Clean Harbors Canada, Inc.
Lambton Facility
4090 Telfer Road, R.R. #1
Corunna, Ontario
N0N 1G0

2016 Annual Landfill Report

Executive Summary

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1. INTRODUCTION

1.1 Background and Scope

Clean Harbors Canada, Inc. operates a hazardous waste management complex on a 140 hectare parcel of land in St. Clair Township, Lambton County, called the Lambton Facility. The location of the Lambton Facility and major site features are shown in **Figure 1** and **Figure 2**, respectively.

The Lambton Facility encompasses an analytical laboratory, a transportation depot, a high temperature incinerator, associated pretreatment processes, as well as a landfill.

The landfill is operated in accordance with Environmental Compliance Approval (ECA) No. **A031806** dated September 5, 1997, as amended by subsequent Notices up to, and including, Notice 10 dated October 20, 2016. Copies of the ECA and amendment Notices are provided in **Appendix A**.

1.2 Site Inspection, Monitoring and Reporting Requirements

Condition 15 of the ECA requires that the Annual Landfill Report be submitted by April 1st of each year and include the following information.

a. The results and an interpretive analysis of the results of all Site monitoring programs, including an assessment of the need to amend the monitoring programs;
b. A summary of any drilling programs, geotechnical monitoring programs, and the results of any soil testing;
c. An assessment of the operation and performance of all Major Works, the need to amend the design or operation of the Site, and the adequacy of and need to implement the contingency plans;
d. Site plans showing the existing contours of the Site; areas of landfilling operation during the reporting period; areas of intended operation during the next reporting period; areas of excavation during the reporting period; any encountered gravel or sand lenses, the progress of final cover, vegetative cover, and any intermediate cover application; facilities existing, added or removed during the reporting period; and Site preparations and facilities planned for installation during the next reporting period;
e. Calculations of the volume of waste, daily and intermediate cover, and final cover deposited or placed at the Site during the reporting period and a calculation of the total volume of Site capacity used during the reporting period;
f. A calculation of the remaining capacity of the Site and an estimate of the remaining Site life;
g. A summary of the monthly, maximum daily and total annual quantity (tonnes) of waste received at the Site for landfilling and pretreatment, including types and origin;
h. Any Unused Tonnage applied to the current year;
i. A summary of any complaints received and the responses made;
j. A discussion of any operational problems encountered at the Site and corrective action taken;
k. Any changes to the Design and Operations Report and the Closure Plan that have been approved by the Director since the last Annual Report;

l. A report on the status of all monitoring wells and a statement as to compliance with Ontario Regulation 903;
m. Site plan showing the location of the storage for the unacceptable waste;
n. A list of all rejected loads, including reasons for any rejection;
o. A summary of quantities and types of wastes temporarily stored and transferred from the Site; and
p. Any other information with respect to the Site which the District Manager may require from time to time.
q. **For QC Results:** a summary of all quality control sampling in accordance with the quality assurance/quality control plans for the Major Works, including interpretation and discussion of compliance with those plans.
r. **For LDR**: a detailed monthly summary of the type (by waste class and characteristic) and quantity of waste received at the Site for LDR and at the Processing Facility for LDR and landfill pretreatment system, total amount and type of reagents used in the process, and the total amount and destination of all outgoing wastes from the Processing Facility; and
s. **For LDR**: a descriptive summary of upgrades conducted during the previous calendar year.

This annual report, which covers the period from **January 1, 2016 to December 31, 2016,** presents the requested information.

1.3 Report Organization

This report is subdivided into two parts:

- The Executive Summary outlines the various site monitoring activities and reporting requirements, as set out in the ECA.
- The Appendices contain supporting information, reports and technical data submitted by consultants responsible for the various environmental monitoring programs conducted at the Lambton Facility.

Figure 1. Site Location Plan

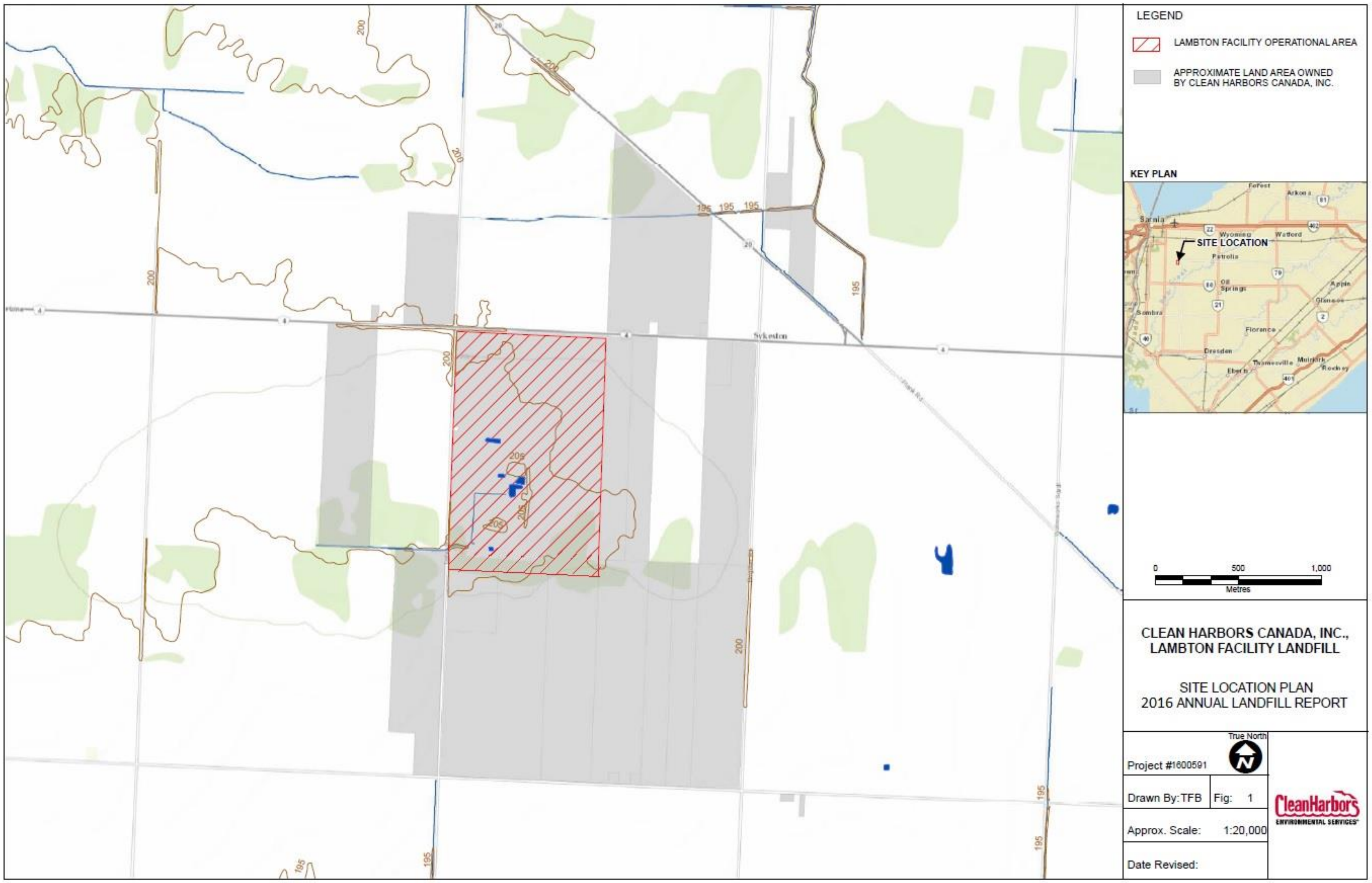


Figure 2. Site Works and Development Plan

Following is a brief description of the contents:

EXECUTIVE SUMMARY	
Section 1: Introduction	Provides background of on-site operations and monitoring activities
Section 2: Facility Operations	Overview of site operations and description of the waste received
Section 3: Waste Types and Quantities	Summary of waste types and quantities received, processed and landfilled; remaining landfill capacity
Section 4: Site Inspection Activities	Summary of quarterly site inspection reports, landfill cap compaction, geotechnical inspection and monitoring, and Sub-Cell 3 mitigation works
Section 5: Environmental Monitoring	Summary of groundwater, surface water, air quality and biomonitoring activities
Section 6: Recommendations	Summary of recommendations contained within each of the technical reports
APPENDICES	
Appendix A: Environmental Compliance Approvals	ECA **#A031806** dated September 5, 1997 as amended by subsequent Notices up to, and including, Notice 10 dated October 20, 2016.
Appendix B: Previous Year Annual Landfill Report Correspondence	Review comments concerning Clean Harbors previous year Annual Landfill Report and Clean Harbors responses.
Appendix C: Waste Material Codes and Descriptions	Description of material codes applied by Clean Harbors Canada, Inc. to characterize waste streams.
Appendix D: Waste Load Rejection Summary	List of rejected waste loads and basis for rejection.
Appendix E: Community Liaison & Advisory Committee Meeting Minutes	Copy of the minutes from the scheduled Community Liaison & Advisory Committee meetings.
Appendix F: Summary of Quarterly Site Inspection Reports	Summary of quarterly site inspection results undertaken by GHD.
Appendix G: Groundwater Monitoring Report	Technical report prepared by RWDI Air, Inc.
Appendix H: Surface Water Quality Monitoring Report	Annual surface water technical report prepared by GHD.
Appendix I: Air Quality Monitoring Report	Technical report prepared by ORTECH Canada Ltd.
Appendix J: Biomonitoring Report	Technical report prepared by Stantec Consulting Limited

1.4 Review of 2015 Annual Landfill Report

It has been the historic practice for the Ministry of the Environment and Climate Change (MOECC) to provide comments on the facility's annual landfill reports. The comments typically relate to requests for clarification and, on occasion, reflect a difference in opinion on data interpretation. With respect to issues pertaining to environmental monitoring, Clean Harbors Canada, Inc. confers closely with its independent consultants in reviewing the MOECC comments and providing a written response. The responses can include, but are not limited to, modifications of reporting procedures and direct correspondence to the MOECC providing further detailed explanations. No comments were received from the MOECC for the 2015 Annual Landfill Report.

Comments on the 2015 Annual Report were received from Neegan Burnside, retained by Walpole Island First Nation (WIFN) as a technical reviewer.

Comments regarding the 2015 Annual Landfill Report that have been provided to Clean Harbors are enclosed in **Appendix B**. A copy of the Clean Harbors responses to comments received is also included in **Appendix B**.

2. REVIEW OF SITE DEVELOPMENT AND OPERATIONS

2.1 Landfill Development Activities

The Lambton Landfill expansion was approved in 2015 and will involve the vertical expansion of the landfill, mainly over previously filled areas of the existing landfill. Construction of the landfill expansion was initiated in Fall 2015 based on the Design and Operations Plan as approved by MOECC on October 19, 2015. Landfill development activities undertaken in 2016 include the following:

- Installation of the perimeter leachate collection trench, leachate pumping wells (1 to 6), and leachate pumping station to support development of Cells 19-1 and 19-2
- Installation of the hydraulic control layer in Cell 19-1
- Construction of the waste receiving area
- Construction of the haul route from the Waste Receiving Area to Cell 19-1
- Construction of the new leachate reservoir
- Interim cap placement in the northern portion of the site

No major development or construction activities are planned for the landfill in 2017.

Major features of the site are shown in **Figure 2.**

2.2 LDR Pretreatment Activities

No upgrades were conducted to LDR during the reporting period.

2.3 Assessment of Major Works

The following engineered design elements of the Lambton Landfill are considered to be Major Works:

- Interim clay cap
- Hydraulic control layer
- Final cover including HDPE liner, geosynthetic liner and geocomposite
- Perimeter leachate control trench.

All Major Works operated as expected in 2016. No issues were identified that require an amendment to the design of the Major Works.

Clean Harbors applied for, and obtained, and amendment to ECA Condition 7 (j) to allow a larger area of 39,200 m^2 (up to two sub cells) to be open at any time for landfilling. This change provides necessary flexibility to develop, open and utilize a new sub cells in advance of interim cap being placed on the entire area of the previous subcell.

2.4 Summary of Complaints

During the reporting period, one off-site complaint was received by Clean Harbors. A complaint was received from a site neighbour regarding trees on their property. The complainant indicated that a representative of the MOECC informed them that the facility was the source of damage to a white pine tree on their property. This complaint could not be verified with the facility's MOECC provincial officer. The Clean Harbors incinerator supervisor visited the neighbour's property and noted that one of the white pine tree's needles were browning, but that the other white pine located next to it showed no signs of distress. The facility's Incinerator General Manager called the neighbour to discuss the matter further and indicate that the facility was not impacting the tree.

2.5 Community Liaison & Advisory Committee (CLAC)

The Community Liaison & Advisory Committee (CLAC) meets regularly during the year to discuss the Lambton Landfill facility operations, updates and potential issues. The Committee is made up of local community members, St. Clair Township Councillors, Walpole Island First Nation, Aamjiwnaang First Nation, a representative of the Ministry of Environment and Climate Change, and Clean Harbors employees. Minutes from the meetings held during the reporting period are included in **Appendix E**.

3. WASTE TYPES AND QUANTITIES

3.1 Pretreatment and Waste Processing

The ECA requires that Clean Harbors provide to the MOECC each year:

a. For LDR: a detailed monthly summary of the type (by waste class and characteristic) and quantity of waste received at the Site for LDR and at the Processing Facility for LDR and landfill pretreatment system, total amount and type of reagents used in the process, and the total amount and destination of all outgoing wastes from the Processing Facility; and
b. For LDR: descriptive summary of upgrades conducted during the previous calendar year.

Table 1 provides a summary of the information for the pretreatment process (stabilization).

Table 1. Waste Pre-treatment (Stabilization) - January 2016 – December 2016

Month	Waste Class	Weight (Tonnes)	REAGENT WEIGHTS (Tonnes)								Weight Landfilled (Tonnes)
			CKD	FA	PC	W	F	D	TSP	FCL	
Jan 2016	143H	190.3	78.2	0	39.0	79.1	4.0	0	0	0	390.6
	N/A	886.7	119.5	0	72.0	278.1	39.0	0	0	0	1395.3
Feb 2016	143H	64.4	20.4	0	20.4	29.0	2.0	0	0	0	136.2
	N/A	683.9	78.8	0	93.6	242.1	27.0	0	0	0	1125.4
Mar 2016	113C	21.7	4.3	0	0	3.0	0	0	0	0	29.0
	131T	14.8	7.4	0	0	0.4	1.0	0.1	0	0	23.7
	143H	276.1	132.4	0	40.4	111.0	4.0	0	0	0	563.9
	146H	79.4	0	0	11.8	0	2.0	0	0	0	93.2
	N/A	1054.5	149.0	0	212.0	388.4	39.3	0	0	0	1843.2
Apr 2016	143H	261.4	83.9	0	73.8	101.4	8.0	0	0	0	528.5
	146H	32.2	10.1	0	0	0	1.3	0.8	0	0	44.4
	146T	13.1	0	0	1.3	1.0	0	0	0	0	15.4
	N/A	908.7	100.0	0	195.2	356.9	25.6	0	0	0	1586.4
May 2016	143H	128.4	38.6	0	38.6	42.6	4.0	0	0	0	252.2
	146T	26.4	0	0	15.8	14.0	0	0	0	0	56.2
	N/A	932.0	78.9	0	88.0	284.3	26.4	0	0	0	1409.6
Jun 2016	131T	8.9	4.4	0	0	1.0	0	0	0	0	14.3
	143H	81.3	33.0	0	17.2	29.4	2.0	0	0	0	162.9
	146T	2.4	0	0	0	0.4	0	0	0	0	2.8
	N/A	816.7	65.1	0	41.8	216.3	27.0	0	0	0	1166.9
Jul 2016	143H	205.1	84.5	0	41.8	68.1	5.0	0	0	0	404.5
	N/A	800.8	98.0	0	16.0	212.4	36.0	0	0	0	1163.2
Aug 2016	143H	36.2	10.0	0	0	10.0	0	0	0	0	56.2
	146C	15.0	14.0	0	0	15.0	0	0	0	0	44.0
	N/A	810.5	66.6	0	38.6	204.7	25.0	0	0	0	1145.4
Sep 2016	143H	60.6	45.5	0	7.9	18.0	1.0	0	0	0	133.0
	146T	216.8	0	0	50.3	60.0	2.0	0	0	0	329.1
	N/A	968.2	95.9	0	118.0	312.4	34.0	0	0	0	1528.5
Oct 2016	143H	84.0	26.8	0	25.1	26.3	3.0	0	0	0	165.2
	146T	209.2	0	0	42.7	80.9	2.0	0	0	0	334.8
	N/A	1046.8	101.5	0	107.6	324.3	30.0	0	0	0	1610.2
Nov 2016	143H	177.2	78.8	0	35.9	64.4	3.0	0	0	0	359.3
	146T	131.8	0	0	13.2	53.0	0	0	0	0	198.0
	N/A	791.4	96.6	0	100.0	283.6	36.0	0	0	0	1307.6
Dec 2016	143H	107.2	32.1	0	32.1	41.6	3.0	0	0	0	216.0
	146T	177.7	2.5	0	15.4	73.8	0	0	0	0	269.4
	N/A	689.6	61.7	0	32.0	221.5	35.0	0	0	0	1039.8
Total:		**13,011.4**	**1,818.5**	**0**	**1,637.5**	**4,248.4**	**427.6**	**0.9**	**0**	**0**	**21,144.3**

Note: *N/A refers to in-house generated waste which includes the incinerator burner ash and the thermal desorber ash.*

Reagents: *Cement Kiln Dust (CKD), Flyash (FA), Portland Cement (PC), Water (W), Ferrous Sulphate (F), Sodium Sulfide (D), Trisodium Phosphate (TSP), Ferric Chloride (FCL)*

Following the stabilization process (performed in the LDR processing building) or the solidification process (performed in exterior mixing pit), all wastes are loaded into an articulating hauler and transported to the landfill for final disposal.

Table 2 and **Table 3** below provide summaries of the quantities of waste processed via solidification and macro-encapsulation pre-treatment processes, respectively, during the reporting period. **Table 4** provides a summary of the quantity of waste processed at the TDU during the reporting period.

Table 2. Waste Pre-treatment (Solidification) – January 2016 – December 2016

Month	Waste Processed (tonnes)	Month	Waste Processed (tonnes)
Jan 2016	32	Jul 2016	328
Feb 2016	50	Aug 2016	0
Mar 2016	164	Sep 2016	44
Apr 2016	166	Oct 2016	110
May 2016	274	Nov 2016	344
Jun 2016	173	Dec 2016	47

Table 3. Waste Pre-treatment (Macro-encapsulation) – January 2016 – December 2016

Month	Waste Processed (tonnes)	Month	Waste Processed (tonnes)
Jan 2016	5	Jul 2016	1003
Feb 2016	130	Aug 2016	786
Mar 2016	157	Sep 2016	94
Apr 2016	284	Oct 2016	156
May 2016	928	Nov 2016	168
Jun 2016	1474	Dec 2016	110

Table 4. Waste Processed at the TDU – January 2016 – December 2016

Month	Waste Processed (tonnes)	Month	Waste Processed (tonnes)
Jan 2016	1547	Jul 2016	1153
Feb 2016	1653	Aug 2016	1860
Mar 2016	1373	Sep 2016	1855
Apr 2016	1476	Oct 2016	2158
May 2016	2040	Nov 2016	1243
Jun 2016	2203	Dec 2016	1243

3.2 Waste Quantities and Landfill Capacity

3.2.1 Waste Quantities

Conditions 4 and 5 of the ECA identify the waste streams that are acceptable for landfill at the Lambton Facility. A description of the material classification codes used by the facility to describe landfill-destined wastes is provided in **Appendix C**.

The waste classification codes used in this report reflect the implementation of Clean Harbors' corporate computer business platform used internally across North America. The waste codes provide a description of the wastes to be received. As per Condition 8 of the ECA, daily records are maintained at the facility, identifying the quantities and types of wastes received, origin of the waste, results of analyses performed and the location of placement in the cell. Associated information (i.e., description of the quantities of waste received and their origin), and an estimate of the remaining capacity are summarized on an annual basis per Condition 15 (b).

In the period from January 1, 2016 through to December 31, 2016, Clean Harbors Lambton Facility received 78,494 tonnes of solid waste. A summary of the waste types and quantities received at the facility is provided in **Table 5**. A detailed monthly breakdown for the three categories of generator location is provided in **Table 6**, **Table 7**, and **Table 8.**

Table 5. Waste Quantity (tonnes) by Waste Types, January 1, 2016 to December 31, 2016

Clean Harbors Waste Codes	Material Type	Generator Location			Total
		Ontario	Other Provinces	United States	
CA1	Solids contaminated with cyanides	84	0	73	157
CANL	Spent pot liner	0	71	1,473	1,544
CATR	Catalyst for reclamation	0	0	0	0
CATRI	Catalyst for reclamation, limited value	28	0	0	28
CBP	Non hazardous	4,580	703	13	5,296
CBPR	RCRA solids	4,995	310	1,000	6,305
CBPS	Semi-solids	504	84	0	588
CCRT	Thermal desorber	6,419	123	11,216	17,758
CCS	Inorganic solids	2,737	2	672	3,411
CCSF	F-Listed for stabilization	0	0	8	8
CCSM	Debris for Micro	166	190	502	858
CCSMA	Debris for Macro	22,448	12,480	617	35,545
CCSS	Characteristic semi-solids	16	0	23	39
CNIA	Non RCRA asbestos	6	19	0	25
CNO	Non RCRA solids	2,506	55	0	2,561
	Incinerator ash	3,423	0	0	3,423
	Other (Lab and Garage)	197	0	0	197
	TOTAL	**48,109**	**14,037**	**15,597**	**77,743**
	Percent of Total	62	18	20	

Table 6. Waste Quantity (tonnes) by Waste Types, Ontario Generators

Clean Harbors Waste Codes	Generator Location: Ontario												Total
	January	February	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	
CA1	0	0	20	0	22	0	0	12	7	15	8	0	**84**
CANL	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CATR	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CATRI	0	0	0	0	0	0	0	0	28	0	0	0	**28**
CBP	93	40	109	259	49	410	649	854	821	469	434	393	**4580**
CBPR	473	448	890	1070	600	587	109	0	32	359	393	34	**4995**
CBPS	3	0	0	18	5	55	51	1	0	0	298	73	**504**
CCRT	67	560	311	457	214	338	160	171	602	704	1344	1491	**6419**
CCS	197	161	154	175	164	198	193	139	804	97	254	201	**2737**
CCSF	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CCSM	7	10	1	74	4	6	8	0	27	18	9	2	**166**
CCSMA	891	1016	1469	1822	2362	2487	2058	2123	2125	2778	1841	1476	**22448**
CCSS	0	0	2	0.4	0	0	0	13	0	0	0	1	**16.4**
CNIA	0	0	0	0	0	0.7	5	0	0	0.7	0	0	**6.4**
CNO	3	1	3	0	2	22	86	110	431	471	959	418	**2506**
TOTAL	**1734**	**2236**	**2959**	**3875.4**	**3422**	**4103.7**	**3319**	**3423**	**4877**	**4911.7**	**5540**	**4089**	44490

Table 7. Waste Quantity (tonnes) by Waste Types, Other Provinces Generators

Clean Harbors Waste Codes	Generator Location: Other Provinces												Total
	January	February	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	
CA1	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CANL	0	0	0	0	0	0	36	0	35	0	0	0	**71**
CATR	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CATRI	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CBP	0	170	22	0	0	30	28	44	314	20	73	2	**703**
CBPR	0	32	8	0	0	10	107	77	56	0	10	10	**310**
CBPS	0	0	0	0	0	0	0	0	0	0	53	31	**84**
CCRT	76	44	0	0	0	0	0	3	0	0	0	0	**123**
CCS	0	0	0	0	0	0	0	0	0	0	2	0	**2**
CCSF	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CCSM	0	10	12	0	0	6	0	14	32	99	6	11	**190**
CCSMA	954	1521	971	706	1275	1305	684	773	1208	1200	868	1015	**12480**
CCSS	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CNIA	0	0	0	0	0	0	0	0	7	0	12	0	**19**
CNO	0	0	0	0	0	55	0	0	0	0	0	0	**55**
TOTAL	**1030**	**1777**	**1013**	**706**	**1275**	**1406**	**855**	**911**	**1652**	**1319**	**1024**	**1069**	**14037**

Table 8. Waste Quantity (tonnes) by Waste Types, United States Generators

Clean Harbors Waste Codes	Generator Location: United States												Total
	January	February	March	April	May	June	July	August	September	October	November	December	
CA1	0	0	0	0	0	0	0	0	25	40	0	8	**73**
CANL	237	309	222	693	12	0	0	0	0	0	0	0	**1,473**
CATR	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CATRI	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CBP	12	1	0	0	0	0	0	0	0	0	0	0	**13**
CBPR	83	34	57	142	22	52	61	16	183	169	163	18	**1,000**
CBPS	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CCRT	1405	249	549	737	811	1469	704	1031	784	1997	911	569	**11,216**
CCS	0	17	0	14	0	0	16	10	108	179	180	148	**672**
CCSF	0	0	3	0	1	0	0	2	0	0	1	0	**8**
CCSM	67	94	42	38	31	39	15	19	14	42	100	2	**502**
CCSMA	19	87	13	15	95	24	5	73	191	44	36	15	**617**
CCSS	0	0	0	0	0	0	0	0	0	23	0	0	**23**
CNIA	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CNO	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**1823**	**791**	**886**	**1639**	**972**	**1584**	**801**	**1151**	**1305**	**2494**	**1392**	**759**	**15,597**

For the reporting period, the total quantity of waste received at the Lambton landfill by point of origin is summarized in **Table 9**.

Table 9. Total Waste Receipts by Source (tonnes)

Source	Quantity Received (tonnes)	% Total Quantity
Ontario	48,109	61
Other Provinces	14,788	19
United States	15,597	20
Total	**78,494**	**100**

During the reporting period, the maximum daily quantity of waste received for pretreatment and landfilling was 694 tonnes on June 30, 2016.

No wastes were temporarily stored and then transferred from the site during the reporting period.

Condition 29 (i) of the ECA specifies that the maximum rate at which the Site may accept waste is 200,000 tonnes per calendar year. No Unused Tonnage was applied to the reporting year. As of December 31, 2016, the two year total Unused Tonnage is 156,440 tonnes.

3.3 Landfill Capacity

The permitted capacity for Cell 18 was 1.91 million cubic metres (cu. m). The remaining permitted space available for landfill as of December 31, 2015 was approximately 8,828 cu. m. Cell 18 reached capacity as of February 2016.

The vertical landfill expansion was approved in 2015 with a permitted capacity of 3,467,000 m^3. Filling within the expansion landfill began in Subcell 19-1 in early 2016. As of December 31, 2016, the remaining capacity of landfill was 3,811,193 m^3 (58,807 m^3 or 1.7% of capacity used).
Based on current projections using 2016 volumes, the landfill expansion is expected to have a site life of 65 years.

3.4 Waste Load Rejection Summary

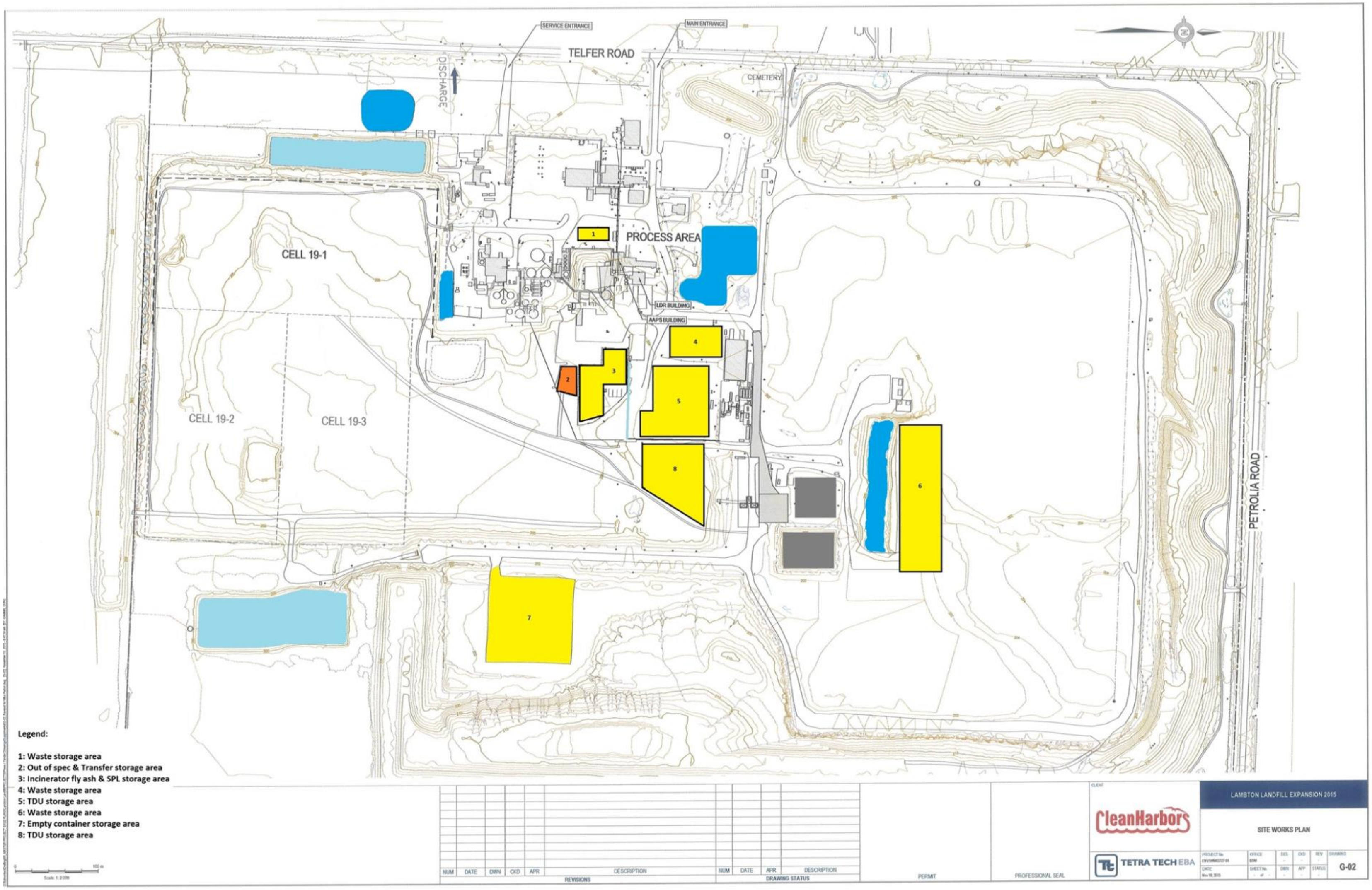
Clean Harbors Canada, Inc. is required under Condition 15 (b) (xiv) of the ECA to provide the MOECC with a list of all rejected waste loads (i.e., vehicle shipments) together with the reasons for rejection.

During the reporting period covered by this report, 12 individual loads of waste were rejected by the Lambton Facility for failing to meet the site's acceptance criteria. The reasons for rejection included:

- Material too thick to pump – two (2) loads
- Failed TVO – two (2) loads
- Failed VHC – four (4) loads
- Non-Conforming – one (1) load
- Not Permitted – one (1) load
- Unable to offload – one (1) load
- Material frozen – one (1) load

A summary of all waste loads rejected and related reasoning is presented in **Appendix D**. Rejected loads are contained within the Out of Spec and Transfer Storage Area. No processing or co-mingling with other waste will take place – containers will stay in this storage area untouched until it is determined that they will be shipped to another disposal location or returned to the customer. Containers will be shipped out of the site as they have been received. Once moved to the Out of Spec and Transfer Storage Area the container will be marked up in such a way as to make it discernible from the Transfer containers stored within the same area. This will be achieved by the use of marking items such as caution tape. Transfer containers will not have any such markings, which will differentiate them from the Out of Spec containers. **Figure 3** provides a site plan showing the various storage areas on site and location of out-of-spec material.

Figure 3. On-Site Waste Storage Areas



4. SITE INSPECTION ACTIVITIES

4.1 Quarterly Site Inspections

Clean Harbors conducts quarterly site inspections of the facility by an independent third party consultant. The inspections provide a review of the landfill operations including landfill cell development, construction and capping, perimeter screening berms, surface water management system, process water management system, leachate management system, and waste processing operations. This summary is compiled from the results of the site inspections conducted during the reporting year. The inspection program provides independent confirmation that the site is being developed in accordance with the provisions set forth in the Design and Operations Report.

The Quarterly Site Inspections were completed on the following dates:

First Quarter 2016 – March 23, 2016
Second Quarter 2016 – June 23, 2016
Third Quarter 2016 – August 26, 2016
Fourth Quarter 2016 – November 10, 2016.

The site inspections consisted of a visual assessment of the landfill operations including the active waste fill area, cell development area, the landfill cap, perimeter screening berms and the various water management systems. The site inspections are documented in interim reports included in **Appendix F**.

4.1.1 Cell Development

4.1.1.1 Construction Activities

Landfill Cell 19-1, Subcell 1 construction commenced during the fourth quarter of 2015 and was completed by February 2016. The development of Cell 19-1, Subcell 1 was initiated over the west portion of the Pre-1986 Landfill Area. Construction of Cell 19-1, Subcell 2 was initiated in the First Quarter and effectively completed by the end of 2016. The location of the active Subcell (19-1-1) and the under construction Subcell (19-1-2) are shown on **Figure 2**.

4.1.1.2 Landfill Cell Advancement

All landfilling activities occurred within Cell 19-1 Subcell 1during the reporting year. Landfilling progressed from south to north within the subcell. It was anticipated that Subcell 1 would reach capacity by the end of 2016. Landfilling would then proceed to the northern half of Subcell 2.

4.1.2 Active Waste Fill Area

A description of the active tipping face location and waste placement is presented in the site inspection reports contained in **Appendix F**. The haul route utilized from the unloading area to the active tipping face is also described in each quarterly report.

4.1.3 Landfill Cap Construction and Conditions

As part of each quarterly site inspection, visual observations are made of any cap placement work and the condition of the interim and final already in place.

With the approval of the vertical expansion of the landfill, previously capped areas of the landfill are considered to be interim, since a portion of the cap will be removed and additional waste placed in these areas. Construction of an interim cap over Trench 1503 (Sub-cell 15) was completed during the second quarter of 2016. No other capping activities were undertaken in 2016.

The interim cap was observed to be in good condition throughout the reporting period, with some noted minor erosion channels. Minor ponding was identified in several areas requiring minor grading improvements to promote drainage to the perimeter ditches.
No areas of the landfill have received final cover.

4.1.4 Perimeter Screening Berms

The geometry of the perimeter berms surrounding the landfill is unchanged. Erosion of the perimeter screening berm was observed to occur in a number of locations on the interior or landfill side of the berm. This ranged from minor channels to more significant channeling in select areas of the site. The erosion channels are a result of the interior side walls being unvegetated. The erosion has resulted in some sedimentation occurring in the perimeter storm water ditching.

4.1.5 Surface Water Management System

The surface water management system at the Lambton Facility is comprised of a network of drainage ditches, and two surface water ponds located in the East and West portions of the site. Surface water runoff from undeveloped portions of the site, perimeter berms, capped and closed landfill cells is directed through this network of drainage ditches and reservoirs to the on-site surface water treatment facility. Treated effluent from the surface water treatment facility is discharged to, and retained in the Equalization Reservoir before being discharged via a channel to the municipal drainage swale located along Telfer Sideroad.

Inspection of the perimeter ditches and surface water ponds established that their sideslopes were stable with only minor evidence of erosion. Some ponding on the site and within the ditches at locations was observed throughout the year due to rainfall events, low or impeded flow due to sedimentation, vegetation and limited elevation differences.

During the reporting period, water levels in the surface water ponds were generally high due to the large amount of precipitation during the year. Water levels within the equalization pond were also generally high during the year but returned to normal operating levels in the Fourth Quarter. The Equalization Pond provides for the adequate retention of the treated storm water. The exposed, concrete-lined sideslopes appear to be stable, although cracks and spalling of the concrete were observed, consistent with previous observations.

Detailed observations of the surface water management system are presented in the site inspections contained in **Appendix F**.

4.1.6 Process Water Management System

The Process Water Management System consists of three ponds and a series of ditches and swales. Impacted and potentially impacted runoff from the operational areas and active landfill sub-cells is directed to the three ponds. The North Process Water Pond is located immediately west of the TDU, the South Process Water Pond is located immediately south of the incinerator, and the West Process Water Pond is located adjacent to the West Storm Water Pond. Water retained in the Process Water Management System is used as quench water for the site incineration operations.

Water levels in the process water ditch adjacent the TDU were generally high during the year. The process water ditch feeding the North Process Water Pond was also full due to sediment buildup.

Levels in the three process water ponds continued to rise during the middle part of the year and began to decrease in the Fourth Quarter.

Detailed observations of the process water management system are presented in the site inspections contained in **Appendix F**.

4.1.7 Leachate Management System

The leachate reservoirs are designed to receive leachate from the active fill area and process areas. Leachate transferred from the active fill area is detained within the leachate reservoirs prior to transfer to the incinerator for disposal. The South and East Leachate Reservoirs operated throughout the year. A third Leachate Reservoir, immediately east of the East Leachate Reservoir, came on line in the Fourth Quarter.

The Leachate Storage Tank was in operation serving as the feed tank to the incinerator.

Detailed observations of the leachate management system are presented in the site inspections contained in **Appendix F**.

5. ENVIRONMENTAL MONITORING

5.1 Groundwater and Landfill Performance Monitoring Program

The 2016 groundwater and landfill performance monitoring program undertaken at the Lambton Facility was based on the document “Final Draft – Groundwater and Landfill Performance Monitoring Programs” prepared by RWDI (December 9, 2015) which formed part of the document titled “Design and Operations Report – Lambton Facility Expansion, Clean Harbors Canada, Inc., 4090 Telfer Road, St. Clair Township, Ontario”, prepared by Tetra Tech WEI Inc., (October 8, 2015). These documents were submitted to the MOECC as part of the Lambton Facility Landfill Expansion approval process.

The Groundwater and Landfill Performance Monitoring Program is subdivided into five programs:

1) Groundwater Monitoring Along Perimeter of Facility
2) Monitoring Program to Assess Effectiveness of Sub-cell 3 Mitigation
3) Performance Monitoring of Engineered Landfill System
4) Purge Wells for Groundwater Control, and
5) Monitoring Well Installation, Maintenance and Decommissioning.

The goals of the various monitoring programs are to provide for the early detection of changes in groundwater quality at the site and to demonstrate that engineering systems are functioning as intended. To address this goal, monitoring wells have been installed along the perimeter of the Facility property in the two hydraulically active water-bearing zones, which are the primary pathways along which contaminants could travel. These are referred to as the Active Aquitard and the Interface Aquifer.

The Active Aquitard is the near surface weathered portion of the clay-silt overburden that is present at the Site. Weathering including summer desiccation and winter frost action has fractured the clay materials to a depth on the order of 3 m to 4 m. Groundwater movement through the fractures is potentially rapid in comparison with movement through unfractured overburden materials.

The Interface Aquifer is located at the contact between the overburden and bedrock, and is characterized by a thin, discontinuous layer of granular material overlying fractured bedrock. This aquifer has been capable of satisfying residential water requirements albeit the yield and quality has been problematic.

The 2016 Annual Groundwater and Landfill Performance Monitoring Program report is appended (**Appendix G**). The reviewer should refer to this report for descriptions of each of the monitoring programs. The following discussion focuses strictly on the major findings of the programs and recommendations that have emerged.

5.2 Monitoring Results

The following is a summary of the key monitoring results for the current monitoring period. Detailed discussions are provided in Section 4 of **Appendix G** of this document (2016 Groundwater and Landfill Performance Monitoring Program Report).

5.2.1 Groundwater Monitoring Along Perimeter of Facility

5.2.1.1 Groundwater Levels

The movement of groundwater beneath the Lambton Facility is described as follows:

Active Aquitard: The hydraulic head distribution in 2016, as observed in the shallow monitoring wells, is consistent with that observed and reported in previous years. The shallow groundwater flow pathways are short, with recharge occurring over topographically elevated areas and discharge occurring in adjacent lows. The shallow groundwater catchment is generally coincident with the surface water catchment areas, the limits of which are delineated by topography.

At the Lambton Facility, the areas where waste is handled/treated/disposed is internal to features along the perimeter of the property such as large perimeter berms (below which the water table is mounded) and retention reservoirs and drainage ditches that act as groundwater 'sinks' under low stage conditions. The shallow groundwater that is collected in the ditches is treated prior to release from the Facility property.

In the northern area of the Facility property, shallow flow is outward from a groundwater mound that has developed within the northern berm towards the property boundary (i.e., drainage ditches along Petrolia Line and Telfer Road). Surface water flow along Petrolia Line is eastward towards Perch Creek, which in turn drains to Lake Huron. A component of flow is also expected to be inward from the berm towards the Facility's internal storm water management system.

In the area south of the Pre-1986 Landfill, shallow groundwater movement is influenced by three factors: mounding within the South Berm; the surface water stage in the East and West Reservoirs and the deep drainage channel installed between the landfill (Pre-1986 Landfill) and the South Berm; and the active extraction of leachate from the Cell 19-1 LCS.

Under normal conditions when the reservoirs and ditch are only partially filled, mounding in the South Berm results in flow from the berm northward to the ditch. The mounding therefore acts to contain the leachate plume that exists along the edges of the landfill. Following a storm event that generates a rapid increase in the water level in the ditch, the hydraulic gradient can reverse resulting in the potential for southward groundwater flow below the berm.

Internal to the property, runoff from the landfill and adjacent areas and shallow interflow will be collected within the various drainage ditches, and be conveyed to two ponds (East and West Reservoirs). Water from the West Reservoir is treated prior to being released from the Facility property.

With approval of the expansion of the landfill a leachate collection trench [LCR] was constructed along the west and south perimeter of the Pre-1986 Landfill Area. Where constructed, the collection trench is expected to alter groundwater flow and intercept leachate moving outward from the landfill.

Vertical Hydraulic Gradient across the Inactive Aquitard: The principal direction of groundwater movement as determined from vertical hydraulic gradient (calculated using water levels measured in adjacent shallow and deep wells) has been downward across most of the Facility property. There has however been a steady increase in the potentiometric surface in the Interface Aquifer, primarily along the northern boundary of the property, since monitoring was initiated in the 1970s.

This increase has been attributed to the expansion of municipal supplies into the area and the general reduction in the volume of water extracted from the Interface Aquifer for residential/farming use. Upward gradients across the clay aquitard are developed over portions of the property.

The installation of a leachate collection trench along perimeter of the landfill as part of the landfill expansion, started in the fall of 2015, and is expected to alter the vertical gradients across the clay aquitard below and immediately adjacent to the landfill, and induce an inward hydraulic gradient towards the trench.

Interface Aquifer: The Facility is located on a regional high, which is reflected in the water level measured at wells installed in the Interface Aquifer. Groundwater flow is outward from this high. The potentiometric head observed in many of the wells installed along the northern boundary of the Lambton Facility property and to the east and west of the property have been rising.

Past and ongoing activities at the Facility, which have involved pumping from the Interface Aquifer, have depressed the potentiometric surface below the property for extended periods of time. This in turn has influenced the pattern of groundwater flow in the Aquifer below the Facility Property.

All pumping has been discontinued (June 2015) and the water level in the Aquifer in the vicinity of where pumping occurred has been slowly rising in response to the discontinuation of pumping.

5.2.1.2 Groundwater Quality

Observations regarding groundwater quality are summarized in this section.

Summary of Observations for Shallow Wells installed in the Active Aquitard

Most the shallow monitoring wells installed at the Facility property are located along the property boundary. This well network is supplemented with wells that are located in areas where groundwater quality is known to be affected by site operations. The data from the perimeter and internal wells are used to monitor changes in chemical composition in groundwater quality with time. The shallow monitoring wells that make up the monitoring network at the Lambton Facility have, for purposes of discussion and data interpretation, been grouped per their location relative to site features.

The chemistry data for the individual wells are compared with the Ontario Drinking Water Standards (ODWS), Guideline B-7 criterion where applicable, and are also reviewed in the context of Provincial Water Quality Objectives (PWQO) as the shallow groundwater along the Facility perimeter is expected to discharge to surface drainage channels and mix with surface runoff. Trends in the parameter concentrations are identified and assessed statistically to determine their significance.

Active Aquitard – Inorganic Chemistry: The interpretation of the chemistry data collected from the shallow monitoring wells over the last several years has identified three contributing sources/activities that have the potential to alter water quality near the wells. These include: the excavation and displacement of clay to construct perimeter berms; use of deicing salt on roadways and parking areas both internal to the Facility property and along Petrolia Line and Telfer Road; and mobilization of chemical constituents in the waste managed at the Facility property. Shallow monitoring wells have been installed to collect information on the groundwater quality within the ‘sphere of influence’ of each of these contributing sources.

In general, Total Dissolved Solids (TDS), boron, chloride, sodium, fluoride, and sulphate were detected on occasion at concentrations above the ODWS in the shallow monitoring wells that have been installed both off-property and within the Facility property.

Bromide which does not have an ODWS, was detected at TW41-99S at a statistically increasing concentration. Bromide is known to be elevated in samples collected from wells installed in the landfill. It is not currently known if the source of bromide at TW41-99S is a leachate plume along the perimeter of the Pre-1986 Landfill or surface water infiltration from the East Reservoir.

Active Aquitard – Organic Chemistry: Samples are collected for VOC analysis at a frequency of once every two years. The most recent sampling event was completed in May 2015. The next shallow biennial sampling event for VOCs is scheduled for spring 2017.

Summary of Observations for Deep Wells Installed in the Interface Aquifer

Two contributing sources/activities have been identified that can alter the chemistry of the groundwater in the Interface Aquifer. The first is the presence or formation of a ‘conduit’ that would allow shallow groundwater or leachate from the landfill to move downward through the thick clay deposit to the Interface Aquifer. The second is the natural mineralization of the groundwater resulting from an alteration of the volume of groundwater flow the bedrock (shale of the Kettle Point Formation) component of the Interface Aquifer.

Interface Aquifer – Inorganic Chemistry: The concentrations of various parameters including TDS, alkalinity, barium, boron, chloride, fluoride, iron, potassium and sodium, have been detected in samples from many of the monitoring wells installed in the Interface Aquifer along the perimeter of the Facility property at concentrations that exceed regulatory criteria (i.e., ODWO and the calculated Guideline B-7 criteria). These parameters (at the concentrations observed) have been detected in samples collected from both the Interface Aquifer deep wells located off the Facility property, and the wells that are installed in the underlying Kettle Point Formation shale, at elevated concentrations, and are therefore considered to be endemic to the groundwater in contact with the bedrock (Kettle Point Formation) in the general vicinity of the Lambton Facility property.

The trend towards increasing mineralization of the groundwater in the Interface Aquifer is most evident in samples from the wells (TW22-99D, TW40-99D, TW47-99D and TW60-13D) installed in the Interface Aquifer that are located in the northwestern portion of the Lambton Facility property.

The increasing mineralization is attributed to an increase in the water levels in the Interface Aquifer across the northern portion of the property and a readjustment of vertical and horizontal hydraulic gradients. The resulting effect is that there is less groundwater flow through the Interface Aquifer and less recharge from the overlying clay, and therefore less water available to dilute the natural constituents present in the matrix of the shale that are released by solution/diffusion into the groundwater.

Interface Aquifer – Organic Chemistry

VOCs Detected at TW22-99D: Trichloroethylene (TCE) has been detected at TW22-99D since 2007, with other VOCs including Methylene Chloride (DCM), cis-1,2-Dichloroethylene (cis-1,2-DCE), trans-1,2-Dichloroethylene (trans-1,2-DCE), Tetrachloroethylene (PCE) and Benzene sporadically detected in one or more samples from in the same well. The area in the vicinity of well TW22-99D has been the focus of an investigation into the source of these VOCs.

The results to date indicate that TCE and Cis-1,2-DCE remain isolated to samples collected from well TW22-99D. Specifically, these parameters have not been detected in TW60-13D, which was installed within the same water bearing zone within a few metres of TW22-99D as part of the investigation, nor has TCE been detected in samples from any other monitoring wells installed in the Interface Aquifer.

VOCs Detected at Other Interface Aquifer Wells: The petroleum hydrocarbon constituents, Benzene and Toluene, were detected in one or more samples collected in 2016 from several wells installed in the Interface Aquifer located both on property (TW22-99D, TW39-99D, TW45-99D, TW46-99D, TW60-13D and TW61-13D) and off property (TW56-13D, TW57-13D and TW59-13D). Benzene and toluene has also historically been detected in the underlying Kettle Point Formation shale (TW32-94-I, TW38-94-I and TW42-99D) [RWDI, 2016]. The hydrocarbons appear to be endemic to groundwater in contact with the bitumen in the Kettle Point Formation and their occurrence at individual wells may be related to the sluggish water movement through the shale and extended groundwater/shale contact time.

5.2.2 Monitoring Program to Assess Effectiveness of Sub-Cell 3

Water level monitoring at the wells installed in the HCLs of the remedial structures in Sub-cell 3 and within the underlying Interface Aquifer confirms that an inward hydraulic gradient is being maintained. The chemistry of the samples collected from wells installed in the northern HCL is stable, whereas the chemistry of samples from wells in the southern HCL is undergoing change (reduction in the degree of mineralization). The ground surface over this portion of Sub-cell 3 is depressed compared to the surrounding area and standing water is frequently observed following a significant precipitation event. The presence of standing water would create a larger downward hydraulic gradient across the clay cap above the HCL. The downward movement of surface water with a relatively low TDS content would dilute the groundwater entering the HCL from the surrounding and underlying clay overburden.

Sulphate was detected at well PW1-N in the fall 2014 at a concentration (49 mg/L) that is atypical of the Interface Aquifer. It was determined that seepage was entering the well at shallow casing joints (above a depth of 6 m). Repairs were subsequently made. The sulphate concentration in the spring 2016 and fall 2016 samples was below 2 mg/L indicating the repair was effective.

Quarterly potentiometric surfaces of the northern portion of Sub-cell 3 evidence the continued recovery of the Interface Aquifer in the vicinity of Sub-cell 3 following discontinuation of pumping from PW1-N in July 2015.

5.2.3 Performance Monitoring of Engineered Landfill System

Perimeter Collection Trench: Water levels are collected from four sumps (PTS-01, PTS-02, PTS-03 and PTS-04) and four observation wells (LCS OW1-15, LCS OW2-15, LCS OW3-15 and LCS OW4-15) installed within the backfill of the initial 500 m length of the leachate collection trench. Hydrographs indicate that for the most part, water levels remained below 198 mASL with the occasional spike in leachate levels which tended to correspond to precipitation events recorded at the Environment Canada, Sarnia, Chris Hadfield Airport Climate Station.

The liquid level profiles exhibited in cross-sections prepared on a quarterly frequency along the initial length of leachate collection trench were generally flat along the length of the LCS. The exception occurred in December, 2016 where a horizontal gradient towards pumping stations PTS-01. PTS-03 and PTS-04 is evident.

Well Transect Monitoring Program: The water levels observed at the various wells, which comprise the initial LCS monitoring transect along the west side of Cell 19-1, were compared to determine if an inward gradient exists towards the LCS. A series of hydrographs and quarterly cross-section through the initial transect suggests that the horizontal gradient within the Active Aquitard is towards the perimeter LSC; and an upward vertical hydraulic gradient is evident between the Inactive Aquitard wells towards the Active Aquitard within the transect well nest (TW64-16).

5.2.4 Performance Monitoring of the Purge Well System

Performance testing of the Purge Well Pumping System is next scheduled to be completed during the 2018 Monitoring Period.

5.3 Surface Water Monitoring

The surface water management system directs all stormwater generated from non-operational areas via a series of ditches and reservoirs to a water treatment plant located within the main processing area of the Lambton Facility. The surface water treatment plant is operated when the live surface water storage across the site needs to be increased, often due to precipitation events and seasonal periods of high water run off. The plant operates in recirculation mode until the effluent criteria established under the ECA are met. Once the effluent from the treatment plant is in compliance with the ECA criteria, the treated water is discharged to the Equalization Pond. Before discharge is permitted, surface waters from this Equalization Pond are analyzed and verified to meet the discharge criteria. When the conditions are satisfied the Equalization Pond is discharged to a ditch along Telfer Road. A revised surface water monitoring program for the Facility was approved by the MOECC in March 2016.

During discharge the treated surface water is monitored daily for continual acceptance against the discharge criteria. Samples are collected and analyzed for pH, specific conductivity, phenols, chloride, solvent extractables (oil and grease), and total suspended solids. Monthly discharge monitoring conducted on-site during discharge includes general chemistry, total metals, volatile organic compounds, semi-volatile organic compounds, toxicity, and the presence/absence of fish in the Equalization Pond. Off-site surface water monitoring is conducted seasonally.

In 2016, there were five distinct periods during which daily discharge monitoring was completed. Monthly discharge monitoring, including toxicity and visual observations, were also undertaken for these five time periods. The detailed surface water monitoring program results are included in **Appendix H**.

5.3.1 Daily Discharge Monitoring

Daily discharge monitoring was completed during discharge from the Equalization Pond during five distinct time periods. With the exception of Period 1, no exceedances of monitoring parameters were recorded. The discharge periods are as follows:

- Period 1: March 31 to April 2, 2016
- Period 2: April 6 to April 28, 2016
- Period 3: July 14 to August 2, 2106
- Period 4: August 16 to September 9, 2016
- Period 5: September 12 to 22, 2016.

During Period 1, an exceedance of the total suspended solids (TSS) permitted limit of 15.0 mg/L was recorded on April 2, 2016 (16.2 mg/L). The surface water treatment plant was placed into recirculation mode so that the treatment process could be adjusted in order to bring the TSS level into compliance with the discharge criteria. The desired result was achieved and discharge from the plant resumed on April 6, 2016.

The daily discharge monitoring results are provided in **Appendix H**.

5.3.2 Monthly Discharge Monitoring

A monthly monitoring sampling event was during each of the five discharge periods. When compared to the Provincial Water Quality Objectives (PWQO), the analytical results were generally below the PWQO with the following noted exceedances, based on the parameter and number of occurrences:

- Total phenolics – during four periods
- Phosphorus – during five periods
- Aluminum – during two periods

- Boron – during one period
- Molybdenum – during four periods
- bis(2-Ethylhexyl)phthalate (DEHP) – during one period.

The off-site up-stream surface water sample location (STN6) provides a representation of general surface water quality in the area. The Lambton Facility is situated on clayey overburden and as such the surface water is impacted by the natural materials that are present in the overburden. Comparing the monthly discharge monitoring results for the six parameters above to the background water quality, the background location also has exceedances of PWQO for three of the parameters at similar levels or higher in the case of phosphorus. The exceptions are molybdenum (slightly elevated over background) plus boron and DEHP which were only detected once above PWQO. There is no identifiable trend related to the exceedances.

The monthly discharge monitoring results are provided in **Appendix H**.

5.3.3 Toxicity Testing

Toxicity testing of the Equalization Pond was completed five times during the reporting period, between April 12th and September 26th, 2016. All samples were within specified limits to characterize the samples as being non-toxic. The toxicity test results are provided in **Appendix H**.

5.3.4 Visual Observation

A visual observation of the presence/absence of fish in the Equalization Pond was completed as part of the quarterly landfill inspections. During each of the quarterly inspections, the presence of live fish in the Equalization Pond was confirmed.

5.3.5 Off-Site Monitoring

Supplementary chemical monitoring of the background upstream (STN6) and downstream (STN6A) off-site monitoring locations was completed on May 3rd and August 26th, 2016. Analysis of samples included general chemistry, metals, VOCs, and sVOCs. When compared to the PWQO, the analytical results for both sampling locations were below the PWQO with the exception of total phenolics, phosphorus, aluminum, cobalt, copper, iron, and vanadium. The analytical results for all parameters analyzed are on approximately the same order of magnitude for both sampling locations.

The off-site water quality is representative of a clay overburden environment with regard to the metal components and the phosphorus levels are representative of agricultural impacts.

The off-site monitoring results are provided in **Appendix H**.

5.3.6 Surface Water Characterization

Supplementary monitoring of the East and West Surface Water Ponds for general chemistry, metals, VOCs and sVOCs was undertaken on May 3, July 14, August 26, and September 22, 2016. Comparison of the on-site surface water data indicates that the surface water quality improves as the water moves from the East Pond to the West Pond and then through the treatment plant and Equalization Pond. Comparison of the on-site data to the off-site background indicates that the water is similar and is generally reflective of clay overburden (surface) water chemistry.

The detailed on-site surface water characterization results are provided in **Appendix H**.

5.4 Air Quality Monitoring

Clean Harbors is required to conduct certain fence line ambient air measurements at the Facility on an annual basis as a condition of the operational ECA for the facility. The monitoring program was reviewed in 2011 by the MOECC and a revised plan based on their recommendations was approved prior to the initiation of the 2011 sampling program. This Plan addressed the following six issues:

- Update of the sampling program from ½-hour Volatile Organic Compounds (VOCs) collected on adsorbent tubes (EPA method TO-17) to 24-hour samples collected in evacuated canisters (EPA method TO-15)
- Update of the target VOC list
- Relocation of the south sampling location
- Fixed placement of the north sampling location
- Sample period from midnight to midnight (eastern standard time)
- Initiation of sampling on the twelve day National Air Pollution Surveillance Network (NAPS) cycle.

In 2016 the MOECC reviewed the Air Quality Monitoring Plan and requested that the north monitoring site location be moved from the bottom of the perimeter berm, adjacent to the north fenceline, to the top of the berm in an area north of the exposed landfill area. This location is also adjacent to the north perimeter fenceline.

A total of twelve pairs of simultaneous north/south fixed location speciated VOC measurements were conducted by sampling for 24-hour periods, initiated at midnight (Eastern Standard Time) on the twelve day NAPS cycle, during May through September 2016. Similarly, 24-hour samples were collected on the same occasions for subsequent analysis of total suspended particulate matter (TSP) and selected elemental constituents along with the acquisition of local meteorological data for these time-frames. In addition, three samples of speciated carbonyls and airborne mercury were collected; one in each of June, July and August concurrent with the VOC and TSP measurements. The measured levels were then compared with the applicable O. Reg. 419 Schedule 3 standards that were available for many of the constituents being measured.

Measured concentrations of TSP, as well as some of the elemental particulate components, were similar at both the north and south monitoring sites during the monitoring period. Confounding sources (e.g., gravel roadways) adjacent to the south site likely contributed to any elevated levels measured at this site. Some of the VOC species were higher during downwind conditions which was indicative of facility contributions to the fenceline concentrations. Of the speciated carbonyl measurements, only formaldehyde was detected on all occasions at both sites and was found to be of similar low concentration. Very low levels of particulate mercury were found in all of the samples whereas mercury vapour was never detected.

All measured levels of the various vapour and particulate constituents were below the accepted regulatory air quality concentration limits (Reg. 419 Schedule 3 standards), which are available for many of the target substances, for all constituents with the exception of TSP. The concentration measured at the south site on May 24th exceeded the Ontario standard of 120 µg/m³. The prevailing winds were southerly on this day and therefore the site was upwind of the Clean Harbors facility. In most instances, the highest measured concentrations of the multiple speciated compounds being determined often represented only a small fraction of the accepted limits. The target elemental constituent levels were found to be significantly less than their specific schedule 3 or guideline values, except for iron (higher fraction of the metallic iron criterion). For iron, this comparison is considered to be conservative since the portion of metallic iron in the analyzed particulate matter, as opposed to other iron compounds, was likely to be minor.

Air Quality monitoring data are provided in **Appendix I**.

5.5 Biomonitoring Program

The Biomonitoring Program is one of the Lambton Facility's ongoing monitoring programs, which are required by its ECA. The Biomonitoring Program provides an indication of trends, through time, in the concentration of analytes within the vicinity of the Lambton Facility. The program uses a network of test sites within 1.5 kilometres from the facility boundaries. In 2015, samples from 14 test sites were monitored. The fixed-plot design ensures that monitoring can be conducted at the same test sites over a number of years. Each summer and fall, samples from up to four environmental media (soil, ditch sediment, natural vegetation and agricultural crops) from each of the test sites are collected and submitted to the analytical laboratory to determine the concentration of selected metals, pesticides, chlorinated phenols, and dioxins and furans.

The review and comparison of the 2015 data relative to the upper control limits (UL15)3 for each site and on a site-wide basis was completed for inorganic analytes. The concentrations of 21 inorganic analytes (15 Group 11 analytes and six Group 2 analytes4) exceeded their respective site-specific UL15 while four Group 1 analytes and one Group 2 analyte exceeded their site-wide UL15.

Concentrations of a limited number of inorganic chemicals in sediment, natural grasses, and soil collected and analyzed in 2015 exceeded the Ontario Typical Ranges for Rural Parkland Soil (rural parkland OTR98) (Ministry of the Environment and Climate Change, MOECC, 2011), the rural Upper Limit of Normal (ULN) (MOECC, 1989), the MOECC O.Reg.153/04 Table 1 Sediment Site Condition Standard (SCS), the MOECC O.Reg.153/04 Table 1 Soil SCS (MOECC, 2011), or the Provincial Sediment Quality Guidelines (PSQG) (MOECC, 2008).

Overall, the majority of exceedances of the UL15 in the 2015 Field Year were identified for Group 1 inorganic analytes (barium, beryllium, boron, calcium, chloride, cobalt, iron, magnesium, manganese, molybdenum, nickel, phosphorus, potassium, strontium and sulfur). With the exception of calcium concentrations in soil, the exceedances of the Group 1 analytes do not warrant additional investigation at this time. Based on the repeated exceedance of the UL15 by calcium in soil at Site N5, additional investigation is warranted.

A select number of Group 2 analytes were found to have exceeded the site-specific UL15 (aluminum, arsenic, copper, lead, mercury and zinc). However, the concentrations of these analytes were below levels associated with potential phytotoxicity. Consequently, continued monitoring is recommended but additional investigation is not warranted at this time.

Concentration trend lines using linear regression statistics were updated on a site-specific basis for inorganic analytes. The purpose was to identify trends in the concentration of analytes (i.e. downward, upward, no change) over time. In summary, 99 regressions (upward and downward trends) were significant at $p<0.003$ based on detected concentrations; 15 showed a downward trend, and 84 showed an upward trend. Twenty five (25) of the 84 increasing trends had 2015 Field Year concentrations measure above their applicable guidelines, and 39 of the 84 increasing trends are repeated trends from the previous reporting cycle in the 2012 Field Year. The majority of the upward trends were Group 1 analytes. Group 2 analytes with upward trends included aluminum, arsenic, cadmium, lead, vanadium and zinc. Given the number of inorganic parameters in sediment at Sites N2 and E2 with repeating upward trends, additional investigation into the health of the benthic communities at these sites is recommended.

Group 3 organic analytes5 were not detected at concentrations representative of concern for ecological health during the 2015 Field Year.

A select number of organochlorine pesticides (OCP) analytes were measured at concentrations above their applicable reporting detection limit (RDL)6. However, all detected concentrations of OCPs were below the applicable rural parkland OTR98 and MOECC 153/04 Table 1 SCS, where available for comparison.

Polychlorinated biphenyls (PCBs) were not identified at concentrations greater than their respective RDLs. Pentachlorophenols (PCPs) were detected at low levels in three agricultural crop samples. Monitoring should continue but no additional examination is warranted.

Dioxins/furans (PCDD/DF) were not reported at concentrations greater than the rural parkland OTR98.

Bio-monitoring data are provided in **Appendix J**.

6. RECOMMENDATIONS

The following recommendations are provided with respect to the above observations and conclusions.

6.1 Site Inspections

The following recommendations are provided based on the observations of the most recent site inspection (November 10, 2016):

- Interim cover work has been completed in the northern area of the Site. As such, the former stockpile area and other areas in the north that have ponded water are scheduled to be assessed and re-graded to promote drainage.
- Maintenance of the perimeter ditches is required to remove areas where sediment has accumulated and is restricting flow of water. Maintenance of the perimeter ditches is a key component to minimize ponding of water on the interim cover and transfer of water to stormwater ponds.
- Portions of the interior side of the perimeter screening berms have significant erosion. These areas should be assessed and corrected to minimize erosion into the perimeter ditches. Installation of reinforced ditches from the top of the berm to the perimeter ditches may be a solution for these areas, as well as vegetation of the internal berm slopes.

6.2 Groundwater Monitoring Program

6.2.1 Groundwater Monitoring Along Perimeter Monitoring Program

Monitoring Well Network

Well Decommissioning: A number of redundant or unused wells exist at the Lambton Facility Landfill. Clean Harbors initiated a program to decommission the wells per the requirements of Ontario Regulation 903. The majority of the redundant wells have been removed in prior monitoring years. If access to the private property located east of the Facility is obtained, the two existing wells nests located on this property (TW35-94 and TW37-94) should be decommissioned.

Well Installation: It is intended that two large diameter wells be installed as part of an evaluation the Purge Well Pumping System. The two wells are to be installed in the Interface Aquifer at locations to be determined along the north and east boundary of the Facility property. This work should be conducted in accordance with the "*Final Draft Groundwater and Landfill Performance Monitoring Programs*" [RWDI, 2015].

Groundwater Monitoring Program

The groundwater and landfill performance monitoring program as outlined in the document "*Final Draft Groundwater and Landfill Performance Monitoring Programs*", prepared by RWDI (December 9, 2015) should continue through 2017 with the following modifications:

- The inside diameter of OW32-90D does not allow for the installation of either low flow or discrete interval sampling apparatus. As such, this well should continue to be purged and sampled using cumulative volume sampling techniques, limiting the drawdown to a maximum depth of 5 m above the well screen.

Investigation of Anomalies Identified in 2016 Analytical Results

TW42-99S: An investigation was conducted to determine the source/cause of the elevated sulphate concentration at TW42-99S. Although the results are inconclusive, it is apparent that the elevated sulphate concentration is limited to this well. Sulphate concentrations in the wells located closer to the Pre-1986 Landfill are substantially lower.

With the installation of the leachate collection system along the southern perimeter of the Pre-1986 Landfill, it is expected that the existing shallow groundwater flow pattern, which is outward from the landfill, will be altered. It is therefore recommended that Clean Harbors Canada, Inc. meet with the MOECC to determine what further action, if any, be taken to assess the elevation of sulphate concentrations at TW42-99S.

TW45-99D: The occurrence of sulphate at concentrations that are atypical of the Interface Aquifer and the sporadic detection of chloroform, which is associated with the chlorination of water, in samples from TW45-99D are suggestive that shallow groundwater may be moving downward to the screen of this well (possibly along the annulus of the well). This well is poorly productive, and is very slow to recover between sampling events. The drawdown associated with purging/sampling induces a near continuous inward gradient towards the well. This would promote downward movement along the annulus of the well.

Well TW45-99D was inspected with a downhole camera in 2015 and the casing appears to be sound down to the 15 m depth examined. The well was also redeveloped in an effort to improve its hydraulic response. Well recovery continues to be poor.

It is not possible to assess the integrity of the annulus around the casing.

It is recommended that well TW45-99D be decommissioned and replaced with a new installation. The replacement well should be completed with Schedule 80 PVC pipe as opposed to the prior practice of using Schedule 40 PVC pipe.

TW22-99D: TCE continues to be detected at TW22-99D at concentrations of concern. Although the source of the TCE has not been determined, the data collected to date indicate that TCE is not within the Interface Aquifer.

Specifically, TCE has not been detected in a well (TW60-13D), which was installed to the same depth immediately next to TW22-99D. The possibility exists that TCE may be entering the well with seepage at a joint in the casing.

Downhole packer testing was attempted to determine if seepage was occurring and whether this seepage contained TCE. Testing was limited to the upper 12 m of the well because of an obstruction in the well. The results were inconclusive.

Clean Harbors will continue to monitor TW22-99D for VOCs on a semi-annual basis to coincide with the routine groundwater monitoring events. However, it is recommended that

Clean Harbors Canada, Inc. staff meet with the MOECC to discuss what additional actions could be taken.

6.2.2 Monitoring Program to Assess Effectiveness of Sub-Cell 3 Mitigation

The Sub-cell 3 Monitoring Program as outlined in the document "*Final Draft – Groundwater and Landfill Performance Monitoring Programs*", prepared by RWDI (December 9, 2015) should continue through the 2017 monitoring period.

In addition, Clean Harbors intends to install high level alarms in the two extraction wells (EW1a-01 and EW2a-01) to provide an additional level of warning should the pumping equipment stop operating. Installation of this equipment is to occur once Sub-cell 3 is accessible in the spring of 2017.

6.2.3 Performance Monitoring of Engineered Landfill System

The Engineered Landfill System Performance Monitoring Program as outlined in the document "*Final Draft – Groundwater and Landfill Performance Monitoring Programs*", prepared by RWDI (December 9, 2015) should continue through the 2017 monitoring period.

In accordance with the program established in the above document, additional wells should be installed in the waste along the initial transect that currently consists of wells LCS OW2-15, TW64-16 (I, II, III, and IV), TW48-00D and TW48-16S once the interim cap has been installed on Cell 19-1. These wells should be nested to allow for the determination of both the vertical and horizontal hydraulic gradients within the waste.

6.3 Surface Water Quality Monitoring

The compliance based monitoring programs detailed within the Surface Water Quality Report (**Appendix H**) and completed in accordance with the requirements of the ECA should continue in subsequent years. No additional recommendations have been identified at this time.

6.4 Air Quality Monitoring

The compliance based monitoring programs detailed within the Air Quality Monitoring Report (**Appendix I**) and completed in accordance with the requirements of the ECA should continue in subsequent years. No additional recommendations have been identified at this time.

6.5 Biomonitoring Program

Based on the findings of the report, there are a number of methods of data analysis and reporting that should continue or require change. These methods are outlined below:

- Monitoring of changes in the RDLs during the program should continue and impacts on the results should be reported where applicable.
- When assessing the results for the Biomonitoring Program the greatest weight should be given to comparisons within and between sites monitored in the program versus comparisons with the Ontario ULN and rural parkland OTR98 which are representative of aging databases.

- Discussion of recurring findings should continue annually so that previous discussions are compiled and either confirmed or revised based on new results.
- PCP and PCB should be entered into the EQuIS database to improve data management efficiency.

A number of modifications have been proposed to the Biomonitoring Program in order to streamline the program and accommodate the vertical expansion of the Lambton Landfill. A summary of recommended changes to the Biomonitoring Program is provided in Table 4-2 and Appendix G of the Biomonitoring Report. Upon approval by the MOECC, these changes could be implemented during the next cycle of the Biomonitoring Program beginning in the 2017 Field Year.