table indicates that the former City Landfill is the most significant source of VOCs in groundwater, whereas the MOE investigation area and the former salvage yard are the least significant sources of VOCs in groundwater.

4.0 2021 GROUNDWATER AND SURFACE WATER FLOW

4.1 Groundwater Levels and Elevations

Groundwater level data from April 1994 to September 2021 are included in **Appendix 2**. "Flowing" (artesian) conditions are occasionally noted in some monitors (such as 00-3 and 99-8). This term indicates that there is artesian pressure in the monitor; however, the monitors are sealed to prevent and control groundwater flow from the wells.

Groundwater level data from the shallow bedrock wells was used to produce the spring 2021 and summer 2021 shallow groundwater flow figures as **Figures A4 and A6** respectively. **Table A1** lists the monitors located within the shallow bedrock groundwater flow system. The shallow groundwater flow system generally follows the ground surface topography and is affected by site-specific groundwater recharge and discharge features including surface water systems, particularly Grant's Creek valley. In the summer of 2016 and 2017, groundwater levels were 0.5 to 2.0 metres lower than the typical historical summer levels at many shallow monitors, particularly those in the vicinity of Grant's Creek and the MOE investigation area. Groundwater levels at some shallow monitors recovered, while the water level in others remains up to 2.0 metres lower than the typical historical range. The wells where groundwater levels remain low, are primarily located in the vicinity of the former salvage yard. The interpreted 2021 spring and summer flow directions are like those presented in previous reports. The 2021 groundwater level data indicate shallow bedrock flow toward Grant's Creek from both sides of the creek.

Groundwater level data from the deep bedrock groundwater flow system was used to produce the 2021 spring and summer deep bedrock flow pattern (**Figures A5** and **A7** respectively). **Table A2** lists the monitors located within the deep bedrock groundwater flow system.

As described for the shallow bedrock flow system, the groundwater levels measured in deep monitors were lower than typical historical levels beginning in approximately the summer of 2016. Groundwater levels have recovered at most locations but remain up to 2.0 m below the typical range at some locations south of the MOE investigation area and south of Highway 401. Groundwater flow directions for 2021 are like interpretations presented in previous annual monitoring reports, with deep bedrock groundwater flow indicated to be generally towards the south.

The historic hydraulic head data, and the data from 2021 indicate that vertical hydraulic gradients are generally downward (recharging) at many of the monitoring well locations. However, upward (discharging) vertical gradients have been documented at the north/central end of the Grant's Creek valley (in the CAZ land). Upward gradients typically also occur at borehole 00-3; however, upward groundwater flow is minimized at 00-3 due to the presence of the thick clay deposit in that area.

The water levels in the domestic water supply wells are provided in **Table A3**. No measurements were taken in 2021. The water levels in the domestic water supply wells are generally higher in the spring and lower in the late summer as would be expected. At these wells, particularly the Pakeman, Basten and Bevan wells, the water levels measured from approximately 2016 to 2019 were lower than the typical historical range but recovered in 2020.

4.2 Rising Head Tests

Rising head tests were completed in monitoring wells 99-7, 99-8, 99-9, 99-10, 99-11, 00-1 and 00-2 in December 2002. Monitoring locations 99-7, 99-8, 99-9, 99-10, and 99-11 are on the south side of Highway 401, southeast of the landfill site. Estimates of the horizontal hydraulic conductivities of the various geological units in which the monitoring wells are screened were calculated from the rising head test data using the method of Hvorslev (Hvorslev, 1951).

The estimated horizontal hydraulic conductivities are summarized in **Table A4**. The rising head test data and graphs are presented in **Appendix 3**. Rising head tests completed between 1988 and 1991 at other monitoring locations produced similar values of hydraulic conductivity.

4.3 Surface Water Elevations and Flows

Surface water elevations measured in the swamp (SWL-1: east of the Brockville Landfill) and pond (SWL-2: west of the Brockville Landfill) since 1993 are summarized in **Table A5.** New staff gauges were installed at SWL-1 and SWL-2 in the spring of 2016 and surveyed in January 2017. The water level at SWL-1 is controlled by means of a weir. Based on the historical surface water elevations in conjunction with the groundwater elevations, the swamp and pond are both indicated to act as local groundwater discharge areas in the spring. The area with the staff gauge at SWL-1 was dry in June 2020 for the first time since 2012. Other measurements taken at SWL-1 and SWL-2 in 2020 were slightly lower than in previous years. The staff gauges could not be located in 2021 and should be re-established in consultation with City staff in 2022.

Estimates of flow discharge for the spring and fall of 2021 are summarized in **Table A6** along with historical flow measurements since 1994. All flow estimates are approximate based on estimates of cross-sectional area and velocity.

In June 2021, stream discharge measurements could not be measured due to dry conditions. More locations than usual were noted to be dry. In November 2021, stream flow estimates ranged from 0.007 m^3/sec at (FS-1) to 0.05 m^3/sec at (FS-8 and FS-9). Stream flows could not be measured at FS- 5 and FS-6 due to dry conditions.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the historical information collected by Golder and as summarized above, and the groundwater and surface water monitoring data to date (discussed in Parts A, B and C), the following conclusions are provided.

There are several known sources of inorganic and/or VOC contamination (groundwater and surface water) in the immediate vicinity of the Brockville Landfill Site. They include:

- The Brockville Landfill Site
- The former City Landfill Site
- The former salvage yard
- The area of the MOE Investigation
- Iron sulphide deposits (former mining operations)
- Road salt impacts from Highway 401

The VOC impacts are of the most concern, considering the high concentrations of vinyl chloride in groundwater at some locations. The former City Landfill Site is a significant source of the volatile organic compounds (VOCs), while the former salvage yard, the area of the MOE investigation and the Brockville Landfill Site are considered to be less significant sources of VOCs.

Groundwater flow in the shallow bedrock flow system and in the deep bedrock flow system is such that impacted groundwater from the former landfill flows to the east-southeast, onto the Brockville Landfill's CAZ as well as to the south and possibly to the southwest. Shallow groundwater impacted by the former salvage yard flows both north towards the Brockville Landfill and south away from the Brockville Landfill.

Surface water elevations were not measured in the swamp and pond in 2021. The staff gauges could not be located and should be reestablished in 2022 in consultation with City staff. Dry or low flow conditions in the spring of 2021 prevented the measurement of stream flows. Late fall stream flows were slightly higher than those measured in recent years.

The presence of the multiple sources of groundwater / surface water contamination and their locations relative to the defined groundwater flow systems indicates that many groundwater monitors could be impacted by more than one source of contamination. The relative magnitudes of impacts caused by individual sources at monitors that are possibly impacted by more than one source cannot be determined with certainty. However, the evidence clearly shows that the former City Landfill Site is the most significant source of volatile organic compounds (VOCs), while the former salvage yard, the area of the MOE investigation and the Brockville Landfill Site are much less significant sources of VOCs.

It is recommended that monitoring of groundwater levels and surface water flow continue as per the site ECA.

TABLE A1 – SHALLOW BEDROCK GROUNDWATER FLOW SYSTEM MONITORING WELLS

Borehole	Ground Surface Elevation (Metres)	Top of Casing Elevation (Metres)	Approximate Screened Interval Elevation (Metres)
B-1D	104.65	105.50	89.40 – 92.00
B-3M	107.14	108.39	93-44 – 96.44
B-4S	111.63	112.86	99.40 – 102.40
90-2D	105.80	106.45	95.90 – 97.40
90-3D	105.10	105.77	97.40 – 99.00
91-1S	119.67	120.55	106.50 – 108.90
91-2S	105.33	105.69	96.10 – 97.60
91-2M	105.33	105.72	88.50 – 90.00
91-3S	103.47	103.57	95.80 – 97.30
91-3M	103.47	105.29	91.50 – 93.00
91-5S	104.01	104.16	94.30 – 95.80
91-6D	106.69	107.24	93.80 – 96.90
91-7S	103.61	105.01	93.70 – 95.20
91-7D	103.59	105.00	89.40 – 90.90
91-9S	106.67	107.43	101.10 – 103.50
91-10S	113.01	113.79	104.20 – 105.80
91-10M	113.01	113.77	100.30 – 101.80
91-11S	108.59	109.43	104.30 – 105.80
93-1S	108.06	108.65	95.00 – 96.80
93-2S	105.94	106.27	100.10 – 101.60
93-3S	106.61	107.35	93.90 – 95.40
93-4S	108.33	109.30	101.20 – 102.70
93-5S	103.92	104.47	95.00 – 96.50
93-5D	103.92	104.42	88.00 – 89.50
93-8S	104.86	105.48	93.00 – 96.00
98-1S	108.10	108.45	101.60 – 103.10
98-2S	112.95	113.82	101.90 – 103.30
98-2D	112.95	113.76	90.00 – 91.50

TABLE A1 – SHALLOW BEDROCK GROUNDWATER FLOW SYSTEM MONITORING WELLS (continued)

Borehole	Surface Elevation (Metres)	Casing Elevation (Metres)	Approximate Screened Interval Elevation (Metres)
98-3S	111.92	112.80	103.00 – 104.50
98-3M	111.92	112.74	98.80 – 100.30
98-4S	115.81	116.59	103.40 – 106.40
98-5S	107.97	108.70	99.80 – 101.30
98-6S	108.59	109.23	101.80 – 103.30
98-7S	110.50	111.20	100.80 – 102.30
98-8S	103.32	103.79	94.30 – 95.80
98-9S *	106.55	107.19	93.60 – 95.10
98-9M *	106.55	107.14	89.50 – 91.0
99-1S	112.30	113.05	99.60 – 101.10
99-2S *	107.03	107.86	92.80 – 94.40
99-3S	115.54	116.19	105.35 – 106.90
99-4S	110.15	110.76	102.60 – 104.10
99-5S	107.07	107.66	99.00 – 100.50
99-6S	107.71	108.19	98.75 – 100.30
99-7S*	106.66	107.16	95.06 – 100.26
99-8S*	99.08	99.58	86.08 – 92.68
99-9S*	104.92	105.42	92.72 – 96.52
99-10S	106.95	107.45	97.55 – 101.15
00-2S**	99.47	100.08	89.87 – 93.67
MW-1S	121.96	119.65	116.00 – 119.00
MW-2S	121.45	121.19	115.50 – 118.50
MW-4S	121.71	119.71	115.50 – 118.50

Notes:

* Monitor elevation is within intermediate flow system

** Not used to create groundwater contours for shallow flow system

Table courtesy of Golder Associates

TABLE A2 – DEEP BEDROCK GROUNDWATER FLOW SYSTEM MONITORING WELLS

Borehole	Surface Elevation (Metres)	Casing Elevation (Metres)	Approximate Screened Interval Elevation (Metres)
B-2M	105.67	106.62	81.27 – 84.37
B-3D	107.14	108.39	85.84 – 88.85
B-4D	111.63	112.86	84.20 – 87.20
91-1D *	119.67	120.53	97.00 – 98.50
91-2D	105.33	105.73	84.10 – 85.60
91-3D	103.47	105.36	86.10 – 89.60
91-5D	104.01	104.16	82.20 – 82.80
93-1D	108.06	108.65	82.50 – 83.70
93-2D	105.94	106.11	80.80 – 82.40
93-8D	104.86	105.20	81.15 – 82.55
98-1D	108.10	108.19	84.80 – 86.30
98-5D	107.97	108.63	85.30 – 86.80
98-6D	108.59	109.13	85.30 – 86.80
98-7D	110.50	111.08	87.50 – 89.00
98-8D	103.32	103.66	79.00 – 80.50
98-9D	106.55	107.07	83.40 – 84.90
99-1D	112.30	113.02	82.30 – 85.30
99-2D	107.03	107.80	84.30 – 87.30
99-3D	115.54	116.09	85.50 – 87.00
99-4D	110.15	110.68	87.45 – 89-05
99-5D	107.07	107.57	84.65 – 86.10
99-6D	107.71	108.02	84.60 – 86.05
99-7D	106.55	107.05	82.78 – 86.95
99-8D	99.02	99.52	75.96 – 79.00
99-9D	104.81	105.31	81.61 – 84.21
99-10D	106.90	107.40	83.70 – 87.20
99-11D	88.61	89.11	65.41 – 68.61
00-1D	84.85	85.35	63.42 – 66.85
00-2D	99.47	100.08	77.07 – 82.17
00-3**	83.28	83.78	58.88 – 61.98
MW-1D *	121.96	122.89	92.00 – 95.00
MW-2D *	121.45	122.26	91.50 – 94.50
MW-4D *	121.71	122.32	91.00 – 94.00

Notes:

* Ground surface elevation significantly higher than other monitors

** Ground surface elevation significantly lower than other monitors

Table courtesy of Golder Associates

TABLE A3 – WATER LEVEL MEASUREMENTS – DOMESTIC WELLS

Date	Depth to Water Table from Top of Casing (Metres)					
	Pakeman*	McGill	Basten	Plaschka	Guy	Bevan
April 17/95	6.77	WNA	8.62	10.05	NM	NM
May 1/96	5.00	1.50	5.89	8.09	1.06	NM
Sept 23/96	9.48	2.49	11.11	13.77	2.04	NM
May 1/97	5.37	1.64	6.50	8.66	1.27	NM
Sept 19/97	7.41	4.93	10.43	12.48	2.82	NM
May 4/98	7.61	2.21	NM	NM	1.99	NM
Sept 17/98	11.58	3.59	12.60	15.35	2.85	5.89
April 28/99	7.53	2.24	9.64	12.37	1.945	3.40
Sept 15/99	16.65	4.75	NM	NM	3.32	13.87
June 1/00	4.71	1.34	5.59	6.17	1.0	3.98
Sept 16/00	10.64	NM	10.65	13.10	2.29	5.32
May 9/01	8.18	1.995	10.10	12.72	1.94	3.45
Sept 11/01	NM	6.54	14.25	NM	3.97	NM
May 5/02	4.69	1.48	4.84	5.11	0.99	3.85
Sept 13/02	13.49	NM	13.84	16.74	3.60	12.79
April 11/03	4.93	NM	6.46	9.01	1.28	2.17
Sept 18/03	11.88	NM	10.62	12.42	3.4	5.62
April 6/04	4.12	NM	5.82	8.11	0.94	2.11
Sept 21/04	6.33	NM	7.88	9.69	3.81	4.29
May 14/05	4.66	NM	6.11	7.99	1.44	2.43
Sept. 27/05	~11	NM	11.52	14.31	2.47	5.59
May 25/06	7.78	NM	9.76	12.52	1.76	3.48
Sept. 21/06	13.42	NM	12.85	15.71	3.14	7.25
May 6/07	7.80	NM	9.82	12.61	1.98	3.56
Sept. 12/07	8.94	NM	10.62	13.78	3.20	4.41
May 27/08 and June 4/08	7.69	NM	9.71	12.38	1.8	3.40

Prepared By: Golder

TABLE A3 – WATER LEVEL MEASUREMENTS – DOMESTIC WELLS (continued)

Date	Depth to Water Table from Top of Casing (Metres)					
	Pakeman *	McGill	Basten	Plaschka	Guy	Bevan
Sept. 26/08	8.02	NM	10.33	13.11	2.11	3.99
May 21/09	6.50	NM	8.42	11.86	1.81	3.04
Sept. 10/09	12.77	NM	12.73	16.21	3.15	6.45
May 3/10	7.73	NM	9.86	12.52	2.04	3.52
Aug. 27/10	12.42	NM	12.48	12.92	3.03	6.65
May 3/11	NM	NM	7.10	9.27	NM	NM
Aug. 31/11	11.81	NM	11.94	14.77	2.76	6.08
May 17/12	6.39	NM	8.27	10.85	1.87	3.02
Aug. 18/12	7.14	NM	9.06	11.35	2.50	4.19
May 17/13	11.60	NM	11.72	14.52	2.21	NM
Sept. 3/13	11.99	NM	11.80	13.88	2.59	7.04
May 20/14	7.79	NM	9.93	12.56	DEC	4.13
Sept. 1/14	12.68	NM	12.79	15.67	DEC	9.99
May 24/15	7.51	NM	9.84	12.30	DEC	4.04
Sept. 14/15	8.01	NM	10.66	13.01	DEC	4.90
May 19/16	9.80	NM	12.94	14.70	DEC	5.88
Aug. 26/16	10.90	NM	14.84	15.88	DEC	9.99
May 25/17	11.29	NM	14.14	11.29	DEC	10.38
Aug. 29/17	11.40	NM	15.01	16.16	DEC	10.46
May 18/18	12.00	NM	15.08	16.14	DEC	11.43
Sept. 6/18	14.41	NM	17.90	19.10	DEC	13.10
May 31/19	12.88	NM	17.72	17.19	DEC	13.13
Sept. 10/19	20.10	NM	19.90	18.40	DEC	15.86
May 15/20	9.94	3.77	10.80	12.89	DEC	4.88
Sept. 11/20	9.60	3.60	14.88	14.20	DEC	6.01
June. 22/21	NM	NM	NM	NM	DEC	NM
Sept. 16/21	NM	NM	NM	NM	DEC	NM

Notes:
* indicates trailer well
WNA well not accessible
NM no measurement
DEC decommissioned

Updated By: NW
Checked By: KM

TABLE A4 – SUMMARY OF HYDRAULIC CONDUCTIVITY (K) AT GROUNDWATER MONITORSINSTALLED IN 1999-2021

Well ID	Unit	Screen Bottom Depth (mbgs)	Screen Top Depth (mbgs)	K (cm/s)
99-7D	Quartzite	23.81	19.6	$3.1x10^{-7}$
99-7M	Quartzite	17.4	13.6	$1.5x10^{-7}$
99-7S	Quartzite	11.6	6.4	$2.5x10^{-4}$
99-8D	Quartzite	23.06	20.2	N/M
99-8M	Quartzite	18.4	15.1	N/M
99-8S	Quartzite	13	6.4	$2.9x10^{-6}$
99-9D	Quartzite	24.4	20.6	$1.2x10^{-5}$
99-9M	Quartzite	18	13.6	$8.1x10^{-5}$
99-9S	Quartzite	12.2	8.4	$6.0x10^{-5}$
99-10D	Quartzite	23.2	19.2	$1.6x10^{-7}$
99-10M	Quartzite	17.2	11.2	$1.6x10^{-7}$
99-10S	Quartzite	9.4	5.8	$3.6x10^{-7}$
99-11D	Quartzite	23.2	20.0	N/A
99-11M	Quartzite	17.4	12.0	$1.1x10^{-4}$
99-11S	Quartzite	10.2	6.0	$3.0x10^{-4}$
00-1D	Quartzite/Granite	21.43	18.0	$3.4x10^{-4}$
00-1M	Quartzite/Granite	16.4	12.2	$5.2x10^{-3}$
00-1S	Quartzite/Granite	10.4	6.4	$1.9x10^{-5}$
00-2D	Quartzite/Granite	21.4	16.3	N/A
00-2M	Quartzite/Granite	14.8	11.4	$3.1x10^{-4}$
00-2S	Quartzite	9.6	5.8	N/A
00-3	Quartzite	24.4	21.3	N/A

Notes:
N/M – unable to measure
N/A – not applicable
Hydraulic conductivity estimated according to Hvorslev, 1951
Table courtesy of Golder Associates

TABLE A5 – SURFACE WATER ELEVATION DATA – 1993 TO 2021

Measurement Dates	Surface Water Elevations (metres)	
	Swamp (SWL-1)	Pond (SWL-2)
May 21, 1993	103.38	Not Measured
September 1, 1993	Dry	107.27
November 18, 1993	103.42	107.51
May 10, 1994	103.49	107.64
September 14, 1994	Dry	Dry
December 1, 1994	103.36	Dry
April 17, 1995	103.90	107.72
September 12, 1995	Dry	dry
November 20, 1995	103.57	107.46
May 1, 1996	103.58	107.83
September 27, 1996	Dry	107.68
November 29, 1996	Frozen	Frozen
May 7, 1997	103.28	108.05
September 22, 1997	Not Measured	107.44
December 2, 1997	103.29	107.52
May 8, 1998	103.43	107.75
September 22, 1998	103.19	107.52
November 25, 1998	103.22	107.41
April 28, 1999	103.27	107.50
September 27, 1999	Dry (103.17)	106.87
November 25, 1999	103.20	107.04
May 30, 2000	103.29	107.44
October 14, 2000	Dry (103.17)	107.37
December 6, 2000	103.30	107.34
May 22, 2001	103.32	107.36
September 11, 2001	103.03	106.82
November 22, 2001	103.23	107.10
April 19, 2002	103.46	107.47
September 16, 2002	Dry (103.17)	Not Measured
November 11, 2002	Dry (103.17)	106.66
April 22, 2003	103.47	108.02
Sept 18, 2003	Dry	107.70
November 24, 2003	103.23	107.95
April 7, 2004	Frozen	108.03
September 24, 2004	103.22	108.02

TABLE A5 – SURFACE WATER ELEVATION DATA – 1993 TO 2021 (continued)

Measurement Dates	Surface Water Elevations (metres)	
	Swamp (SWL-1)	Pond (SWL-2)
November 28, 2004	103.49	107.90
April 28, 2005	103.17	107.89
September 25, 2005	103.12	107.94
December 6, 2005	103.50	107.95
December 1, 2006	103.58	108.02
May 8, 2007	102.98	107.95
November 29, 2007	103.26	107.49
June 3, 2008	102.91	107.99
November 30, 2008	102.96	Not measured due to ice build-up
June 3, 2009	Not measured	Water level above staff gauge
November 24, 2009	Dry	Water level above staff gauge
May 3, 2010	Cannot locate staff gauge	Water level above staff gauge
November 30, 2010 (new staff gauge installed)	103.45	Water level above staff gauge
May 11, 2011	103.44	Water level above staff gauge
November 14, 2011	Dry	107.65
May 29, 2012	103.39	108.06 (estimated; water level too high to access gauge)
November 22, 2012	Dry	107.57
June 12, 2013	103.65	Water level above staff gauge
November 19, 2013	103.76	Water level above staff gauge
May 26, 2014	103.43	NM
November 27, 2014	103.42	Water level above staff gauge
May 24, 2015	103.80	Water level above staff gauge
November 20, 2015	NA	NA
May 18, 2016	103.98	108.99
November 16, 2016	103.86	108.89
May 31, 2017	NA	108.90
November 29, 2017	103.96	108.84
June 8, 2018	103.95	108.93
November 28, 2018	104.01	Frozen
June 12, 2019	103.93	108.90
November 25, 2019	104.11	108.99
June 11, 2020	Dry	108.75
December 1, 2020	103.71	108.68
June and November 2021	Staff gauge not located	Staff gauge not located

Notes:

Top of staff gauge elevations	SWL-1	May 1993-2010	103.99	Updated by NW
		Nov 2010 – Nov 2015	105.19	Checked by KM
		May 2016 – Present	104.80	
	SWL-2	May 1993 – Nov 2015	108.08	
		May 2016 – Present	109.67	

TABLE A6 – SURFACE WATER FLOW ESTIMATES, 1994 TO 2021, BROCKVILLE LANDFILL SITE

Date	Estimated Flow Rate (m^3/s)									
	FS-1	FS-2	FS-3	FS-4	FS-5	FS-6	FS-7	FS-8	FS-9	FS-10
May 16/94	0.03	0.02	0.02	0.02	0.006	0.007	0.006	0.01	0.005	0.02
Sept. 14/94	dry	dry	dry	dry	dry	dry	dry	dry	dry	stagnant
Dec. 1/94	dry	dry	dry	dry	dry	dry	dry	dry	<0.0001	<0.001
Apr. 22/95	0.04	0.05	0.09	0.04	0.008	0.006	0.005	0.02	0.01	0.01
Sept. 12/95	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Nov. 20/95	0.01	0.02	0.03	0.02	0.001	dry	<0.001	0.002	<0.006	0.02
May 15/96	0.04	0.05	0.09	0.07	0.01	0.01	0.01	0.01	0.01	0.1
Sept. 27/96	0.001	dry	dry	dry	dry	0.001	dry	0.001	0.001	dry
Nov. 29/96	0.007	0.01	0.02	0.02	dry	dry	0.0003	0.001	<0.002	0.02
May 8/97	0.02	0.01	0.02	0.03	0.009	0.01	0.01	0.01	0.01	0.01
Sept. 2/97	0.0002	dry	dry	dry	dry	stagnant	dry	0.0007	0.0004	0.000
Dec. 2/97	0.007	0.008	0.01	0.01	0.002	0.003	0.003	0.004	0.004	0.03
May 13/98	0.005	0.005	0.006	0.008	0.002	0.003	0.004	0.004	0.005	0.006
Sept. 22/98	dry	dry	dry	dry	dry	<0.0001	stagnant	stagnant	dry	0.0001
Nov. 25/98	0.002	0.0005	dry	dry	dry	0.0001	dry	0.0001	<0.0001	0.001
Apr. 28/99	0.003	0.005	0.005	0.006	0.0001	0.001	0.001	0.002	0.002	0.008
Sept. 27/99	dry	dry	dry	dry	dry	stagnant	dry	stagnant	dry	stagnant
Dec. 1/99	0.07	0.02	0.03	0.02	dry	dry	dry	frozen	frozen	frozen
May 30/00	0.02	0.03	0.01	0.03	0.002	0.006	0.02	0.005	0.007	0.01
Oct. 14/00	0.005	dry	dry	dry	dry	dry	stagnant	stagnant	stagnant	stagnant

TABLE A6 – SURFACE WATER FLOW ESTIMATES, 1994 TO 2021, BROCKVILLE LANDFILL SITE (continued)

Date	Estimated Flow Rate (m^3/s)									
	FS-1	FS-2	FS-3	FS-4	FS-5	FS-6	FS-7	FS-8	FS-9	FS-10
Dec. 6/00	0.005	0.0345	frozen	0.006	frozen	frozen	frozen	frozen	frozen	frozen
May 22/01	0.02	0.02	0.01	0.01	0.08	0.02	0.03	NA	NA	NA
Sept. 11/01	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Nov. 23/01	0.01	0.05	0.009	0.01	NA	dry	dry	stagnant	NA	0.002
Apr. 19/02	0.04	0.06	0.05	0.07	dry	0.008	0.02	0.08	0.07	dry
Sept. 16/02	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Nov. 11/02	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
May 3/03	0.06	0.08	0.08	0.05	0.001	0.003	0.006	NM	NM	NM
Sept 22/03	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Nov 24/03	0.2	0.2	0.2	0.2	0.04	0.002	0.003	0.01	0.02	NM
Apr. 7/04	0.1	0.07	0.1	0.09	NA[1]	0.004	0.03	0.06	0.03	NA[2]
Sept. 24/04	0.02	0.02	0.02	0.02	NA[1]	0.0007	NA[3]	NA[3]	NA[3]	0.0005
Nov. 28/04	0.06	0.05	0.08	0.05	NA[3]	0.005	NA	NA	NA	NA[2]
Apr. 18/05	0.05	0.05	0.05	NA	NA[1]	0.002	0.02	0.06	0.02	NA[2]
Sept. 25/05	dry	dry	dry	dry	dry	dry	dry	dry	dry	NA[2]
Dec. 6/05	0.01	0.01	0.01	0.01	NA[1]	0.002	frozen	NA[3]	NA[3]	NA[2]
May 31/06	0.04	0.04	0.04	0.05	NA[1]	0.002	0.02	NA[3]	0.03	NA[2]
Dec. 1/06	0.01	0.02	0.01	0.02	NA[1]	0.002	NA[3]	NA[3]	NA[3]	0.008
May 7/07	0.01	0.01	0.01	0.02	NA[1]	0.002	NA[3]	NA[3]	NA[3]	NA[2]
Nov. 29/07	0.02	0.02	0.02	0.02	dry	dry	dry	dry	NA[3]	NA
June 3/08	0.011	0.02	0.02	0.02	NA[1]	0.001	NA[3]	NA[3]	NA[3]	NA[2]
Nov. 30/08	0.007	0.01	0.01	0.02	NA[1]	0.003	NA[3]	NA[3]	NA[3]	NA[2]

TABLE A6 – SURFACE WATER FLOW ESTIMATES, 1994 TO 2021, BROCKVILLE LANDFILL SITE (continued)

Date	Estimated Flow Rate (m^3/s)											
	FS-1	FS-2	FS-3	FS-4	FS-5	FS-6	FS-7	FS-8	FS-9	FS-10	FS02-1	FS02-2
June 3/09	0.04	0.03	0.01	0.03	0.007	0.001	0.004	NA[3]	NA[3]	NA		
Nov. 24/09	0.04	0.01	0.01	0.007	dry	dry	dry	NA[3]	NA[3]	0.007		
May 3/10	0.03	NA[3]	NA[3]	0.02	NA[3]	0.001	NA	0.01	NA[3]	NA		
Nov. 30/10	0.02	0.01	0.01	0.02	NA[3]	0.004	dry	NA[3]	NA[3]	NA		
May 11/11	0.02	0.1	0.02	0.03	0.01	0.007	0.05	0.07	NA[3]	NA		
Nov. 14/11	0.004	dry	dry	dry	dry	dry	dry	stagnant	stagnant	stagnant		
May 29/12	0.005	NA[3]	NA[3]	0.003	NA[3]	0.0001	dry	NA[3]	NA[3]	stagnant		
Nov. 22/12	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry		
June 12/13	0.03	NA[3]	NA[3]	0.009	NA[3]	0.0003	NA[3]	NA[3]	NA[3]	NA		
Nov. 19/13	0.08	NA[3]	NA[3]	0.04	NA[3]	0.0003	NA[3]	NA[3]	NA[3]	NA		
May 26/14	0.01	0.008	0.009	0.006	0.005	0.003	0.008	NA[3]	0.002	dry		
Nov. 27/14	0.02	0.02	0.005	0.005	dry	0.0008	dry	NA[3]	NA[3]	dry		
May 27/15	0.002	0.001	dry	dry	dry	dry	stagnant	NA[3]	NA[3]	stagnant		
Nov. 20/15	0.01	0.01	NA[3]	0.008	NA[1]	dry	NA[3]	NA[3]	0.004	stagnant		
May 18/16	0.002	0.003	0.002	0.003	dry	dry	NA[3]	NA[3]	0.003	NA[4]	0.006	dry
Nov. 16/16	0.004	0.004	0.003	0.003	dry	dry	dry	NA[3]	NA[3]	NA[4]	0.004	dry
May 31/17	0.001	0.002	0.002	0.002	NA[1]	NA[1]	NA[3]	NA[3]	0.003	NA[4]	0.001	0.002
Nov. 29/17	0.005	0.01	0.01	0.009	NA[1]	0.004	0.007	NA[3]	NA[3]	0.01	0.001	0.001
June 8/18	0.004	NA[3]	0.004	NA[3]	NA[1]	dry	NA[3]	NA[3]	NA[3]		dry	dry
Nov. 28/18	0.02	0.02	0.02	0.02	NA[1]	dry	NA[3]	NA[3]	NA[3]	0.04	0.009	0.009
June 12/19	0.003	NA[3]	0.002	NA[3]	NA[1]	0.0004	NA[3]	NA[3]	NA[3]	NA[5]	0.002	dry
Nov. 25/19	0.007	0.008	0.006	0.007	NA[1]	0.001	NA[3]	0.01	0.02	0.002	0.001	dry

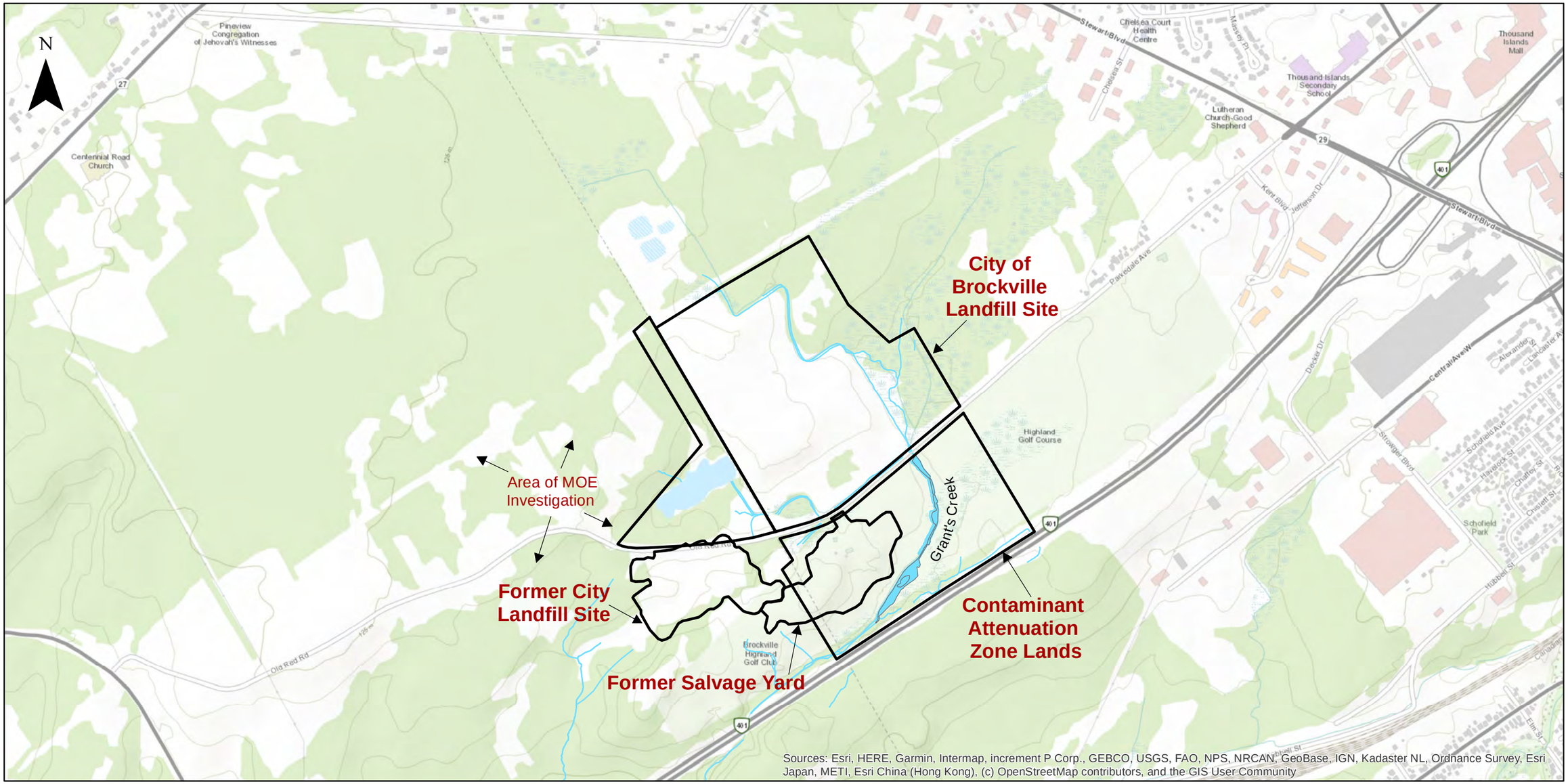
TABLE A6 – SURFACE WATER FLOW ESTIMATES, 1994 TO 2021, BROCKVILLE LANDFILL SITE (continued)

Date	Estimated Flow Rate (m^3/s)											
	FS-1	FS-2	FS-3	FS-4	FS-5	FS-6	FS-7	FS-8	FS-9	FS-10	FS02-1	FS02-2
June 11/20	0.001	dry	dry	dry	0.001	0.001	dry	NA[3]	dry	stagnant	stagnant	dry
Dec. 1/20	0.01	0.01	0.01	0.009	0.007	0.0003	NA[3]	NA[3]	0.008	0.04	0.004	0.003
June. 21/21	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Nov. 3/21	0.007	0.028	0.047	0.003	dry	dry	dry	0.05	0.05	0.03	0.01	0.028

Notes:
NA = measurement not available
[1] not measurable due to beaver dam
[2] culvert under water, could not measure flow
[3] flow not measurable due to vegetation
[4] water backed up at culvert
[5] insufficient information available

Updated By: NW
Checked By: KM

Figures



Notes:
1. BASE PLAN FROM LAND INFORMATION ONTARIO
2. SITE BOUNDARIES FROM GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058

0 0.25 0.5 1 Kilometers

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

Brockville Landfill Site

Brockville, ON

1:10,000	Figure A1- Key Map
	Drawn By: HV
Project No. 21-6149B	Checked by: KM
	Date: June 2022

441500 441750 442000 442250 442500 442750 443000 443250 443500 443750

4938500 4938250 4938000 4937750 4937500 4937250 4937000 4936750

94-1 94-2 SW-1 93-6 FS-1 FS-2 93-7 88-19 90-1 91-1 FS-3 FS-4 SW-2 SW-3 SWL-1 AH.105 B-2 B-1 BH.92-1 BH.92-4 FS-9 FS-10 SW-5 BH.90-4 BH.92-5 BH.92-7 88-6 BH.90-4A BH.92-9 GUY-WELL 91-2 BH.90-3A 90-3 90-5 91-8 91-6 91-3 88-11 SWL-2 SW-7 B-3 FS-5 88-14 88-16 FS-7 FS-8 SW-100 TROW BH.90-2A FS-6 (New) SW-6 FS-6 (Filled in) 91-9 91-4 93-1 93-3 93-4 SW98-1 91-11 98-2 91-10 91-7 SW-8 98-1 98-4 98-5 91-5 93-2D 93-8 99-10 99-7 98-7 98-6 98-3 93-5 BD-03-M2 SW02-1 98-8 98-9 99-9 99-3 SW99-6 99-5 SW04-1 99-4 99-8 99-11 SW99-3 SW99-2 00-2 SW00-1 00-3 00-1 99-6 FS02-2 FS02-1 SW99-4 SW03-1 99-2 SW99-5 99-1 SW99-1 MW-1 MW-2 MW-3 MW-4 MW-5 AREA OF HOE INVESTIGATION

PARKEDALE AVE

CENTRAL AVE W

OLD RED ROAD

HIGHWAY NO. 401

COUNTY ROAD 46

LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- STAFF GAUGE
- FLOW STATION LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

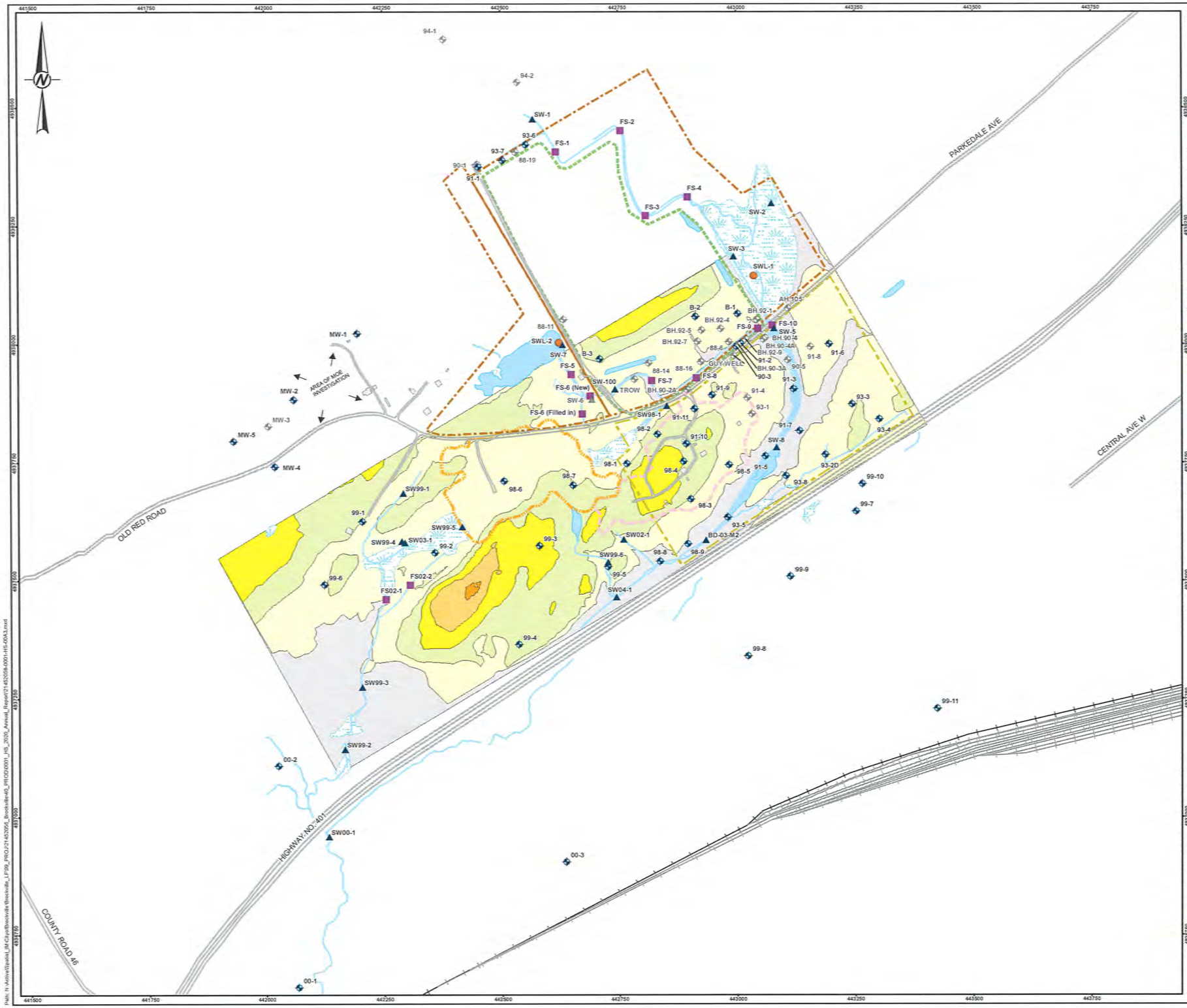
SITE PLAN

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

PROJECT NO.	21-6149B	YYYY-MM-DD	5/27/2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
A2

Path: O:\SHARED\Geographic Information Systems\Shapefiles\6000 and 6500 Environmental\21-6149 Brockville\A2-SitePlan.mxd



LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- STAFF GAUGE
- FLOW STATION LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963
- > 125m GROUND SURFACE ELEVATION
- 120m - 125m GROUND SURFACE ELEVATION
- 115m - 120m GROUND SURFACE ELEVATION
- 110m - 115m GROUND SURFACE ELEVATION
- 105m - 110m GROUND SURFACE ELEVATION
- < 105m GROUND SURFACE ELEVATION

ALL UNITS ARE masl

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. BASE PLAN SUPPLIED BY CH2M GORE & STORRIE LIMITED, 1995 (CITY OF BROCKVILLE MUNICIPAL LANDFILL SITE).
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400
1:8,000 METRES

CLIENT
CITY OF BROCKVILLE

PROJECT
BROCKVILLE LANDFILL SITE

TITLE
GROUND SURFACE CONTOURS CONTAMINANT ATTENUATION ZONE LANDS AND ADJACENT WEST PROPERTY

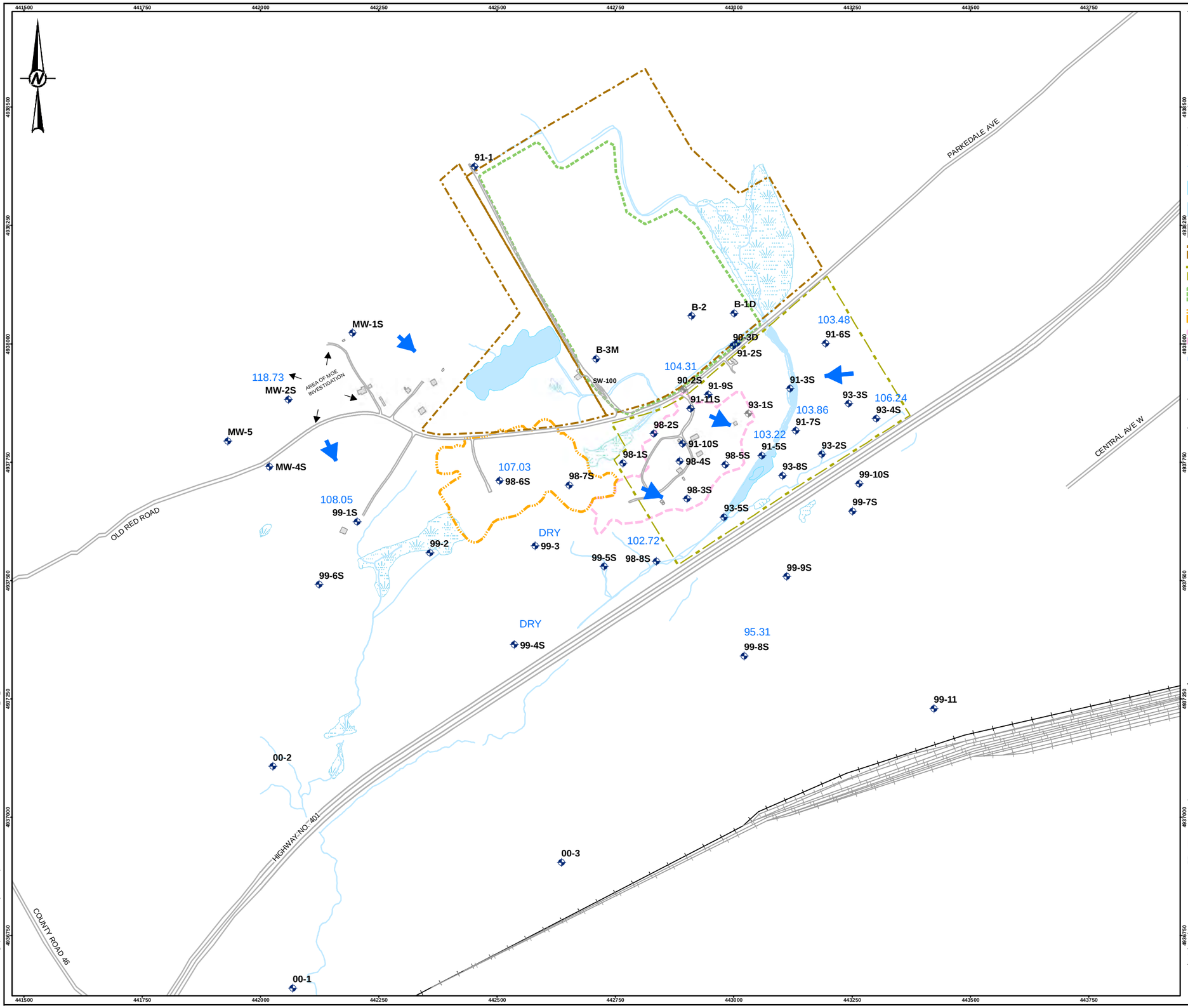
CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-04-22
DESIGNED	---
PREPARED	BR
REVIEWED	LEB
APPROVED	AMH

PROJECT NO.	CONTROL	REV.	FIGURE
21452058	0001	0	A3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:
25mm
0

Path: N:\Active\Kingston_IM\Cityof\Brockville\Brockville_LF\99_PROJ\21452058_Brockville\40_PROD\0001_HS_2020_Annual_Report\21452058-0001-HS-20A3.mxd



LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
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- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963
- INTERPRETED DIRECTIUON OF GROUNDWATER FLOW

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

JUNE 2021 SHALLOW BEDROCK GROUNDWATER FLOW SYSTEM

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

PROJECT NO.	21-6149B	YYYY-MM-DD	5/30/2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
A4

Path: O:\SHARED\Geographic Information Systems\Shapefiles\6000 and 6500 Environmental\21-6149 Brockville\Groundwater - SH - SPRING - A4.mxd

441500 441750 442000 442250 442500 442750 443000 443250 443500 443750

4938500 4938250 4938000 4937750 4937500 4937250 4937000 4936750

PARKEDALE AVE

CENTRAL AVE W

OLD RED ROAD

HIGHWAY NO. 401

COUNTY ROAD 46

AREA OF HOE INVESTIGATION

91-1 MW-1D MW-2D MW-5 MW-4D 99-1D 99-2D 99-6D 00-2D 00-1D

B-2 B-1 B-3 SW-100 BH.90-2A 90-3 91-2D 91-6 91-3 93-3 93-4 91-11 91-9 93-1D 91-7 98-2 91-10 91-5D 93-2D 98-1D 98-4 98-5D 93-8D 99-10D 98-6 98-7D 98-3 93-5 99-7D 99-3D 99-5D 98-8D 99-9D 99-4D 99-8D 99-11D 00-3

110.87 106.11 104.06 108.02 100.28 108.55 103.21 102.14 99.54 98.34 88.05 FLOWING 83.23

LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- STAFF GAUGE
- FLOW STATION LOCATION
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- LIMITS OF FORMER SALVAGE YARD IN 1963
- INTERPRETED DIRECTION OF GROUNDWATER FLOW

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

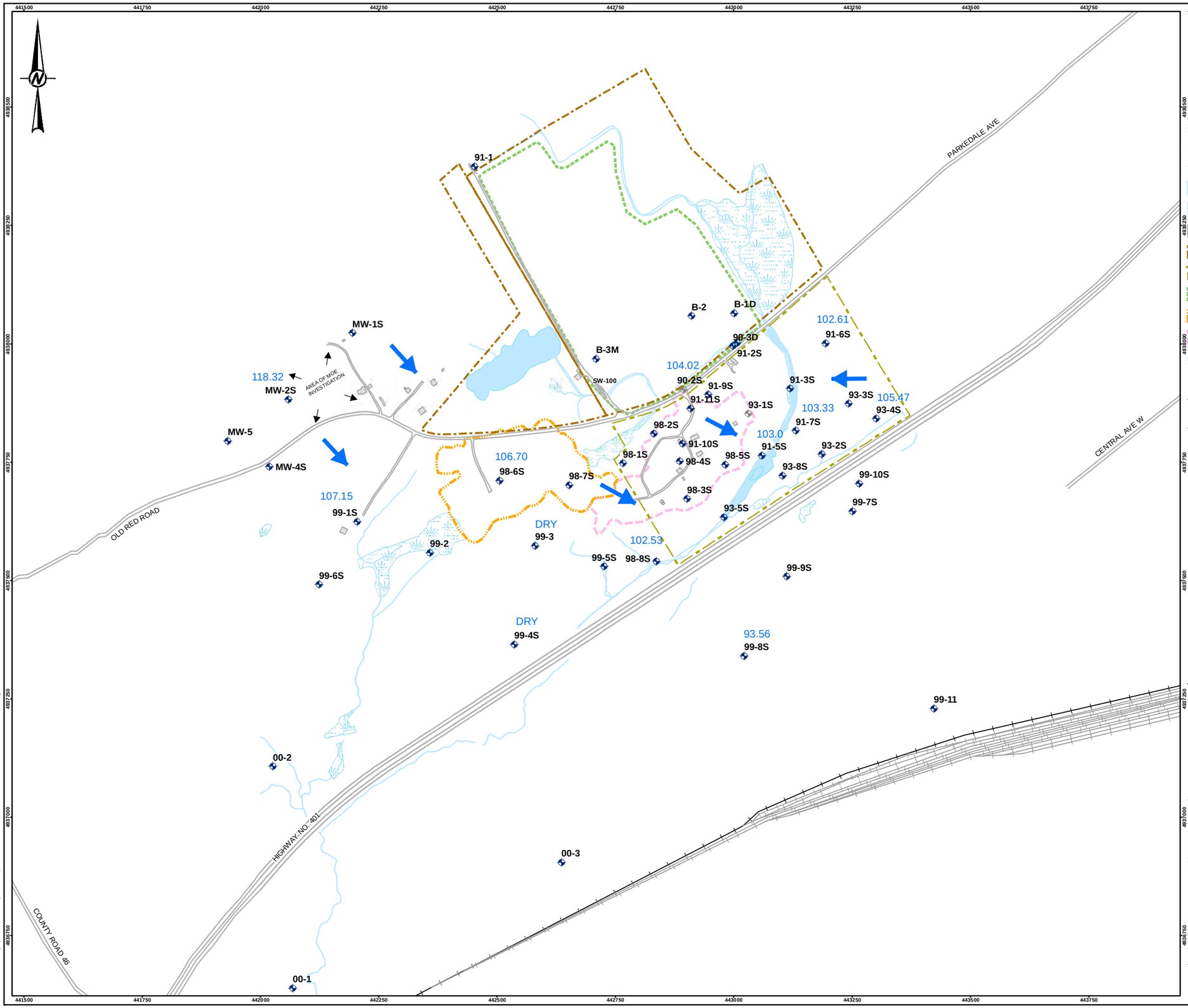
JUNE 2021 DEEP BEDROCK GROUNDWATER FLOW SYSTEM

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

PROJECT NO.	21-6149B	YYYY-MM-DD	5/30/2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
A5

Path: O:\SHARED\Geographic Information Systems\Shapefiles\6000 and 6500 Environmental\21-6149 Brockville\Groundwater_DP_SPRING - A5.mxd



LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
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- LIMITS OF FORMER SALVAGE YARD IN 1963
- INTERPRETED DIRECTION OF GROUNDWATER FLOW

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

SEPTEMBER 2021 SHALLOW BEDROCK GROUNDWATER FLOW SYSTEM

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

PROJECT NO.	21-6149B	YYYY-MM-DD	5/30/2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
A6

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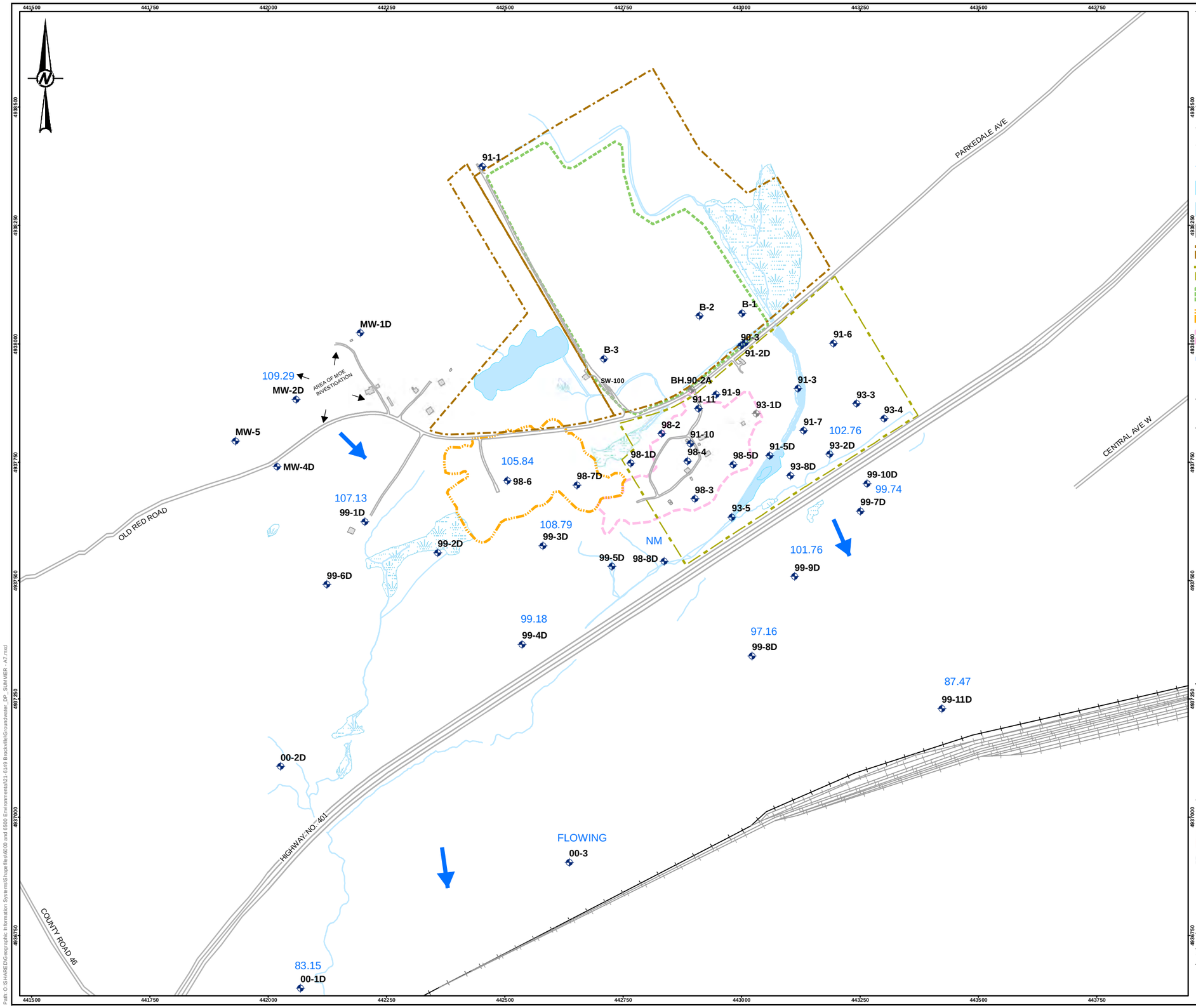

LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
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- INTERPRETED DIRECTION OF GROUNDWATER FLOW

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

SEPTEMBER 2021 DEEP BEDROCK GROUNDWATER FLOW SYSTEM

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

PROJECT NO.	21-6149B	YYYY-MM-DD	5/30/2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
A7

Path: O:\SHARED\Geographic Information Systems\Shapefiles\6000 and 6500 Environmental\21-6149 Brockville\Groundwater_DP_SUMMER - A7.mxd

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

REPORT – PART B

2021 SITE MANAGEMENT, MAINTENANCE AND MONITORING

City of Brockville Landfill Site

Former City Landfill, Former Salvage Yard and MOE Investigation Area

Submitted by:

Jp2g Consultants Inc.
1150 Morrison Drive, Suite 410
Ottawa, ON K2H 8S9
T613.828.7800 | F613.828.2600
Jp2g Project No. 21-6149A

Submitted to:

City of Brockville
1 King Street West
Brockville, ON K8V 7A5

PART B

2021 Site Management, Maintenance and Monitoring, City of Brockville Landfill Site

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

REPORT – PART B

2021 Site Management, Maintenance and Monitoring

City of Brockville Landfill Site

Submitted by:
Jp2g Consultants Inc.
1150 Morrison Drive, Suite 410
Ottawa, ON K2H 8S9

21-6149B

May 2022

Table of Contents

TABLES

FIGURES

APPENDICES (Provided on USB Flash Drive in Volume 2)

1.0 INTRODUCTION

The Closed Brockville Landfill Site is located on Part of Lot 16 and 17, Concession 2 within the western limits of the City of Brockville on Parkdale Avenue as shown on **Figure B1**. A site plan of the Brockville Landfill Site and surrounding area is presented as **Figure B2**.

The Brockville Landfill was in operation from about 1964 until it closed on December 31, 2000. Golder Associates Ltd.(Golder) has carried out annual environmental monitoring at the City of Brockville Landfill Site since 1987. Jp2g Consultants Inc. conducted the environmental monitoring in 2021. The monitoring program included surface water, groundwater and leachate collection system measurements and sampling at the Brockville Landfill Site, on the Contaminant Attenuation Zone (CAZ) and on lands south and west of the closed landfill. Surface water monitoring was completed twice during 2021 including elevations and flow measurements at selected locations. Jp2g conducted supplemental field survey to record the GPS locations of all surface water monitoring stations found. Groundwater levels were measured twice in 2021 at all monitoring wells. Water quality sampling was conducted once for the majority of the groundwater monitors and twice at certain locations. The sampling of the leachate collection system is regularly monitored by City staff, Jp2g conducted sampling on two occasions in 2021. The 2021 monitoring program is similar to the 2006 to 2020 programs with minor changes.

In 2021, the City of Brockville managed and maintained the Brockville Landfill Site facilities. The City typically participates in Public Liaison Monitoring Group (PLMG) meetings, but there was no meetings in 2020 and 2021 due to the COVID-19 pandemic. Part B of this report presents the results of the environmental monitoring at the Brockville Landfill Site and the CAZ, and information on the Brockville Landfill Site. The report format and presentation is consistent with the Golder 2020 Report, with some sections reproduced in their entirety as noted.

2.0 BROCKVILLE LANDFILL SITE MAINTENANCE

The following subsections present information pertaining to the management and maintenance of the Brockville Landfill Site facilities, as stipulated in the site ECA, most recently amended on September 14, 2018.

The Public Liaison Monitoring Group's (PLMG) consultant prepared a report regarding the 2020 Annual Monitoring Report provided in **Appendix 1**. Documents related to the management and maintenance of the Brockville Landfill Site are provided in **Appendix 4**.

2.1 Closure Activities

The following description is reproduced from the 2020 Annual Report (Golder, 2021).

The Phase I cover installation was completed in 2002 along with the installation of landfill gas collection system, followed by final seeding in the spring of 2003. The performance of the Phase I closure cover, was monitored by the City. The ECA amendment, dated March 24, 2006, includes Condition No. 49 which required that the installation of the Phase II cover shall be completed by December 31, 2014. In July and August 2007, cover material was placed on the Brockville Landfill Site (average depth of 0.45 m in addition to the existing depth of the cover (0.3 m) prior to placement). No cover material was placed in 2008. Between November 23, 2009 and December 23, 2009, approximately 6,500 cubic metres of cover material was placed and levelled on the south slope of the Brockville Landfill Site. In 2010 and 2012, additional cover material was placed in the southern and western portions of the site. In 2013, approximately 350 tonnes of cover material was placed in the south central portion of the site.

In 2014, approximately 10,000 cubic metres of fill/topsoil was placed and spread in three areas of the landfill identified as requiring additional fill materials to meet the requirements of the closure and post-closure plan for the site. An additional 1,950 cubic metres of topsoil was then placed in a 15 cm layer on top of the general fill.

Hydro-seeding was completed on all newly filled areas. In addition, the former scale house and the pit scale were demolished and removed, as was the former information kiosk. The former pit scale area was rehabilitated to the same grade as the surrounding area. No additional closure activities have occurred from 2015 to 2021.

2.2 Surface Water Management System

Monitoring of the surface water management system was conducted by the City of Brockville. The monitoring consisted of visual inspections of the surface water swales and ponds, noting sediment build-up, orifice plate blockages, erosion, loss of vegetation and leachate seeps.

Monitoring was conducted by the City staff once per week (as a minimum).

No unusual surface water conditions were noted, and the surface water management system did not require any maintenance in 2021.

2.3 Leachate Collection System

Monitoring of the leachate collection system was carried out by City staff from the Water Pollution Control Plant (WPCP). WPCP staff regularly check the leachate pumping station, including periodic pigging of lines, regular maintenance of all electrical and mechanical equipment (pumps, flowmeters, controls and communications, alarms), and periodic suctioning out of wetwell/collection basin buildup. Fencing and gates are monitored by City staff from Community Services. Leachate flow and quality data is discussed in Part B, Section 9.2.

In late 2006 and early 2007 groundwater seepage through or over the site perimeter sheet-pile wall occurred on an intermittent basis. The seepage occurred due to a combination of unseasonably high temperatures and rain (instead of snow) at a time when the City was completing maintenance on the leachate pumping station equipment and forcemains. On February 2, 2007, the City completed the required maintenance on the leachate pumps, and the seepage ceased (see Section 2.3). In July 2008, the leachate collection system lines were flushed. No groundwater seepage events occurred from 2008 to 2021. Correspondence regarding the leachate collection system is contained in **Appendix 12**.

2.4 Landfill Gas Collection and Flaring System

On August 14, 2012, the landfill gas (LFG) management system was shut down by the City of Brockville. The purpose of the shutdown was to monitor whether on-site and off-site odours would occur when the LFG management system was not operating. The LFG management system remained shut down through 2019 and is to be decommissioned in 2022.

The landfill gas abstraction plant and flare had operated under ECA Number 5172-58KQGH. In 2021, City of Brockville staff regularly monitored for on-site and off-site landfill gas odours. No odours were detected. Historical combustible gas concentrations at monitoring wells 90-2S, 90-3S and 90-4S are presented in **Table B10**.

2.5 Complaints

The City received no complaints in 2021 regarding the Brockville Landfill.

2.6 Landfill Site Changes

No significant changes to the Brockville Landfill Site (apart from those described above) occurred during 2021. The entrance gates to the landfill were noted to be damaged in 2020, but their functionality has not been affected and they continue to secure against access by unauthorized persons.

2.7 MECP Inspection

The MECP did not conduct an inspection at the Brockville Landfill Site in 2021.

2.8 Recommendations Related to Site Maintenance

It is recommended that the City continue to conduct regular, frequent maintenance and cleaning of the leachate collection system pumps and forcemains to avoid seepage through or over the sheet pile wall. Monitoring for on-site and off-site landfill gas odours should also continue.

3.0 2021 MONITORING PROGRAM

All 2021 monitoring activities were carried out by City of Brockville staff or members of the Jp2g technical field staff. **Tables B1 and B2** list the monitoring locations that were considered to be part of landfill monitoring, as opposed to monitoring of the other known sources of groundwater and surface water contamination (see Part C of the report for information regarding the other monitoring program).

All surface water and groundwater inorganic and VOC samples were analyzed by Eurofins Environment Testing of Ottawa, Ontario. Groundwater sampled for per-and polyfluoroalkyl substances (PFAS) and 1,4-dioxane were analyzed by Eurofins Environmental Testing in Lancaster Pennsylvania. The method detection limits (MDLs) for the specific analyses met the standards established in the Provincial Water Quality Objectives (PWQO) and the Ontario Drinking Water Quality Standards (ODWQS).

3.1 Groundwater, Landfill Gas and Leachate Collection System

Table B1 summarizes the groundwater and leachate collection system monitoring program carried out at the Brockville Landfill Site in 2021. The groundwater and leachate collection system monitoring program consisted of the following main components:

- Collection and analysis of groundwater samples from selected groundwater monitors in the spring and summer of 2021.
- Collection and analysis of groundwater samples from selected domestic (residential) wells in the spring and summer of 2021.
- Groundwater level measurements in selected groundwater monitors in the spring and summer (see Part A), and inspection of all groundwater monitors in the spring of 2021.
- Collection and analysis of leachate samples from the leachate pumping station in the spring and summer of 2021 (collection of weekly and monthly leachate samples was also carried out by City of Brockville staff).

During the spring of 2021, groundwater samples could not be collected from monitors 90-2S, 90-2D, 90-2M and 90-3D they were sampled in the summer event.. Monitor 93-4D was damaged and could not be sampled. Water levels were not collected from monitoring wells B-2M, B-2D, B-3M,B-3D and 94-1 during the spring or summer events

3.2 Surface Water

The surface water monitoring program carried out at the Brockville Landfill Site in 2021 is summarized in **Table B2**. The surface water monitoring program consisted of the following main components:

- Collection and analysis of surface water samples in the spring and fall of 2021.
- Surface water flow measurements in the spring and fall of 2021. At each location where discharge flow measurements were collected, the approximate cross-sectional area was estimated based on the measured depth and width of the stream at that location. The stream flow velocity at each station was estimated using conventional techniques (see Part A).
- Surface water elevation measurements were collected from two locations in the spring and fall of 2021 (see Part A).

In addition, Jp2g recorded the GPS coordinates of the surface water locations, additional survey is required in 2022. During the spring of 2021, surface water samples could not be collected from stations SW-1, SW-2 and SW-3 as they were dry.

The MECP (Ministry) surface water reviewer requested in 2017 that visual observations be made of the ditch located near the southwest corner of the Landfill Site and that flow estimates and sampling for leachate parameters be conducted whenever there is visual indication of potential impacts to the ditch (i.e., staining or sheen). This area, labelled as SW-100 was monitored during both the spring and fall events in 2021. This station was dry on June 22, 2021. Surface water with apparent iron staining was observed in this area during the November 2, 2021 event; therefore, a surface water sample was collected and analyzed for the Leachate Indicator Parameters listed in the following section.

3.3 Leachate Indicator Parameters and Surveillance Parameters

Leachate Indicator Parameters are parameters which are useful in determining the presence/absence of landfill leachate impact on water resources, assessing the degree of leachate impact on water resources, and determining the extent of leachate impact near the landfill site.

Monitors B-2M and B-2D are located closest to the Brockville Landfill Site fill and have historically shown to be the most highly leachate-impacted. Wells with the most occurrences of groundwater parameter concentrations above background levels are present at B-2M and B-2D. These impacts are interpreted to be due to leachate impact. Therefore, as initially discussed in Golder 1995 annual monitoring report, leachate indicator parameters for the Brockville Landfill Site are selected using inorganic groundwater monitoring results from monitors B-2M and B-2D. Based on historical groundwater quality data available from B-2M and B-2D and leachate quality from the leachate collection system (installed in 1992), it is considered that the previously determined leachate indicator parameters are appropriate for the purpose of the on-going monitoring and analysis of the Brockville Landfill Site.

The 17 groundwater parameters considered to be leachate indicator parameters at the Brockville Landfill Site are: electrical conductivity, hardness, TDS, alkalinity, phenols, COD, TOC, TKN, ammonia, chloride, boron, calcium, iron, magnesium, potassium, sodium, and strontium.

The groundwater surveillance parameters are a list of 43 parameters used for groundwater monitoring at the Brockville Landfill Site and are provided in **Table B11** along with the wells that are sampled for either the leachate indicator parameters or the surveillance parameters.

The 16 leachate indicator parameters for surface water at the Brockville Landfill Site are: electrical conductivity, hardness, alkalinity, turbidity, colour, BOD, COD, TKN, ammonia, chloride, boron, calcium, magnesium, potassium, sodium and strontium.

The surveillance parameters for surface water are comprised of 44 parameters for monitoring of the surface water at the Brockville Landfill Site. These lists are included in **Table B12** which also indicates the specific surface water stations that are sampled for Leachate Indicator Parameters or Surveillance Parameters.

3.4 Quality Assurance/Quality Control

The samples collected in 2021 at the Brockville Landfill Site and the CAZ included five blind groundwater duplicate samples in the spring sampling session and one blind groundwater duplicate sample in the summer sampling session. These samples were analyzed as part of the quality assurance/quality control (QA/QC) protocol. None of the surface water samples collected at the Brockville Landfill Site and the CAZ were duplicate samples; however, a surface water duplicate was collected as part of monitoring program for the former City Landfill, the former salvage yard and the MOE investigation area (Part C of this report).

The relative percent differences (RPDs) were calculated for parameters where the original and duplicate sample concentrations were greater than ten times the reportable detection limit (RDL). The QA/QC results for all duplicate samples indicated relative percent differences to be less than 30% which is considered to be within acceptable tolerance limits.

4.0 INORGANIC GROUNDWATER QUALITY

The inorganic parameters with reported levels exceeding their respective ODWQS; a comparison of groundwater quality to background conditions; trends in historical chloride concentrations; and an interpretation of the geochemical data with respect to the degree of inorganic impact from the identified sources of inorganic groundwater contamination are summarized in **Table B3** for all overburden groundwater monitors and in **Table B4** for all bedrock monitors. Only those monitors in close proximity to the landfill or in the general downgradient direction from the landfill are included in **Tables B3** and **B4** and are discussed herein. See Part C for monitoring information related to the other known sources of groundwater contamination.

The results of the 2021 and the historical field and laboratory inorganic chemical (and physical) analyses data obtained during the groundwater monitoring programs along with the relevant ODWQS are provided in **Appendix 5** (overburden monitors) and **Appendix 6** (bedrock monitors). Plots of historical chloride concentrations (as an indicator of the presence and degree of landfill leachate impact) from 1990 to 2021 for a number of the groundwater monitors are provided in **Appendix 7**.

In the following sections, discussions relating to the ODWQS relate specifically to health-related standards and aesthetic objectives. Health related standards include both Maximum Acceptable Concentrations (MAC) or Interim Maximum Acceptable Concentrations (IMAC) as specified in Ontario Drinking Water Quality Standards Regulation O.Reg. 169/03.

4.1 Overburden Groundwater

Overburden groundwater monitors that are on-site (the Brockville Landfill Site) and off-site (the CAZ) are part of the annual groundwater monitoring program. Due to the general lack of overburden in the area downgradient of the Brockville Landfill Site, groundwater in this area exists primarily within the bedrock formation.

Off-site overburden groundwater monitors on the CAZ are monitors of background groundwater quality.

4.1.1 Background Overburden Groundwater Quality

Groundwater monitors 91-6S and 91-8 are completed in the overburden (glacial till) east of Grant's Creek. Groundwater elevation data indicates that horizontal groundwater flow in the overburden in this area is toward Grant's Creek. Therefore, since monitoring locations 91-6S and 91-8 are hydraulically upgradient of the landfill, the range in parameter concentrations at monitors 91-6S and 91-8 since monitoring began in 1991 is considered to represent the background groundwater quality in overburden at this site as presented in **Table B5**.

Monitor 91-8 is no longer sampled as part of the monitoring program; therefore monitor 91-6S is used to assess current changes in background conditions. In 2021, 91-6S was sampled and analysed for the Surveillance Parameters. The groundwater quality at 91-6S in 2021 was similar to previous years.

No parameters exceeded the ODWQS at 91-6S in June 2021. In previous years, iron and manganese have exceeded the ODWQS at this location. Due to the natural occurrence of iron and manganese near or above the ODWQS, exceedances of iron and manganese in groundwater downgradient of the Brockville Landfill Site do not necessarily indicate leachate impact; comparisons of leachate indicator parameter concentrations with background concentrations are a more meaningful measure of impact.

4.1.2 Overburden Groundwater Quality

The Brockville Landfill Site overburden monitoring wells are monitors 90-2S and 90-2M (approximately two-thirds of the way west along the southern site boundary) and 90-3S and 90-3M (near the southeast corner of the site). Monitor 90-2S is in waste and earth fill; 90-2M is in glacial till; and, 90-3M is in silty clay.

As indicated by the figures in **Appendix 7**, chloride concentrations (as well as the concentrations of other chemical parameters associated with leachate impact) in the on-site monitors 90-2S, 90-2M, 90-3S and 90-3M declined sharply following the installation of the leachate collection system in the fall of 1992. These improvements in water quality are considered to be related to the operation of the leachate collection system.

Based on monitoring results since 1992, it is concluded that the leachate collection system is likely allowing only minimal impacts to groundwater quality at overburden groundwater monitoring locations along the downgradient boundary of the site. See **Table B3** for a summary of the inorganic groundwater quality in the overburden monitors and **Appendix 5** for a complete listing of the inorganic analytical results.

4.2 Bedrock Groundwater

On-site (the Brockville Landfill Site) and off-site (the CAZ and south of the CAZ) bedrock groundwater monitors are currently part of the annual groundwater monitoring program.

4.2.1 Background Bedrock Groundwater Quality

Monitoring locations 91-10S, 91-10M, 91-10D, 91-11S, 91-11M, and 91-11D are located on the Precambrian bedrock ridge at the north end of the CAZ lands, hydraulically upgradient of any interpreted inorganic groundwater impact. These monitors are interpreted to not be impacted by any inorganic sources based on interpreted groundwater flow directions and on the low levels of dissolved inorganic chemical parameters detected in the groundwater samples from these monitors. Of these monitors, 91-10M and 91-10D are included in the groundwater monitoring program. The range in parameter concentrations obtained from all monitoring to date at the Precambrian background monitors is considered to represent background concentrations in the Precambrian bedrock as presented in **Table B5**.

In 2021, the water quality in the background monitors 91-10M and 91-10D was generally similar to previous years. At monitoring location 91-10M, iron and manganese did not meet the ODWQS, and at 91-10D, manganese did not meet the ODWQS. These results are generally similar to previous years and indicate that concentrations of iron and manganese are naturally elevated at this site.

4.2.2 Bedrock Groundwater Quality

Elevated concentrations of leachate indicator prameters have been identified in groundwater at bedrock monitors located on-site and downgradient of the landfill on the CAZ. Monitors that are impacted by inorganics include those monitors located on the southern boundary of the CAZ (93-2, 93-4, 93-5, 93-8 and 98-9), where the parameters that were elevated relative to background concentrations included: calcium, conductivity, hardness, TDS, TKN, ammonia, chloride, magnesium, potassium, boron, strontium and sodium. TDS, chloride, sodium and iron concentrations did not meet ODWQS criteria at some of the CAZ boundary monitoring locations.

The concentrations of chloride, sodium, TDS and conductivity were significantly elevated at monitor 98-9S in fall 2016 and fall 2018, compared to their historical ranges. It is interpreted that road salt application on Highway 401 affects groundwater quality at this location.

Monitors located south of Highway 401 (monitors installed in 1999) are not impacted by inorganics (apart from potential effects of road salt at several of the monitors). Sampling for inorganics at these monitors was discontinued following the 1999 monitoring sessions and is not included in the current groundwater monitoring program. However, sampling for VOCs continues at these monitors.

Table B4 includes a summary of the inorganic groundwater quality and changes in quality in the bedrock monitors and **Appendix 6** includes a complete listing of the inorganic analytical results. Plots of chloride concentrations in groundwater monitors versus time are provided in **Appendix 7**.

4.3 Gas Pipeline and Former Sludge Lagoon Bedrock Groundwater Monitors

The gas pipeline bedrock monitoring wells (monitors 93-6 and 93-7) were sampled during the 2021 spring monitoring session. Sampling from the former sludge lagoon monitors (94-1S and 94-1D) was discontinued in 2006 upon decommissioning of the lagoons. Inorganic analytical results from the sampling of these monitors are contained in **Appendix 6**. Groundwater elevation data indicates that monitors 93-6 and 93-7 are located upgradient of the landfill. The sampling results indicate that the groundwater at monitors 93-6 and 93-7 was generally of similar quality in 2021 as compared to previous years. At monitor 93-6, there has been a slight increasing trend in some leachate indicator parameter concentrations, including alkalinity, conductivity, hardness, TDS, calcium and strontium since 2017.

The concentrations of TDS and iron at 93-6 exceeded the ODWQS in June 2021 similar to 2020. There were no other exceedances of aesthetic or health related ODWQS parameters at these monitors in 2021. Monitor 93-7 was not sampled during the spring event, a leachate analysis was completed in the summer and there were no exceedances.

As monitors 93-6 and 93-7 are completed in the sandstone bedrock which underlies the northern and central portions of the landfill site, background groundwater quality is assessed differently than for the on-site (Brockville Landfill Site) and off-site (CAZ and south of CAZ) bedrock groundwater monitors. The range in background concentrations of five selected leachate indicator parameters in the sandstone bedrock (using available historical data from the sandstone background monitors 90-1, 91-1S, 91-1M, and 91-1D; see Figure A2 for locations) were compared with the 2020 concentrations of these parameters at monitors 93-6 and 93-7. The five leachate indicator parameters and the maximum background concentrations in sandstone are: chloride (18 mg/L), electrical conductivity (725 µS/cm), COD (61 mg/L), boron (0.35 mg/L), and strontium (14 mg/L). All five of the selected Leachate Indicator Parameter concentrations at monitors 93-6 and 93-7 were below background levels in 2021 with the exception of conductivity at 93-6. These results were generally similar to previous monitoring results.

With respect to the gas pipeline, the groundwater at monitors 93-6 and 93-7 is expected to be non-corrosive to steel since it has a low chloride concentration, low electrical conductivity and near neutral pH (Golder 2021)

4.4 Domestic Water Supply Wells

The results of the inorganic groundwater sampling carried out in the spring and summer of 2021 at three domestic water supply wells are included in **Appendix 8**. It is noted that the domestic wells are located either several hundred metres upgradient of the Brockville Landfill Site (Basten, Plaschka) or several hundred metres to the east (cross-gradient) of the landfill (McGill), as shown on **Figure B3**. Therefore, based on the current groundwater flow direction, it is not considered possible for the landfill to impact these wells. The inorganic groundwater quality in the domestic wells tested in 2021 was similar to the analysis in previous years. The hardness, nitrate, TDS and sodium concentrations at the Basten well were at historical high levels in September 2020, potentially due to the low precipitation levels in the spring and early summer of 2020. In 2021 the concentrations were decreasing. The TDS concentrations reported in June and September 2021 at this location did not meet the ODWQS aesthetic objective.

The TDS concentrations reported in June and September 2021 at the McGill and Plaschka did not meet the ODWQS aesthetic objective; however, the concentrations were similar to historical levels.

The rest of the parameters analyzed in samples from the Basten, McGill and Plaschka wells were within historical ranges and satisfied the ODWQS. No health-related parameters at the Basten, McGill and Plaschka wells exceeded the ODWQS. Due to the hydrogeological setting of the area, the domestic water supply wells are interpreted not to be impacted by the landfill.

5.0 VOLATILE ORGANIC GROUNDWATER QUALITY

Trichloroethene (TCE), cis-1,2-dichloroethene (c-DCE), and vinyl chloride are the most prevalent VOCs present in groundwater in the study area. TCE (a common solvent) is very soluble (approximately 1,100,000 µg/L) relative to the Ontario Drinking Water Quality Standard (ODWQS; 5 µg/L) and can be highly mobile in fractured rock. TCE is also generally considered to be resistant to transformation under oxidizing conditions that are generally expected in shallow groundwater. However, under reducing conditions (e.g., in deeper or high BOD/COD groundwater) TCE may be subject to microbially-mediated reductive dechlorination reactions. These reactions generally proceed slowly and may result in the sequential transformation of TCE to c-DCE, trans-1,2-dichloroethene (t-DCE), and vinyl chloride. There is no ODWQS for c-DCE or t-DCE.

Vinyl chloride is considered the VOC of greatest concern at the Brockville Landfill Site because of its low ODWQS MAC (1 µg/L). Vinyl chloride is more volatile than TCE and c-DCE and therefore can more readily escape from shallow groundwater to soil gas and to the atmosphere. Vinyl chloride anaerobically transforms to ethylene.

TCE, c-DCE and vinyl chloride concentrations and hydrogeological interpretations regarding possible sources of identified VOC impacts are summarized in Table B6 for bedrock monitors. Only those monitors that are included in the Brockville Landfill Site monitoring program (i.e., the monitoring program referenced in the ECA) are included in **Table B6** and in the discussion that follows. See Part C of this report for monitoring information related to the other known sources of groundwater contamination. The results of the 2021 and historical VOC analyses data obtained for the bedrock groundwater monitors, along with the relevant ODWQS, are provided in **Appendix 9**.

During the spring 2017 monitoring event, methylene chloride (or dichloromethane) was detected at concentrations of 7.8 to 13.2 µg/L at several wells included in the Brockville Landfill Site monitoring program. As discussed in Golder (2018), methylene chloride had never been detected before at any of these monitors or domestic wells and it was interpreted that methylene chloride was likely introduced to the samples at the laboratory, as the substance is used for laboratory processes. The detection of methylene chloride in 2017 is not interpreted to be representative of actual groundwater quality at these monitors and domestic wells. Since 2017, methylene chloride has not been detected at any of the monitors or domestic wells where it had been detected in 2017 (Golder 2021)

5.1 Bedrock Groundwater Quality

VOCs have been detected in groundwater at the bedrock monitors located on-site and downgradient of the landfill on the CAZ. Most of the monitors on the western part of the CAZ have historically been impacted by VOCs; monitors on the southern boundary of the CAZ including 93-5, 98-9, 93-8 and 93-2 have also historically been impacted. Two detections of VOCs have occurred at 93-4D, vinyl chloride (VC) in 2006 and TCE in 2009 (Golder, 2021).

Groundwater monitors installed in 1999 south of Highway 401 (99-7 through 99-11), were not impacted by VOCs from 1999 to 2009. However, minor concentrations of TCE were detected at monitors 99-7S, 99-7M, 99-7D, 99-10S and 99-11S (0.4 to 1.2 µg/L) in Spring 2009. To date, these one-time detections of TCE have not reoccurred at 99-7 and 99-10, indicating that TCE may not have been present at these monitoring locations in 2009. In 2021, VOCs were not detected in monitors 99-7 through 99-10. At 99-11D, low levels of Acetone and 99-11S low levels of c-DCE (just above the laboratory detection limit) were detected in 2021. Monitor 99-11 is the southernmost of the monitors located south of Highway 401. Given that VOCs have not been detected at any of the upgradient monitors between 99-11 and Highway 401, the source of the VOC detections at 99-11 is not clear. The water quality at 99-11 will continue to be monitored in 2022.

TCE was detected at the following monitors in 2021: 91-5S and D, 91-10D, 93-5S and D, 98-2 S and M, 98-3M and D, 98-5S, and 98-9D and M. The highest concentrations of TCE (33.3 µg/L and 44.8 µg/L in the spring monitoring session) were at 98-2S and 98-2M, respectively, which are located within the former salvage yard. The TCE concentration at 91-10Dwas 6.7 ug/L. With the exception of the concentration at 98-2S, 98-2M and 91-100 the TCE concentrations measured at these monitors did not exceed the TCE ODWQS of 5 µg/L.

In 2021, TCE concentrations at all monitors were within their historical concentration ranges.

In 2021, c-DCE was detected at the following monitoring wells: 91-2D, 91-3D, 91-5S and D, 91-10M and D and 93-5S and D, 98-2S and M, 98-5D, 98-9M and D. The highest concentration of c-DCE measured in 2021 was at 98-2M (31.8 µg/L during the spring monitoring session). In 2021, c-DCE concentrations at all monitors were within their historical concentration ranges.

In 2021, vinyl chloride was detected at the following monitoring wells: 91-2D, 91-3D, 91-5D, 93-5S, 98-2D and 98-9D. At monitoring wells 91-2D, 91-3D, 93-5S, 98-2D and 98-9D, the vinyl chloride concentration exceeded the ODWQS of 1 µg/L. The highest concentration of vinyl chloride in 2021 (128 µg/L in the spring monitoring session) was at 98-2D. Concentrations of vinyl chloride measured in 2021 were within their historical ranges at all monitors.

6.0 PFAS AND 1,4-DIOXANE IN GROUNDWATER

6.1 Bedrock Groundwater Monitors

The results of the PFAS and 1,4-dioxane groundwater sampling that was carried out in the spring of 2021 at monitoring wells 91-3D and 98-2D are included in **Appendix 9**. The 1,4-dioxane analysis was not completed. At monitoring well 91-3D, 9 of the 17 PFAS compounds analyzed were detected, and the total concentration of the 9 detected parameters was 32.5 ng/L. At 98-2D, 8 of the 17 PFAS compounds analyzed were detected, and the total concentration of the 8 detected parameters was 170.5 ng/L. The total PFAS concentration at monitoring well 98-2D was higher than the MECP's recommended drinking water value of 70 ng/L for total perfluorinated compounds (PFCs).

7.0 INTERPRETATION OF GROUNDWATER QUALITY

The interpretation of the groundwater impacts at the Brockville Landfill Site groundwater monitors is presented in **Tables B3, B4 and B6**, and in **Figures B4 and B5**. The factors which were considered in the interpretation of groundwater impacts are as follows, and are consistent with previous reporting:

- The locations of the potential sources of groundwater contamination as determined by the review of historical land uses (Golder 1998 - Phase I ESA).
- The use of TCE, c-DCE and VC as indicators of groundwater impact by VOCs from one of four identified sources of contamination in the area of the landfill (see Part A).
- The use of the Leachate Indicator Parameters as indicators of inorganic impact possibly attributable to the Brockville Landfill Site.
- The physical hydrogeological setting of the site which governs the direction of groundwater flow and contaminant migration in the deep and shallow flow systems.
- The possible interactions between surface water and shallow groundwater.

Based on the 2021 groundwater quality data in conjunction with historical environmental information, the following interpretations regarding the possible sources of identified groundwater impacts at monitoring locations that were sampled in 2021 are provided below. These interpretations are consistent with previous years (Golder, 2021).

Possible Source of Inorganic Impacts	2021 Impacted Bedrock Monitors
Brockville Landfill	90-3D, 91-2S, 91-2M, 91-2D, 91-3S, 91-3M, 91-3D, 91-7S*, 91-7D*, 93-5S*, 93-5D*
Former landfill	98-3D, 98-9S*, 98-9M, 98-9D*
Brockville Landfill and/or former landfill	91-5D, 93-8D*
Highway 401 only	93-2S, 93-2M, 93-2D, 93-4S, 93-4D, 93-8S, 93-8M

Note: *Indicates that road salt impact due to Highway 401 is also possible.

Possible Source of VOC Impacts	2021 Impacted Bedrock Monitors
Brockville Landfill	90-3D, 91-2M, 91-2D, 91-6D, 93-3S, 93-3D
Former salvage yard	91-10M, 91-10D, 98-5S, 98-5M
Brockville Landfill and/or former salvage yard	91-3M, 91-3D, 91-5S, 91-7S, 91-7D, 93-2D, 93-4D, 93-5S, 93-5D, 93-8S
Brockville Landfill and/or former salvage yard and/or former landfill	91-5D, 93-8M, 93-8D, 98-5D
Former salvage yard and/or former landfill	98-2S, 98-2M, 98-2D, 98-3D, 98-9S, 98-9M, 98-9D

There are three monitors that are interpreted to be located upgradient of the landfill based on historical and 2021 groundwater flow directions and are impacted or possibly impacted by VOCs, as listed below.

- 91-6D: VC has been detected at 91-6D in each year from 2005 through to 2021 (0.2 to 2.0 µg/L), with the exception of 2013, 2018 and 2021. TCE was detected (0.3 µg/L) for the first time in 2009 but was not detected in 2010 through 2021.
- 93-3S: In 2003, a detection of VC was reported at 93-3S for the first time (0.5 µg/L), but no VC was detected in 2004 through to 2021. TCE was detected (0.4 µg/L) for the first time at 93-3S in 2009 but was not detected in 2010 through 2021.
- 93-3D: VC was detected (0.3 µg/L) for the first time at 93-3D in 2007 but was not detected from 2008 to 2021. TCE was detected (0.4 µg/L) for the first time at 93-3D in 2009 but was not detected from 2010 to 2021.

Monitoring location 91-6D is within the shallow bedrock flow system, and 93-3S and 93-3D are within the intermediate flow system. Groundwater elevations available for both spring and summer for the shallow flow system indicate that these monitoring locations are upgradient of the landfill, former salvage yard and the former landfill. Despite their interpreted upgradient locations, these monitors are currently interpreted to be impacted (91-6D) or possibly impacted (93-3S and 93-3D) by low levels of VOCs from the landfill. Monitors 91-6 and 93-3 are located within the eastern portion of the CAZ.

At the groundwater monitors located downgradient of the CAZ, south of Highway 401 (monitors 99-7 through 99-11) VOCs were not detected between 1999 to 2021, with the following exceptions:

- Monitors 99-7S, 99-7M, 99-7D, 99-10S and 99-11S: one-time detections of TCE at low concentrations, slightly above the detection limit (0.4 µg/L to 1.2 µg/L) in the spring of 2009. VOCs were not detected at these monitors from 2010 to 2021, with the exception of chloroethane at 99-7S in 2018 (0.4 µg/L).
- Monitors 99-11S, 99-11M and 99-11D: low levels of TCE and VC (just above the laboratory detection limit) were reported in all three monitoring well intervals in 2020, while c-DCE was reported at 2.5 µg/L at 99-11S in 2020 and 2021. Monitor 99-11 is the southernmost of the monitors located south of Highway 401. Given that VOCs have not been detected at any up the upgradient monitors between 99-11 and Highway 401, the source of the VOC detections at 99-11 is not clear. The water quality at 99-11 will be monitored in 2022.
- Monitor 99-8M: methylene chloride at 18.3 µg/L in 2016 (less than the ODWQS of 50 µg/L).
- Monitor 99-9M: chloroform was detected at 0.6 µg/L in 2012 and methylene chloride at 14.9 µg/L in 2016.

No other VOC concentrations have been reported above the MDL at these monitors. Since VOCs have only been detected once at these monitors in the period of 1999 through to 2021 (or twice in the case of 99-7S, 99-9M and 99-11S), Jp2g interprets that these monitors are not likely impacted by any of the identified sources of VOCs in groundwater.

As indicated above, many groundwater monitors located off-site on the CAZ that are impacted by VOCs are possibly impacted by more than one source of VOC groundwater contamination. The former salvage yard (located on the CAZ) is not considered a source of inorganic groundwater contamination (see Part A); however, road salt from Highway 401 causes inorganic impacts on the southern boundary of the CAZ.

Most monitoring locations near the southern boundary of the CAZ (93-2, 93-4, 93-8, 93-5 and 98-9) are interpreted to be impacted primarily by road salt from Highway 401. Only at 93-5 and 93-8D is the landfill interpreted to be partially contributing to the observed inorganic impacts.

The direction of groundwater flow in the deep and shallow flow system, combined with the relative locations of the known sources of groundwater contamination in the area of the landfill make the interpretation of contaminant migration and the determination of sources of groundwater contaminants uncertain. In terms of monitoring of potential environmental impacts this may be of little consequence; however, this is relevant in terms of MECP guidelines for regulated and unregulated sources of groundwater contamination (Golder, 2021). Compliance with MECP guidelines is addressed in **Section 11.0** of this report.

8.0 SURFACE WATER QUALITY

The 2021 inorganic and VOC surface water quality at the surface water monitoring locations shown on **Figure B2** are presented in **Appendix 10** and summarized in **Tables B7 and B8**, respectively.

Prior to 1998, sampling for VOCs historically occurred only at surface water sampling location SW-5, while inorganic sampling occurred at all surface water sampling locations. Since 1998, sampling for VOCs has also been undertaken at BD-03-M2 and at SW98-1, in addition to sampling for inorganics, as part of the monitoring program for the Former City Landfill, Former Salvage Yard and the MOE investigation area. These results are reported in Part C of this report.

In the following discussion of surface water quality, reference is made to the PWQO, published July 1994 and reprinted February 1999. These criteria are included on the chemical data sheets in **Appendix 10** of this report. Plots of historical chloride concentrations (as an indicator of the presence and degree of inorganic contamination impact) from 1990 to 2021 for each surface water monitoring location are provided in **Appendix 11**.

8.1 Background Quality

Surface water station SW-2 is located just upstream of the northeast corner of the swamp shown on **Figure B2**. Historically, the full range of water quality at SW-2 since sampling started is considered to represent background surface water quality at the landfill and the immediate vicinity (as per the ECA). As discussed in Section 1.3 of Part A of this report, the MECP surface water reviewer requested in 2018 that future reports establish background surface water quality based on the 75th percentile concentrations of Leachate Indicator Parameters at the background monitoring location. Therefore, the comparison to background surface water quality presented in **Table B7** is based on the 75th percentile of background measurements for Leachate Indicator Parameters. **Table B9** presents the historical range of surface water quality at SW-2.

Station SW-2 (a surveillance parameter station) is characterized by moderately hard water with fairly low concentrations of most parameters. Chloride, electrical conductivity, and un-ionized ammonia concentrations fall within the following historical ranges: chloride (<1 to 35 mg/L), electrical conductivity (215 to 774 µS/cm), and un-ionized ammonia (<0.00001 to 0.081 mg/L). In general, surface water quality at SW-2 in 2021 was similar to the historical surface water quality at this location. In 2021 at SW-2 all parameters satisfied the applicable PWQO although historically there have been exceedances. It is assumed for the purpose of this assessment that the background surface water quality in the vicinity of the site does not naturally meet the PWQO for all parameters.

8.2 North of Parkedale Avenue (On-Site)

The surface water stations located north of Parkedale Avenue are SW-1, SW-2 (background station), SW-3 and SW-7. In addition, surface water station SW-100 was added at the request of the MECP and was first sampled in fall 2018 (as discussed in Section 3.2). In 2021, the 75th percentile background level was exceeded for almost all of the Leachate Indicator Parameters at SW-3 and a PWQO exceedance of iron occurred at SW-3.. See **Table B7** for a summary of 2021 inorganic surface water quality information.

8.3 South of Parkedale Avenue (CAZ)

The surface water stations which are located south of Parkedale Avenue (i.e., on the CAZ lands) are SW-5, SW-8, SW98-1 and BD-03-M2. Station SW98-1 (located adjacent to the former salvage yard, south of Parkedale Avenue and upstream of the Brockville Landfill Site) and BD-03-M2 (located on the golf course) are used to monitor impacts caused by the former landfill and salvage yard; therefore, the results of the monitoring at SW98-1 and BD-03-M2 (VOC monitoring only) are discussed in Part C.

Surface water stations SW-5, SW-8 and BD-03-M2 are located progressively downstream in Grant's Creek.

In 2021, the 75th percentile background level was exceeded for several leachate Indicator parameters at these stations. All parameters at the stations met the PWQO criteria in 2021 with the exception of iron (SW-5, SW-8, BD-03-M2 and SW-100), dissolved oxygen (SW-5), total phosphorus (BD-03-M2) and phenols (SW-5). All three locations show a significant improvement in water quality after the fall of 1992, following the construction of the leachate collection system. The improved water quality (indicated particularly by decreased chloride levels) continued throughout 2021, except at SW-5 as discussed below.

In the sample collected at SW-5 on June 11, 2020 during the spring monitoring session, there was a notable increase in several leachate indicator parameters (alkalinity, chloride, hardness, sodium and strontium), as well as total phosphorus, barium, cobalt, iron and manganese. Due to a trigger exceedance for iron (as discussed in Section 11.3), surface water at this location was re-sampled on June 25, 2020, and the concentrations of most parameters were found to remain elevated. It was interpreted that these elevated concentrations may be associated with stagnant surface water conditions at SW-5 in June 2020 (Golder, 2021). The parameter concentrations had returned to the normal historical range by the time of the fall 2020 monitoring session. A similar increase in spring 2021 with lower levels in fall 2021 was detected.

It is noted that the surface water quality south of Parkedale Avenue is also likely affected by road salting activities and the golf course (for example, the high chloride concentrations at BD-03-M2 in 2001 and 2002). See Table B7 for additional inorganic surface water quality information.

Sampling for VOCs was conducted at SW-5 in 2021. No VOCs were detected.

8.4 Comparison to CWQG for Chloride

As requested by the MECP surface water reviewer in 2013, the chloride concentrations at all surface water stations were compared to the applicable Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guideline (CWQG) of 250 mg/L. In 2021, the chloride concentration at SW-5 did not exceed the CWQG. No other chloride concentrations in surface water exceeded the CWQG in 2021.

8.5 Toxicity Testing and Benthic Invertebrate Sampling

Sections 8.5.1 to 8.5.4 that discuss historical results are reproduced from Golder (2021).

8.5.1 2003 - 2005 Toxicity Testing

As reported in Golder (2004a), single dose acute lethality toxicity testing, using *Daphnia Magna* and rainbow trout (*Oncorhynchus Mykiss*) was undertaken at SW-5 on November 24, 2003 (during fall monitoring). The results of the toxicity testing indicated that the surface water at SW-5 was not acutely toxic to aquatic life at 100% concentration (the iron concentration was 0.16 mg/L).

Single dose acute lethality toxicity testing was also undertaken at SW-5 on April 7, 2004 (spring monitoring) and June 17, 2004 (at the time of the 2004 leachate seep through the site perimeter sheet-pile wall). The iron concentration was 0.12 mg/L on April 7, 2004 and was 1.87 mg/L on June 17, 2004. The results of both toxicity tests indicated that the surface water at SW-5 was not acutely toxic to aquatic life (at 100% concentration).

Chronic toxicity testing was conducted in 2005 with water collected from SW-2 and SW-5 on December 13, 2005, approximately one week after groundwater seepage was observed. Chronic testing included two different test methods: reproduction and survival of Ceriodaphnia dubia, Environment Canada Conservation and Protection Ottawa Ontario Report EPS 1/RM/21 (as amended November 1997), and growth and survival using fathead minnows (Pimphales promelas) Environment Canada Conservation and Protection Ottawa Ontario Report EPS 1/RM/21 (as amended November 1997).

The 2005 test results show that chronic exposure to undiluted samples collected from SW-2 (reference) had no effect on Ceriodaphnia dubia reproduction or survival after seven days. Seven-day chronic exposure to undiluted surface water also had no effect on the growth or survival of fathead minnows. Analysis of water samples collected from SW-2 on December 6 and 13, 2005 indicated that neither of these samples exceeded water quality criteria from the PWQOs or CCME guidelines for freshwater aquatic life (FAL).

The 2005 test results also showed that chronic exposure to 100% effluent concentration collected from SW-5 had no effect on Ceriodaphnia dubia reproduction or survival after seven days, and chronic exposure to an undiluted surface water sample also had no effect on the growth or survival of fathead minnows over the same time period. Analysis of water samples collected from SW-5 on December 3 and 13, 2005 indicate that, with the exception of iron, which was at a concentration of 0.33 mg/L on December 13, 2005, none of the parameters tested exceeded PWQOs or CCME FAL guidelines. Concentrations of a number of water quality parameters increased at SW-5 between the two sampling dates (December 3 and 13, 2005) such as: calcium, COD, chloride, hardness, magnesium, phosphate sodium and turbidity. While the iron levels in the test samples were close to PWQO, the toxicity testing illustrated that no long term water quality impact had occurred downstream in the creek, following the leachate seepage.

Toxicity sampling was not conducted between 2006 and 2020, except as discussed in Section 8.5.3.

8.5.2 2010 Benthic Invertebrate Sampling

As reported in Golder (2011), benthic invertebrate sampling at SW-2, SW-5 and SW-8 was conducted in the fall of 2010 due to historical trigger exceedances for iron (revised trigger level of 0.3 mg/L) in the spring of 2008 and 2009. The results indicated low benthic diversity, taxa richness, and evenness at the reference station SW-2 relative to the exposure stations. A difference in community composition between the reference station and the exposure stations (SW-5 and SW-8) was attributed to the difference in substrate and sample collection depth, since at SW-2 the sampler was only able to penetrate the top 5 cm of the sediments due to the high occurrence of leaf matter within the sediments. The benthic communities observed at all stations are comprised mostly of tolerant species and impacts are extremely difficult to detect in such communities.

Based on the benthic invertebrate sampling results, additional benthic investigation was not considered useful due to the lack of appropriate reference station locations and generally tolerant species composition of benthic communities in the area. It was recommended that aquatic toxicity testing be undertaken if a future exceedance of a trigger concentration occurs at SW-5. It was also recommended that the potential risk to fish and fish habitat be addressed by documenting fish and fish habitat in the area affected by elevated iron concentrations and identifying the spatial extent of the elevated iron concentrations in the receiving stream relative to important fish habitat. In conjunction with the results of the benthic investigation, the information on fish and fish habitat would serve to support the development of site specific trigger levels.

Benthic invertebrate sampling was not conducted between 2011 and 2020.

8.5.3 2012 - 2013 Aquatic Bioassay Testing

In 2012, Golder initiated an aquatic bioassay testing program in an effort to establish site-specific surface water trigger levels for iron at the Brockville Landfill. This work addressed recommendations from the benthic invertebrate investigation (see Section 7.5.2) and the MECP request to evaluate the current iron trigger concentration (Golder, 2012).

Aquatic bioassays are used to measure and assess the toxic effects on aquatic species resulting from their exposure to effluent and receiving waters. In order to assess the effects of leachate discharging to Grant's Creek, leachate was collected directly from the leachate collection system and dilution water was collected from the reference surface water monitoring station at SW-2 during spring 2012 and fall 2013. Chronic bioassays incorporating three trophic levels were performed on the collected leachate and surface water at varying dilution ratios. The dilution ratio and the iron concentration of the leachate and dilution water were then correlated to the bioassay test results to determine the concentration of iron present at each inhibition or lethal level observed.

The lowest iron concentration associated with LC50 (lethal concentration for 50% of population) or IC25 (inhibition concentration of 25% of population) was 1.62 mg/L. This was recommended as the site-specific iron trigger concentration. A complete report on the aquatic toxicity testing was included in the 2013 annual monitoring report.

The aquatic toxicity report was reviewed by the MECP Environmental Monitoring and Reporting Branch. The MECP's comments on the proposed revised trigger concentration were summarized in an email to the City of Brockville on December 9, 2016 (see Golder, 2017). The MECP recommended the application of one of the procedures for deriving site-specific water quality objectives as outlined in CCME (2003).

8.5.4 2017 Statistical Derivation of Surface Water Quality Guideline

Based on the MECP's review of the aquatic toxicity report described in the previous section, Golder proposed to derive a water quality guideline and trigger concentration for iron in surface water using the protocol described in CCME (2007). The MECP approved this approach in an email dated March 10, 2017. This approach included toxicity data compilation, evaluation, categorization and endpoint selection, leading to the use of a species sensitivity distribution to develop a water quality guideline of 1.01 mg/L for iron. The technical memorandum titled, "Water Quality Guideline Derivation, Trigger Concentration for Iron in Surface Water, Brockville Landfill, Ontario" was included in the 2016 Annual Monitoring Report (Golder, 2017).

In an email dated August 16, 2017, the MECP indicated that it did not support the proposed site-specific trigger concentration of 1.01 mg/L developed by Golder, and instead specified that two trigger values for iron should be applied, based on the British Columbia Ministry of the Environment guidelines (see Appendix A for correspondence). The MECP's recommended trigger values are 0.35 mg/L for dissolved iron and 1.0 mg/L for total iron; if any one or both of these limits are exceeded, further investigation will then be required.

8.5.5 2020-2021 Iron Sampling

Due to the results of a June 11, 2020 sample at SW-5 there were exceedances of the trigger concentrations for total iron (1.0 mg/L) and dissolved iron (0.35 mg/L) at 4.64 mg/L and 1.21 mg/L respectively. Confirmation sampling on June 25, 2020 also reported an exceedance of dissolved iron at 1 mg/L. In consultation with MECP the City agreed to sample SW-5 over a 6-month period and review the operation of the leachate collection system to determine the possible cause of the exceedances.

The City sampling results provided in **Appendix 1**, show exceedances in August, September and October 2020, and then June to September 2021 for both total and dissolved iron. Total iron concentrations ranged from 0.089 to 37.3 mg/L and dissolved iron concentrations ranged from 0.032 to 8.7 mg/L. The Jp2g sampling results at SW-5 in June and November 2021 did not exceed the trigger concentrations and there were no VOC concentrations above detection limits.

Since the analysis of total and dissolved iron was initiated in 2013 at SW-5, there were exceedances of the total iron trigger concentration in May 2015 (2.54 mg/L) and June 2018 (1.28 mg/L). The 2020-2021 exceedances have decreased in concentration and will be reviewed further in 2022.

9.0 INTERPRETATION OF SURFACE WATER QUALITY

Surface water on the Brockville Landfill Site is interpreted to be impacted by inorganics from the landfill; however, the level of impact has reduced considerably following the installation of the leachate collection system in 1992. Inorganic and VOC impact to surface water on the Brockville Landfill Site by the former City Landfill (via the culvert at SW98-1) and/or the former salvage yard is likely occurring. On-site impacts by road salt from Parkedale Avenue are also possible (Golder 2021)

The ongoing surface water monitoring program continues to demonstrate that the leachate collection system is effectively minimizing the potential for ongoing adverse effects on surface water quality. This is apparent by comparing pre-leachate collection system leachate indicator parameter concentrations against post-leachate collection system leachate indicator parameter concentrations. Groundwater seeps through or over the sheet pile wall have occurred on seven occasions since 2002; the last occurrence was in early 2007. Toxicity testing completed in 2003 to 2005 indicated that no long-term water quality impact occurred downstream of the seeps in the creek (Golder, 2021). There were no observed groundwater seeps from 2008 to 2021.

Regarding the 2021 off-site surface water quality, there were no leachate indicator parameters that exceeded both background and PWQO at off-site downstream locations. VOCs were not detected in the surface water samples collected from SW-5 during 2021. Historically, VOCs have occasionally been detected in samples collected from Grant's Creek, but the presence of VOCs in Grant's Creek is not a consistent occurrence.

It is noted that the off-site surface water quality south of Parkedale Avenue is also likely affected by road salting activities and the golf course. A summary of the potential sources of inorganic and VOC surface water contamination and the corresponding impacted surface water sampling locations are provided in the following table.

Possible Sources of Inorganic and VOC Impacts	Impacted Surface Water Sampling Locations
Brockville Landfill and former landfill**	SW-5*, SW-8*, BD-03-M2*

Notes:
* Indicates possible impacts due to road salt and the golf course
** By surface water flow under Parkedale Avenue via the culvert at sampling station SW98-1

10.0 LEACHATE COLLECTION SYSTEM MONITORING RESULTS

In accordance with the ECA, leachate impacted groundwater collected from the perimeter leachate collection system is monitored by the City of Brockville and by their consultants as part of the Brockville Landfill monitoring program. The leachate collection system at the Brockville Landfill Site was put into operation in the fall of 1992. The collected leachate is sent via the City sanitary sewer system to the Water Pollution Control Plant (WPCP).

The 2021 leachate collection system monitoring results for weekly and monthly samples collected by the City of Brockville are provided in **Appendix 12**. The results for the semi-annual samples collected by Jp2g are included in **Appendices 6** and **9** as described in the following section. These results were compared to the City of Brockville Sewer Use By-Law concentrations. The concentrations in the leachate samples collected by the City of Brockville did not exceed the applicable Sewer Use By-law 046-2014 concentrations. The TKN concentration in the sample collected by Jp2g in September 2021 was 64.2 mg/L compared to the 50 mg/L limit, no other exceedances were exhibited.

10.1 Leachate Quality Monitoring Results

The semi-annual surveillance parameter (inorganic) analytical results from 2021 are included in **Appendix 6** with the inorganic groundwater data. Since 1993, the leachate quality has been generally consistent for the parameters analyzed. The high ammonia and TKN concentrations detected in September 2020 are now back to historical levels.

The semi-annual leachate VOC analytical results from 2021 are included in **Appendix 9** with the VOC groundwater data. The VOCs detected in 2021 were 1,4-dichlorobenzene (0.4 µg/L in September and November). None of the VOC concentrations exceeded the associated PWQO. The presence of low concentrations of VOCs in the leachate are not expected to negatively impact operations at the WPCP.

The results of the PFAS and 1,4-dioxane groundwater sampling program carried out in spring 2021 are included in **Appendix 9.** The 1,4-dioxane analysis was not completed in 2021. There were 8 PFAS compounds detected out of the 17 PFAS compounds that were analyzed, and the total concentration of the 8 detected parameters was 318.3 ng/L. The total PFAS concentration exceeded the MECP's recommended drinking water value of 70 ng/L for total perfluorinated compounds (PFCs).

10.2 Leachate Flow Monitoring Results

The monthly leachate flow in 2021 ranged from 1,620 cubic metres (September) to 34,730 cubic metres (March).

An estimated total of 199,820 cubic metres of leachate was collected in 2021, compared to 285,805 cubic metres estimated in 2020 and a maximum permitted annual volume of 1,501,610 cubic metres under the Permit to Take Water (PTTW) approval.

11.0 GROUNDWATER & SURFACE WATER COMPLIANCE ASSESSMENT

11.1 MECP Reasonable Use Guideline

The purpose of the MECP Reasonable Use Guideline B-7 is to control the degree to which the use or potential use of off-site groundwater quality is adversely affected by "regulated" sources of contamination. "Regulated" refers to those activities that receive specific MECP approval, including licensed waste disposal sites such as the Brockville Landfill Site.

The MECP recognizes that most, if not all of society's waste disposal activities contribute some contamination to the environment. As the agency responsible for licensing such activities, the MECP has established limits to the amount of contamination that waste disposal activities may be allowed to contribute to groundwater.

These limits are set sufficiently low so that adjacent property owners would not be expected to have their reasonable use of groundwater resources impacted. Accordingly, MECP Reasonable Use Guideline B-7 provides a procedure for determining the reasonable use of groundwater on a site-specific basis and establishing a limit of contamination that will be allowed such that its use will not be impaired.

As described in Part A of this report, multiple groundwater contaminant sources exist in the immediate vicinity of the Brockville Landfill Site. The most significant sources of groundwater contamination, in terms of overall groundwater impact (VOC and inorganic impact) are: 1) the Brockville Landfill Site, 2) the former City Landfill, 3) the former salvage yard, 4) Highway 401, and 5) the area of the MECP investigation to the west of the Brockville Landfill Site.

All local groundwater contaminant sources except for the Brockville Landfill Site are considered "unregulated" sources and are not subject to the MECP Reasonable Use Guideline B-7. Discussions regarding the "unregulated" sources are presented in Part C of this report.

11.2 Groundwater Trigger Evaluation

As discussed in Section 6.0, the CAZ south boundary monitors (monitors in boreholes 93-2, 93-4, 93-5, 93-8 and 98-9) are impacted by inorganic and/or VOC sources of groundwater contamination (including impacts by road salt). Therefore, the groundwater quality at these boundary monitors reflects potential effects from both the regulated landfill and unregulated sources, and therefore the MECP Reasonable Use Guideline B-7 is not easily applied. However, according to the revised conditions of the landfill ECA, Reasonable Use Guideline (RUG) concentration values calculated for specific parameters at the boundary ("compliance") monitors are used to define the groundwater monitoring "trigger".

Consistent with the MECP Reasonable Use Guideline B-7, RUG values are determined as follows: water quality is not to be degraded in excess of 50 percent of the difference between background concentrations and established water quality criteria for aesthetic related parameters, and 25 percent of the difference between background conditions and established water criteria for health-related parameters.

For the purposes of calculating RUG values, the historical range in groundwater quality at monitors 91-10S, 91-10M, 91-10D, 91-11S, 91-11M, and 91-11D are considered to represent the inorganic background groundwater quality in the Precambrian bedrock. Because VOCs have been detected in background groundwater, the background VOC concentrations are assumed to be the minimum detection limits (0.0003 mg/L and 0.0002 mg/L for TCE and vinyl chloride, respectively) (the lowest quantifiable VOC concentrations).

The following table lists the compliance monitors, the trigger evaluation parameters, the RUG values (trigger levels) and the 2021 monitoring results.

2021 Spring Monitoring

Parameter	Boron	Chloride	Iron	Sodium	TCE	VC
RUG	1.47	143	14.1	135	0.0015	0.0004
Compliance Monitor						
93-2D	0.14	**660**	0.10	**390**	<0.0003	<0.0002
93-4D[1]						
93-5D	0.43	12	5.82	48	0.0008	<0.0002
93-5S	0.54	12	3.91	55	0.0012	**0.002**
93-8D	0.81	**670**	1.4	**319**	<0.0003	<0.0002
98-9S	0.07	3	<0.03	8	<0.0003	<0.0002

Notes:
All units in mg/L
Bold values indicate trigger occurrences
[1] Well is damaged

2021 Summer Monitoring

Parameter	Boron	Chloride	Iron	Sodium	TCE	VC
RUG	1.47	143	14.1	135	0.0015	0.0004
Compliance Monitor						
93-2D	0.29	**560**	0.1	**196**	<0.0003	<0.0002
93-4D[1]						
93-5D	0.39	12	1.69	46	<0.0003	<0.0002
93-5S	0.28	12	3.9	21	<0.0003	**0.0005**
93-8D	0.71	**680**	0.85	**321**	<0.0003	<0.0002
98-9S[2]						

Notes:
All units in mg/L
Bold values indicate trigger occurrences
[1] Well is damaged
[2] Well was dry

The groundwater trigger evaluation indicates that there were groundwater trigger occurrences at three of the six landfill compliance monitors in 2021. The historical results at 93-4D exhibited concentrations below the trigger limits.

The elevated sodium and chloride concentrations at 93-2D and 93-8D are typical of historical monitoring results at these locations and are interpreted to be caused by road salt impact from nearby Highway 401. Monitor 93-8D is interpreted to also be impacted by inorganics from the landfill and/or former landfill.

The elevated vinyl chloride concentration at 93-5S and 93-5D is within the historical vinyl chloride concentration range at these locations. Monitors 93-5S and historically 93-5D are interpreted to be impacted by VOCs that possibly originate at the Brockville Landfill Site or the former salvage yard (or both).

Groundwater monitors located downgradient of the CAZ, south of Highway 401 (monitors 99-7 through 99-11) were not impacted by VOCs between 1999 to 2021, except for the isolated detections described in Section 7.0 of this report. Since VOCs have only been detected once at these monitors in the period of 1999 through to 2021 (or twice in the case of 99-7S, 99-9M and 99-11S), Golder (2021) interprets that these monitors are not likely impacted by any of the identified sources of VOCs in groundwater.

The Brockville Landfill Site is considered to be in compliance with MECP Reasonable Use Guideline B-7, since monitoring data suggests that (1) the groundwater quality at the CAZ boundaries is likely impacted by multiple sources of groundwater contamination and therefore the exceedances of Reasonable Use criteria indicated above are not a result of contamination from the Brockville Landfill Site, and (2) groundwater quality downgradient of the CAZ boundaries is not interpreted to be impacted by landfill leachate from the Brockville Landfill.

11.3 Surface Water Trigger Evaluation

Surface water compliance is assessed at the surface water station SW-5. SW-5 is located downstream of the Brockville Landfill at a culvert that drains from the Brockville Landfill site onto the CAZ and into Grant's Creek (on the golf course). For parameters other than iron, the surface water trigger is defined as an exceedance of background concentration values (SW-2). For iron, as of 2017 and as established in the latest ECA amendment, the current trigger concentrations are 0.35 mg/L for dissolved iron and 1.0 mg/L for total iron. A discussion of previous iron trigger concentrations is provided in Golder (2018).

The table below lists the applicable surface water trigger concentrations and the impact assessment station concentrations during the spring and fall 2021 monitoring events.

Parameter	Ammonia	Boron	Iron	Dissolved Iron	Zinc	TCE	VC	cis-1,2 -DCE	trans-1,2 -DCE
Trigger	5.3	0.95	1.0	0.35	0.31	<0.0001	<0.0002	<0.0004	<0.0004
SW-5 Spring (June 21, 2021)	0.049	0.01	0.42	0.06	<0.01	<0.0003	<0.0002	<0.0004	<0.0004
SW-5 Fall (Nov 21, 2021)	<0.010	0.02	0.26	0.21	<0.01	<0.0003	<0.0002	<0.0004	<0.0004

Notes:
All units in mg/L
Bold values indicate trigger occurrences

The trigger concentrations for iron and dissolved iron were not exceeded in the 2021 samples from SW-5. In response to the June 2020 trigger exceedance, the City of Brockville completed a supplementary monitoring program consisting of monthly sampling for six months (August 2020 to January 2021, weather permitting) at SW-5 for analysis of iron and dissolved iron, completed at the same time as the City's leachate sampling activities. The MECP approved this monitoring program, and the findings are presented in Section 8.5.5. Correspondence with the MECP regarding this exceedance is included in Appendix 1.

There were no other trigger exceedances reported at station SW-5 during the 2021 surface water monitoring program.

12.0 2022 MONITORING PROGRAM

The proposed 2022 groundwater monitoring program for the Brockville Landfill, including the leachate collection system component, is summarized in **Table B11**. The proposed 2022 surface water monitoring program is summarized in **Table B12**. These monitoring programs are consistent with the site ECA, as amended on September 14, 2018.

The proposed 2022 groundwater monitoring program is the same as was proposed for the 2021 monitoring program, including continued PFAS and 1,4-dioxane sampling at monitoring wells 91-3D, 98-2D and the landfill leachate in spring 2022. At the request of MECP, PFAS and 1,4-dioxane sampling will also be completed at 99-1D, 99-2S and MW-2D.

The proposed 2022 surface water monitoring program is the same as was proposed for the 2021 monitoring program.

13.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the 2021 groundwater, surface water and leachate collection system monitoring program at the Brockville Landfill Site and on the CAZ lands, the following conclusions are provided:

- The 2021 monitoring program carried out at the Brockville Landfill Site was completed in general accordance with Environmental Compliance Approval (Provisional Certificate of Approval) No. A 440101 dated September 14, 2018 and MECP correspondence. The Monitoring Checklist is included in **Appendix 13**.
- The groundwater quality at the Brockville Landfill Site overburden monitors is consistent with historical conclusions and indicates minimal impact due to the landfill as has been the case since the construction of the landfill leachate collection system.
- It has been shown that the extent of the off-site bedrock groundwater impacts and the concentration of the constituents in the impacted groundwater have, on average, been relatively constant over time, although significant seasonal (temporary) variations are occasionally evident. The extent of the groundwater contamination emanating from the landfill continues to be likely limited to the CAZ.
- The monitored domestic supply wells are not interpreted to be impacted by inorganic or VOC groundwater contamination from the Brockville Landfill.
- The Brockville Landfill Site is interpreted to be in compliance with MECP Reasonable Use Guideline B-7, since monitoring data suggests that the groundwater quality at the CAZ boundaries does not exceed Reasonable Use criteria as a result of contamination from the Brockville Landfill Site. All groundwater contaminant sources except the Brockville Landfill Site are considered “unregulated” sources and are not subject to the MECP Reasonable Use Guideline B-7.
- The groundwater trigger mechanism evaluation indicated that further action by the City (relating to the CAZ) is not required.
- The results of the leachate collection system monitoring carried out by the City of Brockville and Jp2g indicate that the collected leachate is not likely having an adverse effect on the performance of the Water Pollution Control Plant. Regular maintenance of the leachate collection system appears to reduce, or eliminate, the occurrence of groundwater seeps through or over the sheet pile wall.
- The ongoing surface water monitoring program continues to demonstrate that the leachate collection system is effectively minimizing ongoing adverse effects on surface water quality. This is apparent based on comparing pre-leachate collection system against post-leachate collection system Leachate Indicator Parameter concentrations.
- The surface water trigger concentrations for iron and dissolved iron were exceeded in the spring of 2020. In response, the City of Brockville completed a supplementary monitoring program consisting of monthly sampling for six months at SW-5 for analysis of iron and dissolved iron completed at the same time as the City’s leachate sampling activities. There were exceedances but concentration levels continued to decrease.
- The 2021 VOC sampling results are interpreted to indicate no significant VOC impacts on the surface water quality associated with the Brockville Landfill Site.

TABLE B1
2021 GROUNDWATER SAMPLING PROGRAM
BROCKVILLE LANDFILL SITE

Monitoring Well Locations		Sampled		Sampling Parameters	
		Spring	Summer	Jun-21	Sep-21
OVERBURDEN WELLS					
Background	91-6S	√	√	S	WL
	91-8	√	√	WL	WL
On-site	90-2S	No sample collected (Needs tubing replaced)	Dry	L	WL
	90-2M	No sample Collected (Needs tubing replaced)	√ (Leachate sample collected)	L	WL
	90-3M	√ (Leachate + VOC sample collected)	√	S	WL
BEDROCK WELLS					
Background	91-10M*	√	√	S +VOC	WL
	91-10D*	√	√	S +VOC	WL
	91-11S*	√	√	WL	WL
	91-11D*	√	√	WL	WL
On-Site	B-1S	√	√	WL	WL
	B-1D	√	√	WL	WL
	B-2M	Not Located	Not Located	WL	WL
	B-2D	Not Located	Not Located	WL	WL
	B-3M	Not Located	Not Located	WL	WL
	B-3D	Not Located	Not Located	WL	WL
	90-2D	No sample collected (Needs tubing replaced)	√ (Leachate sample collected)	L	WL
	90-3D	No sample collected (Needs tubing replaced)	Dry	L +VOC	WL
	91-2S	√	√	L	WL
	91-2M	√+ DUP #9	√	S+ VOC	WL
	91-2D	√	√	L +VOC	WL
CAZ LANDS (GOLF COURSE)					
	91-3S*	√	√	L	WL
	91-3M*	√	√	L +VOC	WL
	91-3D*	√	√	L +VOC +PFAS	WL
	91-5S, 91-5D*	√	√	L +VOC	WL
	91-6D	√	√	L + VOC	WL
	91-7S*, 91-7D*	√ +Dup #4 of 91-7D	√	L +VOC	WL
	91-9S*, 91-9D*	√	√	WL	WL

Monitoring Well Locations		Sampled		Sampling Parameters	
		Spring	Summer	Jun-21	Sep-21
	93-1S*, 93-1M*, 93-1D*	√	√	WL	WL
	93-2S*, 93-2M*	√	√	L +VOC	VOC
	93-2D*	√ +Dup #5	√	L +VOC	L +VOC
	93-3S, 93-3D	√ +Dup #6 of 93-3D	√	VOC	WL
	93-4S	√ +Dup #7	√	VOC	VOC
	93-4D*	Broken	Broken	L +VOC	L +VOC
	93-5S*, 93-5D*	√	√	L+ VOC	L +VOC
	93-8S*, 93-8M*	√	√	L+VOC	VOC
	93-8D*	√	√ +Dup#3	L+ VOC	L + VOC
	98-1S, 98-1M, 98-1D*	√	√	WL	WL
	98-2S, 98-2M*	√	√	VOC	WL
	98-2D*	√ +Dup #8	√	VOC + PFAS	WL
	98-3S, 98-3M, 98-3D*	√	√	L +VOC	WL
	98-4S, 98-4M, 98-4D*	√	√	WL	WL
	98-5S, 98-5M, 98-5D*	√	√	L +VOC	WL
	98-6D**	√	√	VOC	WL
	98-7M**	√	√	VOC	WL
	98-9S, 98-9M, 98-9D*	√	√ +Dup#2 of 98-9D	L + VOC	L +VOC
SLUDGE LAGOON WELLS					
	94-1S	Not Located	Not Located	WL	WL
	94-1D	Not Located	Not Located	WL	WL
GAS PIPELINE BEDROCK WELLS					
	93-6	√	√	L	WL
	93-7	Not Located	√ (Leachate sample taken)	L	WL
SOUTH OF HIGHWAY 401					
	99-7S, 99-7M, 99-7D*	√ +Dup #3 of 99-7D	√	VOC	WL
	99-8S, 99-8M,	√	√	VOC	WL

Monitoring Well Locations		Sampled		Sampling Parameters	
		Spring	Summer	Jun-21	Sep-21
	99-8D*	+Dup #1 of 99-8D			
	99-9S, 99-9M, 99-9D*	√ +Dup #2 of 99-9D	√	VOC	WL
	99-10S, 99-10M, 99-10D*	√	√	VOC	WL
	99-11S, 99-11M, 99-10D*	√	√	VOC	WL
LEACHATE COLLECTION SYSTEM MONITOR					
	Leachate	No Sample Collected	√ (S +VOC & PFAS)	S + VOC + PFAS	S +VOC
DOMESTIC WATER SUPPLY WELLS					
	Basten	√	√	S	S
	McGill	√	√	S	S
	Plaschka	√	√	S	S
Trip Blank		√		-	-

Created By: NW
Checked By: KM

Note: * Locations also included in the former landfill, former salvage yard and MOE investigation area monitoring program – only one sample analyzed for both programs

** To be sampled every 5 years. Next event occurs in **spring 2024**

L – Leachate Indicator Parameters

S – Surveillance Parameters

VOC – Volatile Organic compounds

PFAS – Per-and Polyfluoroalkyl Substances + 1,4 dioxane

WL – Water level only

TABLE B2
2021 SURFACE WATER PROGRAM
BROCKVILLE LANDFILL SITE

SW ID	Analysis	Jun-21	Nov-21
SW-1	Leachate	Dry	√ (L)
SW-2	Surveillance	Dry	√ (S)
SW-3	Leachate	Dry	√ (L)
SW-5*	Surveillance +VOC	√ (S + VOC) + Dup #3	√ (S +VOC)
SW-7	Leachate	√ (L) + Dup #1	√ (L)
SW-8*	Leachate	√ (L)	√ (L) + Dup #1
BD-03-M2*	Surveillance	√ (S) + Dup #2	√ (S)
SW100	Leachate	Dry	√ (L)
Field Blank	Routine or Surveillance	--	--

Created: NW
Checked: KM

Notes:

* Locations also included in the former landfill, former salvage yard and MOE investigation area monitoring program – only one sample analyzed for both programs
** FS-1 to FS-10 and FS02-1 to FS02-2 surface water flow
*** SWL-1 and SWL-2 measurements on staff gauges
L – Leachate Indicator Parameters
S – Surveillance Parameters
VOC – Volatile Organic Compounds

TABLE B3
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT OVERBURDEN MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[2] during 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
90-2S (LIP)	dry	dry	▪ decreased after installation of LCS ▪ pre LCS range: 210 to 820 mg/L ▪ post LCS range: 6 to 61 mg/L	▪ on-site monitor (landfill) ▪ downgradient of landfill ▪ groundwater interpreted to reflect remnant landfill leachate effects
90-2M (LIP)	Iron	none	▪ decreased after installation of LCS ▪ pre LCS range: 50 to 570 mg/L ▪ post LCS range: 5 to 110 mg/L	▪ on-site monitor (landfill) ▪ downgradient of landfill ▪ groundwater interpreted to reflect remnant landfill leachate effects
90-3M (SP)	dry	dry	▪ decreased after 1993 ▪ pre 1993 range: 120 to 190 mg/L ▪ post 1993 range: 15 to 130 mg/L	▪ on-site monitor (landfill) ▪ downgradient of landfill ▪ groundwater interpreted to reflect remnant landfill leachate effects
91-6S (background) (SP)	none	none – background monitor	▪ generally similar with a peak in fall 1999 (58.5 mg/L) ▪ historical range[1]: 2.2 to 58.5 mg/L	▪ upgradient of landfill ▪ background monitor

Updated: NW
Checked: KM

Notes:
1. Historical range - includes 2021 data
2. ODWQS - Only the aesthetic objectives and health related standards are considered in this table.
3. LIP - Leachate indicator parameters
4. SP - Surveillance Parameters
5. LCS - Leachate Collection System. LCS was installed at the site in the fall of 1992.

TABLE B4
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
90-2D *Shallow* (LIP)	iron	none	▪ decreased after installation of LCS, generally stable since 1994 ▪ pre-LCS range: 23 to 250 mg/L ▪ post-LCS range: 2 to 43 mg/L	▪ downgradient of and close to landfill ▪ groundwater interpreted not to be impacted by inorganics
90-3D *Deep* (LIP)	iron, TDS	Hardness, TDS, magnesium, strontium	▪ decreased mainly in 1994 ▪ generally stable since 2008 ▪ historical range 59 to 140 mg/L	▪ downgradient of and close to landfill ▪ groundwater interpreted to be impacted by inorganics from the landfill
91-2S *Shallow* (LIP)	Hardness, TDS	chloride, hardness, TDS, magnesium, potassium, strontium	▪ decreased mainly in 1994 ▪ variable concentrations since 1999 ▪ historical range: 36 to 140 mg/L	▪ downgradient of and close to landfill ▪ groundwater interpreted to be impacted by inorganics from the landfill
91-2M *Intermediate* (SP)	TDS	chloride, magnesium, potassium, strontium	▪ variable ▪ generally decreasing trend since 2006 ▪ historical range: <1 to 417 mg/L	▪ same as 91-2S
91-2D *Deep* (LIP)	TDS	chloride, magnesium, potassium, sodium	▪ slightly variable since 2001 ▪ historical range 57 to 260 mg/L	▪ same as 91-2S
Guy Well *Shallow* (SP)	--	--	▪ variable, highest reading in summer 1991, generally stable after 2000 ▪ historical range: 2 to 240 mg/L	▪ likely downgradient of former salvage yard ▪ groundwater historically interpreted not to be impacted by inorganics from the landfill ▪ well decommissioned in 2013

TABLE B4 (continued)
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
91-3S *Shallow* (LIP)	none	Ammonia, chloride, magnesium, potassium, strontium	▪ variable ▪ historical range: 3 to 110 mg/L	▪ likely downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by inorganics from the landfill
91-3M *Shallow* (LIP)	iron, TDS	ammonia, boron, chloride, magnesium, potassium, sodium, strontium, TDS, TKN	▪ variable ▪ historical range: 19 to 170 mg/L	▪ likely downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by inorganics from the landfill
91-3D *Intermediate* (LIP)	none	magnesium,	▪ variable ▪ historical range: 10 to 170 mg/L	▪ same as 91-3S
91-5S *Shallow* (LIP)	none	Chloride, sodium	▪ variable ▪ historical range: 6 to 95 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater historically interpreted to be impacted by inorganics from the landfill

TABLE B4 (continued)
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
91-5D *Deep* (LIP)	Iron, TDS	chloride, sodium	▪ was historically constant but has been elevated since 2016 ▪ historical range: 9.6 to 85 mg/L	▪ downgradient of former salvage yard and possibly downgradient of landfill and former landfill ▪ overall increasing trend in boron and sodium concentrations since 1991 ▪ groundwater interpreted to be impacted by inorganics from the landfill and/or former landfill
91-6D *Shallow* (LIP)	none	magnesium	▪ significant peak in fall 1999, stable since 2000 ▪ historical range: 2.2 to 540 mg/L	▪ possibly downgradient of landfill ▪ groundwater interpreted not to be impacted by inorganics
91-7S *Shallow* (LIP)	iron, TDS	chloride, conductivity, magnesium, sodium, strontium, TDS	▪ variable ▪ historical range: 5 to 340 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by inorganics possibly from the landfill and road salt from Highway 401
91-7D *Shallow* (LIP)	TDS	chloride, conductivity, magnesium, sodium, TDS	▪ variable ▪ historical range: 100 to 420 mg/L	▪ same as 91-7S

TABLE B4 (continued)
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
91-10M *Intermediate* (background) (SP)	iron, manganese	none - background monitor	▪ generally constant with minor variations, elevated in 2011 ▪ historical range: 4 to 29 mg/L	▪ located within the limits of former salvage yard, upgradient of landfill ▪ groundwater interpreted not to be impacted by inorganics
91-10D *Intermediate* (background) (SP)	manganese	none - background monitor	▪ generally constant with minor variations, elevated in 2011 ▪ historical range: 3.8 to 30 mg/L	▪ same as 91-10M
93-2S *Shallow* (LIP)	chloride, sodium	chloride, conductivity, hardness, magnesium, sodium, TDS	▪ increasing trend since 2014 ▪ historical range: 200 to 704 mg/L	▪ not downgradient of landfill or former salvage yard ▪ groundwater interpreted to be impacted by road salt from Hwy 401
93-2M *Intermediate* (LIP)	chloride, sodium, TDS	chloride, conductivity, hardness, magnesium, sodium, TDS	▪ increasing trend since 2014 ▪ historical range: 310 to 703 mg/L	▪ same as 93-2S
93-2D *Deep* (LIP)	chloride, sodium, TDS	boron, chloride, conductivity, magnesium, potassium, sodium, TDS	▪ increasing trend since 2014 ▪ historical range: 64 to 656 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by road salt from Hwy 401
93-3S *Intermediate* (LIP)	none	none	▪ generally constant ▪ historical range: 2.8 to 7 mg/L	▪ likely upgradient of landfill ▪ groundwater historically interpreted to be possibly impacted by an unknown source

TABLE B4 (continued)
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
93-3D *Intermediate* (LIP)	iron	none	▪ generally constant except for peakin fall 1999 (244 mg/L) ▪ historical range: 3.9 to 35 mg/L	▪ likely upgradient of landfill ▪ groundwater interpreted not to be impacted by inorganics
93-4S *Shallow* (LIP)	none	none	▪ increasing trend from 2015 to 2018, now decreasing ▪ historical range: 3.5 to 47 mg/L	▪ likely upgradient of landfill ▪ groundwater interpreted not to be impacted by inorganics ▪ groundwater interpreted to be impacted by road salt from Highway 401
93-4D *Intermediate* (LIP)	n/a	n/a	▪ slight increasing trend since 2015 ▪ historical range: 18 to 150 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by road salt from Highway 401
93-5S *Shallow* (LIP)	iron	ammonia, boron, magnesium, potassium, TKN	▪ generally constant ▪ historical range: 7 to 42 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ increasing trend in some leachate indicator parameters ▪ groundwater interpreted to be impacted by inorganics possibly from the landfill, and road salt from Hwy 401
93-5D *Shallow* (LIP)	iron, TDS	ammonia, boron, magnesium, potassium	▪ generally constant with peak in fall 1995 (390 mg/L) ▪ historical range: 7 to 41 mg/L	▪ same as 93-5S

TABLE B4 (continued)
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
93-8S *Shallow* (LIP)	chloride, sodium, TDS	chloride, conductivity, calcium, hardness, magnesium, potassium, sodium, TDS	▪ large seasonal variations ▪ historical range: 210 to 738 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by road salt from Hwy 401
93-8M *Intermediate* (LIP)	chloride, sodium, TDS	calcium, chloride, conductivity, hardness, magnesium, potassium, sodium, strontium, TDS	▪ variable ▪ historical range: 200 to 768 mg/L	▪ downgradient of former salvage yard, possibly landfill and possibly former landfill ▪ groundwater interpreted to be impacted by road salt from Hwy 401
93-8D *Deep* (LIP)	chloride, iron, sodium, TDS	boron, chloride, conductivity, hardness, magnesium, potassium, sodium, strontium, TDS	▪ increasing trend since 2017 ▪ historical range: 280 to 685 mg/L	▪ downgradient of former salvage yard, possibly landfill and possibly former landfill ▪ groundwater interpreted to be impacted by inorganics from the landfill and/or former landfill and by road salt from Hwy 401
98-3S *Shallow* (LIP)	none	none	▪ peak concentration in fall 1999, stable since 2000 ▪ historical range: 2 to 18.3 mg/L	▪ located within the limits of former salvage yard ▪ groundwater interpreted not to be impacted by inorganics
98-3M *Shallow* (LIP)	none	none	▪ variable ▪ historical range: 2 to 26.4 mg/L	▪ located within the limits of former salvage yard ▪ groundwater historically interpreted to be impacted by inorganics from the former landfill

TABLE B4 (continued)
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-3D *Intermediate* (LIP)	iron	Ammonia, potassium	▪ slight decreasing trend ▪ historical range: 3 to 39 mg/L	▪ located within the limits of former salvage yard, possibly downgradient of former landfill ▪ groundwater interpreted to be impacted by inorganics from the former landfill
98-5S *Shallow* (LIP)	none	none	▪ peak concentration in fall 1999, stable since 2000 ▪ historical range: 5 to 22.9 mg/L	▪ located within the limits of former salvage yard ▪ groundwater interpreted not to be impacted by inorganics
98-5M *Intermediate* (LIP)	none	none	▪ peak concentration in fall 1999, stable since 2000 ▪ historical range: 3 to 25 mg/L	▪ located within the limits of former salvage yard ▪ groundwater interpreted not to be impacted by inorganics
98-5D *Deep* (LIP)	none	Magnesium	▪ slight increasing trend from 2006 to 2013, slight decreasing trend since 2018 ▪ historical range: 9 to 24 mg/L	▪ located within the limits of former salvage yard, also possibly downgradient of landfill and former landfill ▪ groundwater interpreted not to be impacted by inorganics

TABLE B4 (continued)
SUMMARY OF 2021 INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Historical Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-9S *Intermediate* (LIP)	none	ammonia, magnesium	▪ concentration is generally stable, except for elevated concentrations in September 2016 (357 mg/L) and September 2018 (77 mg/L) ▪ historical range: 5 to 357 mg/L	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be possibly impacted by inorganics from the former landfill and road salt from Hwy 401
98-9M *Intermediate* (LIP)	TDS	boron, magnesium, potassium	▪ generally stable since 2009 ▪ historical range: 8 to 26 mg/L	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be possibly impacted by inorganics from the former landfill
98-9D *Deep* (LIP)	TDS	boron, magnesium, sodium	▪ slight decreasing trend since 2009 ▪ historical range: 21 to 79 mg/L	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by inorganics possibly from the former landfill and/or by road salt from Highway 401

Updated: NW
Checked: KM

Notes:
1. ODWQS – Only the aesthetic objectives and health related standards are considered in this table.
2. *Shallow* – monitoring well with screened interval within the shallow flow system
3. *Deep* – monitoring well with screened interval within the deep flow system
4. *Intermediate* – monitoring well with screened interval between the shallow and the deep flow system
5. LIP – Leachate indicator parameters
6. SP – Surveillance Parameters
7. LCS – Leachate Collection System. LCS was installed at the site in the fall of 1992.
8. Historical range – includes 2021 data

TABLE B5
RANGE OF HISTORICAL BACKGROUND OVERBURDEN AND BEDROCK GROUNDWATER QUALITY
BROCKVILLE LANDFILL SITE

Parameter	Ontario Drinking Water Quality Standards (ODWQS)	Range in Background Overburden [1] Apr/91 to June/21	Range in Background Bedrock [2] Nov/91 to Sept/21
Electrical Conductivity (µS/cm)		390 – 850	270 – 1140
Hardness	80-100 (OG)	180 – 490	41 – 490
TDS	500 (AO)	170 – 560	130 – 630
Alkalinity	30-500 (OG)	220 – 1020	151 – 680
Phenols		<0.0010 – 0.021	<0.0005 – 0.0245
BOD		<1 – 5	<0.5 – 7.0
COD		<3 – 190	<5 – 76
TOC		<0.35 – 31	1.8 – 50
TKN		<0.005 – 4.3	<0.05 – 2.90
Ammonia		<0.02 – 0.50	<0.01 – 0.68
Nitrate	10	<0.050 – 8.6	<0.05 – 1.6
Nitrite	1	<0.005 – 0.18	<0.005 – 0.10
Nitrate + Nitrite	10	<0.1 – 2.016	<0.1 – <1.7
Total Phosphorus		<0.10 – 2.10	<0.01 – <1
Dissolved Reactive Phosphorus		<0.01 – 0.13	<0.003 – 0.08
Chloride	250 (AO)	2.0 – 58.5	3.8 – 36
Fluoride	1.5	<0.010 – 0.62	<0.07 – 1.1
Sulphate	500 (AO)	13 – 80	13 – 310
Bromide		<0.05 – <0.5	<0.05 – 0.66
Cyanide	0.2	<0.001 – <0.020	<0.001 – <0.02
Arsenic	0.025	0.0003 – 0.005	<0.0001 – <0.06
Aluminum	0.10 (OG)	<0.01 – 0.28	<0.005 – 0.13
Boron	5.0	<0.005 – 0.07	0.02 – 0.29
Barium	1.0	<0.01 – 0.140	0.06 – 0.732
Beryllium		<0.0001 – <0.01	<0.0005 – <0.010

TABLE B5 (continued)
RANGE OF HISTORICAL BACKGROUND OVERBURDEN AND BEDROCK GROUNDWATER QUALITY
BROCKVILLE LANDFILL SITE

Parameter	Ontario Drinking Water Quality Standards (ODWQS)	Range in Background Overburden [1] Apr/91 to June/21	Range in Background Bedrock [2] Nov/91 to Sept/21
Calcium		54.5 – 130	58 – 170
Cadmium	0.005	<0.00008 – <0.005	<0.00008 – <0.005
Cobalt		<0.0001 – <0.090	<0.0002 – <0.090
Chromium	0.05	<0.001 – <0.020	<0.001 – <0.02
Copper	1.0 (AO)	<0.001 – 0.039	<0.0005 – <0.02
Iron	0.30 (AO)	0.02 – 2.2	<0.03 – 14.1
Lead	0.01	<0.0006 – <0.05	<0.0006 – <0.050
Magnesium		30 – 53	8.5 – 23
Manganese	0.05 (AO)	<0.005 – 0.14	<0.0050 – 3.90
Molybdenum		<0.004 – <0.50	<0.001 – <0.5
Nickel		<0.003 – <0.05	<0.005 – <0.05
Organic Nitrogen	0.15 (OG)	<0.05 – 4.04	0.01 – 2.68
Potassium		<1.00 – 3.1	<1.00 – 3.70
Silver		<0.0001 – 0.085	<0.0001 – <0.02
Sodium	200 (AO)	3.90 – 13.50	<0.01 – 69
Strontium		0.140 – 0.450	0.07 – 1.9
Titanium		<0.003 – 0.050	<0.003 – <0.05
Thallium		<0.00005 – <0.20	<0.00005 – <1.0
Vanadium		<0.001 – <0.01	<0.001 – 0.01
Zinc	5.0 (AO)	0.003 – 0.088	<0.005 – 0.173
Zirconium		<0.001 – <0.10	<0.001 – <0.1

Updated: NW
Checked: KM

Notes:
All units are in milligrams per Litre (mg/L) unless otherwise noted.
1. Overburden background concentrations from monitors 91-6S (2021) and 91-8 (May 1999)
2. Bedrock background concentrations from monitors 91-10M, 91-10D (2021), 91-11S and 91-11D (Sept 1999)
3. (OG) Operational Guideline, (AO) Aesthetic Objective

TABLE B6
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc.(µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
90-3D *Shallow*	30	<0.3, ---	0.2 - <0.5	<0.4, ---	<0.4 - 1	<0.2, ---	<0.5 - 14.6	▪ downgradient of and close to landfill ▪ groundwater interpreted to be impacted by VOCs from the landfill
91-2M *Intermediate*	31	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - 6.6	<0.2, ---	<0.2 - 147	▪ downgradient of and close to landfill ▪ groundwater interpreted to be impacted by VOCs from the landfill
91-2D *Deep*	31	<0.3, ---	<0.1 - <2	**3.8**, ---	<0.4 - 6.8	**16.4**, ---	<0.5 - 186	▪ downgradient of and close to landfill ▪ groundwater interpreted to be impacted by VOCs from the landfill
Guy Well *Shallow*	25	---, ---	<0.1 - <0.5	---, ---	<0.1 - 1	---, ---	<0.2 - 12	▪ likely downgradient of former salvage yard ▪ groundwater historically interpreted to be occasionally impacted by VOCs from the former salvage yard ▪ well decommissioned in 2013
91-3M *Shallow*	31	<0.3, ---	0.2 - <2.5	<0.4, ---	<0.4 - 8.9	<0.2, ---	<0.5 - 222	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or former salvage yard
91-3D *Intermediate*	31	<0.3, ---	<0.1 - 0.6	**1.2**, ---	<0.4 - 3.6	**21.7**, ---	<0.5 - 61.5	▪ likely downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or former salvage yard

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
91-5S *Shallow*	31	**0.7**, ---	0.8 - 5.3	**1.9**, ---	<0.4 - 5.2	<0.2, ---	<0.2 - 10.4	▪ downgradient of former salvage yard and possibly downgradient of landfill ▪ groundwater interpreted to be impactedby VOCs from former salvage yard and possibly the landfill
91-5D *Deep*	31	**0.6**, ---	<0.5 - 12.5	**6.2**, ---	<0.4 - 6.9	**0.2**, ---	<0.2 - 18.4	▪ downgradient of former salvage yard and possibly downgradient of landfill and/or former landfill ▪ groundwater interpreted to be impactedby VOCs from former salvage yard andpossibly the landfill and/or former landfill
91-6D *Shallow*	23	<0.3, ---	<0.1 - 0.3	<0.4, ---	<0.1 - <0.4	<0.2, ---	<0.2 - 3.4	▪ potentially upgradient of landfill ▪ groundwater interpreted to be impactedby VOCs possibly from the landfill
91-7S *Shallow*	30	<0.3, ---	<0.3 - 1.1	<0.4, ---	<0.4 - 4.2	<0.2, ---	<0.2 - 133	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby VOCs possibly from the landfill and/or former salvage yard
91-7D *Shallow*	31	<0.3, ---	<0.3 - 1	<0.4, ---	<0.4 - 2.6	<0.2, ---	<0.2 - 21.5	▪ same as 91-7S

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
91-10M *Intermediate*	30	<0.3, ---	<0.3 - 7	**0.8**, ---	<0.4 - 2.8	<0.2, ---	<0.2 - 24.3	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard
91-10D *Intermediate*	30	**6.7**, ---	3.4 - 10.7	**2.3**, ---	<0.4 - 2.4	<0.2, ---	<0.2 - 3.4	▪ same as 91-10M
93-2S *Shallow*	5	<0.3, <0.3	<0.1 - <0.5	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <0.86	▪ not downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
93-2M *Intermediate*	50	<0.3, <0.3	<0.1 - <0.5	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <1	▪ same as 93-2S
93-2D *Deep*	49	<0.3, <0.3	<0.1 - 0.7	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - 1.9	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby VOCs possibly from the landfill and/or former salvage yard
93-3S *Intermediate*	24	<0.3, ---	<0.1 - 0.4	<0.4, ---	<0.1 - <0.4	<0.2, ---	<0.2 - 0.5	▪ potentially downgradient of landfill ▪ groundwater interpreted to be possibly impacted by VOCs from the landfill ▪ VC was detected (0.5 µg/L) in 2003,and TCE was detected (0.4 µg/L) in 2009, only

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
93-3D *Intermediate*	23	<0.3, ---	<0.1 - 0.4	<0.4, ---	<0.1 - <0.4	<0.2, ---	<0.2 - <0.5	▪ potentially downgradient of landfill ▪ groundwater interpreted to be possibly impacted by VOCs from the landfill ▪ VC was detected for the first time (0.3 µg/L) in 2007, and TCE was detected (0.4 µg/L) in 2009, only
93-4S *Shallow*	45	<0.3, <0.3	<0.1 - 0.6	<0.4, <0.4	<0.1 - <0.4	<0.2, <0.2	<0.2 - <0.5	▪ likely upgradient of landfill ▪ groundwater interpreted not to be impacted by VOCs
93-4D *Intermediate*	45	---,---	<0.1 - 0.6	---,---	<0.1 - <0.4	---,---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ VOCs not detected from 2000 to 2016 except for low detection of VC in summer 2006 and TCE in 2009 ▪ groundwater interpreted to be possibly impacted by VOCs from the landfill and former salvage yard
93-5S *Shallow*	52	**1.2**, **1.0**	<0.3 - 4.6	**0.8**, <0.4	0.2 - 5.7	**2.0, 0.5**	<0.2 - 12.3	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby VOCs possibly from the landfill and/or salvage yard
93-5D *Shallow*	52	**0.8**, <0.3	<0.3 - 2.6	**0.6**, <0.4	<0.4 - 2.3	<0.2, <0.2	<0.2 - 7.2	▪ same as 93-5S

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
93-8S *Shallow*	49	<0.3, <0.3	0.1 - 0.6	<0.4, <0.4	0.3 - <1	<0.2, <0.2	<0.2 - 1	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby VOCs possibly from the landfill and/or salvage yard
93-8M *Intermediate*	49	<0.3, <0.3	0.2 - 0.8	<0.4, <0.4	0.2 - <1	<0.2, <0.2	<0.2 - 3.5	▪ downgradient of former salvage yard, and possibly the landfill and former landfill ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard and/or possibly the landfill and former landfill
93-8D *Deep*	49	<0.3, <0.3	0.2 - 0.9	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - 0.9	▪ downgradient of former salvage yard, and possibly the landfill and former landfill ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard and/or possibly the landfill and former landfill
94-1S *Intermediate*	6	---, ---	<0.1 - <0.3	---, ---	<0.1 - <0.4	---, ---	<0.2 - <0.5	▪ located just to the north-west of the former location of the sludge lagoons; not sampled after 2005 ▪ not impacted by VOCs
94-1D *Intermediate*	6	---, ---	<0.1 - <0.3	---, ---	<0.1 - <0.4	---, ---	<0.2 - <0.5	▪ located just to the east of sludge lagoons; not sampled after 2005 ▪ not impacted by VOCs

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-2S *Shallow*	10	**33.3**, ---	7.1 - 160	**6.1**, ---	<0.5 – 7.1	<0.2, ---	<0.2 - <0.5	▪ located near the limits of former salvage yard, downgradient of formersalvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard and/or possibly the former landfill
98-2M *Shallow*	10	**44.8**, ---	15.4 - 160	**31.8**, ---	0.9 – 15.4	<0.2, ---	0.4 – 7.2	▪ located near the limits of former salvage yard, downgradient of formersalvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard and/or possibly the former landfill
98-2D *Intermediate*	26	<0.3, ---	<0.3 - 120	<0.4, ---	<0.4 - 48	**128**, ---	<0.2 - 175	▪ located near the limits of former salvage yard, downgradient of formersalvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard and/or possibly the former landfill

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-3S *Shallow*	26	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be possibly impacted by VOCs from the former salvage yard
98-3M *Shallow*	26	**0.9**, ---	<0.3 - 3.9	<0.4, ---	0.3 - <1	<0.2, ---	<0.2 - 3.8	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard
98-3D *Intermediate*	26	**0.8**, ---	<0.3 - 3.5	<0.4, ---	0.3 - 6.6	<0.2, ---	<0.2 - 17	▪ located within the limits of former salvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard and/or former landfill
98-5S *Shallow*	26	**1.2**, ---	<0.3 - 2.8	<0.4, ---	<0.4 - <1	<0.2, ---	<0.2 - 0.7	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard
98-5M *Intermediate*	26	<0.3, ---	<0.3 - 3.5	<0.4, ---	<0.1 - 1.2	<0.2, ---	<0.2 - <0.5	▪ same as 98-5S

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-5D *Deep*	26	<0.3, ---	<0.3 - 15	**11**, ---	<0.4 - 10.8	<0.2, ---	<0.2 - 21.9	▪ located within the limits of former salvage yard, also possibly downgradient of landfill and the formerlandfill ▪ groundwater interpreted to be impactedby VOCs from the former salvage yard and/or possibly from the landfill and/or the former landfill
98-9S *Intermediate*	48	<0.3, ---	0.1 - 0.7	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be possibly impacted by VOCs from the former landfill and/or former salvage yard
98-9M *Intermediate*	48	**0.3**, <0.3	<0.3 - 1.4	**0.5**, <0.4	<0.4 - 2	<0.2, <0.2	<0.2 - 15	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impactedby VOCs possibly from the former landfill and/or former salvage yard
98-9D *Deep*	48	**0.3**, 1.7	0.8 - 6.1	**0.4**, <0.4	<0.4 - 7.3	<0.2, **5.3**	<0.2 - 29	▪ same as 98-9M
99-7S *Shallow*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
99-7M	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ same as 99-7S
99-7D	23	<0.3, ---	<0.1-1.2	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 – 0.5	▪ same as 99-7S

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-7D *Deep*	23	<0.3, ---	<0.1 - 1.2	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard, and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-8S *Shallow*	23	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-8M *Intermediate*	14	<0.3, ---	<0.3 - <0.5	<0.4, ---	<0.4 - <1	<0.2, ---	<0.2 - <0.5	▪ not impacted by VOCs
99-8D *Deep*	21	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-9S *Shallow*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
99-9M *Intermediate*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ same as 99-9S
99-9D *Deep*	23	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard, and former landfill ▪ groundwater interpreted not to be impacted by VOCs

TABLE B6 (continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORS
BROCKVILLE LANDFILL SITE

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-10S *Shallow*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
99-10M *Intermediate*	23	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
99-10D *Deep*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-11S *Deep*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 – 2.5	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-11M *Deep*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-11D *Deep*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs

Notes:
Bold – exceeds detection limits

Updated: NW
Checked: KM

1. Historical range –includes 2021 data
2. *Shallow* – monitoring well with screened interval within the shallow flow system
3. *Deep* – monitoring well with screened interval within the deep flow system
4. *Intermediate* – monitoring well with screened interval between the shallow and the deep flow system
5. TCE – Trichloroethene
6. c-DCE – cis-1,2 Dichloroethene
7. VC – Vinyl Chloride
8. --- Monitor not sampled (not included in summer monitoring program)

TABLE B7

SUMMARY OF 2021 INORGANIC SURFACE WATER QUALITY
BROCKVILLE LANDFILL SITE

Surface Water Monitoring Location	Parameters Not Meeting PWQOin 2021	Leachate Indicator Parameters Exceeding 75% Percentile Background Levels in 2021	Chloride Trends Over Time (Refer to Appendix 11)	Interpretation
SW-1 (LIP)	none	alkalinity, conductivity, hardness, calcium, magnesium	▪ decreased after installation of LCS, now generally constant ▪ pre LCS range: 2.1 to 106 mg/L ▪ post LCS range: <1 to 7.4 mg/L ▪ 2021 concentrations: 1 mg/L	▪ upstream from landfill ▪ surface water interpreted not to be impacted by inorganics from the landfill
SW-2 (background) (SP)	none	alkalinity, conductivity, hardness, calcium, magnesium, strontium	▪ previously variable, generally stable since 2015 ▪ historical range: <1 to 35 mg/L ▪ 2021 concentrations: 15 mg/L	▪ upstream from landfill ▪ surface water interpreted not to be impacted by inorganics from the landfill
SW-3 (LIP)	Iron	alkalinity, COD, chloride, hardness, TKN, conductivity, iron, potassium, sodium, turbidity	▪ decreased after installation of LCS, now generally constant ▪ pre LCS range: 223 to 1195 mg/L ▪ post LCS range: 1 to 120 mg/L ▪ 2021 concentrations: 28 mg/L	▪ in swamp located on the east side of landfill, east of LCS ▪ impacted by landfill prior to installationof LCS ▪ significant decline in concentration of LIPs following construction of LCS ▪ surface water historically interpreted tobe impacted by inorganics from the landfill

TABLE B7 (continued)

SUMMARY OF 2021 INORGANIC SURFACE WATER QUALITY
BROCKVILLE LANDFILL SITE

Surface Water Monitoring Location	Parameters Not Meeting PWQOin 2021	Leachate Indicator Parameters Exceeding 75% Percentile Background Levels in 2021	Chloride Trends Over Time (Refer to Appendix 11)	Interpretation
SW-5 (SP)	dissolved oxygen, iron, phenols	alkalinity, COD, BOD, chloride,colour, conductivity, TKN, calcium, hardness, magnesium, potassium, sodium, strontium, dissolved iron	▪ decreased after installation of LCS, now generally constant ▪ pre LCS range: 29 to 350 mg/L ▪ post LCS range: 0.21 to 165 mg/L ▪ 2021 concentrations: 74, 23mg/L	▪ downstream of landfill, former landfill and former salvage yard, close to Parkedale Avenue, south/east of LCS pumping station ▪ decline in concentration of LIPs following construction of LCS ▪ surface water interpreted to be impacted by inorganics from the former landfill, the landfill and possibly by the golf course and road salt.
SW-7 (LIP)	none	TKN	▪ slight increasing trend since 2018 ▪ historical range: 2 to 12 mg/L ▪ 2021 concentrations: 6, 6 mg/L	▪ in pond west of landfill and north of former landfill ▪ surface water interpreted to be not impacted by inorganics from the landfill
SW-8 (LIP)	iron	COD, chloride,colour, conductivity, hardness, TKN, magnesium, potassium, sodium, dissolved iron	▪ decreased after installation of LCS, generally constant with minor variations ▪ pre LCS range: 33 to 240 mg/L ▪ post LCS range: 0.26 to 91 mg/L ▪ 2021 concentrations: 6, 26 mg/L	▪ halfway south in Grant's Creek in golf course, downstream from landfill, former landfill and former salvage yard ▪ improvement in general water quality after installation of LCS ▪ surface water interpreted to be impacted by inorganics from the formerlandfill, the landfill, possibly by road saltfrom Parkedale Avenue and the Golf Course

TABLE B7 (continued)

SUMMARY OF 2021 INORGANIC SURFACE WATER QUALITY
BROCKVILLE LANDFILL SITE

Surface Water Monitoring Location	Parameters Not Meeting PWQOin 2021	Leachate Indicator Parameters Exceeding 75% Percentile Background Levels in 2021	Chloride Trends Over Time (Refer to Appendix 11)	Interpretation
BD-03-M2 (SP)	iron, total phosphorus	ammonia, COD, chloride, colour, conductivity, hardness, TKN, phosphorus, dissolved iron, magnesium, potassium, sodium, strontium, turbidity	▪ decreased after installation of LCS, now variable ▪ pre LCS range: 39 to 201 mg/L ▪ post LCS range: 13 to 664 mg/L ▪ 2021 concentrations: 85, 43 mg/L	▪ farthest south in Grant's Creek in golf course, downstream from landfill, former landfill and former salvage yard ▪ improvement in general water quality after installation of LCS ▪ surface water interpreted to be impacted by inorganics from the formerlandfill, the landfill and possibly by the Golf Course and road salt from Parkedale Avenue/ Highway 401
SW-100 (LIP)	iron	alkalinity, ammonia, COD, chloride, conductivity, hardness, boron, calcium, iron, dissolved iron, magnesium, potassium, sodium strontium, turbidity	N/A	▪ Ditch located near the southwest cornerof the landfill ▪ Sampled for the first time in fall 2018

Notes:

1. LIP - Leachate Indicator Parameters
2. SP - Surveillance Parameter
3. LCS - Leachate Collection System. LCS was installed at the site in the fall of 1992
4. Historical or Post LCS range – includes 2021 data

Updated: NW
Checked: KM

TABLE B8
SUMMARY OF 2021 VOLATILE ORGANIC COMPOUNDS IN SURFACE WATER
BROCKVILLE LANDFILL SITE

Surface Water Monitoring Station	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Interpretation (Based on 2021 and Historical Data)
SW-5	66	<0.3, <0.3	<0.1 - <0.5	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <2	▪ downstream of former landfill, former salvage yard and landfill ▪ interpreted not to be impacted by VOCs

Updated: NW
Checked: KM

Notes:
1. Historical range - includes 2021 data
2. TCE - Trichloroethene
3. c-DCE - cis-1,2, Dichloroethene
4. VC - Vinyl Chloride

TABLE B9

CONCENTRATIONS OF LEACHATE INDICATOR PARAMETERS AND OTHER SELECTED PARAMETERSIN BACKGROUND SURFACE WATER (LOCATION SW-2)

Parameter	Provincial Water Quality Objectives (PWQO)	Range in Values Apr./90 to Nov./21	75th Percentile Concentration Apr/90 to Nov/21
Electrical Conductivity (µS/cm)		215 – 774	472
Hardness		158 – 360	238
Alkalinity	Decrease <25% (65)	87 – 329	241
Turbidity (NTU)	<10% change to Secchi disc reading (0.27-14.3)	0.2 – >100	2
Colour (TCU)		<2 – 80	35
Phenols	0.001	<0.0005 – 0.002	0.001
BOD		<0.5 – 49	2
COD		<5.0 – 34	20
TKN		<0.05 – 9.64	0.4
Ammonia		<0.02 – 5.30	0.13
Unionized Ammonia	0.020	<0.00001 – 0.081	0.0005
Chloride		<1 – 35	20
Cyanide (free)	0.005	<0.001 – 0.010	
Aluminum	0.075	<0.005 – 0.48	
Boron	0.200	<0.010 – 0.95	0.035
Barium		0.01 – 1.26	
Calcium		40 – 88	63
Cadmium	0.0005 (hardness>100)	<0.00006 – 0.0035	
Chromium	0.001 Cr VI 0.0089 Cr III	<0.001 – 0.02 (Cr total)	
Copper	0.005 (hardness>20)	0.0006 – 0.044	
Iron	0.3	<0.01 – 3.94	
Dissolved Iron	0.3	<0.03 – 0.03	
Cobalt	0.0009	<0.0001 – <0.05	
Phosphorus (total)	0.03	<0.01 – 1.1	
Lead	0.005	<0.0005 – 0.012	
Zirconium	0.004	<0.001 – <0.1	
Silver	0.0001	<0.00005 – 0.011	
Nickel	0.025	<0.001 – 0.03	
Magnesium		14 – 34	20
Potassium		0.64 – 7.8	1
Sodium		1 – 23	15.5
Strontium		0.028 – 0.57	0.14
Vanadium	0.006	<0.0002 – 0.04	0.002
Zinc	0.020	<0.002 – 0.31	0.04

Updated: NW
Checked: KM

Notes: All units are provided in milligrams per Litre (mg/L).

TABLE B10

COMBUSTIBLE GAS MEASUREMENTS, 1994 TO 2005

Date	Combustible Gas Concentration		
	90-2S	90-3S	90-4S
May 10/94	100 % LEL	160	0
Sept.14/94	4 % LEL	130	30
Dec 1/94	6%	100	0
April 17/95	NM	NM	NM
Sept. 12/95	150	0	NA
Nov 20/95	150	0	NA
May 6/96	175	200	NA
Sept. 27/96	0	4	NA
Dec 11/96	2	0	NA
May 1/97	1.0 % LEL	0	NA
Sept. 22/97	430	450	NA
Dec 2/97	32 % LEL	325	NA
May 8/98	105	2 % LEL	NA
Sept. 21/98	55	30	NA
Dec. 8/98	60	85	NA
May 11/99	0	10	NA
Sept. 29/99	60	29	NA
Dec. 13/99	65	75	NA
May 30/00	10% LEL	10% LEL	NA
Sept. 18/00	150	200	NA
Dec. 7/00	840	864	NA
May 7/01	960	NM	NA
Sept. 11/01	75	100	NA
Dec. 7/01	28	39	NA
May 10/02	75	55	NA
Sept. 13/02	50	15	NA
Nov. 11/02	45	60	NA
May 3 /03	38	0	NA
Sept. 18/03	30	0	NA
Nov. 24/03	15	NA	NA
Apr. 6/04	20	NA	NA
Sept. 25/04	25	NA	NA
Nov. 28/04	15	NA	NA
Apr. 18/05	65	NA	NA
Sept. 25/05	25	NA	NA
Dec. 6/05	60	NA	NA

Notes:

1. All measurements were taken using a Gastechtor model 1314 and are reported inparts per million (relative to methane), unless otherwise noted.
2. "% LEL" = percent of Lower Explosive Limit relative to methane
3. NA indicates measurement not available (due to blocked monitoring well)

Table courtesy of Golder Associates Ltd.

TABLE B11
2022 GROUNDWATER SAMPLING PROGRAM
BROCKVILLE LANDFILL SITE

Monitoring Well Locations		Sampling Parameters	
		Spring	Summer
Background	91-6S	S	WL
	91-8	WL	WL
On-site	90-2S	L	WL
	90-2M	L	WL
	90-3M	S	WL
BEDROCK WELLS			
Background	91-10M*	S +VOC	WL
	91-10D*	S +VOC	WL
	91-11S*	WL	WL
	91-11D*	WL	WL
On-Site	B-1S	WL	WL
	B-1D	WL	WL
	B-2M	WL	WL
	B-2D	WL	WL
	B-3M	WL	WL
	B-3D	WL	WL
	90-2D	L	WL
	90-3D	L +VOC	WL
	91-2S	L	WL
	91-2M	S+ VOC	WL
	91-2D	L +VOC	WL
	91-3S*	L	WL
	91-3M*	L +VOC	WL
	91-3D*	L +VOC +PFAS	WL
	91-5S, 91-5D*	L +VOC	WL
	91-6D	L + VOC	WL
	91-7S*, 91-7D*	L +VOC	WL
	91-9S*, 91-9D*	WL	WL
	93-1S*, 93-1M*, 93-1D*	WL	WL
	93-2S*, 93-2M*	L +VOC	VOC
	93-2D*	L +VOC	L +VOC
	93-3S, 93-3D	VOC	WL
	93-4S	VOC	VOC
	93-4D*	L +VOC	L +VOC
	93-5S*, 93-5D*	L+ VOC	L +VOC
	93-8S*, 93-8M*	L+VOC	VOC
	93-8D*	L+ VOC	L + VOC
	98-1S, 98-1M,	WL	WL

Monitoring Well Locations		Sampling Parameters	
		Spring	Summer
	98-1D*		
	98-2S, 98-2M*	VOC	WL
	98-2D*	VOC + PFAS	WL
	98-3S, 98-3M, 98-3D*	L +VOC	WL
	98-4S, 98-4M, 98-4D*	WL	WL
	98-5S, 98-5M, 98-5D*	L +VOC	WL
	98-6D**	VOC	WL
	98-7M**	VOC	WL
	98-9S, 98-9M, 98-9D*	L + VOC	L +VOC
SLUDGE LAGOON WELLS			
	94-1S	WL	WL
	94-1D	WL	WL
GAS PIPELINE BEDROCK WELLS			
	93-6	L	WL
	93-7	L	WL
SOUTH OF HIGHWAY 401			
	99-7S, 99-7M, 99-7D*	VOC	WL
	99-8S, 99-8M, 99-8D*	VOC	WL
	99-9S, 99-9M, 99-9D*	VOC	WL
	99-10S, 99-10M, 99-10D*	VOC	WL
	99-11S, 99-11M, 99-10D*	VOC	WL
	Leachate	S + VOC + PFAS	S +VOC
	Basten	S	S
	McGill	S	S
	Plaschka	S	S
Trip Blank		-	-

Created By: KM

Note: * Locations also included in the former landfill, former salvage yard and MOE investigation area monitoring program
- only one sample analyzed for both programs

** To be sampled every 5 years. Next event occurs in **spring 2024**

L – Leachate Indicator Parameters

S – Surveillance Parameters

VOC – Volatile Organic compounds

PFAS – Per-and Polyfluoroalkyl Substances + 1,4 dioxane

WL – Water level only

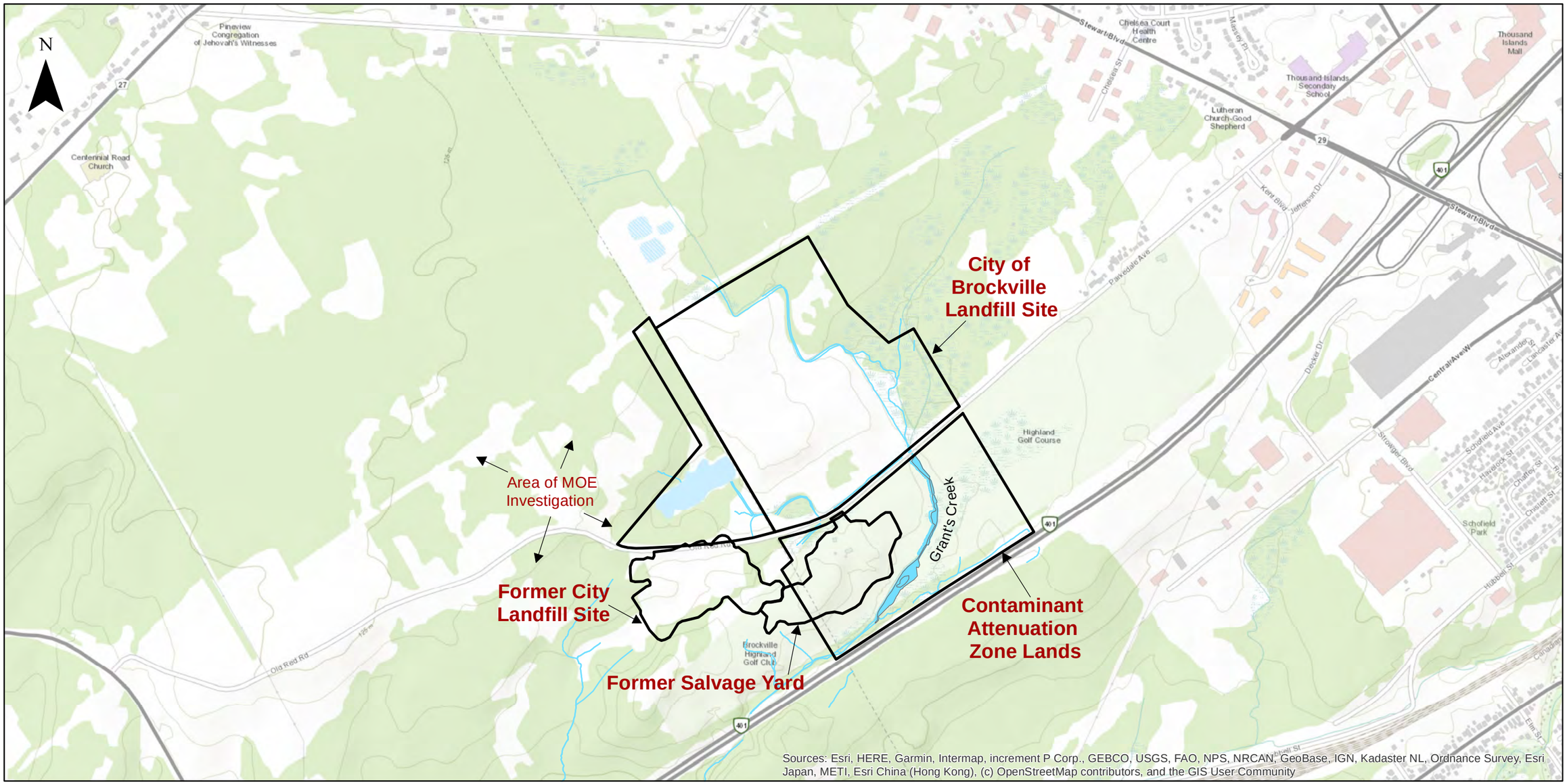
TABLE B12
2022 SURFACE WATER PROGRAM
BROCKVILLE LANDFILL SITE

SW ID	Spring	Fall	UTM East	UTM North
SW-1	L	L		
SW-2	S	S		
SW-3	L	L		
SW-5*	S + VOC	S + VOC		
SW-7	L	L		
SW-8*	L	L		
BD-03-M2*	S	S		
SW100	L	L		
Field Blank	--	--		

Created: KM

Notes:

* Locations also included in the former landfill, former salvage yard and MOE investigation area monitoring program – only one sample analyzed for both programs
** FS-1 to FS-10 and FS02-1 to FS02-2 surface water flow
*** SWL-1 and SWL-2 measurements on staff gauges
L – Leachate Indicator Parameters
S – Surveillance Parameters
VOC – Volatile Organic Compounds



Notes:
1. BASE PLAN FROM LAND INFORMATION ONTARIO
2. SITE BOUNDARIES FROM GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058

0 0.25 0.5 1 Kilometers

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

Brockville Landfill Site

Brockville, ON

1:10,000	Figure B1- Key Map
	Drawn By: HV
Project No. 21-6149B	Checked by: KM
	Date: June 2022

441500 441750 442000 442250 442500 442750 443000 443250 443500 443750

4938500 4938250 4938000 4937750 4937500 4937250 4937000 4936750

94-1 94-2 SW-1 93-6 FS-1 FS-2 93-7 88-19 90-1 91-1 FS-3 FS-4 SW-2 SW-3 SWL-1 AH.105 B-2 B-1 BH.92-1 BH.92-4 FS-9 FS-10 SW-5 BH.90-4 BH.92-5 BH.92-7 88-6 BH.90-4A BH.92-9 GUY-WELL 91-2 BH.90-3A 90-3 90-5 91-8 91-6 91-3 88-11 SWL-2 SW-7 B-3 FS-5 88-14 88-16 FS-7 FS-8 SW-100 TROW BH.90-2A FS-6 (New) SW-6 FS-6 (Filled in) 91-9 91-4 93-1 93-3 93-4 SW98-1 91-11 98-2 91-10 91-7 SW-8 98-1 98-4 98-5 91-5 93-2D 93-8 99-10 99-7 98-7 98-6 98-3 93-5 BD-03-M2 SW02-1 98-8 98-9 99-9 99-3 SW99-6 99-5 SW04-1 99-4 99-8 99-11 SW99-3 SW99-2 00-2 SW00-1 00-3 00-1 99-6 FS02-2 FS02-1 SW99-4 SW03-1 99-2 SW99-5 99-1 SW99-1 MW-1 MW-2 MW-3 MW-4 MW-5 AREA OF HOE INVESTIGATION

PARKEDALE AVE

CENTRAL AVE W

OLD RED ROAD

HIGHWAY NO. 401

COUNTY ROAD 46

LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- STAFF GAUGE
- FLOW STATION LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

SITE PLAN

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

PROJECT NO.	21-6149B	YYYY-MM-DD	5/27/2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
B2

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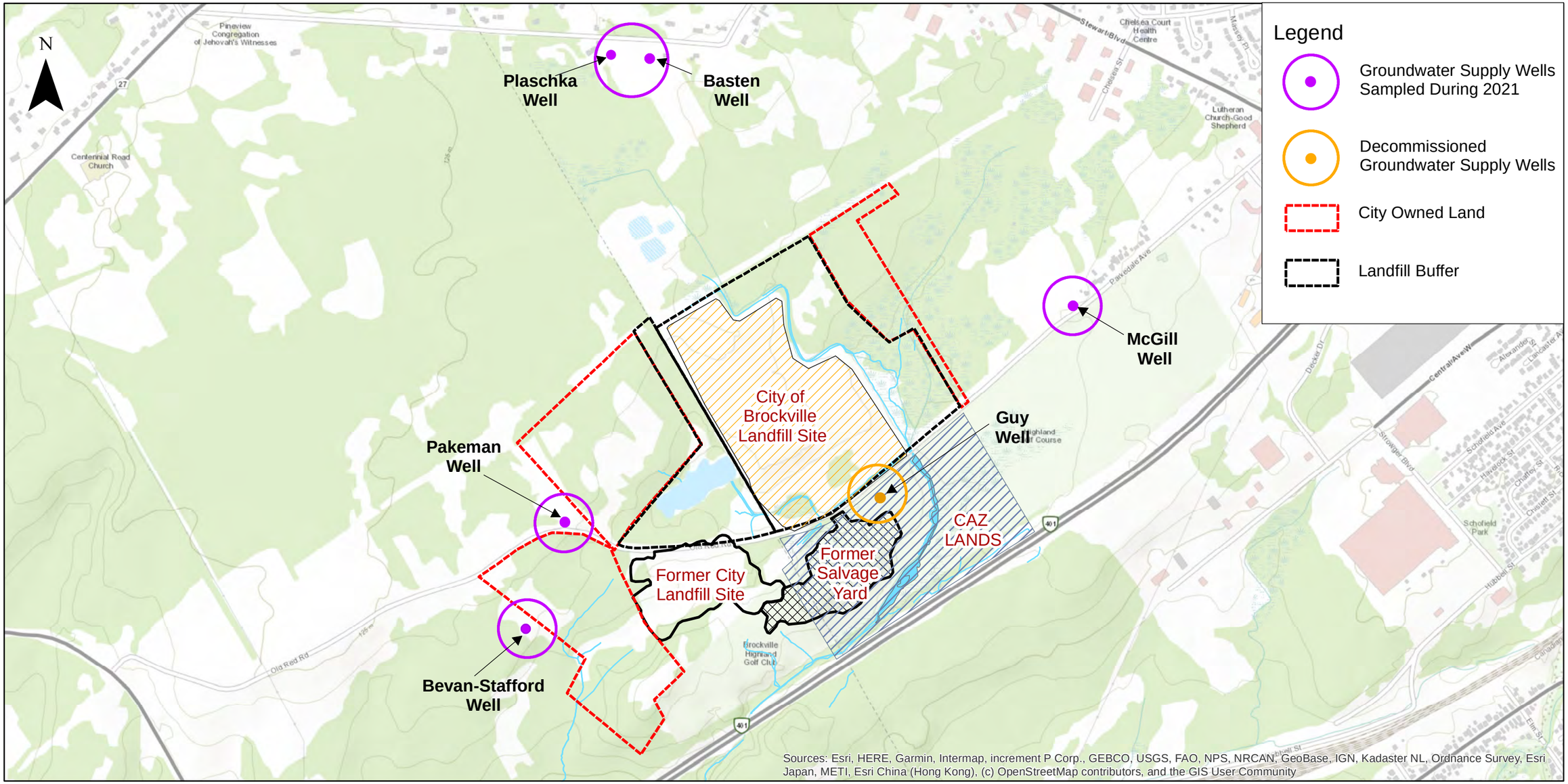

Notes:
1. BASE PLAN FROM LAND INFORMATION ONTARIO
2. SITE BOUNDARIES FROM GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058

0 0.25 0.5 1 Kilometers

Jp2g Consultants Inc.
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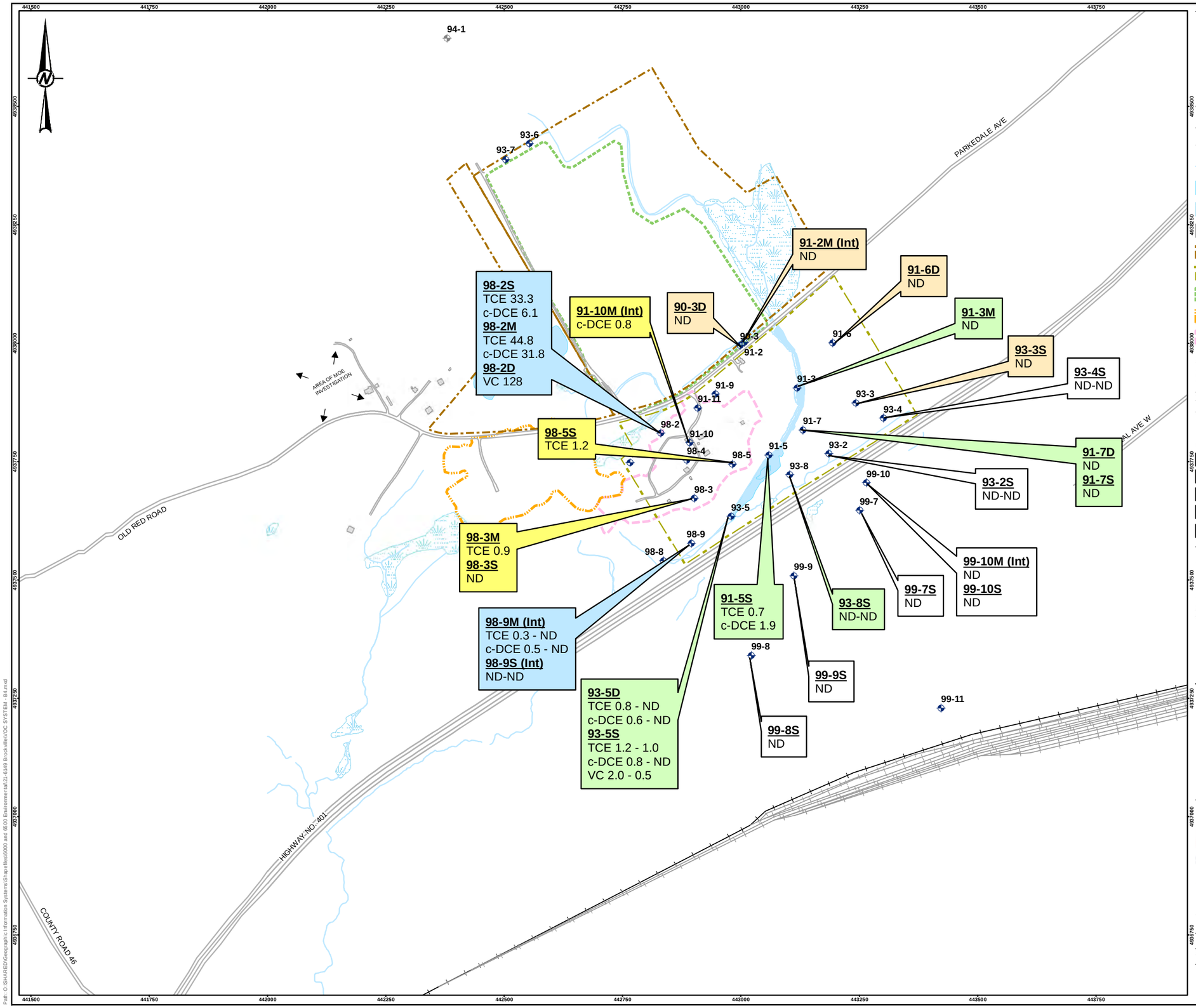
Brockville Landfill Site

Brockville, ON

1:10,000	Figure B3- Location of Sampled Domestic Wells
	Drawn By: HV
Project No. 21-6149B	Checked by: KM
	Date: June 2022



Path: O:\SHARED\Geographic Information Systems\Shapefiles\6000 and 6100 Environmental\21-6149 Brockville\VOC SYSTEM - B4.mxd

LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

2021 GROUNDWATER ANALYSIS RESULTS
UNITS = MICROGRAMS PER LITER (ug/L)
(Int) - INTERMEDIATE FLOW SYSTEM MONITOR

VC	Vinyl Chloride
TCE	Trichloroethylene
c-DCE	cis 1,2 - Dichloroethylene
ND	Not Detected (below lab detection limits)

IMPACTED OR POSSIBLY IMPACTED BY:

- LANDFILL
- FORMER SALVAGE YARD
- LANDFILL AND FORMER SALVAGE YARD
- FORMER LANDFILL AND FORMER SLAVAGE YARD
- NOT IMPACTED

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

2021 VOC IN SHALLOW BEDROCK GROUNDWATER FLOW SYSTEM

Jp2g Consultants Inc.
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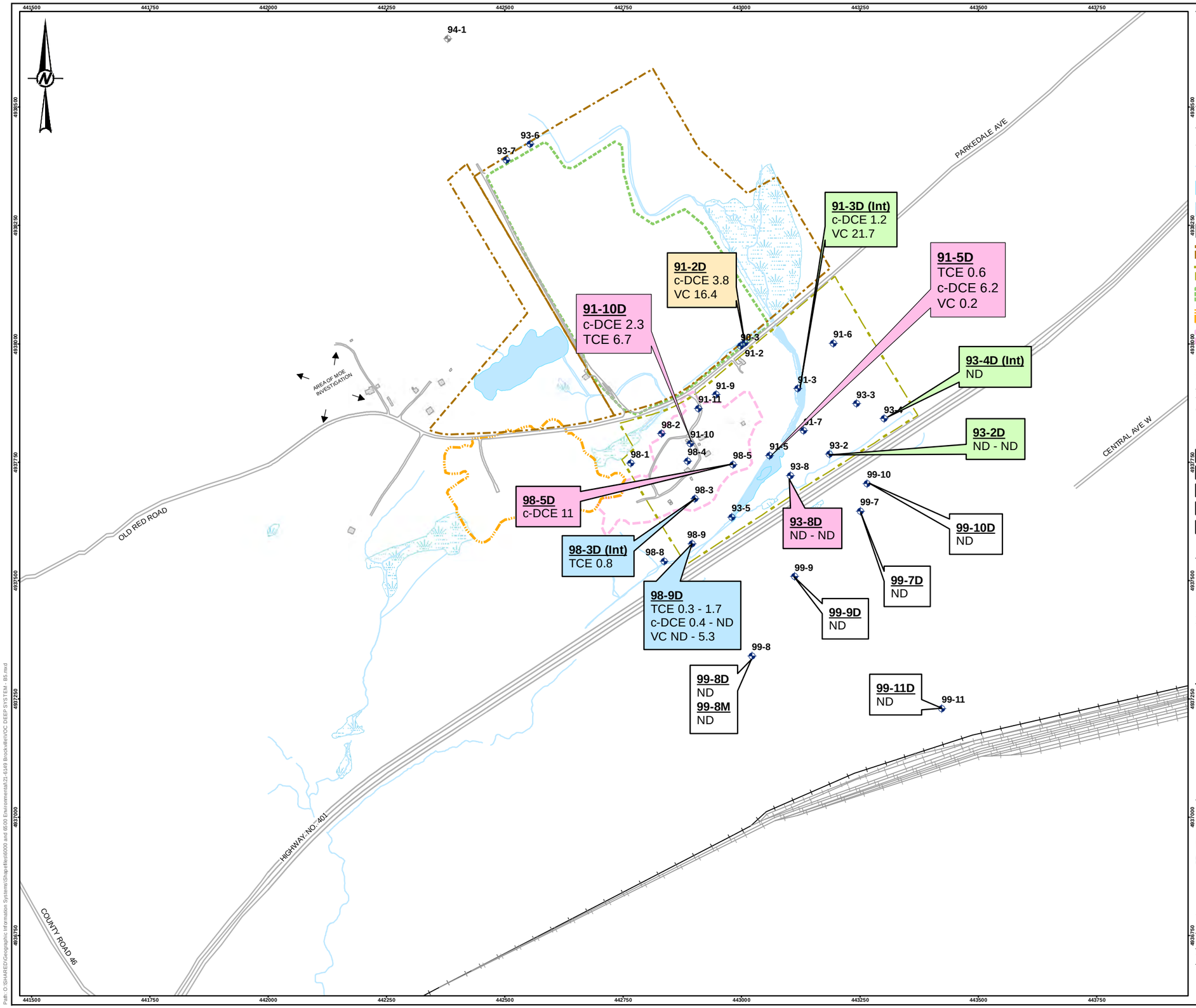
PROJECT NO.	21-6149B	YYYY-MM-DD	06-14-2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
B4



LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

2021 GROUNDWATER ANALYSIS RESULTS
UNITS = MICROGRAMS PER LITER (ug/L)
(Int) - INTERMEDIATE FLOW SYSTEM MONITOR

VC Vinyl Chloride
TCE Trichloroethylene
c-DCE cis 1,2 - Dichloroethylene
ND Not Detected (below lab detection limits)

IMPACTED OR POSSIBLY IMPACTED BY:

- LANDFILL
- FORMER SALVAGE YARD
- LANDFILL AND FORMER SALVAGE YARD
- FORMER LANDFILL AND FORMER SLAVAGE YARD
- NOT IMPACTED

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

2021 VOC IN DEEP BEDROCK GROUNDWATER FLOW SYSTEM

Jp2g Consultants Inc.
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PROJECT NO.	21-6149B	YYYY-MM-DD	06-14-2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
B5

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Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

REPORT – PART C

2021 MONITORING

City of Brockville Landfill Site

Former City Landfill, Former Salvage Yard and MOE Investigation Area

Submitted by:

Jp2g Consultants Inc.
1150 Morrison Drive, Suite 410
Ottawa, ON K2H 8S9
T613.828.7800|F613.828.2600
Jp2g Project No. 21-6149A

Submitted to:

City of Brockville
1 King Street West
Brockville, ON K8V 7A5

PART C

2021 Monitoring
Former City Landfill, Former Salvage Yard and MOE Investigation Area

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

REPORT – PART C

2021 Monitoring

Former City Landfill, Former Salvage Yard, MOE Investigation Area

Submitted by:
Jp2g Consultants Inc.
1150 Morrison Drive, Suite 410
Ottawa, ON K2H 8S9

21-6149B

May 2022

Table of Contents

TABLES

FIGURES

APPENDICES (Provided on USB Flash Drive in Volume 2)

1.0 INTRODUCTION

In 2021, Jp2g Consultants Inc. (Jp2g) carried out surface water, groundwater and leachate collection systemmonitoring at the Brockville Landfill Site, on the contaminant attenuation zone (CAZ) lands, at the former City Landfill, at the former salvage yard and in the area of the 1990 Ministry of Environment (MOE) investigation.The Brockville Landfill Site is located on part of Lot 16and17, Concession 2 within the Brockville city limits shown on **Figure C1**. A site plan of the Brockville Landfill Site and surrounding area and relevant monitoring locations is presented as **Figure C2**.

Part C of this report presents the results and interpretation of the 2021 environmental monitoring (groundwater and surface water monitoring) at the former City Landfill, at the former salvage yard and in the area of the MOE investigation.

2.0 2021 MONITORING PROGRAM

All 2021 monitoring activities were carried out by Jp2g technical field staff. **Tables C1and C2** list the monitoring locations that were part of former City Landfill, the former salvage yard and in the area of the 1990 MOE investigation, rather than monitoring of the Brockville Landfill Site (see Part B for information regarding the Brockville Landfill Site monitoring program).

All surface water and groundwater inorganic and VOC samples were analyzed by Eurofins Environment Testingof Ottawa, Ontario. Groundwater sampled for per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane wereanalyzed by Eurofins Environment Testing Lancaster Pennsylvania.

The method detection limits (MDLs) for the specific analyses met the standards established in the ProvincialWater Quality Objectives (PWQO) and the Ontario Drinking Water Quality Standards (ODWQS).

Surface water samples were analysed for total chromium and hexavalent chromium. The concentration of trivalent chromium is estimated to be the difference between those analyses. Therefore, when detectable levelsof total chromium are present, the concentration of trivalent chromium is reported; however, trivalent chromium cannot be quantified to the level of the applicable PWQO.

2.1 Groundwater

The groundwater monitoring program carried out by Jp2g at the former landfill, the former salvage yard and theMOE investigation area in 2021 is summarized in **Table C1**. Monitors 99-3S and 99-4S were dry in the spring andsummer of 2020. A house was constructed in the vicinity of MW-3, destroying the monitors at this location in late 2004 or early 2005.

As indicated in Table C1, the groundwater monitoring program consisted of the following main components:

- Collection and analysis of groundwater samples from selected groundwater monitoring wells in the spring and summer. Note that monitoring wells 98-6D and 98-7M are to be sampled for VOCs every 5 years, they were sampled in 2019 and are therefore scheduled to be sampled in spring 2024. In addition, as requested by the MECP groundwater reviewer in 2018, PFAS and 1,4-dioxane sampling at monitoringwells 91-3D, 98-2D and 99-2S was completed in spring 2021.
- Collection and analysis of groundwater samples from selected domestic wells in the spring and summer.
- Groundwater level measurements in selected groundwater monitors in the spring and summer and inspection of all groundwater monitors in the spring (see Part A).

2.2 Surface Water

The surface water monitoring program carried out in 2021 at the former landfill site, the former salvage yard andthe area of the 1990 MOE investigation is summarized in **Table C2**. As indicated in the surface water monitoring program consisted of the collection and analysis of surface water samples in the spring and fall. Surface water stations SW02-1, SW98-1, SW99-1, SW99-5 and SW99-6 were dry or contained insufficient waterfor sampling during the spring monitoring session.

2.3 Leachate Indicator Parameters and Surveillance Parameters

Leachate Indicator Parameters are parameters which are useful in determining the presence/absence of landfillleachate impact on water resources, assessing the degree of leachate impact on water resources, and determining the extent of leachate impact near the landfill site.

Monitors B-2M and B-2D are the closest to the Brockville Landfill Site fill area and historically were shown to be the most highly leachate-impacted monitors in the area. Most occurrences of groundwater parameters at concentrations above background levels were interpreted to be due to leachate impact. Therefore, as initially discussed in the 1995 annual monitoring report, Leachate Indicator Parameters for the Brockville Landfill Site have been selected using inorganic groundwater monitoring results from monitors B-2M and B-2D and leachate quality from the leachate collection system. The selected Leachate Indicator Parameters are also used to assessthe inorganic groundwater quality in the vicinity of the former City Landfill, the former salvage yard and the MOE investigation area.

The 17 Leachate Indicator Parameters that are used to assess the inorganic groundwater quality in the vicinity ofthe former City Landfill, the former salvage yard and the MOE investigation area are: electrical conductivity, hardness, TDS, alkalinity, phenols, COD, TOC, TKN, ammonia, chloride, boron, calcium, iron, magnesium, potassium, sodium, and strontium.

Surveillance Parameters are parameters which provide a comprehensive assessment of water quality.

The Surveillance Parameters list (43 parameters) for groundwater monitoring at the former City Landfill, the former salvage yard and the MOE investigation area are included in **Table C9** which also indicates the specific groundwater monitors that are monitored for Leachate Indicator Parameters or Surveillance Parameters.

The 16 Leachate Indicator Parameters for surface water at the Brockville Landfill Site are: electrical conductivity,hardness, alkalinity, turbidity, colour, BOD, COD, TKN, ammonia, chloride, boron, calcium, magnesium, potassium, sodium and strontium. The same Leachate Indicator Parameters are used to assess the inorganic surface quality in the vicinity of the former City Landfill, the former salvage yard and the MOE investigation area.

The Surveillance Parameters used for surface water monitoring at the Brockville Landfill Site are also used for surface water monitoring at the former City Landfill, the former salvage yard and the MOE investigation area. The Surveillance Parameters list (44 parameters) is included in **Table C10** which also indicates the specificsurface water stations monitored for Leachate Indicator Parameters or Surveillance Parameters.

2.4 Quality Assurance/Quality Control

The samples collected in 2021 as part of monitoring program for the former City Landfill, the former salvage yardand the MOE investigation area included eight blind groundwater duplicate samples collected in the spring sampling session as part of the quality assurance/quality control (QA/QC) protocol. In the summer event 8 groundwater duplicate samples and 3 surface water duplicate samples were analyzed,respectively. In the late summer 3 groundwater and in the fall 1 surface water duplicate were analyzed.

The relative percent differences (RPDs) were calculated for parameters where the original and duplicate sample concentrations were greater than ten times the reportable detection limit (RDL). The commonly accepted industry standard data quality objective for the RPD in groundwater and surface water between a sample and its duplicateis 30%. QA/QC results for all duplicate samples were within acceptable tolerance limits in 2021.

3.0 INORGANIC GROUNDWATER QUALITY

The inorganic parameters with reported levels exceeding their respective Ontario Drinking Water Quality Standards (ODWQS); a comparison of groundwater quality to background conditions; trends in historical chlorideconcentrations; and an interpretation of the geochemical data with respect to the degree of inorganic impact fromthe identified sources of inorganic groundwater contamination are summarized in **Table C3** for all bedrock monitors.

Bedrock groundwater monitors that are located on the western part of the CAZ, west of the Brockville Landfill Site and CAZ, and south of the CAZ, serve as monitors of potential impacts from the former landfill, the former salvageyard and MOE investigation area. Only those monitors considered relevant to the former landfill, former salvage yard and MOE investigation area (i.e., monitors in close proximity to, or in the general downgradient direction of the former landfill, former salvage yard and MOE investigation area) are included in **Table C3** and in the discussion herein. See Part B for monitoring information related to the Brockville Landfill Site.

The results of the 2021 and the historical field and laboratory inorganic chemical (and physical) analyses dataobtained during the groundwater monitoring programs along with the relevant ODWQS are provided in **Appendix 6**. Plots of historical chloride concentrations (as an indicator of the presence and degree of landfill leachate impact) from 1990 to 2021 for a number of the groundwater monitors are provided in **Appendix 7**.

In the following sections, discussions relating to the ODWQS relate specifically to health-related standards andaesthetic objectives. Health-related standards include both Maximum Acceptable Concentrations (MAC) or Interim Maximum Acceptable Concentrations (IMAC) as specified in Ontario Drinking Water Quality StandardsRegulations O.Reg. 169/03 (MOE, 2006).

3.1 Background Bedrock Groundwater Quality

Groundwater monitors 91-10S, 91-10M, 91-10D, 91-11S, 91-11M, and 91-11D are located on the Precambrian bedrock ridge at the north end of the CAZ lands, hydraulically upgradient of any interpreted inorganic groundwaterimpact. These monitors are indicated to not be impacted by any inorganic sources based on interpreted groundwater flow directions and on the low levels of dissolved inorganic chemical constituents detected in the groundwater from these monitors. Of these monitors, 91-10M and 91-10D were included for sampling during the 2021 annual groundwater monitoring program. The range in parameter concentrations obtained from all monitoring to date at the Precambrian background monitors is considered to represent background concentrations in the Precambrian bedrock presented in **Table C4**.

In 2021, the water quality in the background monitors 91-10M and 91-10D was generally similar to previous years.At monitoring location 91-10M, iron and manganese did not meet the ODWQS, and at 91-10D, manganese did not meet the ODWQS. These 2021 results are generally similar to previous years and indicate that concentrations of iron and manganese are naturally elevated at this site.

3.2 Bedrock Groundwater Quality

Many of the monitors located within the former salvage yard (93-1, 91-10, 91-11, 98-2, 98-3, 98-4, 98-5), as wellas the monitors located west and south of the former landfill, and south of the Highway 401 (monitors installed in1999) are not impacted by inorganics (apart from potential effects of road salt) with the exception of 98-3D whichmay be impacted by inorganics from the former landfill. Monitors 93-1, 91-11, 98-2D, 98-4 and monitors installedsouth of Highway 401 were removed from the inorganics sampling program because it was determined that inorganic water quality data was not useful in terms of identification of impacts from the potential source areas of interest (Golder, 2021).

Monitors located on the southern boundary of the CAZ 93-2, (93-4 was damaged), 93-5, 93-8 and 98-9 contained elevated concentrations of calcium, conductivity, hardness, TDS, TKN, ammonia, chloride, magnesium, potassium, boron,strontium and sodium in 2021. TDS, chloride, sodium and iron concentrations did not meet ODWQS criteria at some of the CAZ boundary monitoring locations. Elevated concentrations of Leachate Indicator Parameters were also identified in groundwater at the bedrock monitors 91-3, 91-5, 91-7, 98-3, 98-8, 99-1, 99-2, 99-3, 99-4 and 99-5 in 2021. Iron, sodium and TDS concentrations were above ODWQS criteria at some of these monitors.

The concentrations of chloride, sodium, TDS and conductivity were significantly elevated at monitor 98-9S infall 2016 and fall 2018, compared to their historical ranges. It is interpreted that road salt application on Highway 401 affects groundwater quality at this location (Golder, 2021).

See **Table C3** for a summary of the inorganic groundwater quality in the bedrock monitors and **Appendix 6** for acomplete listing of the inorganic analytical results.

3.3 Domestic Water Supply Wells

The results of the inorganic groundwater sampling carried out in the spring and late summer of 2021 at two domestic water supply wells are included in **Appendix 8**. It is noted that the two domestic wells are located severalhundred metres to the west of the landfill (Bevan-Stafford and Pakeman). Therefore, considering the direction of groundwater flow (to the south and southwest) the MOE investigation area and the former landfill are the only identified sources of contamination that could potentially cause impacts to these wells (Golder, 2021). The inorganic groundwater quality in the Bevan-Stafford and Pakeman domestic well in 2021 was generally similar to the quality in previous years.

The TDS concentrations reported in June and September 2021 at the Bevan-Stafford well did not meet the ODWQS aesthetic objective; however, the concentrations were similar to historical levels. The concentrations at the Pakeman well were slightly below the TDS ODWQS aesthetic objective of 500 mg/L. No other exceedances of ODWQS for analysed health-related or aesthetic parameters were identified at the Bevan-Stafford or Pakeman wells during 2021. Due to the hydrogeological setting of the area, the domestic water supply wells are interpreted not to be impacted by the landfill.

4.0 VOLATILE ORGANIC GROUNDWATER QUALITY

Trichloroethylene (TCE), cis-1,2-dichloroethene (c-DCE), and vinyl chloride (VC) are the most prevalent VOCs present in groundwater in the study area. TCE (a common solvent) is very soluble (approximately 1,100,000 µg/L)relative to the applicable Ontario Drinking Water Quality Standard (5 µg/L) and can be highly mobile in fractured rock. TCE is also generally considered to be resistant to transformation under oxidizing conditions that are generally expected in shallow groundwater. However, under reducing conditions (e.g., in deeper or high BOD/COD groundwater) TCE may be subject to microbially-mediated reductive dechlorination reactions. These reactions generally proceed slowly and may result in the sequential transformation of TCE to c-DCE,trans-1,2-dichloroethene (t-DCE), and vinyl chloride. There is no ODWQS for c-DCE or t-DCE. Vinyl chloride is considered the VOC of greatest concern in the area near the former landfill because of its low ODWQS MAC (1 µg/L). Vinyl chloride is more volatile than TCE or c-DCE and therefore can more readily escape from shallow groundwater to soil gas and then to the atmosphere. Vinyl chloride anaerobically transforms to ethylene (Golder, 2021).

The TCE, c-DCE and VC concentrations and hydrogeological interpretation regarding the possible sources of identified VOC impacts are summarized in **Table C5** for all bedrock monitors. Only those monitors in close proximity to, or in the general downgradient direction from the former landfill, former salvage yard and the MOE investigation area are included in **Table C5** and in the discussion that follows. See Part B for monitoring information related specifically to the regulated Brockville Landfill Site. The results of the 2021 and the historicalVOC analyses data obtained for the bedrock groundwater monitors, along with the relevant ODWQS, are provided in **Appendix 9**.

During the spring 2017 monitoring event, methylene chloride (or dichloromethane) was detected at concentrationsof 7.2 to 15.1 µg/L at several wells included in the monitoring program for the former City Landfill/former salvage yard/area of the MOE investigation. As discussed in Golder (2018), methylene chloride had never been detected before at any of the monitors or domestic wells, and it was interpreted that methylene chloride was introduced to the samples at the laboratory, as it is used for laboratory processes. The detection of methylene chloride in 2017 is not interpreted to represent actual groundwater conditions at these monitors and domestic wells (Golder, 2021). During 2021 monitoring, methylene chloride was not detected at any of the monitors or domestic wells where it had been detected in 2017.

4.1 Bedrock Groundwater Quality

Most of the monitors that are part of the sampling program on the western part of the CAZ are impacted by VOCs including monitors at 98-2, 98-3 and 98-9. Monitors at 93-5, 93-8 and 98-9, which are located on the southern boundary of the CAZ, are interpreted to be impacted by VOCs. Monitors at 93-2 and 93-4, the most easterly monitoring locations on the southern boundary of the CAZ, are interpreted to possibly be impacted by VOCs fromthe Brockville / former landfill and former salvage yard, according to the results of historical monitoring. Previous groundwater monitoring has indicated VOC impacts at 93-2D and possible VOC impacts at 93-4D in 2006 and in 2009 (Golder, 2021).

Most of the monitors located west of the CAZ are also impacted by VOCs. Historically, the highest VOC concentrations have been reported for samples from monitors 98-6 and 98-7, which are located within the formerlandfill (where the vinyl chloride concentration was up to 300 times the ODWQS in 1999). Due to the previously documented high concentrations of VOCs at 98-6 and 98-7, and in order to limit chemical exposure of field staff, sampling from 98-6 and 98-7 was discontinued following the 1999 monitoring program. In accordance with the Environmental Compliance Approval (ECA) for the Brockville Landfill Site (as amended on March 24, 2006), sampling from 98-6D and 98-7M recommenced in 2006 and is to take place once every five years. These wellswere sampled in June 2019; therefore, they will next be sampled in 2024. The MOE investigation area, which is located northwest of the CAZ, is mainly impacted by relatively low concentrations of TCE and c-DCE (Golder, 2021).

Groundwater monitors installed in 1999 south of Highway 401 (99-7 through 99-11), were not interpreted to be impacted by VOCs from 1999 to 2009. However, minor concentrations of TCE were detected at monitors 99-7S, 99-7M, 99-7D, 99-10S and 99-11S (0.4 to 1.2 µg/L) in Spring 2009. To date, these one-time detections of TCE have not reoccurred at 99-7 and 99-10, indicating that TCE may not have been present at these monitoring locations in 2009. In 2020, VOCs were not detected in monitors 99-7 through 99-10. At 99-11, low levels of TCE and VC (just above the laboratory detection limit) were reported in all three monitoring well intervals in 2020, whilec-DCE was reported at 2.5 µg/L at 99-11S in 2020. Monitor 99-11 is the southernmost of the monitors located south of Highway 401. Given that VOCs have not been detected at any of the upgradient monitors between 99-11and Highway 401, the source of the VOC detections at 99-11 is not clear (Golder, 2021). The water quality at 99-11 will continue to be monitored in 2022.

In 2009, VOCs were also detected in monitor 00-1 installed south of Highway 401. They were detected again atlow levels in 2013, 2018 and 2020, but not detected in 2021. At monitor 00-3, located about 350 metres south of Highway 401, VC, TCE and/or c-DCE have been detected in all but three years since 2000, c-DCE was detected in 2021.

In 2021, TCE was detected in the following monitoring wells: 91-5S and D, 91-10D, 93-5S and D, 98-2S and M, 98-3M and D, 98-5S, 98-9M and D, 99-2D, 99-6M and MW-2M and D. The highest concentrations of TCE (33.3 µg/L and 44.8 µg/L) in June 2021 were at 98-2S and 98-2M, respectively, which are located within the former salvage yard. Monitors 98-2S and 98-2M are interpreted to be impacted by VOCs fromthe former salvage yard and/or possibly the former landfill. The ODWQS for TCE was exceeded at 98-2S and 98-2M, but not at any other monitoring wells in 2021. TCE concentrations were within their historical concentrationranges at all monitors in 2021.

In 2021, c-DCE was detected in the following monitoring wells: 00-2D, 00-3, 91-3D, 91-5S and D, 91-10M and D, 93-5 S and D, 98-2 S and M, 98-5D, 98-9M and D, 99-2D, 99-3D, 99-5M, 99-6M, 99-11S and MW-2M. The highest concentration of c-DCE in2020 was measured at 98-2M (31.8 µg/L). The c-DCE concentrations werewithin their historical concentration ranges at all monitors.

In 2021, vinyl chloride was detected in the following monitoring wells: 91-3D, 91-5D, 93-5S, 98-2D, 98-9D, 99-2S, 99-2D, 99-3D, 99-5M and 99-6M. The ODWQS for vinyl chloride was exceeded at the following monitoring wells: 91-2D, 91-3D, 91-5D, 98-2D, 98-7M, 98-9D, 99-2S and D, 99-3D, 99-5M and 99-6M. The highest concentration of vinyl chloride in 2021 was at monitor 99-2D (355 µg/L in the spring monitoringsession). Concentrations of vinyl chloride were within their historical ranges.

4.2 Domestic Water Supply Wells

The results of the VOC groundwater sampling program carried out in 2021 at the domestic water supply wells areincluded in **Appendix 8**. At the Pakeman well in September 2021, c-DCE (0.9 µg/L) and TCE (1.2 ug/L) was detected. All other VOCs were below detection in the Pakeman well. At the Bevan well, bromodichloromethane (4.4 µg/L), chloroform (69.8 µg/L) and TCE (0.6 ug/L) were detected in June 2021. All other VOCs were below detection in the Bevan well. All VOCs were below the ODWQS. Organic and inorganic sampling results for 2021 were provided both to residents. Groundwater elevation data for the shallow and deep groundwater flow systems suggest that the Bevan and Pakeman wells are downgradient of the MOE investigation area.

5.0 PFAS AND 1,4-DIOXANE IN GROUNDWATER

5.1 Bedrock Groundwater Monitors

The results of the PFAS and 1,4-dioxane groundwater sampling program carried out in June 2021 monitoring wells 91-3D, 98-2D and 99-2S are included in **Appendix 9**. At 91-3D, 9 of the 17 PFAS compounds analyzed were detected, andthe total concentration of the 9 detected parameters was 32.5 ng/L. At 98-2D, 8 of the 17 PFAS compounds analyzed were detected, and the total concentration of the 8 detected parameters was 208.1 ng/L. At 99-2S, 8 of the 17 PFAS compounds analyzed were detected, and the total concentration of the 8 detected parameters was 28.39 ng/L. The total PFAS concentration at monitoring well 98-2D was higher than the MECP's recommended drinking water value of 70 ng/L for total perfluorinated compounds (PFCs).

6.0 INTERPRETATION OF GROUNDWATER QUALITY

The interpretation of the groundwater impacts in the area of the former landfill, the former salvage yard and the area of the MOE investigation is presented in **Tables C3 and C5**, and on **Figures C4 and C5**. The factors whichwere considered in the interpretation of the groundwater impacts are as follows:

- The locations of the potential sources of groundwater contamination as determined by the review of historicalland uses by Golder in 1998 (Phase I ESA).
- The use of TCE, c-DCE and VC as indicators of groundwater impact by VOCs from one of four identified sources of contamination in the area of the landfill (see Part A).
- The use of the Leachate Indicator Parameters as indicators of inorganic impact possibly attributable to the former landfill.
- The physical hydrogeological setting of the site which governs the direction of groundwater flow and contaminant migration in the deep and shallow flow systems.
- The possible interactions between surface water and shallow groundwater.

Based on the 2021 groundwater quality data in conjunction with historical environmental information, the following interpretations regarding the possible sources of identified groundwater impacts at monitor locations sampled in 2021 are provided below:

Possible Source of Inorganic Impacts	2021 Impacted Bedrock Monitors
Brockville Landfill	91-3S, 91-3M, 91-3D, 91-5S, 91-7S*, 91-7D*, 93-5S*, 93-5D*
Former landfill	98-3M, 98-3D, 98-8S, 98-8M, 98-8D, 98-9S*, 98-9M, 98-9D*, 99-3D, 99-5S, 99-5M, 99-5D
Brockville Landfill and/or former landfill	91-5D, 93-8D*
MOE investigation area and/or former landfill	99-2S
Highway 401 only	93-2S, 93-2M, 93-2D, 93-4S, 93-4D, 93-8S, 93-8M

Notes: *indicates that road salt impact due to Highway 401 is interpreted to be possible.

Possible Source of VOC Impacts	2021 Impacted Bedrock Monitors
Former landfill	99-3S, 99-3D, 00-3
Former salvage yard	91-10M, 91-10D, 98-3S, 98-3M, 98-5S, 98-5M
MOE investigation area	99-1S, 99-1M, 99-1D, 99-2D, 99-6S, 99-6M, MW-2M, MW-2D, MW-3M, MW-3D, 00-2S, 00-2M, 00-2D
Brockville Landfill and/or former salvage yard	91-3M, 91-3D, 91-5S, 91-7S, 91-7D, 93-2D, 93-5S, 93-5D, 93-8S
Former landfill and/or former salvage yard	98-2S, 98-2M, 98-2D, 98-3D, 98-8S, 98-8M, 98-8D, 98-9S, 98-9M, 98-9D, 99-5S, 99-5M, 99-5D
Former landfill and/or MOE investigation area	98-6D, 98-7M, 98-7D, 99-2S
Former landfill and/or former salvage yard and/or landfill	91-5D, 93-8M, 93-8D, 98-5D

At the groundwater monitors located downgradient of the CAZ, south of Highway 401 (monitors 99-7 through99-11) VOCs were not detected between 1999 to 2021, with the following exceptions:

- Monitors 99-7S, 99-7M, 99-7D, 99-10S, and 99-11S: one-time detections of TCE at low concentrations, slightly above the detection limit (0.4 µg/L to 1.2 µg/L) in the spring of 2009. VOCs were not detected at these monitors from 2010 to 2019, with the exception of chloroethane at 99-7S in 2018 (0.4 µg/L).
- Monitors 99-11S, 99-11M and 99-11D: did not detect levels of TCE and VC above the laboratory detection limit in 2021, while c-DCE was reported at 2.5 µg/L at 99-11S. in 2021. Monitor 99-11 is the southernmost of the monitors located south of Highway 401. Given that VOCshave not been detected at any up the upgradient monitors between 99-11 and Highway 401, the source of the VOC detections at 99-11 is not clear. The water quality at 99-11 will continue to be monitored in 2022.
- Monitor 99-8M: methylene chloride at 18.3 µg/L in 2016 (less than the ODWQS of 50 µg/L).
- Monitor 99-9M: chloroform was detected at 0.6 µg/L in 2012 and methylene chloride at 14.9 µg/L in 2016.

No other VOC concentrations have been reported above the MDL at these monitors. Since VOCs have only beendetected once at these monitors in the period of 1999 through to 2021 (or twice in the case of 99-7S, 99-9M and 99-11S), it is interpreted that these monitors are not likely impacted by any of the identified sources of VOCs in groundwater (Golder, 2021).

As indicated above, inorganic and/or VOC impacts associated with each known potential source of groundwater contamination have been identified. Many groundwater monitors are interpreted to be impacted by groundwater contamination from more than one source (primarily the monitors on the CAZ). As has been reported since 1998 in the annual monitoring reports, the MOE investigation area, which is a source of VOCs, is also impactedby inorganics from an unknown source (possibly related to road salt and/or septic system effluent). Downward hydraulic gradients have been identified in this area (see Part A).

Groundwater elevation data indicates that bedrock monitors at 99-1, 99-2, 99-3, 99-4, 99-5, 99-6 and 00-3 (and possibly at 00-1 and 00-2) are hydraulically downgradient of the former landfill, the former salvage yard and/or the area of the MOE investigation. Therefore, analytical results from monitors at these locations provide information on the downgradient groundwater quality from identified contaminant sources other than the Brockville Landfill Site (Golder, 2021).

In terms of VOC impacts, the vinyl chloride concentration at 91-3D, 91-5D, 98-2D, 98-9D, 99-2S and D, 99-3D and 99-5M exceeded the ODWQS of 1 µg/L in 2021. TCE was detected at 15 monitoring wells, but the TCE concentrations exceeded the applicable ODWQS at 91-10D, 98-2M and 98-2S. At 21 monitoring locations c-DCE was detected. There is no ODWQS for c-DCE; however, for reference, the concentrations of c-DCE did not exceed the US EPA maximumconcentration limit of 70 µg/L at these monitors.

The source of VOCs at 99-1 and 00-2 has been interpreted to possibly be the area of the MOE investigation and the source of VOCs at 99-3, 99-4 (historically) and 00-3 has been interpreted to possibly be the former landfill. At 99-2 and 00-1, the source of VOCs has been interpreted to possibly be the former landfill and area of the MOE investigation. At 99-5, the source of VOCs has been interpreted to possibly be the former landfill and the former salvage yard (Golder, 2021).

7.0 SURFACE WATER QUALITY

The 2021 inorganic and VOC surface water quality at the surface water monitoring stations shown on **Figure C6** are presented in **Appendix 10** and summarized in **Tables C6 and C7**, respectively.

As discussed in Section 1.3 of Part A of this report, the MECP surface water reviewer requested in 2018 that future reports establish background surface water quality based on the 75th percentile concentrations of LeachateIndicator Parameters at the background monitoring location. Therefore, the comparison to background surface water quality presented in **Table C6** is based on the 75th percentile of background measurements.

Prior to 1998, sampling for VOCs historically occurred only at surface water sampling station SW-5, whileinorganic sampling occurred at all surface water sampling stations that had been established at the time (within the CAZ). In 1998 and 1999, new surface water sampling stations were established in order to assess andmonitor the inorganic and VOC surface water impacts from the former landfill and/or the former salvage yard (SW98-1, SW98-2, and SW99-1 through SW99-6). SW00-1, SW02-1 and SW04-1 were established in 2000, 2002and 2004, respectively. SW03-1 was established in 2003 to replace SW99-4 which was consistently dry, while SW98-2 was eliminated from the program in 2000. In 2020, samples were collected from the current surface water monitoring locations for inorganic and VOC analysis, except at the locations listed as dry in Section 2.2.

Sampling for VOCs was also undertaken at BD-03-M2 in addition to sampling for inorganics as part of theBrockville Landfill Site monitoring program.

In the following discussion of surface water quality, reference is made to the Provincial Water Quality Objectives (PWQO), published July 1994 (MOEE, 1994) and reprinted February 1999. These criteria are included on the chemical data sheets in **Appendix 10** of this report. Plots of historical chloride concentrations (as an indicator of the presence and degree of inorganic contamination impact) from 1990 to 2020 for each surface water monitoring location are provided in **Appendix 11.**

7.1 Background Quality

Surface water station SW-2 is located just upstream of the northeast corner of the swamp east of the Brockville Landfill. The full range of water quality at SW-2 since sampling started in 1990 is considered to represent background surface water quality at the landfill and the immediate vicinity. **Table C8** presents thehistorical range of surface water quality at SW-2.

Station SW-2 (a surveillance parameter station) is characterized by moderately hard water with fairly low concentrations of most parameters. Chloride, electrical conductivity, and un-ionized ammonia concentrations fall within the following historical ranges: chloride, <1 to 35 mg/L; electrical conductivity, 215 to 774 µS/cm; un-ionized ammonia, <0.00001 to 0.081 mg/L. In general, surface water quality at SW-2 in 2021 was similar to the historical surface water quality at this location. In 2021 at SW-2, all parameters except dissolved oxygen, iron and phenols (June) satisfied the applicable PWQO.

7.2 Surface Water Quality on the CAZ

The surface water locations that are located on or near the CAZ lands (i.e., south of Parkedale Avenue) are SW98-1, SW-5, SW-8 and BD-03-M2. SW98-1 is located on a watercourse that drains an area of the former salvage yard and the former landfill toward the landfill, at the south (upstream) end of a culvert that runs north andunder Parkedale Avenue onto the Brockville Landfill Site. SW-5 is located downstream of the Brockville Landfill at a second culvert that drains from the landfill site back onto the CAZ and into Grant's Creek (on the golf course). Surface water locations SW-5, SW-8 and BD-03-M2 are located progressively downstream in Grant's Creek.

At all three downstream locations, a significant improvement in water quality after the fall of 1992 is evident, i.e., following the construction of the leachate collection system. The improved water quality (indicated particularlyby decreased chloride levels) continued throughout 2021, except in 2020 at SW-5 as discussed below.

At surface water locations SW98-1, SW-8 and BD-03-M2, the Leachate Indicator Parameter concentrations weregenerally similar in 2021 to recent years' monitoring data. Parameters that did not satisfy the PWQO in 2021 at SW98-1 included total phosphorus, cobalt and iron, at BD-03M2 the parameters included iron and/or total phosphorus. There was only iron PWQO exceedances at SW-8. At each location, the concentration of between eleven and twelve Leachate Indicator Parameters exceeded the 75th percentile background values. However, there were no Leachate Indicator Parameters that exceeded both the PWQO and background concentrations in 2021.

In the sample collected at SW-5 on June 11, 2020 during the spring monitoring session, there was a notable increase in several Leachate Indicator Parameters (alkalinity, chloride, hardness, sodium and strontium), as well as total phosphorus, barium, cobalt, iron and manganese. There were also PWQO exceedances for dissolved oxygen, iron, phenols, total phosphorus and cobalt. As discussed in Part B of this report, surface water at this location was re-sampled on June 25, 2020, and the concentrations of most parameters were found to remain elevated. It was suggested that these elevated concentrations may be associated with stagnant surface water conditions at SW-5 in June 2020 as the parameter concentrations had returned to the normal historical range by thetime of the fall monitoring session. Due to the exceedance of trigger concentrations additional sampling was completed as detailed in Part B Section 8.5.5.

It is noted that the surface water quality south of Parkedale Avenue is likely affected by road salting activities andactivities associated with the golf course. See Table C6 for additional inorganic surface water quality information.

VOCs were not detected at SW98-1, SW-5 and BD-03-M2 in 2021 and are not monitored at SW-8. See Table C7and Appendix 10 for additional VOC surface water quality information.

7.3 Surface Water Quality West of the CAZ

The surface water stations located west of the CAZ are: SW99-1 through SW99-6, SW00-1, SW02-1, SW03-1 and SW04-1. SW99-4 and SW99-5 are within what was formerly a ponded area that was created as a result of abeaver dam, while SW99-1, SW99-2, SW99-3, SW99-6, SW02-1 and SW04-1 are located on streams that drain into Grant's Creek. SW00-1 is located on Grant's Creek, immediately south of Highway 401 as shown on **Figure C6**. The beaver dam located west of the former City Landfill site was breached (not by the City) during the summer of 2002, draining the beaver pond. SW03-1 was previously established within the stream channel toreplace SW99-4 which went dry after the breach of the beaver dam.

The results of the 2021 sampling indicated that a number of inorganic parameters were present at concentrations exceeding background concentrations at all locations west of the CAZ that were sampled in 2021. PWQO exceedances for one or more inorganic parameters also occurred at all locations sampled with the exception of SW99-1, SW99-2, SW99-3 and SW99-6. Iron as a Leachate Indicator Parameter had concentrations exceeding both background and PWQO in2021 at SW99-5 and SW03-1. See **Table C6** and **Appendix 10** for additional inorganic surface water quality information.

In general, the 2021 surface monitoring results indicate that inorganic surface quality is most impacted at locations near the former landfill and improves in the downstream direction. The surface water quality at SW99-6is also interpreted to be possibly affected by activities associated with the golf course, and the water quality at SW00-1 is interpreted to be affected by road salting activities associated with Highway 401.

No VOCs were detected in 2021 and as a result no PWQO exceedances for VOC parameters were reported atsurface water stations located west of the CAZ in 2021.

7.4 Comparison to CWQG for Chloride

As requested by the MECP surface water reviewer in 2013, the chloride concentrations at all surface water stations were compared to the applicable Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guideline (CWQG) refer to **Appendix 11**. In 2021, the chloride concentrations at SW00-1 in June 2021 exceeded the CWQG of 250mg/L..No other chloride concentrations in surface water exceeded theCWQG in 2021.

7.5 Fish Habitat West of the CAZ

In April and October 2003, Golder completed a qualitative fish habitat assessment downstream of the former City Landfill to assess potential impacts to surface water quality and local fisheries resources. Habitat surveys were conducted from the former beaver pond within the wetland located immediately west of the landfill site, tothe Highway 401 watercourse crossing near SW00-1 shown on **Figure C2**. The results of this assessment are presented in the report “Surface Water Investigations West of the Former City Landfill, Township of Elizabethtown, Ontario” (Golder, 2004a). Surface water toxicity testing was also carried out at SW99-3 in 2004and was reported in the 2004 Annual Monitoring Report (Golder, 2005).

During the habitat assessment, no fish were observed from the upstream beaver pond/wetland area, located directly adjacent to the former City Landfill site, downstream to the highway 401 road crossing. It is likely thatfish are limited in their upstream migration by physical barriers (e.g., Beaver dams, culverts, and rock boulder cascades – C1 and C2 on Figure C2). Therefore, the wetland is not considered to be fish habitat. Upstream of therock cascades would be considered a source of nutrients for the fish habitat immediately downstream.

In response to recommendations by the MECP, in November of 2004 Golder conducted sediment testing and analyses for metals downstream of the breached beaver dam. The goal of this work was to examine the potentialfor sediment transport to impact the surface water quality of the downstream receiving stream and fish habitat, with particular focus on the impact of iron contamination. Golder prepared a letter report regarding the sediment quality assessment dated February 8, 2005. In summary, the sediment quality assessment found elevated concentration of metals in the sediment downstream of the breached beaver dam; however, the concentrations were determined not to be sufficiently elevated to cause serious toxic effects to the surface water or downstreamfish habitat. The metals concentrations are also not considered high enough to cause any toxic effects to invertebrates inhabiting the sediment in the sampling locations. Given the findings regarding existing metals concentrations in the sediment and the unlikelihood of their bioavailability, Golder recommended that furthersediment quality assessment or remediation was not warranted (Golder, 2021).

The MECP Eastern Region Surface Water Unit reviewed the report and concurred with the conclusions presentedby Golder that further assessment or remediation was not required.

Based on historical surface water monitoring, toxicity testing and sediment quality analysis, it is interpreted that there is limited potential for adverse impact on aquatic life due to potential impacts associated with the former City Landfill.

8.0 INTERPRETATION OF SURFACE WATER QUALITY

Monitoring data from SW98-1 (on the CAZ) indicate possible inorganic surface water impacts due to the former landfill. Therefore, it is likely that the former City Landfill is impacting surface water on the Brockville Landfill Site. Site re-grading in the area of SW98-1 and FS-6 was undertaken in conjunction with closure activities that took place in 2001, in an attempt to reduce the impact of the former landfill and the former salvage yard on on-site surface water. Following this re-grading, some parameters including chloride and sodium, exhibited a slight decrease in concentrations, although they have increased again somewhat since 2016. Elevatedconcentrations of parameters such as iron are typical at SW98-1 (Golder, 2021).

Regarding the CAZ surface water quality, there were no Leachate Indicator Parameters that exceeded both background concentrations and the PWQO at surface water stations SW98-1, SW-5, SW-8 and BD-03-M2. NoVOCs were detected at SW98-1, SW-5 and BD-03-M2 in 2021. It is noted that the surface water quality on theCAZ is also interpreted to be affected by road salting activities and by activities associated with the golf course.

West of the CAZ, exceedances of background surface water quality or applicable PWQOs for inorganic parameters are interpreted to originate primarily from the former landfill and possibly from iron sulphide-rich rockrelated to former mining activities. In 2021, no VOCs were detected at surface water stations located west of theCAZ.

A summary of the potential sources of inorganic and VOC surface water contamination and the correspondingimpacted surface water sampling locations are provided below:

Possible Sources of Inorganic Impacts	2021 Impacted Surface Water Sampling Locations
Former landfill and iron sulphide-rich rock	SW99-5, SW03-1
Brockville Landfill and former landfill	SW-5**, SW-8**, BD-03-M2**
Former landfill	SW98-1*, SW02-1, SW04-1
Highway 401 road salting only	SW00-1

Notes: * indicates possible impacts due to road salt and iron due to salvage yard
** indicates possible impacts due to road salt and/or activities associated with the golf course

Possible Sources of VOC Impacts	2021 Impacted Surface Water Sampling Locations
Former landfill	SW99-5*
Former landfill and former salvage yard	SW98-1

Notes: * interpreted to be impacted based on historical water quality

9.0 GROUNDWATER AND SURFACE WATER COMPLIANCE

The following sections were reproduced from Golder (2021).

9.1 Groundwater

The former City Landfill, the former scrap yard and the area of the MOE 1990 investigation are considered “unregulated” sources and are therefore not subject to the MECP Reasonable Use Guideline B-7. The groundwater contamination emanating from these sources is dealt with using the MECP Groundwater Interference Guideline B-9. This guideline describes the MECP position in dealing with the abatement of groundwater contamination caused by activities that are not being carried out under an ECA issued by the MECP.The intent of Guideline B-9 is to provide guidance to MECP staff in evaluating and resolving issues of groundwater quality interference caused by such activities.

Groundwater contamination from Highway 401 winter road salt applications (also an “unregulated” source), was historically dealt with using the MECP Water Well Quality Problems Resulting from Winter Road Maintenance Guideline B-3. This guideline summarizes cost-sharing arrangements for situations in which restoration of groundwater supplies is required as a result of winter road maintenance by a road authority. It provides guidanceto MECP field staff, road maintenance authorities and the public in the interpretation, implementation and application of these arrangements.

At present, no nearby groundwater supply wells are adversely affected by the unregulated sources of groundwater contamination. However, the Bevan-Stafford well and the Pakeman well are downgradient of andpossibly impacted by the MOE investigation area. The monitoring carried out to date indicates that both wells contain low levels of VOCs, below the applicable ODWQS.

Active remediation (i.e., clean-up) of the contaminated groundwater, or the source areas of the contamination (the former landfill, the former salvage yard and the area of the MOE investigation) is considered impractical dueto the hydrogeological setting of the area (fractured bedrock environment and a potentially large source area).

Capture, control and treatment of all impacted groundwater would be expected to be exceedingly expensive and would not likely achieve a ‘clean-up’ of the aquifer within a reasonable time frame (decades) due to the type (dense non-aqueous phase liquid) and age of the contamination. Therefore, in the absence of an adverse impact on an existing groundwater supply wells associated with the above sources, and because groundwater remediation is not technically or economically feasible, the City has pursued obtaining control of the impacted groundwater areas. The City reached a permanent groundwater easement agreement with the owners of the existing golf course on December 1, 2000. The City also purchased lands west of the former landfill (the Pakemanproperty) in 2003.

9.2 Surface Water

For the assessment of surface water compliance, it is considered that Policy 2 (MOEE, 1994) would apply to surface water quality in the vicinity of the former City Landfill, west of the CAZ. Policy 2 indicates that “water quality which presently does not meet Provincial Water Quality Objectives shall not be degraded further,and all practical measures shall be taken to upgrade the water quality to the Objectives”.

The results of assessments of fish habitat and sediment quality along with surface water quality monitoring data indicate that the identified potential sources of surface water impacts are not causing adverse impacts to aquaticlife. Therefore, remediation of the area west of the CAZ to improve surface water quality is not considered to be necessary at this time.

10.0 2022 MONITORING PROGRAM

Monitoring of the former City Landfill, the former salvage yard and the area of the MOE investigation are carriedout by the City on a voluntary basis. The proposed 2022 groundwater monitoring program for the former landfill,the former salvage yard and the area of the MOE investigation is summarized in **Table C9**. The proposed 2022 surface water monitoring program is summarized in **Table C10**.

The proposed 2022 groundwater and surface water monitoring programs are generally the same as were proposed for 2021. (monitors 98-6D and 98-7M are to be sampled every 5 years (scheduled to be sampled next in spring 2024).

In addition, as requested by the MECP in 2018, monitoring wells 91-3D, 98-2D, 99-2S and the landfill leachate willcontinue to be sampled for PFAS and 1,4-dioxane on an annual basis in spring 2022. As requested by MECP in spring 2021 monitoring wells 99-1D and MW-2D will also be sampled for PFAS and 1,4-dioxane in spring 2022.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the 2021 surface water and groundwater monitoring program at the former landfill, theformer salvage yard and the area of the MOE investigation the following conclusions are provided.

- Bedrock monitors at 99-1, 99-2, 99-3, 99-4, 99-5, 99-6 and 00-3 (and likely 00-1 and 00-2) are likely located hydraulically downgradient of the identified sources of groundwater contamination (the former landfill, the former salvage yard or the area of the MOE investigation). Therefore, monitoring results from these locationsprovide information on the downgradient groundwater quality from these sources (Golder, 2021).

- With respect to the bedrock monitors hydraulically downgradient from the former landfill, the former salvage yard and/or the area of the MOE investigation (99-1, 99-2, 99-3, 99-4, 99-5, 99-6, 00-3, and possibly 00-1 and00-2), the only health or aesthetic inorganic parameters that did not meet ODWQS criteria in 2021 were iron and/or TDS at 99-1, 99-2 and 99-5. In terms of VOCs, the vinyl chloride concentration at 99-2, 99-3 and 99-5exceeded the ODWQS of 1 µg/L in 2021. TCE was detected at 99-2, but the TCEconcentrations did not exceed the applicable ODWQS. At monitoring locations 99-2, 99-3, 99-5, 99-6 and 00-2 and 00-3 c-DCE was reported. There is no ODWQS for c-DCE; however, for reference, the concentrations ofc-DCE did not exceed the US EPA maximum concentration limit of 70 µg/L at these monitors.

- The former landfill, the former salvage yard, and the area of the MOE investigation are “unregulated” sourcesand are not subject to the MECP Reasonable Use Guideline B-7. MECP Groundwater Interference Guideline B-9 applies.

- In 2021 no groundwater supply wells were interpreted to be adversely affected by the unregulated sources ofgroundwater contamination. However, the Bevan-Stafford well and the Pakeman well are downgradient of and possibly impacted by the MOE investigation area. The monitoring carried out to date indicates that bothwells contain low levels of VOCs, below the applicable ODWQS.

- At the surface water locations that are located on or near the CAZ lands (i.e., south of Parkedale Avenue), dissolved oxygen, iron, phenols, cobalt and/or total phosphorus did not satisfy the PWQO in 2020. At each location, the concentration of between seven and thirteen Leachate Indicator Parameters exceeded the 75th percentile background values. Only iron as a Leachate Indicator Parameter exceeded both the PWQO and background concentrations at SW99-5 and SW03-1 in 2021. There were no VOCs detected at these locations in 2021. A significant increase in concentrations of several Leachate Indicator Parameters was reported at SW-5 in spring 2020; however the concentrations had returned to the typical historical range by the time of the fall 2020 monitoring session and in 2021.

- West of the CAZ, exceedances of background surface water quality and/or PWQOs for inorganic parameters are interpreted to originate primarily from the former landfill and possibly from iron sulphide-rich rock related to former mining activities. In 2021, no VOCs were detected at surface water stations located west of theCAZ.

- In general, the 2020 surface water monitoring results indicate that inorganic surface water quality is most impacted at locations near the former landfill and generally improves (i.e., lower parameter concentrations) inthe downstream direction. Regarding the stream that flows out of the drained beaver pond (swamp) to the west of the former City Landfill, there are physical barriers (e.g., cascades) to fish movement between Highway 401 and the swamp. Therefore, the swamp is not considered to be fish habitat. The segment upstream of the cascades would be considered a source of nutrients for the fish habitat immediately downstream. Based on historical surface water monitoring and toxicity testing results, it is interpreted that there is limited potential for adverse impact on aquatic life due to the former City Landfill (Golder, 2021).

- A proposed monitoring program for 2022 for the former City Landfill site, former salvage yard area and the area of the MOE investigation area is included in this report.

12.0 LIMITATIONS

This report was prepared for the exclusive use of the City of Brockville. The report, which specifically includes Part A, Part B, Part C, and all tables, figures and appendices, is based on data and information collected by Jp2g Consultants Inc. and is based solely on the conditions of the site at the time of the work, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this report, and in the previousreports prepared by Golder Associates Ltd. (see References for list of previous reports). Each of these reports must be read and understood collectively and can only be relied upon in their totality.

This landfill impact report involves a limited sampling of locations to assess the probability of contamination on site. The test data, chemical analyses, and conclusions given herein are the results of analyzing the groundwater encountered during the sampling programs. Based upon the total number of test holes performed, these are considered to be fairly representative of the groundwater conditions within each area tested. It should be noted, however, that any assessment regarding the presence of contamination on the property is based on interpretation of conditions determined at specific locations and depths. Chemical results are limited to those parameters tested.

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Table C1: 2021 Groundwater Program
Former Landfill, Former Salvage Yard and MOE Investigation

Monitoring Well Locations		Sampled		Sample Parameters	
		Jun-21	Summer	Jun-21	Sep-21
CAZ LANDS (GOLF COURSE)					
	91-3S*	√	√	L	WL
	91-3M*	√	√	L + VOC	WL
	91-3D*	√	√	L +VOC + PFAS	WL
	91-5S, 91-5D*	√	√	L +VOC	WL
	91-7S*, 91-7D*	√ +Dup #4 of 91-7D	√	L +VOC	WL
	91-9S*, 91-9D*	√	√	WL	WL
	91-10M*, 91-10D*	√	√	S + VOC	WL
	91-11S*, 91-11D*	√	√	WL	WL
	93-1S*, 93-1M*, 93-1D*	√	√	WL	WL
	93-2S*, 93-2M*, 93-2D*	√ +Dup #5 at 93-2D	√	L + VOC	VOC
	93-4D*	Broken	Broken	L + VOC	L + VOC
	93-5S*, 93-5D*	√	√	L + VOC	L +VOC
	93-8S*, 93-8M*, 93-8D*	√	√ +Dup#3 of 93-8D	L + VOC	VOC
	98-1S*, 98-1M*, 98-1D*	√	√	WL	WL
	98-2S*, 98-2M*	√	√	VOC	WL
	98-2D*	√ +Dup #8	√	VOC +PFAS	WL
	98-3S*, 98-3M*, 98-3D*	√	√	L + VOC	WL
	98-4S*, 98-4M*, 98-4D*	√	√	WL	WL
	98-5S*, 98-5M*, 98-5D*	√	√	L +VOC	WL
	98-6D**	√	√	VOC	WL
	98-7S, 98-7D	√	√	WL	WL
	98-7M**	√	√	VOC	WL
	98-8S, 98-8M, 98-8D	√ 98-8D IS BROKEN	√	L + VOC	WL
	98-9S, 98-9M, 98-9D*	√	√ +Dup#2 of 98-9D	L + VOC	L + VOC
WEST OF CAZ					
	99-1S, 99-1M, 99-1D	√	√	L + VOC	VOC
	99-2S	√	√	L+ VOC +PFAS	WL
	99-2D	√	√	L+ VOC	WL
	99-3S, 99-3M, 99-3D	√	√ 99-3S was dry	L+ VOC	VOC

Monitoring Well Locations		Sampled		Sample Parameters	
		Jun-21	Summer	Jun-21	Sep-21
		99-3S was dry	+Dup #1 of 99-3D		
	99-4S, 99-4M, 99-4D	√	√ 99-4S was dry	L+ VOC	VOC
	99-5S, 99-5M, 99-5D	√	√	L+ VOC	WL
	99-6S, 99-6M, 99-6D	√	√	VOC	WL
	00-1S, 00-1M, 00-1D	√	√	VOC	WL
	00-3	√	√	VOC	WL
SOUTH OF HIGHWAY 401					
	99-7S, 99-7M, 99-7D*	√ +Dup #3 of 99-7D	√	VOC	WL
	99-8S, 99-8M, 99-8D*	√ +Dup #1 of 99-8D	√	VOC	WL
	99-9S, 99-9M, 99-9D*	√ +Dup #2 of 99-9D	√	VOC	WL
	99-10S, 99-10M, 99-10D*	√	√	VOC	WL
	99-11S, 99-11M, 99-10D*	√	√	VOC	WL
	00-2S, 00-2M, 00-2D	√	√	VOC	WL
MOE INVESTIGATION AREA					
	MW-1S, MW-1M, MW-1D	√	√	WL	WL
	MW-2S	√	√	WL	WL
	MW-2M, MW-2D	√	√	VOC	WL
	MW-4S, MW-4M, MW-4D	√	√	WL	WL
	MW-5S, MW-5M, MW-5D	Not Located	Not Located	WL	WL
DOMESTIC WATER SUPPLY WELLS					
	Bevan	√ (no VOC)	√	S + VOC	S +VOC
	Pakeman	√ (no VOC)	√	S +VOC	S +VOC
Trip Blank		√		-	-

Created By: NW
Checked By: KM

Notes: * Locations also included in Brockville Landfill Site Monitoring Program
** To be completed in 2024
L – Leachate Indicator Parameters
S – Surveillance Parameters
VOC - Volatile Organic Compounds
PFAS – Per-and Polyfluoroalkyl Substances + 1,4 dioxane
WL – Water Level Only

Table C2: 2021 Surface Water Program
Former Landfill, Former Salvage Yard and MOE Investigation

SW ID	Inorganic Package Planned for 2021	Jun-21	Nov-21	UTM Easting (Zone 18)	UTM Northing (Zone 18)
SW-5*	Surveillance +VOC	√ (S+VOC) + Dup #3	√ (S + VOC)		
SW-8*	Leachate	√ (L)	√ (L) +Dup #1		
BD-03-M2*	VOC	√ (VOC) + Dup #2	√ (VOC)		
SW98-1	Surveillance + VOC	DRY	√ (S + VOC)		
SW99-1	Surveillance + VOC	DRY	√ (S + VOC)	442269.24	4937654.04
SW99-2	Surveillance + VOC	DRY	√ (S + VOC)	442171.50	4937153.57
SW99-3	Surveillance + VOC	DRY	√ (S + VOC)	442208.53	4937308.32
SW99-5	Surveillance + VOC	DRY	√ (S + VOC)	442424.35	4937590.78
SW99-6	Surveillance + VOC	DRY	√ (S + VOC)		
SW00-1	Surveillance + VOC	DRY	√ (S + VOC)	442136.17	4936922.49
SW02-1	Surveillance + VOC	DRY	√ (S + VOC)		
SW03-1	Surveillance	DRY	√ (S)	442283.14	4937574.04
SW04-1	Surveillance + VOC	DRY	√ (S + VOC)		
Field Blank	Routine or Surveillance	--	--	--	--

Created By: NW
Checked By: KM

Notes:

* Locations also included in the Brockville Landfill Site monitoring program – only one sample analyzed for both programs

L – Leachate Indicator Parameters

S – Surveillance Parameters

VOC - Volatile Organic Compounds

TABLE C3
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
Guy Well *Shallow* (SP)	--	--	▪ variable, highest reading in summer 1991, generally stableafter 2000 ▪ historical range: 2 to 240 mg/L	▪ likely downgradient of former salvage yard ▪ groundwater historically interpreted not to be impacted by inorganics from the landfill ▪ well decommissioned in 2013
91-3S *Shallow* (LIP)	none	Ammonia, chloride, magnesium, potassium, strontium	▪ variable ▪ historical range: 3 to 110 mg/L	▪ likely downgradient of landfill and formersalvage yard ▪ groundwater interpreted to be impacted byinorganics from the landfill
91-3M *Shallow* (LIP)	iron, TDS	ammonia, boron, chloride, magnesium, potassium, sodium, strontium, TDS, TKN	▪ variable ▪ historical range: 19 to 170 mg/L	▪ likely downgradient of landfill and formersalvage yard ▪ groundwater interpreted to be impacted by inorganics from the landfill
91-3D *Intermediate* (LIP)	none	magnesium,	▪ variable ▪ historical range: 10 to 170 mg/L	▪ same as 91-3S
91-5S *Shallow* (LIP)	none	Chloride, sodium	▪ variable ▪ historical range: 6 to 95 mg/L	▪ possibly downgradient of landfill andformer salvage yard ▪ groundwater historically interpreted to beimpacted by inorganics from the landfill

TABLE C3 (continued)
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
91-5D *Deep* (LIP)	Iron, TDS	chloride, sodium	▪ was historically constant but has been elevated since 2016 ▪ historical range: 9.6 to 85 mg/L	▪ downgradient of former salvage yard and possibly downgradient of landfill and former landfill ▪ overall increasing trend in boron and sodium concentrations since 1991 ▪ groundwater interpreted to be impactedby inorganics from the landfill and/or former landfill
91-7S *Shallow* (LIP)	iron, TDS	chloride, conductivity, magnesium, sodium, strontium, TDS	▪ variable ▪ historical range: 5 to 340 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby inorganics possibly from the landfill and road salt from Highway 401
91-7D *Shallow* (LIP)	TDS	chloride, conductivity, magnesium, sodium, TDS	▪ variable ▪ historical range: 100 to 420 mg/L	▪ same as 91-7S
91-10M *Intermediate* (background) (SP)	iron, manganese	none - background monitor	▪ generally constant with minor variations, elevated in 2011 ▪ historical range: 4 to 29 mg/L	▪ located within the limits of former salvage yard, upgradient of landfill ▪ groundwater interpreted not to beimpacted by inorganics
91-10D *Intermediate* (background) (SP)	manganese	none - background monitor	▪ generally constant with minor variations, elevated in 2011 ▪ historical range: 3.8 to 30 mg/L	▪ same as 91-10M

TABLE C3 (continued)
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
93-2S *Shallow* (LIP)	chloride, sodium	chloride, conductivity, hardness, magnesium, sodium, TDS	▪ increasing trend since 2014 ▪ historical range: 200 to 704 mg/L	▪ not downgradient of landfill or former salvage yard ▪ groundwater interpreted to be impactedby road salt from Hwy 401
93-2M *Intermediate* (LIP)	chloride, sodium, TDS	chloride, conductivity, hardness, magnesium, sodium, TDS	▪ increasing trend since 2014 ▪ historical range: 310 to 703 mg/L	▪ same as 93-2S
93-2D *Deep* (LIP)	chloride, sodium, TDS	boron, chloride, conductivity,magnesium, potassium, sodium, TDS	▪ increasing trend since 2014 ▪ historical range: 64 to 656 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby road salt from Hwy 401
93-4S *Shallow* (LIP)	none	none	▪ increasing trend from 2015 to 2018, now decreasing ▪ historical range: 3.5 to 47 mg/L	▪ likely upgradient of landfill ▪ groundwater interpreted not to be impacted by inorganics ▪ groundwater interpreted to be impactedby road salt from Highway 401
93-4D *Intermediate* (LIP)	n/a	n/a	▪ slight increasing trend since 2015 ▪ historical range: 18 to 150 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby road salt from Highway 401
93-5S *Shallow* (LIP)	iron	ammonia, boron, magnesium, potassium, TKN	▪ generally constant ▪ historical range: 7 to 42 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ increasing trend in some leachate indicator parameters ▪ groundwater interpreted to be impactedby inorganics possibly from the landfill, ▪ and road salt from Hwy 401

TABLE C3 (continued)
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
93-8S *Shallow* (LIP)	chloride, sodium, TDS	chloride, conductivity, calcium, hardness, magnesium, potassium, sodium, TDS	▪ large seasonal variations ▪ historical range: 210 to 738 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby road salt from Hwy 401
93-8M *Intermediate* (LIP)	chloride, sodium, TDS	calcium, chloride, conductivity, hardness, magnesium, potassium, sodium, strontium, TDS	▪ variable ▪ historical range: 200 to 768 mg/L	▪ downgradient of former salvage yard, possibly landfill and possibly former landfill ▪ groundwater interpreted to be impactedby road salt from Hwy 401
93-8D *Deep* (LIP)	chloride, iron, sodium, TDS	boron, chloride, conductivity,hardness, magnesium, potassium, sodium, strontium, TDS	▪ increasing trend since 2017 ▪ historical range: 280 to 685 mg/L	▪ downgradient of former salvage yard, possibly landfill and possibly former landfill ▪ groundwater interpreted to be impacted by inorganics from the landfill and/or former landfill and by road salt from Hwy 401
98-3S *Shallow* (LIP)	none	none	▪ peak concentration in fall 1999, stable since 2000 ▪ historical range: 2 to 18.3 mg/L	▪ located within the limits of former salvageyard ▪ groundwater interpreted not to beimpacted by inorganics
98-3M *Shallow* (LIP)	none	none	▪ variable ▪ historical range: 2 to 26.4 mg/L	▪ located within the limits of former salvageyard ▪ groundwater historically interpreted to be impacted by inorganics from the former landfill
93-8S *Shallow* (LIP)	chloride, sodium, TDS	chloride, conductivity, calcium, hardness, magnesium, potassium, sodium, TDS	▪ large seasonal variations ▪ historical range: 210 to 738 mg/L	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impactedby road salt from Hwy 401

TABLE C3 (continued)
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
98-3D *Intermediate* (LIP)	iron	ammonia	▪ slight decreasing trend ▪ historical range: 3 to 39 mg/L	▪ located within the limits of former salvage yard, possibly downgradient of former landfill ▪ groundwater interpreted to be impacted by inorganics from the former landfill
98-5S *Shallow* (LIP)	none	none	▪ peak concentration in fall 1999, stable since 2000 ▪ historical range: 5 to 22.9 mg/L	▪ located within the limits of former salvage yard ▪ groundwater interpreted not to be impacted by inorganics
98-5M *Intermediate* (LIP)	none	none	▪ peak concentration in fall 1999, stable since 2000 ▪ historical range: 3 to 25 mg/L	▪ located within the limits of former salvage yard ▪ groundwater interpreted not to be impacted by inorganics
98-5D *Deep* (LIP)	none	none	▪ slight increasing trend from 2006 to 2013, slight decreasing trend since 2018 ▪ historical range: 9 to 24 mg/L	▪ located within the limits of former salvage yard, also possibly downgradient of landfill and former landfill ▪ groundwater interpreted not to be impacted by inorganics
98-8S *Shallow* (LIP)	iron	COD, boron, sodium	▪ variable ▪ historical range: 5 to 31 mg/L	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by inorganics from the former landfill
98-8M *Intermediate* (LIP)	sodium, TDS	boron, sodium, TDS	▪ slight decreasing trend from 2004 to 2012, stable since 2012 ▪ historical range: 25 to 48 mg/L	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by inorganics from the former landfill

TABLE C3 (continued)
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
98-8D *Deep* (LIP)	not sampled in 2021	not sampled in 2021	▪ generally stable ▪ historical range: 40 to 49.3 mg/L	▪ same as 98-8M
98-9S *Intermediate* (LIP)	none	ammonia, magnesium	▪ concentration is generally stable, except for elevated concentrations in September 2016 (357 mg/L) and September 2018 (77 mg/L) ▪ historical range: 5 to 357 mg/L	▪ possibly downgradient of former landfilland former salvage yard ▪ groundwater interpreted to be possibly impacted by inorganics from the formerlandfill and road salt from Hwy 401
98-9M *Intermediate* (LIP)	TDS	boron, magnesium, potassium	▪ generally stable since 2009 ▪ historical range: 8 to 26 mg/L	▪ possibly downgradient of former landfilland former salvage yard ▪ groundwater interpreted to be possibly impacted by inorganics from the formerlandfill
98-9D *Deep* (LIP)	TDS	boron, magnesium, sodium	▪ slight decreasing trend since 2009 ▪ historical range: 21 to 79 mg/L	▪ possibly downgradient of former landfilland former salvage yard ▪ groundwater interpreted to be impactedby inorganics possibly from the former ▪ landfill and/or by road salt fromHighway 401
99-1S *Shallow* (LIP)	none	chloride	▪ variable ▪ historical range: 9 to 63.4 mg/L	▪ downgradient of MOE investigation area ▪ groundwater interpreted to not be impacted by inorganics
99-1M *Intermediate* (LIP)	none	Chloride, magnesium	▪ variable ▪ historical range: 22 to 132 mg/L	▪ same as 99-1S

TABLE C3 (continued)
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
99-1D *Deep* (LIP)	TDS	chloride, magnesium	▪ slight decreasing trend since 2016 ▪ historical range: 48 to 94 mg/L	▪ same as 99-1S
99-2S *Intermediate* (LIP)	iron	ammonia, chloride, potassium	▪ generally stable ▪ historical range: 12 to 75.6 mg/L	▪ possibly downgradient of former landfill and MOE investigation area ▪ groundwater interpreted to be impacted by inorganics possibly from the former landfill and/or unknown source in the vicinity of the MOE investigation area
99-2D *Deep* (LIP)	Iron, TDS	chloride, magnesium, potassium	▪ generally variable ▪ historical range: 5 to 62 mg/L	▪ downgradient of the MOE investigation area ▪ groundwater interpreted not to be impacted by inorganics
99-3S *Shallow* (LIP)	not sampled in 2021 (dry)	not sampled in 2021 (dry)	▪ generally constant ▪ historical range: 3 to 5 mg/L	▪ downgradient of former landfill ▪ groundwater interpreted not to be impacted by inorganics
99-3M Intermediate (LIP)	none	TOC, potassium	▪ generally constant ▪ historical range: 2 to 6.7 mg/L	▪ downgradient of former landfill ▪ groundwater interpreted not to be impacted by inorganics
99-3D Deep (LIP)	none	boron, sodium	▪ generally constant ▪ historical range: 2 to 7 mg/L	▪ downgradient of former landfill ▪ groundwater interpreted to be possibly impacted by inorganics from the former landfill based on past data

TABLE C3 (continued)
2021 SUMMARY OF INORGANIC GROUNDWATER QUALITY AT BEDROCK MONITORSFORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Parameters Exceeding ODWQS[1] During 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends over Time (Refer to Appendix 7)	Hydrogeological Interpretation
99-4S *Shallow* (LIP)	not sampled in 2021 (dry)	not sampled in 2021 (dry)	▪ generally constant ▪ historical range: 3 to 9 mg/L	▪ possibly downgradient of former landfill ▪ groundwater interpreted not to be impacted by inorganics
99-4M *Intermediate* (LIP)	none	none	▪ generally constant with peak in fall 1999 (48.6 mg/L) ▪ historical range: 4 to 48.6 mg/L	▪ possibly downgradient of former landfill ▪ groundwater interpreted not to be impacted by inorganics
99-4D *Deep* (LIP)	none	boron	▪ generally constant ▪ historical range: 4 to 8.2 mg/L	▪ downgradient of former landfill ▪ groundwater interpreted not to be impacted by inorganics
99-5S *Shallow* (LIP)	none	magnesium	▪ fairly stable with peak in 2002 (30 mg/L) ▪ historical range: 4 to 30 mg/L	▪ possibly downgradient of former landfill and/or former salvage yard ▪ groundwater interpreted to be possibly impacted by inorganics from the former landfill based on past data
99-5M *Intermediate* (LIP)	iron	none	▪ generally constant with peak in fall 1999 (41.5 mg/L) ▪ historical range: 4 to 41.5 mg/L	▪ possibly downgradient of former landfill and/or former salvage yard ▪ groundwater interpreted to be possibly impacted by inorganics from the former landfill based on past data
99-5D *Deep* (LIP)	iron	ammonia, potassium	▪ variable with peak in fall 1999 (59 mg/L) ▪ historical range: 6 to 59 mg/L	▪ possibly downgradient of former landfill and/or former salvage yard ▪ groundwater interpreted to be impacted by inorganics from the former landfill

Notes:

Updated By: NW
Checked By: KM

1. ODWQS – Only the aesthetic objectives and health related standards are considered in this table
2. *Shallow* – monitoring well with screened interval within the shallow flow system
3. *Deep* – monitoring well with screened interval within the deep flow system
4. *Intermediate* – monitoring well with screened interval between the shallow and the deep flow system
5. LIP – Leachate indicator parameters
6. SP – Surveillance Parameters
7. LCS – Leachate Collection System. LCS was installed at the site in the fall of 1992
8. Historical range - includes 2021 data

TABLE C4
RANGE OF HISTORICAL BACKGROUND BEDROCK GROUNDWATER QUALITYBROCKVILLE LANDFILL SITE

Parameter	Ontario Drinking Water Quality Standards (ODWQS)	Range in Background Bedrock Nov./91 to Sept./21
Electrical Conductivity (µS/cm)		270 – 1140
Hardness	80-100 (OG)	41 – 490
TDS	500 (AO)	130 – 630
Alkalinity	30-500 (OG)	151 – 680
Phenols		<0.0005 – 0.0245
BOD		<0.5 – 7.0
COD		<5 – 76
TOC		1.8 – 50
TKN		<0.05 – 2.90
Ammonia		<0.01 – 0.68
Nitrate	10	<0.05 – 1.6
Nitrite	1	<0.005 – 0.10
Nitrate + Nitrite	10	<0.1 – <1.7
Total Phosphorus		<0.01 – <1
Dissolved Reactive Phosphorus		<0.003 – 0.08
Chloride	250 (AO)	3.8 – 36
Fluoride	1.5	<0.07 – 1.1
Sulphate	500 (AO)	13 – 310
Bromide		<0.05 – 0.66
Cyanide	0.2	<0.001 – <0.02
Arsenic	0.025	<0.0001 – <0.06
Aluminium	0.10 (OG)	<0.005 – 0.13
Boron	5.0	0.02 – 0.29
Barium	1.0	0.06 – 0.732
Beryllium		<0.0005 – <0.010
Calcium		58 – 170

TABLE C4 (continued)
RANGE OF HISTORICAL BACKGROUND BEDROCK GROUNDWATER QUALITYBROCKVILLE LANDFILL SITE

Parameter	Ontario Drinking Water Quality Standards (ODWQS)	Range in Background Bedrock Nov./91 to Sept./21
Cadmium	0.005	<0.00008 – <0.005
Cobalt		<0.0002 – <0.090
Chromium	0.05	<0.001 – <0.02
Copper	1.0 (AO)	<0.0005 – <0.02
Iron	0.30 (AO)	<0.03 – 14.1
Lead	0.01	<0.0006 – <0.050
Magnesium		8.5 – 23
Manganese	0.05 (AO)	<0.0050 – 3.90
Molybdenum		<0.001 – <0.5
Nickel		<0.005 – <0.05
Organic Nitrogen	0.15 (OG)	0.01 – 2.68
Potassium		<1.00 – 3.70
Silver		<0.0001 – <0.02
Sodium	200 (AO)	<0.01 – 69
Strontium		0.07 – 1.9
Titanium		<0.003 – <0.05
Thallium		<0.00005 – <1.0
Vanadium		<0.001 – 0.01
Zinc	5.0 (AO)	<0.005 – 0.173
Zirconium		<0.001 – <0.1

Updated By: NW
Checked By: KM

Notes:
All units are provided in milligrams per Litre (mg/L) unless otherwise noted
Bedrock background concentrations from monitors 91-10M, 91-10D (2021), 91-11S and 91-11D (1999)
(OG) Operational Guideline
(AO) Aesthetic Objective

TABLE C5
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
Guy Well *Shallow*	25	---, ---	<0.1 - <0.5	---, ---	<0.1 - 1	---, ---	<0.2 - 12	▪ well decommissioned in 2013
91-3M *Shallow*	31	<0.3, ---	0.2 - <2.5	<0.4, ---	<0.4 - 8.9	0.2, ---	<0.5 - 222	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or former salvage yard
91-3D *Intermediate*	31	<0.3, ---	<0.1 - 0.6	**1.2**, ---	<0.4 - 3.6	**21.7**, ---	<0.5 - 61.5	▪ likely downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or former salvage yard
91-5S *Shallow*	31	**0.7**, ---	0.8 - 5.3	**1.9**, ---	<0.4 - 5.2	<0.2, ---	<0.2 - 10.4	▪ downgradient of former salvage yard and possibly downgradient of landfill ▪ groundwater interpreted to be impacted by VOCs from former salvage yard and possiblythe landfill

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021c -DCE Conc. (µg/L)	Historical Range of c-DCE Conc.(µg/L)	2021 VC Con. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
91-5D *Deep*	31	**0.6**, ---	<0.5 - 12.5	**6.2**, ---	<0.4 - 6.9	**0.2**, ---	<0.2 - 18.4	▪ downgradient of former salvage yard and possibly downgradient of landfill and/or former landfill ▪ groundwater interpreted to be impacted by VOCs from former salvage yard and possibly the landfill and/or former landfill
91-7S *Shallow*	30	<0.3, ---	<0.3 - 1.1	<0.4, ---	<0.4 - 4.2	<0.2, ---	<0.2 - 133	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or former salvage yard
91-7D *Shallow*	31	<0.3, ---	<0.3 - 1	<0.4, ---	<0.4 - 2.6	<0.2, ---	<0.2 - 21.5	▪ same as 91-7S
91-10M *Intermediate*	30	<0.3, ---	<0.3 - 7	**0.8**, ---	<0.4 - 2.8	<0.2, ---	<0.2 - 24.3	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard
91-10D *Intermediate*	30	**6.7**, ---	3.4 - 10.7	**2.3**, ---	<0.4 - 2.4	<0.2, ---	<0.2 - 3.4	▪ same as 91-10M
93-2S *Shallow*	5	<0.3, <0.3	<0.1 - <0.5	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <0.86	▪ not downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impactedby VOCs

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc.(µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
93-2M *Intermediate*	50	<0.3, <0.3	<0.1 - <0.5	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <1	▪ same as 93-2S
93-2D *Deep*	49	<0.3, <0.3	<0.1 - 0.7	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - 1.9	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or former salvage yard
93-4D *Intermediate*	45	---,---	<0.1 - 0.6	---,---	<0.1 - <0.4	---,---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ VOCs not detected from 2000 to 2016 except for low detection of VC in summer 2006 and TCE in 2009 ▪ groundwater interpreted to be possibly impacted by VOCs from the landfill and former salvage yard
93-5S *Shallow*	52	**1.2, 1.0**	<0.3 - 4.6	**0.8**, <0.4	0.2 - 5.7	**2.0, 0.5**	<0.2 - 12.3	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or salvage yard
93-5D *Shallow*	52	**0.8**, <0.3	<0.3 - 2.6	**0.6**, <0.4	<0.4 - 2.3	<0.2, <0.2	<0.2 - 7.2	▪ same as 93-5S

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc.(µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
93-8S *Shallow*	49	<0.3, <0.3	0.1 - 0.6	<0.4, <0.4	0.3 - <1	<0.2, <0.2	<0.2 - 1	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the landfill and/or salvage yard
93-8M *Intermediate*	49	<0.3, <0.3	0.2 - 0.8	<0.4, <0.4	0.2 - <1	<0.2, <0.2	<0.2 - 3.5	▪ downgradient of former salvage yard, and possibly the landfill and former landfill ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard and/or possibly the landfill and former landfill
93-8D *Deep*	49	<0.3, <0.3	0.2 - 0.9	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - 0.9	▪ downgradient of former salvage yard, and possibly the landfill and former landfill ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard and/or possibly the landfill and former landfill
98-2S *Shallow*	10	**33.3**, ---	7.1 - 160	**6.1**, ---	<0.5 – 7.1	<0.2, ---	<0.2 - <0.5	▪ located near the limits of former salvage yard, downgradient of former salvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard and/or possibly the former landfill

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-2M *Shallow*	10	**44.8**, ---	15.4 - 160	**31.8**, ---	0.9 – 15.4	<0.2, ---	0.4 – 7.2	▪ located near the limits of former salvage yard, downgradient of former salvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard and/or possibly the former landfill
98-2D *Intermediate*	26	<0.3, ---	<0.3 - 120	<0.4, ---	<0.4 - 48	**128**, ---	<0.2 - 175	▪ located near the limits of former salvage yard, downgradient of former salvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard and/or possibly the former landfill
98-3S *Shallow*	26	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be possibly impacted by VOCs from the former salvage yard
98-3M *Shallow*	26	**0.9**, ---	<0.3 - 3.9	<0.4, ---	0.3 - <1	<0.2, ---	<0.2 - 3.8	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc.(µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-3D *Intermediate*	26	**0.8**, ---	<0.3 - 3.5	<0.4, ---	0.3 - 6.6	<0.2, ---	<0.2 - 17	▪ located within the limits of former salvage yard and possibly downgradient of former landfill ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard and/or former landfill
98-5S *Shallow*	26	**1.2**, ---	<0.3 - 2.8	<0.4, ---	<0.4 - <1	<0.2, ---	<0.2 - 0.7	▪ located within the limits of former salvage yard ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard
98-5M *Intermediate*	26	<0.3, ---	<0.3 - 3.5	<0.4, ---	<0.1 - 1.2	<0.2, ---	<0.2 - <0.5	▪ same as 98-5S
98-5D *Deep*	26	<0.3, ---	<0.3 - 15	**11**, ---	<0.4 - 10.8	<0.2, ---	<0.2 - 21.9	▪ located within the limits of former salvage yard, also possibly downgradient of landfill and the former landfill ▪ groundwater interpreted to be impacted by VOCs from the former salvage yard and/or possibly from the landfill and/or the former landfill

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-6D *Deep*	9	Not sampled in 2021	<0.3 - 150	Not sampled in 2021	<0.4 – 1,500	Not sampled in 2021	<0.2 - 900	▪ located within the limits of former landfill and possibly downgradient of the MOE investigation area ▪ groundwater interpreted to be impacted by VOCs from the former landfill and possibly from the MOE investigation area
98-7M *Intermediate*	9	Not sampled in 2021	0.6 - 2100	Not sampled in 2021	635 – 8,500	Not sampled in 2021	370 – 1,600	▪ located within the limits of former landfill and possibly downgradient of the MOE investigation area ▪ groundwater interpreted to be impacted by VOCs from the former landfill and possibly from the MOE investigation area
98-7D *Deep*	5	Not sampled in 2021	<0.3 – 18.0	Not sampled in 2021	18.0 - 280	Not sampled in 2021	220 - 410	▪ located within the limits of former landfill and possibly downgradient of the MOE investigation area ▪ groundwater interpreted to be impacted by VOCs from the former landfill and possibly from the MOE investigation area

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-8S *Shallow*	26	<0.3, ---	0.2 - 0.7	<0.4, ---	0.2 - <1	<0.2, ---	<0.2 - 7.4	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the former landfill and/or former salvage yard
98-8M *Intermediate*	25	<0.3, ---	<0.1 - 0.8	<0.4, ---	<0.4 – 1.3 (3.3*)	<0.2 ---	<0.2 – 11.9 (44.2*)	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the former landfill and/or former salvage yard
98-8D *Deep*	9	Not sampled in 2021	<0.1 - <0.5	Not sampled in 2021	<0.1 - 3.7	Not sampled in 2021	<0.5 - 5.7	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the former landfill and/or former salvage yard
98-9S *Intermediate*	48	<0.3, <0.3	0.1 - 0.7	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be possibly impacted by VOCs from the former landfill and/or former salvage yard

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
98-9M *Intermediate*	48	**0.3**, <0.3	<0.3 - 1.4	**0.5**, <0.4	<0.4 - 2	<0.2, <0.2	<0.2 - 15	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the former landfill and/or former salvage yard
98-9D *Deep*	48	0.3, **1.7**	0.8 - 6.1	**0.4**, <0.4	<0.4 - 7.3	<0.2, **5.3**	<0.2 - 29	▪ same as 98-9M
99-1S *Shallow*	46	---, <0.3	<0.3 - 2	---, <0.4	<0.1 - <1	---, <0.2	<0.2 - <0.5	▪ downgradient of MOE investigation area ▪ groundwater interpreted to be impacted by VOCs from the MOE investigation area
99-1M *Intermediate*	46	---, <0.3	<0.3 - 2.2	---, <0.4	<0.1 - <1	--- ,<0.2	<0.2 - <0.5	▪ same as 99-1S
99-1D *Deep*	46	--- ,<0.3	<0.3 - 1.8	--- ,<0.4	<0.1 - <1	--- ,<0.2	<0.2 - <0.5	▪ downgradient of MOE investigation area ▪ groundwater interpreted to be impacted by VOCs from the MOE investigation area

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-2S *Intermediate*	23	<0.3, ---	0.4 - 1.1	<0.4, ---	<0.4 - 4.4	**7.4**, ---	<0.5 – 1,500	▪ possibly downgradient of former landfill and MOE investigation area ▪ groundwater interpreted to be impacted by VOCs from the former landfill and MOE investigation area
99-2D *Deep*	23	**0.6** ,---	<0.1 - <0.5	**2.6**, ---	0.1 - <1	**355**, ---	<0.2 – 355	▪ downgradient of the MOE investigation area ▪ groundwater interpreted to be impacted by VOCs from the MOE investigation area
99-3S *Shallow*	6	dry	<0.1 - <0.3	dry	<0.1 - <0.4	dry	<0.2 - <0.5	▪ downgradient of former landfill ▪ groundwater interpreted to be possibly impacted by VOCs from former landfill
99-3M *Intermediate*	45	<0.3 - <0.3	<0.1 - 0.5	<0.4 –<0.4	<0.1 - <1	<0.2-<0.2	<0.2 - <0.5	▪ downgradient of former landfill ▪ groundwater interpreted to be possibly impacted by VOCs from former landfill
99-3D *Deep*	45	<0.3, <0.3	<0.1 - 0.7	**5.9**, <0.4	<0.4 - 35.9	<0.2 - **9.2**	<0.2 - 23.9	▪ downgradient of former landfill ▪ groundwater interpreted to be impacted by VOCs from the former landfill
99-4S *Shallow*	20	dry	<0.1 - 0.5	dry	<0.1 - <0.4	dry	<0.2 - <0.5	▪ possibly downgradient of former landfill ▪ groundwater interpreted to be possibly impacted by VOCs from former landfill

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-4M *Intermediate*	45	<0.3, <0.3	<0.1 - 0.7	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <0.5	▪ possibly downgradient of former landfill ▪ groundwater interpreted to be possibly impacted by VOCs from former landfill
99-4D *Deep*	44	<0.3, <0.3	<0.1 - 0.7	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <0.5	▪ possibly downgradient of former landfill ▪ groundwater interpreted to be possibly impacted by VOCs from former landfill
99-5S *Shallow*	24	<0.3, ---	<0.1 - 0.6	<0.4, ---	0.2 - 6.9	<0.2, ---	<0.2 - 72	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the former landfilland the former salvage yard
99-5M *Intermediate*	24	<0.3, ---	0.1 - 0.6	**5.5**, ---	<0.4 - 72	**3.8**, ---	<0.2 - 320	▪ possibly downgradient of former landfill and former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the former landfilland the former salvage yard
99-5D *Deep*	24	<0.3, ---	<0.1 - 0.5	<0.4, ---	<0.4 - 71	<0.2, ---	<0.2 - 390	▪ downgradient of former landfill and/or former salvage yard ▪ groundwater interpreted to be impacted by VOCs possibly from the former landfilland the former salvage yard

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-6S *Shallow*	24	<0.3, ---	<0.1 - 0.8	<0.4, ---	0.1 - 1.2	<0.2, ---	<0.2 - <0.5	▪ downgradient of MOE investigation area ▪ groundwater interpreted to be possibly impacted by VOCs from MOE investigation area
99-6M *Intermediate*	24	**2.4**, ---	<0.3 - 9.3	**22.7**, ---	0.4 - 37.9	**3.7**, ---	<0.2 - 2.8	▪ downgradient of MOE investigation area ▪ groundwater interpreted to be impacted by VOCs possibly from MOE investigation area
99-6D *Deep*	23	<0.3, ---	<0.1 - 0.8	<0.4, ---	<0.1 - <0.8	<0.2, ---	<0.2 - <0.5	▪ downgradient of MOE investigation area ▪ groundwater interpreted to be possibly impacted by VOCs from MOE investigation area
99-7S *Shallow*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
99-7M *Intermediate*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ same as 99-7S

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-7D *Deep*	23	<0.3, ---	<0.1 - 1.2	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard, and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-8S *Shallow*	23	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, formersalvage yard and former landfill ▪ groundwater interpreted not to beimpacted by VOCs
99-8M *Intermediate*	14	<0.3, ---	<0.3 - <0.5	<0.4, ---	<0.4 - <1	<0.2, ---	<0.2 - <0.5	▪ not impacted by VOCs
99-8D *Deep*	21	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, formersalvage yard and former landfill ▪ groundwater interpreted not to beimpacted by VOCs
99-9S *Shallow*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill andformer salvage yard ▪ groundwater interpreted not to beimpacted by VOCs
99-9M *Intermediate*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ same as 99-9S

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-9D *Deep*	23	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard, and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-10S *Shallow*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
99-10M *Intermediate*	23	<0.3, ---	<0.1 - <0.5	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill and former salvage yard ▪ groundwater interpreted not to be impacted by VOCs
99-10D *Deep*	23	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-11S *Deep*	24	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 – 2.5	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs
99-11M *Deep*	24	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yard and former landfill ▪ groundwater interpreted not to be impacted by VOCs

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
99-11D *Deep*	24	<0.3, ---	<0.1 - <0.6	<0.4, ---	<0.1 - <1	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of landfill, former salvage yardand former landfill ▪ groundwater interpreted not to be impacted by VOCs
MW-2M *Intermediate*	26	**0.6**, ---	<0.3 - 9.3	**3.5**, ---	<0.4 - 2.7	<0.2, ---	<0.2 - <0.5	▪ located within MOE investigation area ▪ groundwater interpreted to be impacted by VOCs associated with the MOE investigationarea
MW-2D *Deep*	26	**1.1**, ---	<0.3 - 6	<0.4, ---	<0.4 - 2.4	<0.2, ---	<0.2 - <0.5	▪ located within MOE investigation area ▪ groundwater interpreted to be impacted by VOCs associated with the MOE investigationarea
MW-3M *Intermediate*	8	---, ---	<0.3 - 11.2	---, ---	<0.4 - 3.1	---, ---	<0.2 - <0.5	▪ located within MOE investigation area ▪ groundwater historically interpreted to be impacted by VOCs associated with the MOE investigation area ▪ well destroyed in 2004
MW-3D *Deep*	8	---, ---	<0.3 - 7.4	---, ---	0.3 - 2.9	---, ---	<0.2 - <0.5	▪ same as MW-3M

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
00-1S *Deep*	22	<0.3, ---	<0.1 – 1.0	<0.4, ---	<0.1 - 0.9	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of MOE investigation area and the former landfill ▪ groundwater interpreted to be possibly impactedby VOCs from MOE investigation area and former landfill
00-1M *Deep*	22	<0.3, ---	<0.1 – 1.1	<0.4, ---	0.1 - 0.8	<0.2, ---	<0.2 - <0.5	▪ possibly downgradient of MOE investigation area and the former landfill ▪ groundwater interpreted to be possibly impactedby VOCs from MOE investigation area and the former landfill
00-1D *Deep*	22	<0.3, ---	<0.1 – 1.0	<0.4, ---	<0.1 - 0.8	<0.2, ---	<0.2 - 0.5	▪ possibly downgradient of MOE investigation area and the former landfill ▪ groundwater interpreted to be possibly impactedby VOCs from MOE investigation area and the former landfill
00-2S *Shallow*	22	<0.3, ---	<0.3 - 3.8	<0.4, ---	<0.4 - 5.4	<0.2, ---	<0.2 - 0.8	▪ possibly downgradient of MOE investigation area ▪ groundwater interpreted to be impacted by VOCs possibly from MOE investigation area

TABLE C5 (Continued)
2021 SUMMARY OF VOLATILE ORGANIC COMPOUNDS IN BEDROCK GROUNDWATER MONITORSFORMER LANDFILL SITE, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Monitoring Well	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 c-DCE Conc. (µg/L)	Historical Range of c-DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc. (µg/L)	Hydrogeological Interpretation (Based on 2021 and Historical Data)
00-2M *Medium*	22	<0.3, --	<0.3 - 4.5	<0.4, ---	<0.4 - 7.8	<0.2, --	<0.2 - 0.8	▪ possibly downgradient of MOE investigation area ▪ groundwater interpreted to be impacted by VOCs possibly from MOE investigation area
00-2D *Deep*	22	<0.3, --	<0.3 - 10.7	**0.9**, ---	<0.4 - 20.5	<0.2, --	0.1 - 0.9	▪ possibly downgradient of MOE investigation area and the former landfill ▪ groundwater interpreted to be impacted by VOCs possibly from MOE investigation area
00-3 *Deep*	22	<0.3, --	0.3 - 0.6	**2.7**, ---	<0.4 - 5.8	<0.2, --	<0.2 - 1.3	▪ possibly downgradient of the former landfill ▪ groundwater interpreted to be impacted by VOCs from the former landfill area

Updated By: NW
Checked By: KM

Notes:

Bold – exceeds detection limits
1. Historical range –includes 2021 data
2. *Shallow* – monitoring well with screened interval within the shallow flow system
3. *Deep* – monitoring well with screened interval within the deep flow system
4. *Intermediate* – monitoring well with screened interval between the shallow and the deep flow system
5. TCE – Trichloroethene
6. c-DCE – cis-1,2 Dichloroethene
7. VC – Vinyl Chloride
8. --- Monitor not sampled – not included in spring and/or summer monitoring program
9. * Anomalous value not considered representative of groundwater monitoring results

TABLE C6
SUMMARY OF 2021 INORGANIC SURFACE WATER QUALITY
FORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Surface Water Monitoring Location	Parameters Not Meeting PWQO in 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends Over Time (Refer to Appendix 11)	Interpretation
SW-5 (SP)	dissolved oxygen, iron, phenols	alkalinity, COD, chloride, colour, conductivity, calcium, hardness, magnesium, potassium, sodium, strontium, TKN, turbidity	▪ decreased after installation of LCS,now generally constant ▪ pre LCS range: 29 to 350 mg/L ▪ post LCS range: 0.21 to 165 mg/L ▪ 2021 concentrations: 74, 23mg/L	▪ downstream of landfill, former landfill and former salvage yard, close to Parkedale Avenue, south/east of LCSpumping station ▪ decline in concentration of LIPs following construction of LCS ▪ surface water interpreted to be impacted by inorganics from the former ▪ landfill, the landfill and possibly by thegolf course and road salt.
SW-8 (LIP)	iron	BOD, COD, chloride, colour, conductivity, potassium, sodium, dissolved iron	▪ decreased after installation of LCS, generally constant with minor variations ▪ pre LCS range: 33 to 240 mg/L ▪ post LCS range: 0.26 to 91 mg/L ▪ 2021 concentrations: 6, 26 mg/L	▪ halfway south in Grant's Creek in golf course, downstream from landfill, formerlandfill and former salvage yard ▪ improvement in general water quality after installation of LCS ▪ surface water interpreted to be impacted by inorganics from the formerlandfill, the landfill, possibly by road saltfrom Parkedale Avenue and the Golf Course

TABLE C6 (continued)
SUMMARY OF 2021 INORGANIC SURFACE WATER QUALITY
FORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Surface Water Monitoring Location	Parameters Not Meeting PWQO in 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends Over Time (Refer to Appendix 11)	Interpretation
BD-03-M2 (SP)	iron, total phosphorus	COD, chloride, colour, conductivity, potassium, sodium	▪ decreased after installation of LCS, now variable ▪ pre LCS range: 39 to 201 mg/L ▪ post LCS range: 13 to 664 mg/L ▪ 2021 concentrations: 85, 43 mg/L	▪ farthest south in Grant's Creek in golf course, downstream from landfill, formerlandfill and former salvage yard ▪ improvement in general water qualityafter installation of LCS surface water interpreted to be impacted by inorganics from the formerlandfill, the landfill and possibly by the Golf Course and road salt from Parkedale Avenue/ Highway 401
SW98-1 (SP)	total phosphorus, Cobalt, Iron,	chloride, calcium, sodium,	▪ variable ▪ historical range: 12 to 150 mg/L ▪ 2021 concentrations: dry, 50 mg/L	▪ downstream from former landfill and former salvage yard, adjacent to Parkedale Avenue ▪ water quality is interpreted to be impacted by inorganics from the former landfill, possibly by iron from the former salvage yard and possibly by road salt from Parkedale Avenue
SW99-1 (SP)	none	none	▪ variable, increasing trend since 2015 ▪ highest concentrations to date in 2019 ▪ historical range: 22 to 96 mg/L ▪ 2021 concentrations: dry, 36 mg/L	▪ downstream of former landfill ▪ interpreted to be impacted by inorganics likely from the former landfill and possibly from iron sulphide deposits

TABLE C6 (continued)
SUMMARY OF 2021 INORGANIC SURFACE WATER QUALITY
FORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Surface Water Monitoring Location	Parameters Not Meeting PWQO in 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends Over Time (Refer to Appendix 11)	Interpretation
SW99-2 (SP)	none	chloride	▪ variable ▪ historical range: 4 to 99 mg/L ▪ 2021 concentrations: dry, 36 mg/L	▪ downstream of former landfill ▪ interpreted to be impacted by inorganics likely from the former landfill and possibly from iron sulphide deposits
SW99-3 (SP)	none	chloride, calcium	▪ variable ▪ historical range: 4 to 65 mg/L ▪ 2021 concentrations: dry, 52 mg/L	▪ downstream of former landfill ▪ interpreted to be impacted by inorganics likely from the former landfill and possibly from iron sulphide deposits
SW99-4 (SP)	replaced by SW03-1	replaced by SW03-1	▪ variable ▪ historical range: 23 to 64 mg/L	▪ downstream of former landfill ▪ interpreted to be impacted by inorganics likely from the former landfill and possibly from iron sulphide deposits ▪ location replaced by SW03-1 in 2003 due to change in surface water level after the removal of beaver dam
SW99-5 (SP)	iron, phosphorus	alkalinity, chloride, conductivity, calcium, iron, sodium	▪ variable ▪ historical range: 23 to 80 mg/L ▪ 2021 concentrations: dry, 56	▪ near limit of former landfill ▪ interpreted to be impacted by inorganics likely from the former landfill and possibly from iron sulphide deposits
SW99-6 (SP)	none	none	▪ generally constant ▪ historical range: <1 to 13.5 mg/L ▪ 2021 concentrations: dry, 3 mg/L	▪ downstream of former landfill and former salvage yard ▪ interpreted to be impacted by inorganics likely from the former landfill and possibly from the golf course

TABLE C6 (continued)
SUMMARY OF 2021 INORGANIC SURFACE WATER QUALITY
FORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Surface Water Monitoring Location	Parameters Not Meeting PWQO in 2021	Leachate Indicator Parameters Exceeding Background Levels in 2021	Chloride Trends Over Time (Refer to Appendix 11)	Interpretation
SW00-1 (SP)	iron	chloride, sodium, calcium	▪ variable; peak in spring 2001 (1050 mg/L) ▪ historical range: 21 to 1050 mg/L ▪ 2021 concentrations: 253, 100 mg/L	▪ south of Highway 401 at the confluence of Grant's Creek and the creek that flows from southwest of the former landfill area ▪ interpreted to be impacted by road salt from Highway 401
SW02-1	Copper, vanadium, iron, total phosphorus	COD	▪ constant ▪ historical range: 3 to 6 mg/L ▪ 2021 concentrations: dry, 2 mg/L	▪ downstream of former salvage yard and possibly former landfill ▪ interpreted to be impacted by inorganics, likely from the former landfill
SW03-1	Phosphorus, iron	Chloride, conductivity, calcium, iron, sodium	▪ variable ▪ highest concentration to date in November 2021 ▪ historical range: 6 to 94 mg/L ▪ 2021 concentrations: dry, 94 mg/L	▪ downstream of former landfill ▪ interpreted to be impacted by inorganics likely from the former landfill and possibly from iron sulphide deposits
SW04-1	iron, total phosphorus	COD, sodium	▪ variable ▪ historical range: 2 to 149 mg/L ▪ 2021 concentrations: dry, 59 mg/L	▪ downstream of former landfill and possibly former salvage yard ▪ interpreted to be possibly impacted by inorganics, likely from the former landfill

Updated By: NW
Checked By: KM

Notes:
1. LIP – Leachate Indicator Parameters
2. SP – Surveillance Parameter
3. LCS – Leachate Collection System. LCS was installed at the site in the fall of 1992
4. Historical range or post LCS range – Includes 2021 data

TABLE C7
SUMMARY OF 2021 VOLATILE ORGANIC COMPOUNDS IN SURFACE WATER FORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Surface Water Monitoring Station	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 DCE Levels (µg/L)	Historical Range of DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrological Interpretation (Based on 2021 and Historical Data)
SW-5	66	<0.3, <0.3	<0.1 - <0.5	<0.4, <0.4	<0.1 - <1	<0.2, <0.2	<0.2 - <2	▪ downstream of former landfill, former salvage yard and landfill ▪ interpreted not to be impacted by VOCs
BD-03-M2	50	<0.3, <0.3	<0.1 - <0.5	<0.4, <0.4	<0.1 - <1	<0.2, <0.8	<0.2 - <0.8	▪ downstream of former landfill, former salvage yard and landfill ▪ interpreted not to be impacted by VOCs
SW98-1	45	dry, <0.3	<0.1 - 2.5	dry, <0.4	<0.1 - <1	dry, <0.2	0.2 - <0.5	▪ downstream of former landfill and former salvage yard ▪ interpreted to be impacted by VOCs possibly from the former landfill and the former salvage yard
SW99-1	37	dry, <0.3	<0.1 - 0.9	dry, <0.4	<0.1 - 4.5	dry, <0.2	<0.2 - 7.6	▪ downstream of former landfill ▪ historically interpreted to be impacted by VOCs from the former landfill. No impact in 2021.
SW99-2	46	dry, <0.3	0.1 - 5.3	dry, <0.4	0.1 - <1	dry, <0.2	<0.2 - <0.5	▪ downstream of former landfill ▪ historically interpreted to be impacted by VOCs from the former landfill. No impact in 2021.

TABLE C7 (continued)
SUMMARY OF 2021 VOLATILE ORGANIC COMPOUNDS IN SURFACE WATER FORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Surface Water Monitoring Station	Number of Sampling Events	2021 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2021 DCE Levels (µg/L)	Historical Range of DCE Conc. (µg/L)	2021 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrological Interpretation (Based on 2021 and Historical Data)
SW99-3	46	dry, <0.3	<0.1 - 3.8	dry, <0.4	0.1 - 1.2	dry, <0.2	<0.2 - <0.5	▪ downstream of former landfill ▪ historically interpreted to be impacted by VOCs from the former landfill. No impact in 2021.
SW99-4[6]	12	No longer sampled	<0.3 - 3.4	No longer sampled	<0.4 - 1.1	No longer sampled	<0.2 - <0.5	▪ downstream of former landfill ▪ historically interpreted to be impactedby VOCs from the former landfill ▪ no longer sampled
SW99-5	39	dry, <0.3	0.1 - 7.3	dry, <0.4	<0.1 - 20	dry, <0.2	<0.2 - 32	▪ near limit of former landfill ▪ interpreted to be impacted by VOCs from the former landfill based on historical water quality
SW99-6	40	dry, <0.3	<0.1 - 1.9	dry, <0.4	<0.1 - <1	dry, <0.2	<0.2 - <0.5	▪ downstream of former landfill and former salvage yard ▪ historically interpreted to be impacted by VOCs possibly from the former landfill and/or the former salvage yard. No impact in 2021.
SW00-1	43	<0.3, <0.3	<0.1 - <0.3	<0.4, <0.4	0.1 - <0.4	<0.2, <0.2	<0.2 - <0.5	▪ south of Highway 401 at the confluence of Grant's Creek and the creek that flows from the southwest of the former landfill area ▪ historically interpreted to be possibly impacted by VOCs from the former landfill. No impact in 2021.

TABLE C7 (continued)
SUMMARY OF 2020 VOLATILE ORGANIC COMPOUNDS IN SURFACE WATER FORMER LANDFILL, FORMER SALVAGE YARD AND MOE INVESTIGATION AREA

Surface Water Monitoring Station	Number of Sampling Events	2020 TCE Conc. (µg/L)	Historical Range of TCE Conc. (µg/L)	2020 DCE Levels (µg/L)	Historical Range of DCE Conc. (µg/L)	2020 VC Conc. (µg/L)	Historical Range of VC Conc.(µg/L)	Hydrological Interpretation (Based on 2020 and Historical Data)
SW02-1	23	dry, <0.3	<0.1 - <0.3	dry, <0.4	<0.1 - <0.4	dry, <0.2	<0.2 - <0.5	▪ interpreted not to be impacted by VOCs
SW03-1[7]	15	---, ---	<0.3 - 0.8	---, ---	<0.4 - 1	---, ---	<0.2 - 0.6	▪ downstream from former landfill ▪ historically interpreted to be impacted by VOCs from the former landfill.
SW04-1	12	dry, <0.3	<0.3	dry, <0.4	<0.4	dry, <0.2	<0.2	▪ downstream of former landfill ▪ interpreted not to be impacted by VOCs

Updated By: NW
Checked By: KM

Notes:
1 Historical range –includes 2021 data
2 TCE – Trichloroethene
3 DCE – cis-1,2, Dichloroethene
4 VC – Vinyl Chloride
5 --- Sampling Station not sampled for VOCs during this sampling round
6 No longer sampled – replaced by SW03-1
7 Monitoring program does not indicate VOC sampling

TABLE C8
CONCENTRATIONS OF LEACHATE INDICATOR PARAMETERS AND OTHER SELECTED PARAMETERS INBACKGROUND SURFACE WATER (LOCATION SW-2)

Parameter	Provincial Water Quality Objectives (PWQO)	Range in Values Apr./90 to Sept./21	75th Percentile Concentration Apr/90 to Sept/21
Electrical Conductivity (µS/cm)		215 – 774	472
Hardness		158 – 360	238
Alkalinity	Decrease <25% (65)	87 – 329	241
Turbidity (NTU)	<10% change to Secchi disc reading (0.27-14.3)	0.2 – >100	2
Colour (TCU)		<2 – 80	35
Phenols	0.001	<0.0005 – 0.002	0.001
BOD		<0.5 – 49	2
COD		<5.0 – 34	20
TKN		<0.05 – 9.64	0.4
Ammonia		<0.02 – 5.30	0.13
Unionized Ammonia	0.020	<0.00001 – 0.081	0.0005
Chloride		<1 – 35	20
Cyanide (free)	0.005	<0.001 – 0.010	
Aluminum	0.075	<0.005 – 0.48	
Boron	0.200	<0.010 – 0.95	0.035
Barium		0.01 – 1.26	
Calcium		40 – 88	63
Cadmium	0.0005 (hardness>100)	<0.00006 – 0.0035	
Chromium	0.001 Cr VI 0.0089 Cr III	<0.001 – 0.02 (Cr total)	
Copper	0.005 (hardness>20)	0.0006 – 0.044	
Iron	0.3	<0.01 – 3.94	
Dissolved Iron	0.3	<0.03 – 0.03	
Cobalt	0.0009	<0.0001 – <0.05	
Phosphorus (total)	0.03	<0.01 – 1.1	
Lead	0.005	<0.0005 – 0.012	
Zirconium	0.004	<0.001 – <0.1	
Silver	0.0001	<0.00005 – 0.011	
Nickel	0.025	<0.001 – 0.03	
Magnesium		14 – 34	20
Potassium		0.64 – 7.8	1
Sodium		1 – 23	15.5
Strontium		0.028 – 0.57	0.14
Vanadium	0.006	<0.0002 – 0.04	0.002
Zinc	0.020	<0.002 – 0.31	0.04

Updated By: NW
Checked By: KM

Table C9:
2022 Groundwater Program
Former Landfill, Former Salvage Yard and MOE Investigation

Monitoring Well Locations		Sample Parameters	
		Spring	Summer
CAZ LANDS (GOLF COURSE)			
	91-3S*	L	WL
	91-3M*	L + VOC	WL
	91-3D*	L +VOC + PFAS	WL
	91-5S, 91-5D*	L +VOC	WL
	91-7S*, 91-7D*	L +VOC	WL
	91-9S*, 91-9D*	WL	WL
	91-10M*, 91-10D*	S + VOC	WL
	91-11S*, 91-11D*	WL	WL
	93-1S*, 93-1M*, 93-1D*	WL	WL
	93-2S*, 93-2M*, 93-2D*	L + VOC	VOC
	93-4D*	L + VOC	L + VOC
	93-5S*, 93-5D*	L + VOC	L +VOC
	93-8S*, 93-8M*, 93-8D*	L + VOC	VOC
	98-1S*, 98-1M*, 98-1D*	WL	WL
	98-2S*, 98-2M*	VOC	WL
	98-2D*	VOC +PFAS	WL
	98-3S*, 98-3M*, 98-3D*	L + VOC	WL
	98-4S*, 98-4M*, 98-4D*	WL	WL
	98-5S*, 98-5M*, 98-5D*	L +VOC	WL
	98-6D**	VOC	WL
	98-7S, 98-7D	WL	WL
	98-7M**	VOC	WL
	98-8S, 98-8M, 98-8D	L + VOC	WL
	98-9S, 98-9M, 98-9D*	L + VOC	L + VOC
WEST OF CAZ			
	99-1D, 99-1S, 99-1M	L + VOC	VOC
	99-1D	L+ VOC+PFAS	VOC
	99-2S	L+ VOC +PFAS	WL
	99-2D	L+ VOC	WL
	99-3S, 99-3M, 99-3D	L+ VOC	VOC
	99-4S, 99-4M, 99-4D	L+ VOC	VOC
	99-5S, 99-5M, 99-5D	L+ VOC	WL
	99-6S, 99-6M, 99-6D	VOC	WL
	00-1S, 00-1M, 00-1D	VOC	WL

Monitoring Well Locations		Sample Parameters	
		Spring	Summer
	00-3	VOC	WL
SOUTH OF HIGHWAY 401			
	99-7S, 99-7M, 99-7D*	VOC	WL
	99-8S, 99-8M, 99-8D*	VOC	WL
	99-9S, 99-9M, 99-9D*	VOC	WL
	99-10S, 99-10M, 99-10D*	VOC	WL
	99-11S, 99-11M, 99-10D*	VOC	WL
	00-2S, 00-2M, 00-2D	VOC	WL
MOE INVESTIGATION AREA			
	MW-1S, MW-1M, MW-1D	WL	WL
	MW-2S	WL	WL
	MW-2M	VOC	WL
	MW-2D	VOC+ PFAS	WL
	MW-4S, MW-4M, MW-4D	WL	WL
	MW-5S, MW-5M, MW-5D	WL	WL
DOMESTIC WATER SUPPLY WELLS			
	Bevan	S + VOC	S +VOC
	Pakeman	S +VOC	S +VOC
Trip Blank		-	-

Created By: KM

Notes: * Locations also included in Brockville Landfill Site Monitoring Program
** To be completed in 2024
L – Leachate Indicator Parameters
S – Surveillance Parameters
VOC - Volatile Organic Compounds
PFAS – Per-and Polyfluoroalkyl Substances + 1,4 dioxane
WL – Water Level Only

Table C10:
2022 Surface Water Program
Former Landfill, Former Salvage Yard and MOE Investigation

SW ID	Spring	Fall	UTM Easting (Zone 18)	UTM Northing (Zone 18)
SW-5*	S + VOC	S + VOC		
SW-8*	L	L		
BD-03-M2*	VOC	VOC		
SW98-1	S + VOC	S + VOC		
SW99-1	S + VOC	S + VOC	442269.24	4937654.04
SW99-2	S + VOC	S + VOC	442171.50	4937153.57
SW99-3	S + VOC	S + VOC	442208.53	4937308.32
SW99-5	S + VOC	S + VOC	442424.35	4937590.78
SW99-6	S + VOC	S + VOC		
SW00-1	S + VOC	S + VOC	442136.17	4936922.49
SW02-1	S + VOC	S + VOC		
SW03-1	S	S	442283.14	4937574.04
SW04-1	S + VOC	S + VOC		
Field Blank	--	--	--	--

Created By: KM

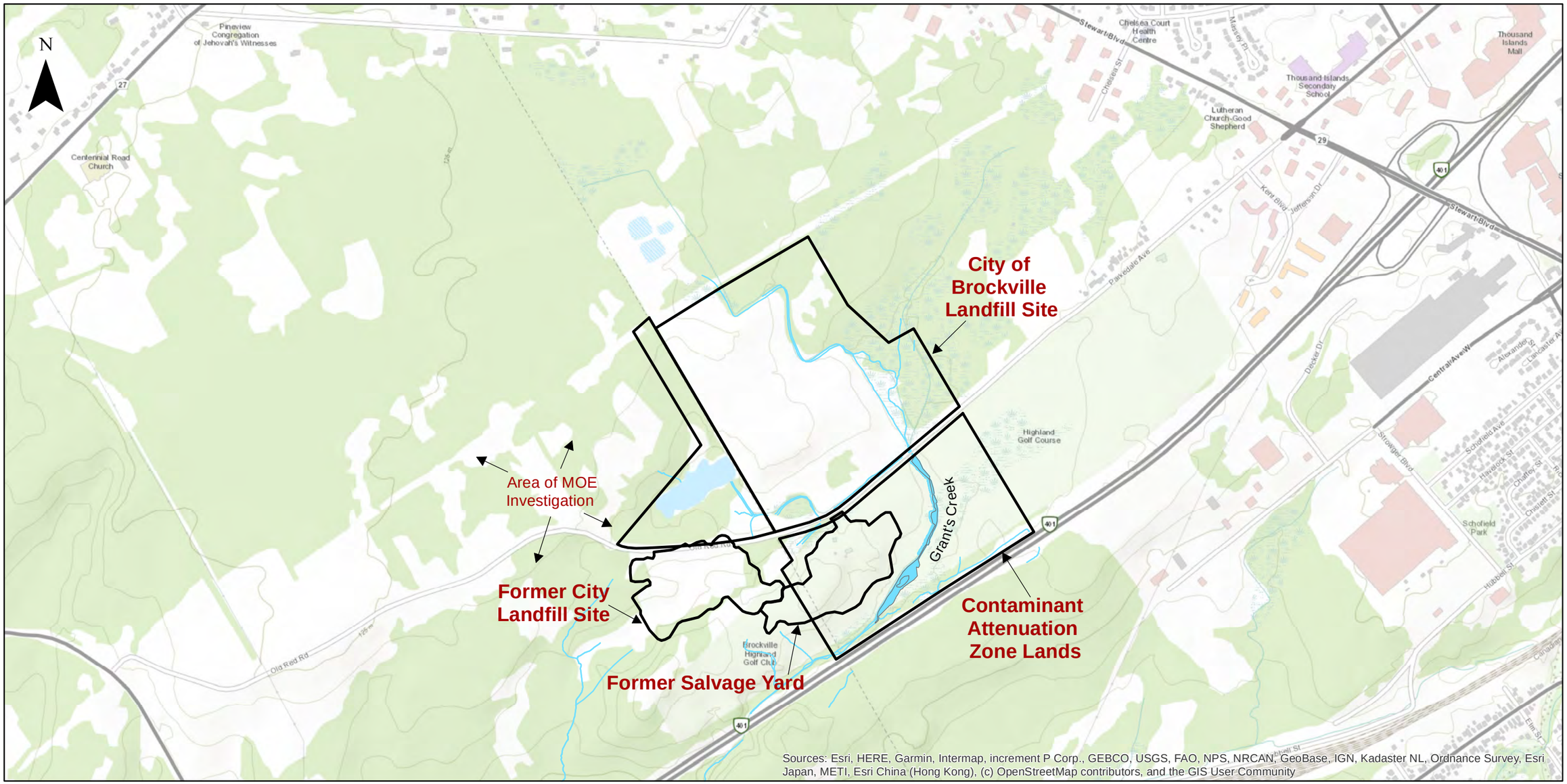
Notes:

* Locations also included in the Brockville Landfill Site monitoring program – only one sample analyzed for both programs

L – Leachate Indicator Parameters

S – Surveillance Parameters

VOC - Volatile Organic Compounds



Notes:
1. BASE PLAN FROM LAND INFORMATION ONTARIO
2. SITE BOUNDARIES FROM GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058

0 0.25 0.5 1 Kilometers

Jp2g Consultants Inc.
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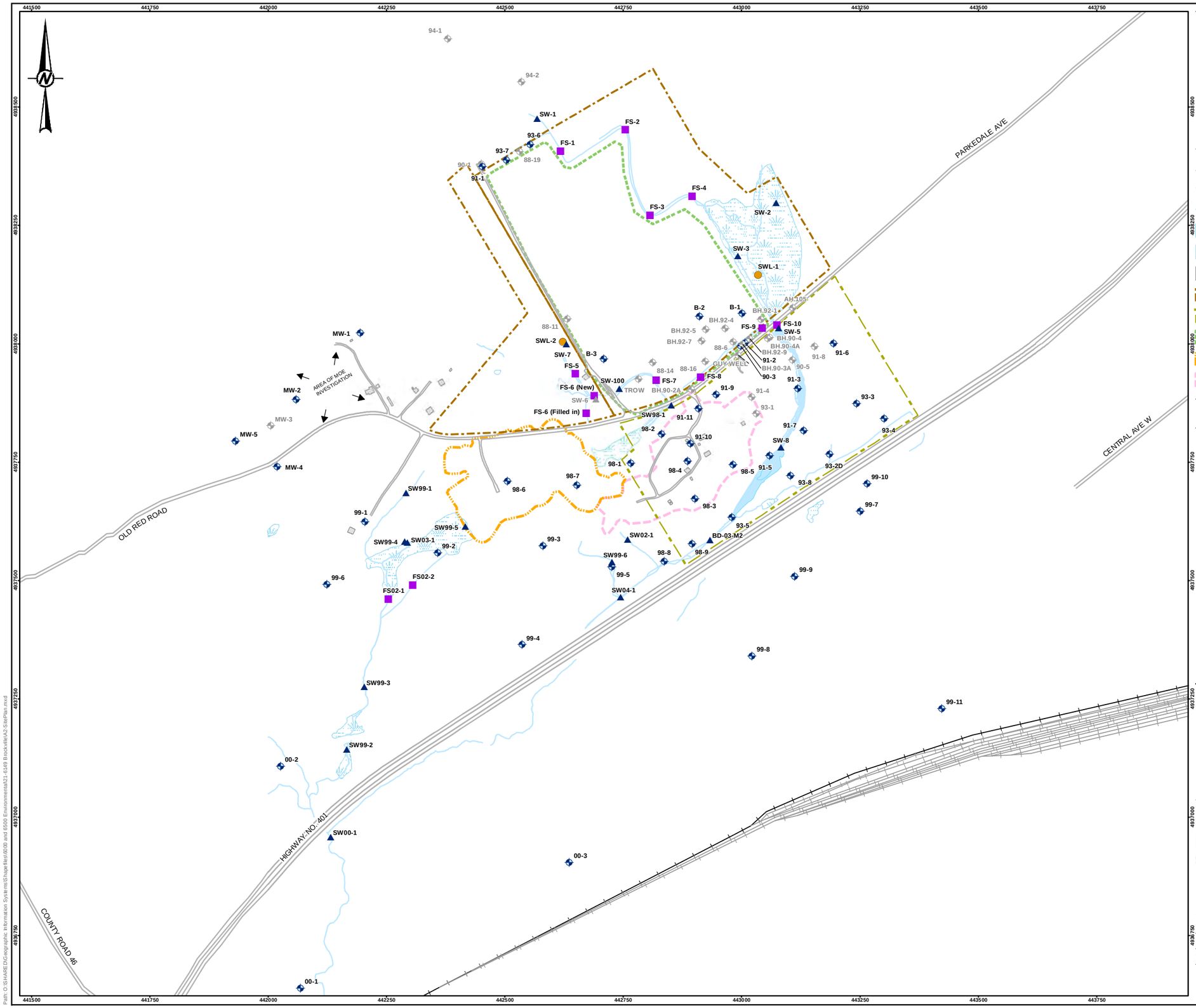
Brockville Landfill Site

Brockville, ON

1:10,000	Figure C1- Key Map
	Drawn By: HV
Project No. 21-6149B	Checked by: KM
	Date: June 2022



LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- STAFF GAUGE
- FLOW STATION LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

SITE PLAN

Jp2g Consultants Inc.
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PROJECT NO.	21-6149B	YYYY-MM-DD	5/27/2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
C2

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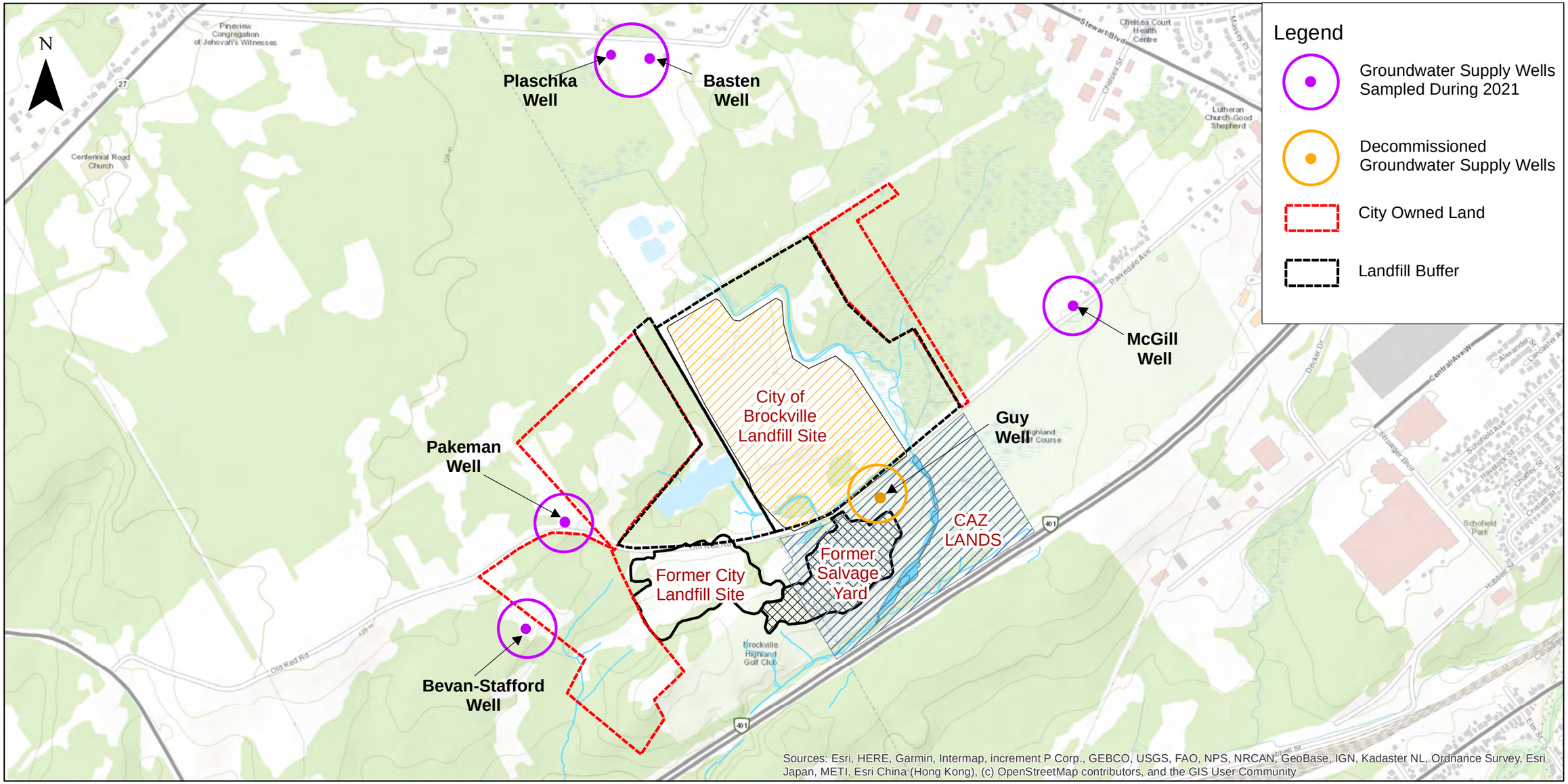

Notes:
1. BASE PLAN FROM LAND INFORMATION ONTARIO
2. SITE BOUNDARIES FROM GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058

0 0.25 0.5 1 Kilometers

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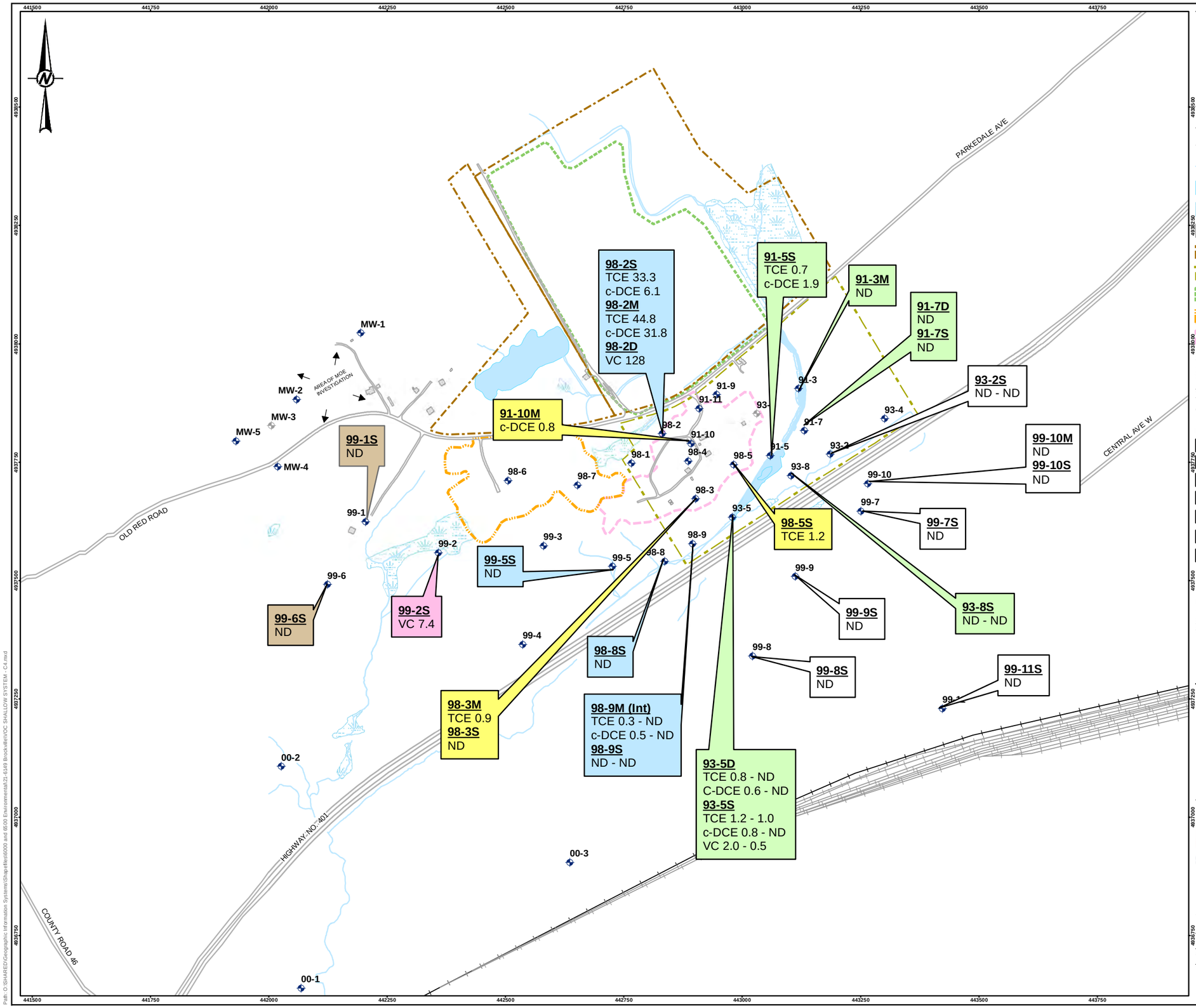
Brockville Landfill Site

Brockville, ON

1:10,000	Figure C3- Location of Sampled Domestic Wells
	Drawn By: HV
Project No. 21-6149B	Checked by: KM
	Date: June 2022



LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

2021 GROUNDWATER ANALYSIS RESULTS
UNITS = MICROGRAMS PER LITER (ug/L)
(Int) - INTERMEDIATE FLOW SYSTEM MONITOR

VC Vinyl Chloride
TCE Trichloroethylene
c-DCE cis 1,2 - Dichloroethylene
ND Not Detected (below lab detection limits)

IMPACTED OR POSSIBLY IMPACTED BY:

- M.O.E. INVESTIGATION AREA
- FORMER SALVAGE YARD
- LANDFILL AND FORMER SALVAGE YARD
- FORMER LANDFILL AND FORMER SLAVAGE YARD
- FORMER LANDFILL
- FORMER LANDFILL AND M.O.E INVESTIGATION AREA
- NOT IMPACTED

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

2021 VOC IN SHALLOW BEDROCK GROUNDWATER FLOW SYSTEM

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PROJECT NO.	21-6149B	YYYY-MM-DD	06-14-2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
C4

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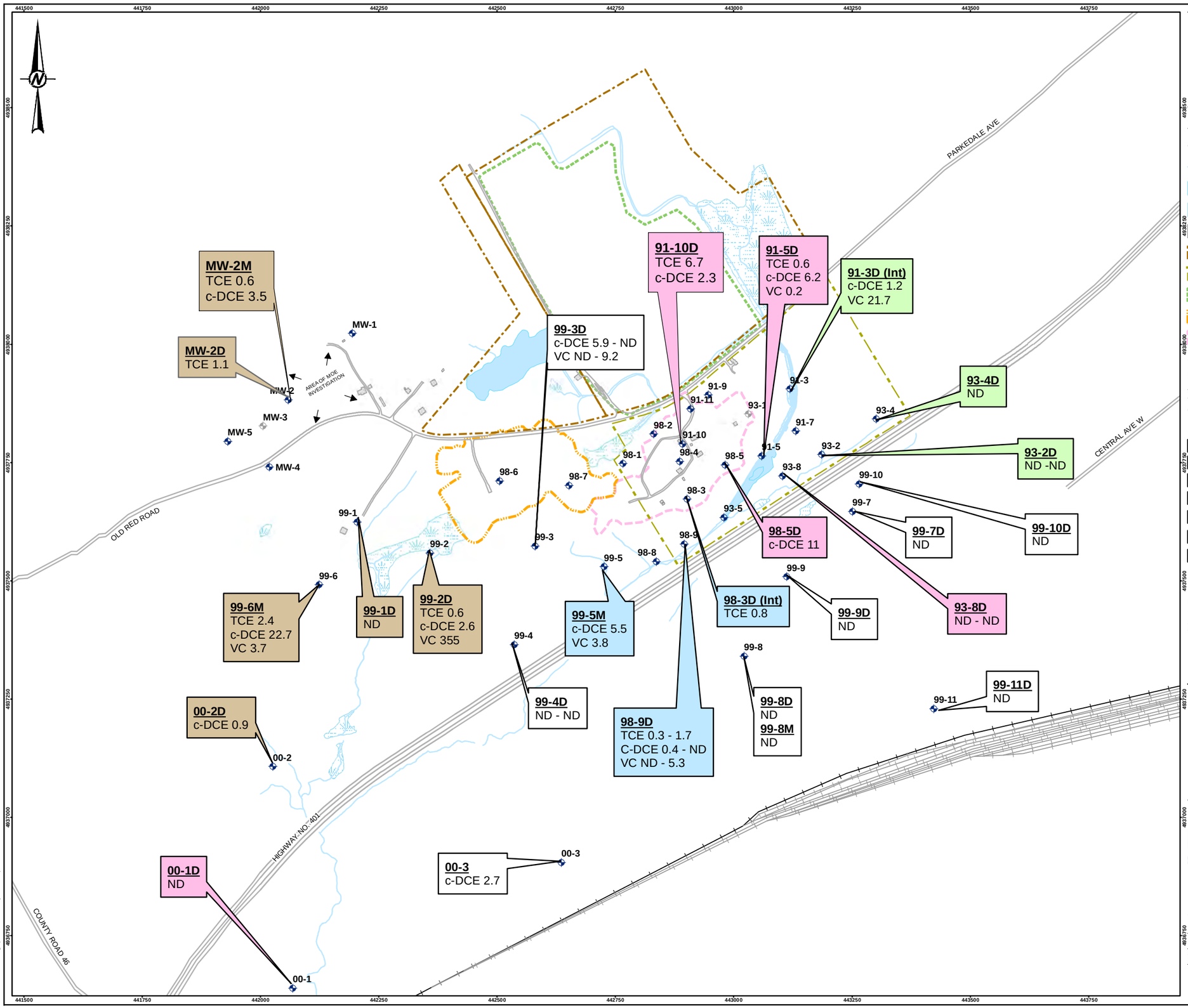

LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

2021 GROUNDWATER ANALYSIS RESULTS
UNITS = MICROGRAMS PER LITER (ug/L)
(Int) - INTERMEDIATE FLOW SYSTEM MONITOR

VC Vinyl Chloride
TCE Trichloroethylene
c-DCE cis 1,2 - Dichloroethylene
ND Not Detected (below lab detection limits)

IMPACTED OR POSSIBLY IMPACTED BY:

- M.O.E. INVESTIGATION AREA
- FORMER SALVAGE YARD
- LANDFILL AND FORMER SALVAGE YARD
- FORMER LANDFILL AND FORMER SLAVAGE YARD
- FORMER LANDFILL
- FORMER LANDFILL AND M.O.E INVESTIGATION AREA
- NOT IMPACTED

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

2021 VOC IN DEEP BEDROCK GROUNDWATER FLOW SYSTEM

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PROJECT NO.	21-6149B	YYYY-MM-DD	06-14-2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
C5

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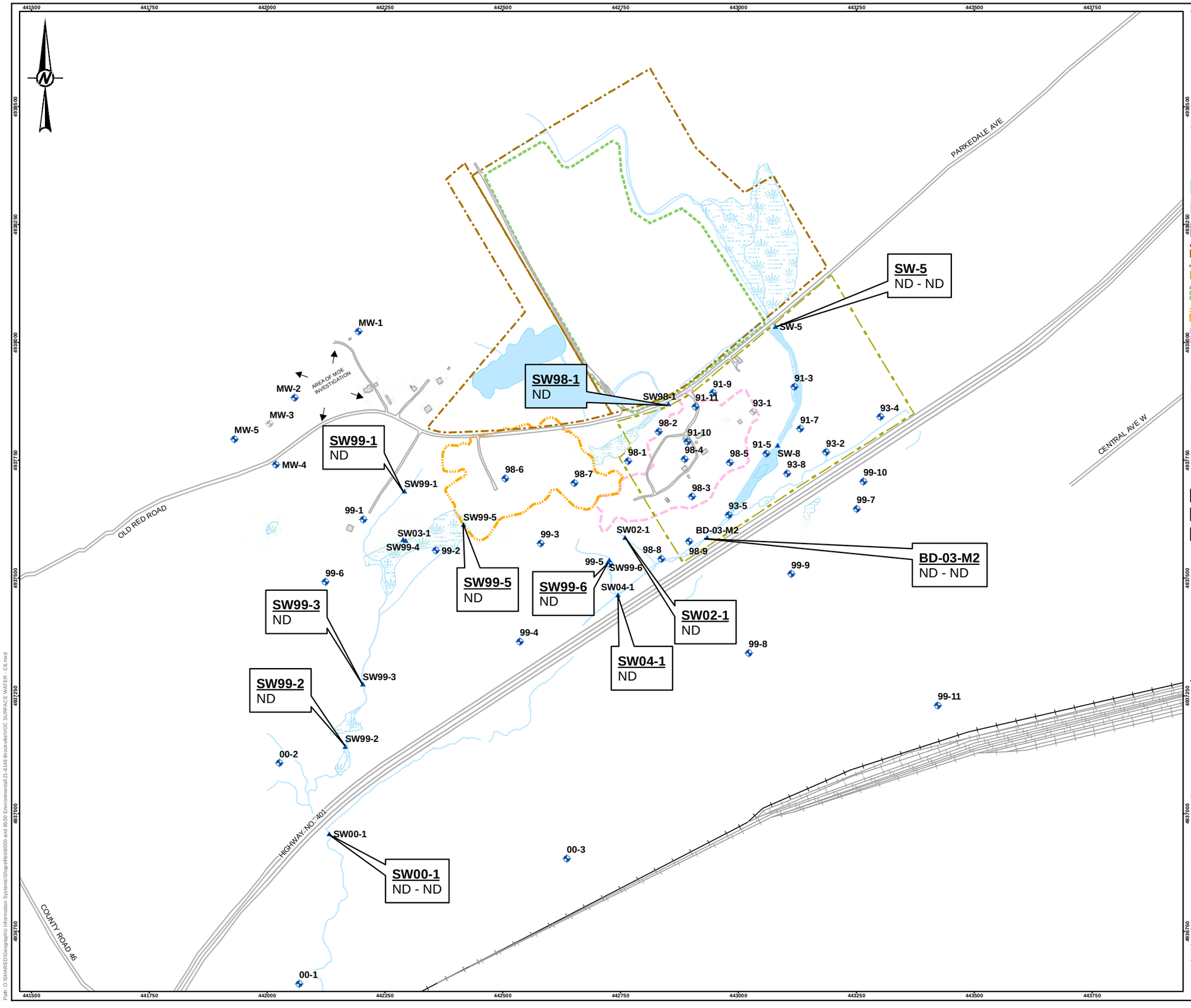

LEGEND

- WELL SAMPLING LOCATION
- FORMER WELL SAMPLING LOCATION
- SURFACE WATER SAMPLING LOCATION
- FORMER SURFACE WATER SAMPLING LOCATION
- ROAD
- RAILWAY AND TRANSIT LINES
- RAILWAY - SIDETRACK
- WATER COURSE
- OPEN WATER
- SWAMP
- BUILDING
- CITY OF BROCKVILLE LANDFILL PROPERTY LINE
- CONTAMINANT ATTENUATION ZONE BOUNDARY
- BROCKVILLE LANDFILL SITE APPROXIMATE FILL AREA
- LIMITS OF FORMER LANDFILL SITE IN 1963
- LIMITS OF FORMER SALVAGE YARD IN 1963

2021 GROUNDWATER ANALYSIS RESULTS
UNITS = MICROGRAMS PER LITER (ug/L)
(Int) - INTERMEDIATE FLOW SYSTEM MONITOR

VC	Vinyl Chloride
TCE	Trichloroethylene
c-DCE	cis 1,2 - Dichloroethylene
ND	Not Detected (below lab detection limits)

IMPACTED OR POSSIBLY IMPACTED BY:

- FORMER LANDFILL AND FORMER SLAVAGE YARD
- FORMER LANDFILL
- NOT IMPACTED

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. BASE PLAN SUPPLIED BY GOLDER ASSOCIATES LTD (2021) PROJECT NUMBER 21452058
2. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18 VERTICAL DATUM: CGVD28

0 100 200 400

BROCKVILLE LANDFILL SITE

BROCKVILLE, ONTARIO

~

2021 VOC IN SURFACE WATER

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

PROJECT NO.	21-6149B	YYYY-MM-DD	06-14-2022
DRAWN BY	HV	SCALE	1:8,000
CHECKED BY	KM		

FIGURE
C6

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