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July 6, 2018

Mr. Mike Kraemer and Mr. Richard Wright
Municipality of West Perth
169 David St., P.O. Box 609
Mitchell, ON N0K 1N0

Re: **2018 Annual Monitoring Event Summary
Hibbert Landfill
Municipality of West Perth, ON
RWDI Reference No. 1802469**

Dear Richard and Mike,

RWDI AIR Inc. (RWDI) is pleased to present this summary letter for the 2018 annual monitoring event completed at the Hibbert Landfill (Site). The Site is operated by the Municipality of West Perth and is located in the former township of Hibbert, Ontario.

1. SAMPLING AND METHODOLOGY

The 2018 annual monitoring event at the Site included groundwater, surface water, leachate, and combustible gas monitoring and was completed on May 2, 2018. The monitoring program was conducted in accordance with Condition 3.0 of Waste Disposal Site Environmental Compliance Approval No. A151301, dated July 8, 1980, as amended to September 20, 2010 (Waste ECA). The monitoring program consists of procedures for the purging of monitoring wells, the collection of samples, and ancillary tasks and was completed in accordance with the Waste ECA and the Environmental Monitoring Plan (EMP) for the Site, dated December 2010. A Detailed Site Plan (Figure 3 of the 2017 Annual Monitoring Report) is provided as **Attachment 1**.

1.1 Groundwater

Groundwater samples were collected from monitoring wells using dedicated inertial-lift pumps and tubing. The samples were collected directly into bottles provided by the laboratory. Prior to purging and sample collection, groundwater liquid levels were measured at each monitoring well.

1.2 Surface Water

Surface water samples were collected directly from the water source in a laboratory-prepared, unpreserved sample bottle for transfer to relevant bottles with preservatives.



1.3 Leachate

Leachate samples were collected from leachate monitoring wells MW1 and MW4 using dedicated inertial-lift pumps and tubing. The samples were collected directly into bottles provided by the laboratory. Prior to purging and sample collection, the leachate liquid levels were measured at each leachate monitoring well.

Collected groundwater, surface water, and leachate samples were submitted to ALS Environmental Inc. in Waterloo, Ontario, for analysis. The laboratory Certificates of Analysis for the collected samples are maintained on file and will be appended within the 2018 Annual Monitoring Report.

1.4 Combustible Gas Monitoring

Combustible gas monitoring was completed at the leachate and groundwater monitoring well locations at the Site. Combustible gas measurements were obtained prior to collecting liquid level measurements and conducting the sampling procedure, and immediately after removing the monitoring well's push-on cap, where present. Monitoring was completed using a 4-way gas meter calibrated to detect 100% of the lower explosive limit (LEL) for methane (CH₄). For combustible gas measurements calibrated for methane, 100% of the LEL is equivalent to 5% volume of methane in air.

2. MONITORING RESULTS

Findings from the 2018 monitoring event were assessed against the relevant trigger mechanisms established for the Site. The trigger mechanisms for water quality are to provide a guidance tool for the evaluation of waste fill area effects, where relevant, on surface water and/or groundwater at and adjacent to the Site.

For the groundwater monitoring wells, the trigger mechanism was established in accordance with Condition 4.0 of the Waste ECA (Notice No. 2) and the Environmental Contingency Plan (ECP) for the Site, as dated December 2013 and prepared by R.J. Burnside and Associates Limited. For the surface water monitoring stations, Condition 3.0 and 4.0 of the Waste ECA (Notice No. 2) indicate that surface water quality at the Site is to be monitored to confirm compliance with the relevant Provincial Water Quality Objectives (PWQO). However, a trigger mechanism for surface water is not identified in the ECP for the Site. As the Hibbert Landfill has a similar potential groundwater discharge to surface water setting as the Mitchell Domestic Landfill, the surface water trigger mechanism established for the Mitchell Domestic Landfill has been adopted herein to assess the surface water quality at the Site. The surface water trigger mechanism is described in **Section 2.2**.



2.1 Groundwater Analytical Results

The trigger mechanism for the groundwater monitoring at the Site involves the calculation of trigger concentrations for the groundwater monitoring wells based on the Ministry of the Environment and Energy (MOEE) Guideline B-7 Reasonable Use Concept (Guideline B-7). The Guideline B-7 criteria (trigger concentrations) for the background monitoring wells are calculated based on the geometric mean of the historical analytical concentrations to the end of the previous reporting year (for the purpose of this report, to the end of 2017). The trigger concentrations are calculated for analytical parameters which: i) are identified in the Waste ECA and EMP for analysis at the groundwater monitoring wells; and ii) have an existing Ontario Drinking Water Standard (ODWS) criterion.

For each relevant parameter, the analytical results from the 2018 monitoring event for the compliance monitoring wells were compared to the calculated trigger concentrations for the background monitoring wells. The groundwater compliance monitoring wells for the Site are those located along, or outside of, the Site property boundary, including: MW2S/D and MW3 (shallow). The background monitoring wells for the Site are MW5S and MW5D for the shallow and deep flow systems, respectively.

The trigger mechanism for groundwater at the Site is activated if one of the following conditions is met.

- If the concentration of chloride from the most recent monitoring event is greater than its respective trigger concentration at a compliance monitoring well. Due to the elevated chloride concentrations noted at monitoring well MW5S, a chloride exceedance is to be interpreted with caution. It is noted that, as a measure of conservatism, the trigger concentration for chloride within the groundwater compliance wells is 75% of the respective calculated Guideline B-7 criterion.
- If at least three (3) parameters, other than chloride, from the most recent monitoring event are greater than their respective trigger concentration at a compliance monitoring well.

The analytical results for the 2018 monitoring event and the respective trigger concentrations are presented in **Table 1** and **Table 2**. The results that were greater than their respective trigger concentrations are summarized on the following page. It is noted that if a result is greater than its respective trigger concentration, a trigger mechanism for the Site is not necessarily activated, per the ECP for the Site.



Property Boundary Well	Parameter(s)	Trigger Concentration (mg/L)	Analytical Result (mg/L)
Shallow Groundwater Monitoring Wells			
MW2S	Total Hardness	343	386
	Total Dissolved Solids	541	613
	Manganese	0.027	0.0776
	Selenium	0.0038	0.00471
MW3	Total Hardness	343	411
	Total Dissolved Solids	541	633
	Alkalinity	437	458
	Dissolved Organic Carbon	3.7	4.3
Deep Groundwater Monitoring Wells			
MW2D	Total Hardness	212	285
	Total Dissolved Solids	380	520

For the 2018 monitoring event, the trigger concentration for chloride was not exceeded at the groundwater compliance monitoring wells. The analytical results for at least three (3) parameters, excluding chloride, were greater than their respective trigger concentration within compliance monitoring wells MW2S and MW3. The analytical results noted in the above summary were generally consistent with historical results at the respective monitoring locations.

Monitoring well MW2S is located along the west boundary of the Site, between the landfill footprint and the McMillan Drain. The 2018 and historical analytical results at monitoring well MW2S for the parameters noted in the above summary have generally fluctuated with no apparent increasing or decreasing trend. Since 2014, the concentration of selenium has slightly increased over time, however, it has remained below the ODWS criterion for selenium. The concentrations of selenium at MW2S since 2014 have also been generally greater than the concentrations historically detected within the leachate at the Site, as assessed at monitoring wells MW1 and MW4. As such, the slight increasing concentration trend for selenium at MW2S does not appear to be a result of a landfill leachate influence.



Based on the 2018 and historical results for the remaining parameters that were greater than their respective trigger concentration at MW2S, an increasing trend is not apparent, which indicates that the groundwater quality at this location is stable and not degrading as a result of a landfill leachate influence. Additionally, the parameters that were detected at concentrations greater than their respective trigger concentration at MW2S were detected at acceptable concentrations in the surface water within the McMillan Drain, which is downgradient of monitoring well MW2S.

Monitoring well MW3 is located along the south boundary of the Site. The 2018 and historical analytical results at monitoring well MW3 for the parameters noted in the above summary have generally fluctuated with no apparent increasing or decreasing trend. In 2018, each parameter was detected within its respective historical range. Based on the 2018 and historical results for the parameters that were greater than their respective trigger concentration, an increasing trend is not apparent, which indicates that the groundwater quality at this location is stable and not degrading as a result of a landfill leachate influence. Additionally, similar to the results at monitoring well MW2S, the parameters that were greater than their respective trigger concentration at MW3 were detected at acceptable concentrations in the surface water within the McMillan Drain, which is downgradient of monitoring well MW3.

Overall, for parameters detected at elevated concentrations in the leachate at the Site, an increasing trend in the groundwater analytical concentrations is not apparent for the parameters that were greater than their respective trigger concentration at monitoring wells MW2S and MW3. The concentrations of the relevant parameters were also detected at acceptable concentrations in the surface water downstream of the landfill. Thus, remedial action at monitoring wells MW2S and MW3 is not warranted.

Based on a review of the analytical results for the 2018 monitoring event, the groundwater quality around the waste footprint at the Site is of acceptable quality. Ongoing monitoring should be completed for monitoring wells MW2S and MW3 to evaluate the groundwater quality at these locations over time and determine if any trends of concern are developing.

2.1.1 Organic Compounds

For the 2018 monitoring event, concentrations of volatile organic compound (VOC) constituents within the groundwater compliance monitoring wells at the Site were below their respective laboratory reportable detection limits (RDLs), with one (1) exception. A low concentration of n-hexane (0.54 µg/L) was detected slightly above its RDL (0.50 µg/L) within MW2S.



A slightly lower concentration of n-hexane (0.52 µg/L) was also detected in May 2015, which was the first detection of n-hexane within MW2S. As such, the historical analytical results at monitoring well MW2S for n-hexane are generally below its RDL with no apparent increasing or decreasing trend. The VOC concentrations in the groundwater at MW2S should be evaluated over subsequent monitoring events to assess the repeatability of the May 2018 result and determine if a trend of concern is developing. It is noted that there is no ODWS for n-hexane. No remedial action is warranted, at this time, to address the noted May 2018 n-hexane concentration at MW2S.

2.2 Surface Water Analytical Results

Based on the surface water trigger mechanism established for the Mitchell Domestic Landfill, the trigger mechanism for the surface water monitoring at the Site involves the comparison of the surface water analytical results from the most recent monitoring event to their respective PWQO, where available. Trigger concentrations are established for analytical parameters which: i) are identified in the Waste ECA and EMP for analysis at the surface water stations, and ii) have an existing PWQO. As there is no PWQO for chloride, the trigger concentration calculated for chloride in the shallow groundwater system is used as an indicator of landfill impacts in surface water.

The surface water compliance station for the Site is SW2, which is positioned downstream of the Site in the McMillan Drain. The McMillan Drain flows southerly along the west side of the Site.

The trigger mechanism for surface water at the Site is activated if one of the following conditions is met.

- If the concentration of chloride from the most recent monitoring event is greater than its respective shallow groundwater trigger concentration at the compliance station.
- If the analytical results for at least three (3) parameters, other than chloride, from the most recent monitoring event are greater than their respective PWQO at the compliance station.

For parameters that have a PWQO, the analytical results for the 2018 monitoring event are presented in **Table 3**. For the 2018 monitoring event, the shallow groundwater trigger concentration for chloride was not exceeded at the surface water compliance station. The analytical results for the tested parameters at the surface water compliance station were also each below their respective PWQO. Therefore, the 2018 surface water quality satisfied the relevant trigger mechanisms for the Site.



2.3 Leachate Analytical Results

Leachate samples were collected as required from leachate monitoring wells MW1 and MW4. The analytical results were reasonable for a municipal solid waste landfill and were generally consistent with historical results for each respective location.

2.4 Combustible Gas Monitoring Results

For the 2018 annual monitoring event, combustible gas (methane) was not detected at each of the leachate and groundwater monitoring wells at the Site. As combustible gas was not detected at the Site above 5% by volume (100% of the LEL for methane), there are no explosive concerns related to combustible gas for nearby structures.

In summary, based on the 2018 combustible gas monitoring results, methane gas is not migrating beyond the waste footprint within the subsurface at concentrations that would represent an explosive risk to nearby structures.

3. CONCLUSIONS

The findings from the 2018 annual monitoring event for the Site indicate that the groundwater quality around the landfill property boundary is, generally, of acceptable quality. Although the analytical results for select parameters were greater than their respective trigger concentrations at MW2S and MW3, an increasing trend for parameters elevated in the leachate is not apparent, which indicates that the groundwater quality within MW2S and MW3 is stable and not degrading as a result of a landfill leachate influence. The relevant parameters noted at concentrations greater than their respective trigger concentration at monitoring wells MW2S and MW3 were detected at acceptable concentrations in the surface water for the McMillan Drain, which is downgradient of MW2S and MW3. The surface water quality at compliance station SW2 satisfied the relevant trigger mechanisms for the Site. As such, no remedial actions are warranted, at this time, to address the 2018 annual monitoring results for the Site.

For the 2018 monitoring event, combustible gas (methane) was not detected at each of the leachate and groundwater monitoring wells at the Site and thus, combustible gas is not migrating beyond the waste foot-print within the subsurface at concentrations that would represent an explosive risk to nearby structures. No remedial actions are required, at this time.



2018 Annual Monitoring Event Summary
Hibbert Landfill
Municipality of West Perth, ON
RWDI Reference No. 1802469
July 6, 2018

4. CLOSURE

We trust this summary letter for the 2018 annual monitoring event is satisfactory for your current requirements. Complete details of this monitoring event will be presented in the 2018 Annual Monitoring Report for the Site. Should there be any questions or comments, please contact us.

Yours very truly,

RWDI AIR Inc.

Prepared By:

A handwritten signature in black ink, appearing to read 'Ying Lei'.

Ying Lei, B.Eng., M.A.Sc.
Scientist – Geoscience

A handwritten signature in black ink, appearing to read 'Andy de Jong'.

Andy de Jong, M.A.Sc., P.Eng.
Project Manager | Senior Engineer

TABLES

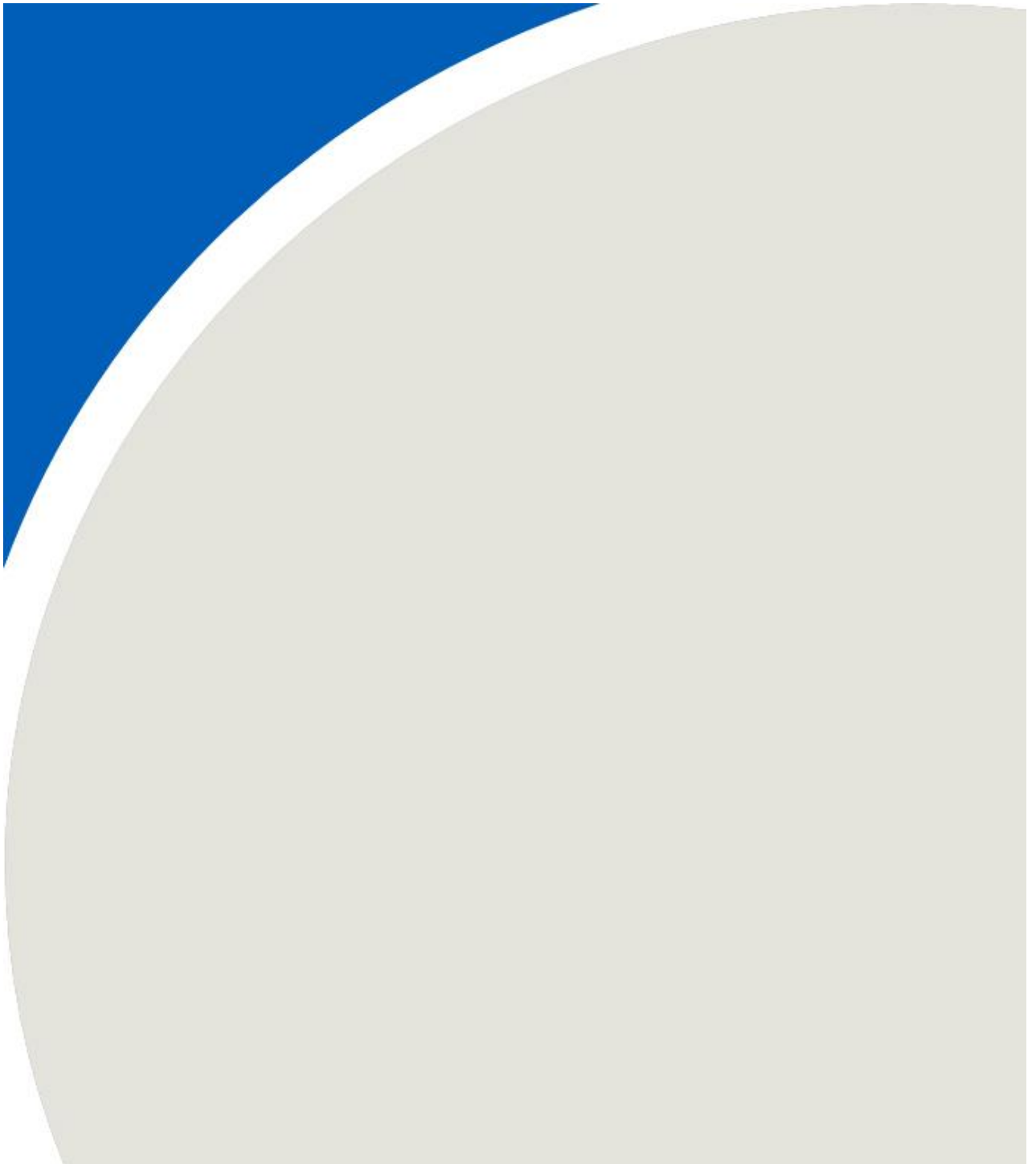


Table 1: Summary of Groundwater Compliance for the Shallow Flow System

Hibbert Landfill, Hibbert, Ontario
Municipality of West Perth
Project No. 1802469

Parameter	Background Quality (C _b)	ODWS (C _r)	X	Guideline B-7 Criteria (C _m)	Background Well	Property Boundary Wells	
					MW5S	MW2S	MW3
					May-18	May-18	May-18
<i>General Chemistry</i>							
Total Hardness (as CaCO ₃)	343	100	0.5	<u>343</u>	305	386	411
Total Dissolved Solids	541	500	0.5	<u>541</u>	579	613	633
Alkalinity, Total (as CaCO ₃)	373	500	0.5	437	337	411	458
Chloride	20.2	250	0.5	101	8.26	10.2	16.6
Fluoride	0.50	1.5	0.25	0.75	0.806	0.153	0.08
(Nitrate + Nitrite) as N	0.092	10	0.25	2.6	18.4	1.764	0.093
Nitrate-N	0.099	10	0.25	2.6	18.4	1.75	0.093
Nitrite-N	0.024	1.0	0.25	0.27	<0.010	0.014	<0.010
Sulphate	95.6	500	0.5	298	46.9	8.97	11.2
Dissolved Organic Carbon	2.4	5.0	0.5	3.7	1.7	3	4.3
Aluminum	0.0066	0.10	0.5	0.053	<0.0050	<0.0050	<0.0050
Arsenic	0.00085	0.025	0.25	0.0069	0.00046	0.00055	0.00022
Barium	0.10	1.0	0.25	0.32	0.099	0.0725	0.0702
Boron	0.026	5.0	0.25	1.3	0.014	0.027	0.025
Cadmium	0.00012	0.005	0.25	0.0013	<0.000010	0.000078	0.000024
Chromium	0.00081	0.05	0.25	0.013	<0.00050	<0.00050	<0.00050
Copper	0.00093	1.0	0.5	0.50	0.00053	0.00111	0.00195
Iron	0.0069	0.30	0.5	0.15	<0.010	<0.010	<0.010
Lead	0.00028	0.01	0.25	0.0027	<0.000050	<0.000050	<0.000050
Manganese	0.0031	0.05	0.5	0.027	<0.00050	0.0776	0.00646
Selenium	0.0017	0.01	0.25	0.0038	0.00154	0.00471	0.000377
Sodium	60.4	200	0.5	130	68.9	18.5	27.9
Zinc	0.0023	5.0	0.5	2.5	<0.0010	<0.0010	<0.0010

- Notes:** 1) Background quality is based on the geometric mean of the historical results for monitoring well MW5S.
2) Ontario Drinking Water Standards, Objectives and Guidelines, Ontario Ministry of the Environment, as revised June 2006 (ODWS).
3) Guideline B-7 Criteria (C_m) = C_b + X(C_r - C_b).
4) C_m = Maximum concentration of a contaminant that may exist beyond the property boundary.
5) C_b = Concentration (geometric mean of historical results) for a given parameter at the background well.
6) C_r = Maximum allowable concentration of a parameter in groundwater (based on the ODWS criteria).
7) X = Reduction constant associated with assessing whether a parameter of concern is health related (0.25) or non-health related (0.5), based on ODWS criteria.
8) If Background Quality < Detection Limit (DL), half the DL value is used in the Guideline B-7 calculation.
9) Groundwater compliance is assessed based on the analytical results for the Property Boundary Wells.
10) Underline denotes where C_b is > ODWS criteria, C_b = C_m.
11) Bold and shaded denotes concentration at a Property Boundary Well exceeds Guideline B-7 Criteria.
12) Dash (-) denotes data not available.
13) Unless otherwise stated, all units are reported in mg/L.
14) Compliance criteria for chloride is 75% of the calculated Guideline B-7 Criteria.

Table 2: Summary of Groundwater Compliance for the Deep Flow System

Hibbert Landfill, Hibbert, Ontario
Municipality of West Perth
Project No. 1802469

Parameter	Background Quality (C _b)	ODWS (C _r)	X	Guideline B-7 Criteria (C _m)	Background Well		Property Boundary Well	
					MW5D		MW2D	
					May-18		May-18	
General Chemistry								
Total Hardness (as CaCO ₃)	212	100	0.5	<u>212</u>	222		285	
Total Dissolved Solids	260	500	0.5	380	306		520	
Alkalinity, Total (as CaCO ₃)	255	500	0.5	378	247		336	
Chloride	5.3	250	0.5	95.7	7.03		25.6	
Fluoride	1.2	1.5	0.25	1.3	1.52		0.872	
(Nitrate + Nitrite) as N	0.047	10	0.25	2.5	<0.022		<0.022	
Nitrate-N	0.046	10	0.25	2.5	<0.020		<0.020	
Nitrite-N	0.018	1.0	0.25	0.26	<0.010		<0.010	
Sulphate	9.6	500	0.5	255	7.93		60.9	
Dissolved Organic Carbon	1.6	5.0	0.5	3.3	<1.0		3	
Aluminum	0.0085	0.10	0.5	0.054	<0.0050		<0.0050	
Arsenic	0.0056	0.025	0.25	0.010	0.00692		0.00161	
Barium	0.047	1.0	0.25	0.28	0.0456		0.0433	
Boron	0.11	5.0	0.25	1.3	0.107		0.073	
Cadmium	0.00019	0.005	0.25	0.0014	<0.000010		<0.000010	
Chromium	0.00084	0.05	0.25	0.013	<0.00050		<0.00050	
Copper	0.0010	1.0	0.5	0.50	0.00031		0.0007	
Iron	0.025	0.30	0.5	0.16	<0.010		<0.010	
Lead	0.00036	0.01	0.25	0.0028	<0.000050		<0.000050	
Manganese	0.011	0.05	0.5	0.030	0.00603		<0.00050	
Selenium	0.00053	0.01	0.25	0.0029	<0.000050		0.000094	
Sodium	19.3	200	0.5	110	22.3		65.1	
Zinc	0.0021	5.0	0.5	2.5	<0.0010		<0.0010	

- Notes:**
- 1) Background quality is based on the geometric mean of the historical results for monitoring well MW5D.
 - 2) Ontario Drinking Water Standards, Objectives and Guidelines, Ontario Ministry of the Environment, as revised June 2006 (ODWS).
 - 3) Guideline B-7 Criteria (C_m) = C_b + X(C_r - C_b).
 - 4) C_m = Maximum concentration of a contaminant that may exist beyond the property boundary.
 - 5) C_b = Concentration (geometric mean of historical results) for a given parameter at the background well.
 - 6) C_r = Maximum allowable concentration of a parameter in groundwater (based on the ODWS criteria).
 - 7) X = Reduction constant associated with assessing whether a parameter of concern is health related (0.25) or non-health related (0.5), based on ODWS criteria.
 - 8) If Background Quality < Detection Limit (DL), half the DL value is used in the Guideline B-7 calculation.
 - 9) Groundwater compliance is assessed based on the analytical results for the Property Boundary Well.
 - 10) Underline denotes where C_b is > ODWS criteria, C_b = C_m.
 - 11) **Bold and shaded** denotes concentration at a Property Boundary Well exceeds Guideline B-7 Criteria.
 - 12) Dash (-) denotes data not available.
 - 13) Unless otherwise stated, all units are reported in mg/L.
 - 14) Compliance criteria for chloride is 75% of the calculated Guideline B-7 Criteria.

Table 3: Summary of Surface Water Compliance

Hibbert Landfill, Hibbert, Ontario

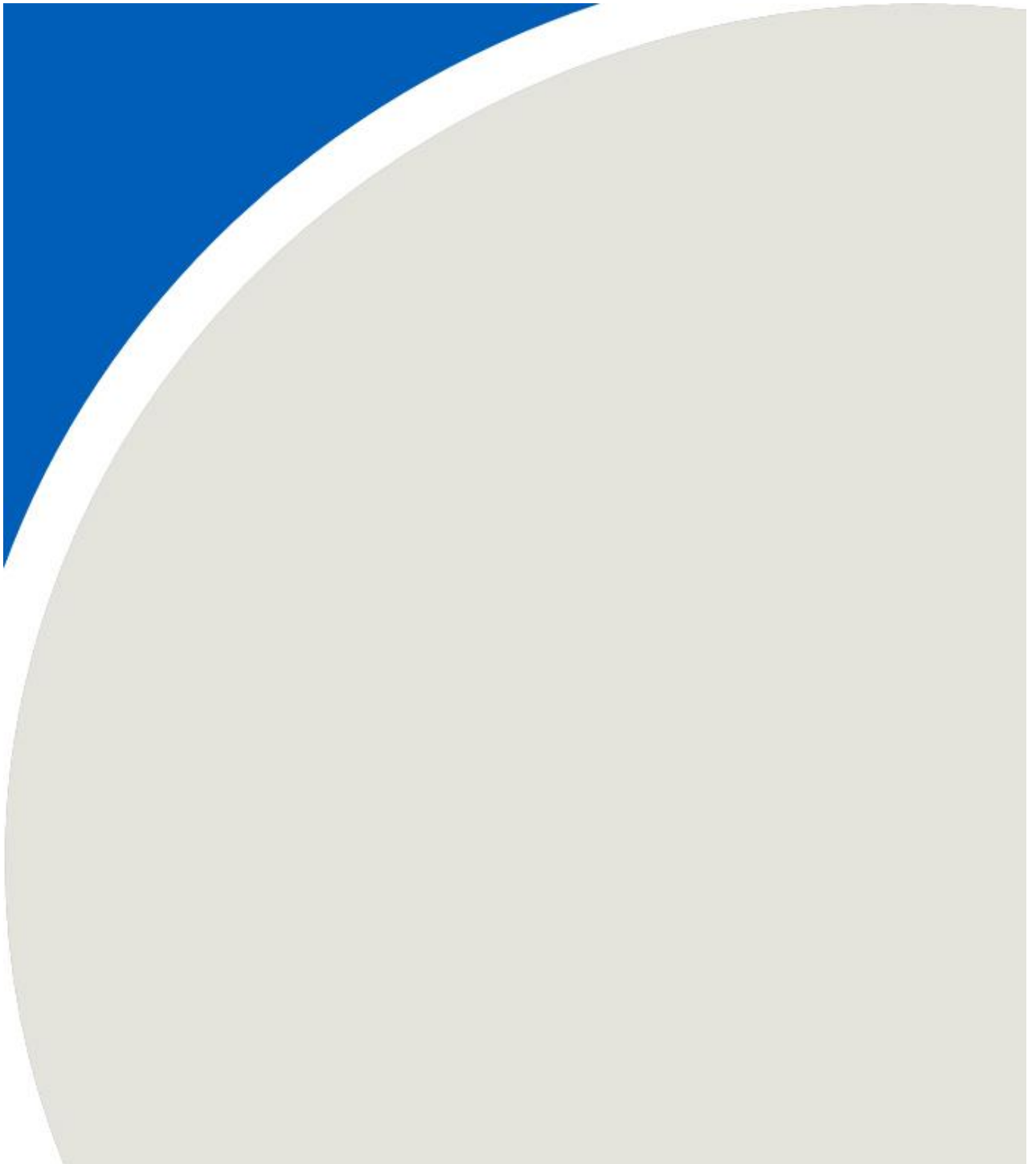
Municipality of West Perth

Project No. 1802469

Parameter	PWQO	Background Station	Compliance Station
		SW1	SW2
		May-18	May-18
General Chemistry			
Alkalinity, Total (as CaCO3)	>25% Decrease	210	211
Chloride	137	25.2	27.8
Arsenic	0.005	0.00023	0.00024
Boron	0.2	0.010	0.011
Cadmium	0.0005	<0.000010	0.00001
Copper	0.005	<0.0010	<0.0010
Iron	0.3	0.063	0.081
Lead	0.005	<0.00010	<0.00010
Selenium	0.1	0.00044	0.00047
Zinc	0.02	<0.0030	<0.0030
Dissolved Aluminum	0.075	<0.0050	<0.0050

- Notes:**
- 1) PWQO denotes Provincial Water Quality Objectives of the Ministry of the Environment and Energy, as revised February 1999.
 - 2) Background quality is based on the result for upstream surface water station SW1.
 - 3) Surface water compliance is assessed based on the analytical results for downstream station SW2.
 - 4) There is no PWQO for chloride; the calculated Guideline B-7 criteria for chloride in the shallow groundwater wells is provided for reference.
 - 5) Bold and shaded denotes concentration exceeds the PWQO.
 - 6) Blank denotes data not available.
 - 7) Unless otherwise stated, all units are reported in mg/L.

ATTACHMENT 1



LEGEND:

- HIBBERT LANDFILL SITE BOUNDARY
- MW3 MONITORING WELL LOCATION AND DESIGNATION
- SW2 SURFACE WATER SAMPLE LOCATION
- TP-1 TEST PIT LOCATION (BURNSIDE, 2006 & 2009)
- SS-7 SOIL SAMPLE LOCATION (BURNSIDE, 2011)
- APPROXIMATE WASTE FOOTPRINT (BURNSIDE, 2013)



1:2000

Detailed Site Plan
 2017 Annual Monitoring Report
 Hibbert Landfill

Municipality of West Perth

Note:
 1. Plan details obtained from Fig. 3 of the 2013 Annual Monitoring Report (Burnside, 2013).
 2. Air photo from First Base Solutions (2010).



Project #1601427.5

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Approx. Scale: 1:2,000	
Date Revised: Nov. 22, 2017	

