Waste Management of Canada Corporation

Environmental Assessment for a New Landfill Footprint at the West Carleton Environmental Centre

ATMOSPHERIC
LANDFILL GAS (VOC)
DETAILED IMPACT ASSESSMENT

Prepared by:
RWDI

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60242342

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1. Introduction

This report documents the landfill gas (LFG) volatile organic compounds (VOC) impact assessment of the Preferred Alternative Landfill Footprint for the Environmental Assessment (EA) for a new landfill footprint at Waste Management of Canada Corporation's (WM) West Carleton Environmental Centre (WCEC). In the preceding Alternative Methods phase of the EA, a net effects analysis as well as a comparative evaluation of the four alternative landfill footprint options were carried out in order to identify a Preferred Alternative Landfill Footprint. The Preferred Alternative Landfill Footprint was determined to be Option #2 – the North Footprint Option. The potential environmental effects, mitigation or compensation measures to address the potential adverse environmental effects, and the remaining net effects following the application of the mitigation or compensation measures were identified for the Preferred Alternative Landfill Footprint.

The Preferred Alternative Landfill Footprint was refined based on stakeholder comments received and in order to further avoid or mitigate potential adverse environmental effects, and is illustrated in **Figure 1**.

A Facilities Characteristics Report (FCR) as well as a description of the ancillary facilities associated with the WCEC has been prepared so that potential environmental effects and mitigation or compensation measures identified for the Preferred Alternative Landfill Footprint during the Alternative Methods phase of the EA could be more accurately defined, along with enhancement opportunities and approval requirements.

The discipline-specific work plans developed during the Terms of Reference (ToR) outlined how impacts associated with the Preferred Alternative Landfill Footprint would be assessed. The results of these assessments have been documented in the following 10 standalone Detailed Impact Assessment Reports:

- Atmospheric (Air Quality, Noise, Odour and Landfill Gas)
- Geology and Hydrogeology
- Surface Water
- Biology
- Archaeology
- Cultural Heritage
- Transportation
- Land Use
- Agriculture
- Socio-Economic (including Visual)

Despite being standalone documents, there are; however, interrelationships between some of the reports, where the information discussed overlaps between similar disciplines. Examples of this include the following:

- Geology and Hydrogeology, Surface Water, and Biology (Aquatic Environment); and
- Land Use, Agricultural, and Socio-Economic.

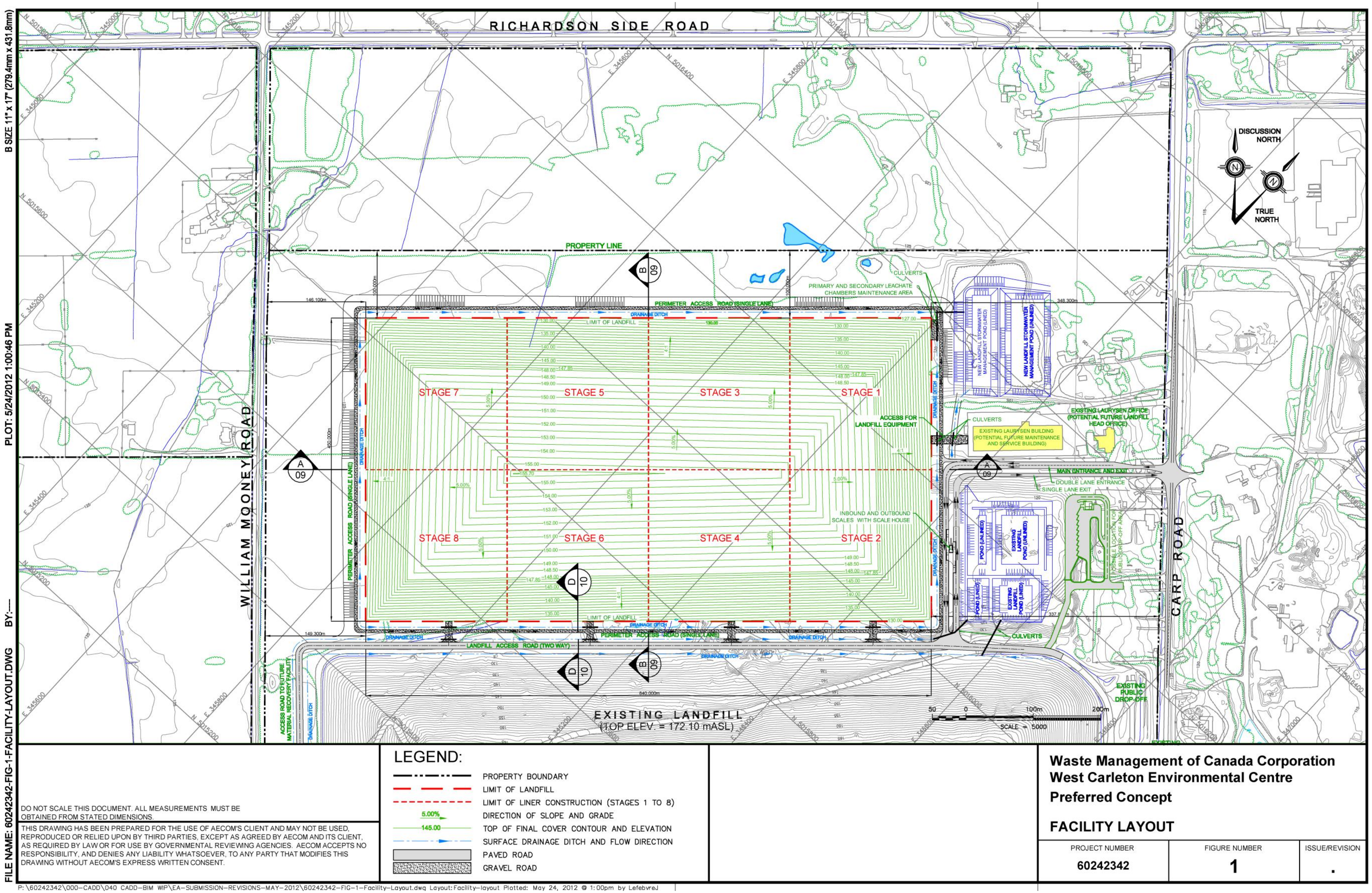


Figure 1. Preferred Alternative Landfill Footprint

1.1 Description of the Preferred Alternative Landfill Footprint

The southern half of the Preferred Alternative Landfill Footprint is on WM owned lands and the northern half is on lands that WM has options to purchase. A 100 metre (m) buffer is maintained between the north limit of the Preferred Footprint and the private lands to the north (e.g., lands which front onto Richardson Side Road) in accordance with Ontario Regulation (O. Reg.) 232/98, and an approximate 350 m buffer is maintained between the east limit of the footprint and Carp Road. A light industrial building (e.g., the Laurysen building) is situated in the eastern portion of WM optioned lands, which WM anticipates using for equipment storage/maintenance or waste diversion activities in the future. An approximate 45 to 50 m buffer is maintained between the toe of slope of the existing and new landfill footprints, thus allowing sufficient area for a new waste haul road to the new landfill footprint, and for maintenance and monitoring access. The location of the west limit of the Preferred Alternative Landfill Footprint was determined by maintaining the noted buffers and providing the required 6,500,000 m^3 of disposal capacity, while maintaining landfill elevation below 158 metres above sea level (mASL) (as reported in the Conceptual Design Report (CDR)) and maintaining side slopes required by O. Reg. 232/98 (e.g., varying from 4H to 1V to 5%). This results in an approximate 146 m buffer between the west limit of the Preferred Footprint and William Mooney Road. This buffer preserves a portion of the existing woodlot within the west part of the WM-owned lands.

The final contours of the landfill are shown in Figure 1 and reflect a rectangular landform with a maximum elevation (top of final cover) of 155.7 mASL. This elevation is approximately 30.7 m above the surrounding existing grade. By comparison, the maximum elevation of the existing Ottawa WM landfill is approximately 172 mASL or approximately 47 m above the surrounding existing grade. The contours reflect maximum side slopes of 4H to 1V, and a minimum slope of 5%. The total footprint area of the new landfill is 37.8 ha.

1.2 Facilities Characteristics Report

The FCR presents preliminary design and operations information for the Preferred Alternative Landfill Footprint (Option #2) and provides information on all main aspects of landfill design and operations including:

- Site layout design;
- Surface water management;
- Leachate management;
- Gas management; and,
- Landfill development sequence and daily operations.

The FCR also provides estimates of parameters relevant to the Detailed Impact Assessment including estimates of leachate generation, contaminant flux through the liner system, LFG generation, LFG collection, and traffic levels associated with waste and construction materials haulage.

1.3 Other WCEC Facilities

In addition to the new landfill footprint, the WCEC will also include other facilities not subject to EA approval. These include:

- A material recycling facility
- A construction and demolition material recycling facility
- An organics processing facility
- Residential diversion facility
- Community lands for parks and recreation
- A landfill-gas-to-energy facility
- Greenhouses

Some of the proposed WCEC facilities, such as the material and recycling facility, the residential diversion facility, and the organic processing facility, have the potential to generate VOC emissions. The proposed facilities are at the initial stages of conception and no design details, including operation (i.e., waste volumes handled) or building details exist at present. These facilities do not require EA approval and were not included in the VOC Detailed Impact Assessment.

The other facilities proposed as part of the WCEC but not subject to EA approval will be designed with the intent of minimizing VOC emissions discharged to the atmosphere. An assessment of their emissions, including VOC and reduced sulphur compound emissions, will be completed to ensure compliance with applicable requirements prior to construction as part of the Environmental Compliance Approval (ECA) process. The possible addition of any of these facilities will require compliance with the Ministry of the Environment (MOE) ECA process and any other applicable environmental approvals processes.

1.4 Atmospheric – Air Quality Study Team

The atmospheric study team consists of RWDI AIR Inc. staff. The actual individuals and their specific roles are provided as follows:

- **John DeYoe**, B.A., d.E.T., Project Director, John.DeYoe@rwdi.com
- **Brad Bergeron**, A.Sc.T.,d.E.T., Senior Project Manager, Brad.Bergeron@rwdi.com

- **Sarah Pellatt**, B.Sc., Senior Scientist, Sarah.Pellatt@rwdi.com
- **Claire Finoro**, B.Sc. (Eng), E.I.T., Project Co-ordinator, Claire.Finoro@rwdi.com

1.5 Contaminants of Interest

LFG, although consisting mainly of methane and carbon dioxide, contains trace amounts of VOCs and reduced sulphur compounds. Although these contaminants account for less than 1% by volume of LFG escaping from the landfill, their concentrations must be assessed because they can potentially result in health impacts at residences or businesses that surround the landfill site. The type and concentration of compounds within the LFG can vary greatly, depending on the composition of the decomposing waste from which the LFG is created. Based on the MOE's Interim Guideline to Assess Air Impacts from Landfills and the ToR, 24 contaminants of interest in the LFG were reviewed. These compounds, which include 20 VOCs and 4 reduced sulphur species, were assessed in the LFG study.

Contaminants emitted from the leachate management system were not previously assessed in the LFG Baseline Conditions report. Contaminants emitted in common from the landfill and the leachate management system were assessed (i.e., benzene and dichloromethane), as well as ammonia, which is solely emitted from the leachate management system. Ammonia was included in the LFG assessment because it is the typical contaminant of concern emitted from leachate management systems.

All 25 contaminants of interest, forming the basis of the LFG assessment, are listed in Table 1. Vinyl chloride, benzene and hydrogen sulphide were selected as contaminants of particular interest based on historical issues at the existing WCEC. A comparison of the maximum predicted results to applicable standards was conducted for all 25 contaminants in this assessment; however, detailed results are only presented for the three contaminants of particular interest.

Emissions related to combustion parameters from the flares and generators are included in the companion study noted as the Haul Route Detailed Impact Assessment Report. The Haul Route report outlines the emissions from all related sources of combustion.

Emissions related to particulate matter parameters from the leachate evaporator are included in the companion study noted as the Dust Detailed Impact Assessment Report. The Dust report outlines the emissions from all related sources of fugitive dust.

1.6 Applicable Guidelines

Predicted concentrations of VOCs, reduced sulphur compounds, and ammonia were compared against O. Reg. 419/05 Air Pollution, Local Air Quality (O. Reg. 419) Point of Impingement (POI) Standards. The term POI is taken to be in the natural environment outside the boundaries of the property. For O. Reg. 419 Guidelines and Standards with a 10-minute averaging period, the POI is taken to be any locations where and when human activities regularly occur.

Table 1 presents the O. Reg. 419 Schedule 3 air quality standards used in the LFG assessment for the selected list of compounds. For compounds that do not have established Schedule 3 air quality standards, other criteria such as Ambient Air Quality Criteria (AAQC) and Jurisdictional Screening Level (JSL) were used for this assessment. The basis for the limiting effect and averaging period for each individual contaminant is included in Table 1.

Table 1. Summary of Applicable Criteria for Landfill Gas Compounds

CAS #	COMPOUND	Averaging Period	MOE POI Limit [1] (µg/m³)	Limiting Effect	Regulation Schedule
74-93-1	Methyl Mercaptan (as Mercaptans)	10 Minute	13	Odour	3
75-08-1	Ethyl Mercaptan (as Mercaptans)	10 Minute	13	Odour	3
75-01-4	Vinyl Chloride/Chloroethene	24 Hour	1	Health	3
75-00-3	Chloroethane	24 Hour	5,600	Health	3
75-35-4	1,1-Dichloroethylene	24 Hour	10	Health	3
75-18-3	Dimethyl Sulphide	10 Minute	30	Odour	AAQC
75-09-2	Dichloromethane	24 Hour	220	Health	3
156-60-5	1,2-Dichloroethene (Trans)	24 Hour	105	Health	AAQC
156-59-2	1,2-Dichloroethene (Cis)	24 Hour	105	Health	AAQC
75-34-3	1,1-Dichloroethane	24 Hour	165	Health	3
78-92-2	sec-Butyl Alcohol/2-Butanol (as n-Butanol)	24 Hour	920	Health	3
67-66-3	Chloroform/Trichloromethane	24 Hour	1	Health	3
71-55-6	1,1,1-Trichloroethane	24 Hour	115,000	Health	3
56-23-5	Carbon Tetrachloride	24 Hour	2.4	Health	3
71-43-2	Benzene	24 Hour	2.3	CARC	AAQC
		Annual	0.45	CARC	3 [1]
107-06-2	1,2-Dichloroethane	24 Hour	2	Health	3
79-01-6	Trichloroethylene	24 Hour	12	Health	3
75-27-4	Bromodichloromethane	n/a	n/a	n/a	n/a
111-65-9	Octane	10 Minute	61,800	Odour	AAQC
79-00-5	1,1,2-Trichloroethane	24 Hour	0.31	JSL	-
127-18-4	Tetrachloroethylene	24 Hour	360	Health	3
106-93-4	Ethylene Dibromide	24 Hour	3	Health	3
79-34-5	1,1,2,2-Tetrachloroethane	n/a	n/a	n/a	n/a
7783-06-4	Hydrogen Sulphide	24 Hour	7	Health	3
		10 Minute	13	Odour	3
7664-41-7	Ammonia	24 hour	100	Health	3

Notes: [1] The Phase in Date for the updated Benzene O. Reg. 419, Schedule 3 standard is July 1, 2016.

1.7 Emission Sources

The on-site sources of VOCs and reduced sulphur compounds include the existing landfill mound under final cover, the preferred alternative landfill and associated sources (i.e., working face and contaminated soil stockpiles), the landfill gas-fired engines, the LFG flares, and the leachate management system (preferred and contingency methods).

WM's WCEC current ECA includes approval for the operation of the soil bioremediation biopile process. After receiving approval for the operation of the soil bioremediation biopile process, WM decided to not move forward with this process. For the reasons stated above, the soil bioremediation biopile process is not a source of landfill gas (VOC) and was not assessed as part of this LFG Detailed Impact Assessment.

A source summary table including each source of emission is provided in the Table Section. The Source Summary Table provides a summary of each source, the type of modelled source, and the overall emission rate for each contaminant of interest per source of emission. Each of these sources is discussed in the following sections.

1.7.1 Existing Landfill Mound under Final Cover

The existing landfill mound under final cover is the portion of the WCEC where waste is no longer being deposited. The existing landfill is closed and the entire landfill mound is under final cover. This area is characterized by the presence of a clay landfill cap and LFG collection system. The top portion of the landfill is covered with a heavy polymer membrane (beanie). The total landfill final cover area is estimated to be approximately 355,000 m^2 with a final peak height of 47 m above grade. However, the existing landfill mound was modelled at a height of zero m above grade for a conservative estimate, as referred to in the LFG Baseline Conditions Report.

Fugitive emissions of LFG compounds may occur from the final cover area, due to the release of LFG through the surface of the landfill. The LFG collection system in the final cover area of the landfill serves to extract the LFG from the mound, thus reducing the amount of LFG available to escape through the surface of the mound. In addition, the cover material filters and limits the ability of the LFG to be released through the surface of the landfill. However, even with the LFG collection system and cap in place, some LFG is released through the atmosphere through the final cover.

Between the years 2004 and 2010, the efficiency of the LFG collection system has increased due to the progressive increase in the portion of the existing landfill with final cover in place and the increase in the total number of LFG extraction wells installed in the landfill mound. These factors have resulted in an increase in the overall LFG collection efficiency from 23% in 2004 to 85% in 2010.

The existing LFG collection system will continue to supply LFG to the on-site landfill-gas-to-energy facility (5 landfill gas-fired generators) and the gas flaring system (3 flares).

1.7.2 Preferred Alternative Landfill Footprint

The preferred alternative landfill area is the portion of the landfill where accepted waste will be deposited at an estimated rate of 400,000 tonnes per year over a ten year period, equating to a total waste tonnage of 4,000,000 tonnes. As stated in the FCR, the material accepted will consist primarily of institutional, commercial and industrial waste, as well as residential waste and 'special' waste. 'Special' waste consists primarily of impacted soils that may be used for daily or interim covers. The composition of the waste stream is expected to vary based on actual waste sources.

The total landfill final cover area is estimated to be approximately 378,000 m^2 with a final peak height of 31 m above grade. However, the proposed landfill mound was modelled at a height of zero m above grade for a conservative estimate, as done for the existing landfill mound. Please refer to the LFG Baseline Conditions Report for full details.

It was assumed that the construction of the preferred alternative landfill would begin in the year 2013. The preferred alternative landfill will be filled in eight stages, each stage having an approximate surface area of 47,250 m^2. The waste placement will generally occur in two phases. Phase 1 reflects filling sequentially from Stages 1 to 8, from East to West, to an elevation of approximately 141.5 mASL. Phase 2 reflects filling sequentially from Stages 1 to 8, from East to West, to the final design contours. Only two worst case scenarios were assessed as part of the LFG Detailed Impact Assessment: an intermediate operation scenario (Year 2018) and final operating scenario (Year 2023).

For the intermediate operation year scenario (Year 2018), it was assumed that Phase 1 was completed and therefore half of the total waste, approximately 2,000,000 tonnes, had been deposited in all eight stages of the landfill. This area is characterized by the presence of a LFG collection system with a collection efficiency of 85%. Phase 2 was also assumed to have commenced, and approximately 250,000 tonnes of waste was deposited in Stage 1 during the year 2018. As a conservative approach, it was assumed that the entire surface area (47,250 m^2) of Stage 1 was considered the "active stage". The active stage is the area where waste has been deposited within the modelled year. The active stage is characterized by an interim cover, and includes a 900 m^2 working face where landfilling is actively occurring. The active stage does not have a completely installed LFG collection system, therefore only collecting the LFG with a collection efficiency of 50%.

For the final operation scenario (Year 2023), it was assumed that Phase 1 had been completed and approximately 3,720,000 tonnes had been deposited in all eight stages of the landfill. The entire landfill area, with the exception of Stage 8, is characterized by the presence of a final cover and a LFG collection system with a collection efficiency of 85%. Phase 2 was also assumed to have been complete with the last 250,000 tonnes of waste deposited in Stage 8 during the year 2023. As a conservative approach, it was assumed that the entire surface area (47,250 m^2) of Stage 8 was considered the active stage area. As previously described, the active stage area is characterized by an interim cover, which includes a working face, where waste has been deposited within the modelled year. The active stage does not have a completely installed LFG collection system; therefore the LFG collection efficiency for the active stage is 50%.

Although LFG generation is at a maximum during the first year post-closure of a landfill, an assessment of the post-closure year was not completed in this detailed impact assessment. It is more conservative to assess the last year of operations approaching closure, as this scenario included a full Stage of the landfill without final cover and a working face with reduced LFG collection efficiency (50% efficiency). A LFG source with reduced collection efficiency (50%) will result in higher overall LFG emissions from the landfill mound in comparison to the LFG emission from the landfill mound under final cover and equipped with a full gas collection system during its first year post closure of the landfill.

The preferred alternative LFG collection system will supply LFG to the on-site landfill-gas-to-energy facility (5 landfill gas-fired generators) and the gas flaring system (3 flares).

1.7.3 Contaminated Soil Stockpiles

The FCR states that the WCEC receives contaminated soil or 'special' waste from off-site locations for use as daily cover. The majority of this soil is petroleum fuel-contaminated and contains fuel-related VOCs such as benzene and other light aromatics. The contaminated soil is stockpiled near the haul routes for daily access. It was assumed that the contaminated soil stockpile has a surface area of 4,000 m^2, based on the size of the contaminated soil stockpile at the existing landfill during its years of peak operation (2004). It was also assumed that the contaminated soil stockpile was placed in the southwest corner of the preferred alternative landfill. The contaminated soil stockpile was modelled at a height of zero m above grade for a conservative estimate, consistent with the preferred alternative landfill mound and the existing landfill mound. Please refer to the LFG Baseline Conditions Report for full details.

1.7.4 Landfill Gas-Fired Generators and Flares

The LFG collection systems, serving the existing landfill mound and the preferred alternative landfill mound, will supply LFG to the on-site electricity generation system at the landfill-gas-to-energy facility (LGTE). The LGTE consists of five reciprocating engine-generator sets, all located inside a building near the southeast corner of the property boundary, along Carp Road. The engine-generators are used to combust the landfill gases and the energy generated through the combustion reaction is used to supply up to 8 MW of electricity to the municipal grid.

Each engine-generator set exhausts into the atmosphere through its own stack, having an exit diameter of 0.4 m and extending 5.5 m above the roof of the building and 13.4 m above grade. Currently, two types of engine-generator sets are in place at the landfill gas-to-energy (LGTE) facility. In effort to conservatively assess the landfill gas-fired generators and in anticipation of the increased LFG generation due to the construction and operation of the preferred alternative landfill footprint, the smaller engine-generator sets with a power rating of 800 kilowatts (kW), are assumed to be replaced with the larger engine-generator sets with a power rating of 1,600 kW during the landfill expansion years. There have not been any formal applications submitted to the MOE for approval of the larger engine-generator sets as the larger engine-generator sets were used as a conservative assessment of potential future emissions. Each large engine-generator set has a maximum LFG firing rate of 0.28 m^3 per second, resulting in an exhaust flow rate of 6.48 m^3 per second.

During the intermediate operation year scenario and the final operation year scenario, the LGTE facility will be operating five 1,600 kW engines for a total power rating of 8.000 kW and a maximum LFG firing rate of 1.4 m^3 per second. This configuration of generators (in combination with the flare configuration, the recommended LFG collection efficiency, and expected LFG potential) is expected to have the capacity to handle the LFG collected by the LFG collections systems from both the existing and proposed preferred alternative landfills.

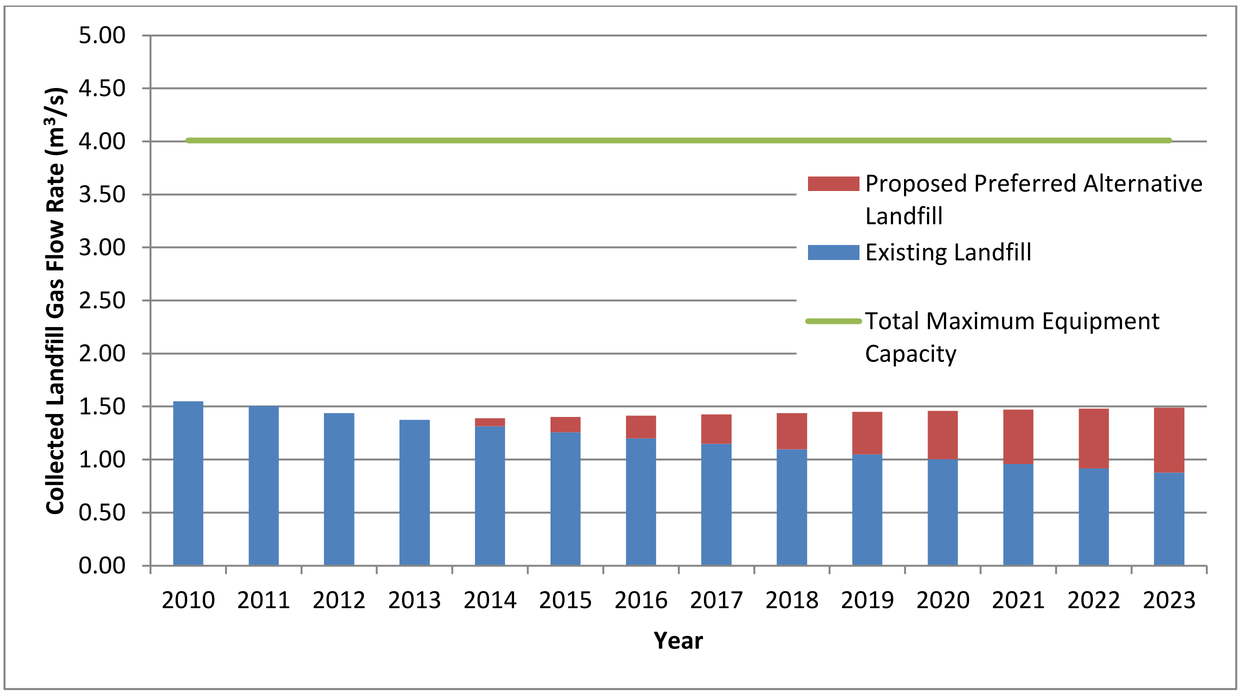
In addition to the landfill gas-fired engine-generator sets, the WCEC LFG collection system, serving the existing landfill and the preferred alternative landfill, also supplies three flares. The flares are utilized to combust and destroy the LFG that was not sent to the generators.

The flare sources are included in the dispersion model with the following parameters:

- One (1) enclosed flare system, used to incinerate the landfill gases from a landfill gas collection system at a maximum volumetric gas flow rate of 0.57 standard m^3 per second based on a methane content of 50 percent by volume. The landfill flare has a maximum heat input of 41.7 gigajoules per hour, exhausting into the atmosphere through a stack, having an exit diameter of 2.1 m, extending 12.2 m above grade;
- One (1) enclosed flare system, used to incinerate the landfill gases from an expanded LFG collection system at a maximum volumetric gas flow rate of 1.04 standard m^3 per second based on a methane content of 50 percent by volume. The landfill flare has a maximum heat input of 70.7 gigajoules per hour, exhausting into the atmosphere through a stack, having an exit diameter of 2.7 m, extending 12.2 m above grade; and,
- One (1) candlestick flare system, used to incinerate the landfill gases from a LFG collection system at a maximum volumetric gas flow rate of 1.0 standard

m^3 per second based on a methane content of 50 percent by volume. The landfill flare exhausts into the atmosphere through a stack, having an exit diameter of 0.2 m, extending 10.4 m above grade.

The three flares at the WCEC facility have a maximum combined LFG firing rate of 2.61 m^3 per second. This configuration of flares in combination with the five generators having a maximum gas firing rate of 1.4 m^3 per second, the recommended LFG collection efficiency, and expected LFG potential is expected to have the capacity to handle the LFG collected by the LFG collections systems from both the existing and proposed preferred alternative landfills, as illustrated in Graph 1.



Graph 1. Summary of Landfill Gas Collected from Existing Landfill and Proposed Preferred Alternative Landfill and Maximum Equipment Capacity

1.7.5 Leachate Management System

WM has proposed two methods to treat the leachate generated at the WCEC: the preferred leachate treatment method and a contingency leachate treatment method. Both of the methods are described in this section. For both methods, the leachate collection mains are placed under negative pressure so that no leachate gases escape from the manholes or other open points in the leachate management system.

1.7.5.1 Preferred Leachate Management System

As referred to in the FCR, the preferred leachate management system consists of disposal of leachate through pre-treatment and discharge to the City of Ottawa sanitary system, in tandem with disposal through irrigation of trees. The leachate will be pre-treated on-site using a sequencing batch reactor (SBR) system, similar to the one proposed for the existing landfill with a pending Environmental Compliance Approval.

The SBR leachate pre-treatment system will have a single train. The tanks associated with the SBR system operation include the raw leachate equalization tank, the SBR tank, the effluent equalization tank, and the sludge tank. Raw leachate from the leachate collection wells will be pumped to an equalization tank for storage. From the equalization tank, raw leachate will be pumped using leachate transfer pumps to the SBR tank. There will be two duty and one standby raw leachate transfer pumps.

The SBR operates on a batch cycle which includes the following steps:

- Fill cycle – in the fill cycle the raw leachate is pumped into the SBR tank to fill the tank to a preset level;
- React cycle – in the react cycle the SBR tank contents are aerated and the biological decomposition of the leachate occurs;
- Settle phase – after the reaction phase, the aeration and mixing of the SBR is stopped and the mixed liquor suspended solids are allowed to settle;
- Decant phase – in the decant phase the clarified effluent is decanted from the top of the SBR tank to the treated leachate effluent tank; and,
- On a periodic basis, waste activated sludge is pumped from the SBR tank to the sludge storage tank.

The effluent from the effluent equalization tank is pumped to the leachate discharge force main to the Ottawa sanitary sewage collection system.

The SBR system consists of the following sources, included in the dispersion model with the following parameters:

- One (1) raw leachate equalization tank, which is an outdoor above-ground storage tank, exhausting through a passive vent with a diameter of 0.2 me, located 0.6 m above the roof of the tank, which is equivalent to 6.6 m above grade;
- One (1) SBR tank, which is an outdoor above-ground storage tank, exhausting through a passive vent with a diameter of 0.2 m, located 0.6 m above the roof of the tank, which is equivalent to 6.6 m above grade;

- One (1) effluent equalization tank, which is an outdoor above-ground storage tank, exhausting through a passive vent with a diameter of 0.2 m, located 0.6 m above the roof of the tank, which is equivalent to 6.6 m above grade; and
- One (1) sludge holding tank, which is an outdoor above-ground storage tank, exhausting through a passive vent with a diameter of 0.2 m, located 0.6 m above the roof of the tank, which is equivalent to 6.6 m above grade.

1.7.5.2 Contingency Leachate Management System

The contingency method of leachate disposal would also involve pre-treatment of the leachate using the SBR system with the addition of a leachate evaporator system. For the leachate evaporator, the current technology selected to be evaluated in the Detailed Impact Assessment is the E-Vap® Leachate Evaporator System, which has the capacity to treat 20,000 gallons of leachate per day.

The evaporator system will use LFG as the primary fuel for the combustion process. The hot combustion gases are injected into the leachate reservoir generating water vapour. Prior to being discharged, the water vapour is sent through spin vane separators (mist eliminators) in line with the exhausts and then discharged to the atmosphere. The mist is returned to the leachate equalization tanks.

Fresh leachate is fed into the evaporator continuously and the residual is drawn off and sent to a clarifier tank for further concentration. The concentrate is collected and used at other locations within the facility or shipped off-site. For the 20,000 gallons per day operation, LFG is fed into the burner at a rate of 0.16 standard m^3 per second. The feed rate of the leachate would be approximately 14 gallons per minute. The leachate evaporator stack was modelled with the following parameters:

- One (1) leachate evaporator system, used to evaporate leachate collected by the leachate collection system, exhausting to the atmosphere at a maximum combined flow rate 13.3 standard m^3 per second through two stacks modelled as one stack, having an equivalent exit diameter of 0.9 m and extending 22 m above grade.

1.7.6 Off-Site Sources

In the vicinity of the landfill, there are no other major man-made sources for the majority of the VOC compounds found in the LFG. Benzene and other light aromatic compounds are the exception to this statement. Vehicles traveling on the major roadways adjacent to the landfill site (Carp Road and Highway 417) emit this type of compound through their tailpipes. These off-site sources were not included in this LFG Detailed Impact Assessment.

2. Landfill Footprint Study Areas

The specific On-Site, Site-Vicinity, and Regional study areas for the Preferred Alternative Landfill Footprint at the WCEC are listed below:

On-Site: .... the lands owned or optioned by WM and required for the Preferred Alternative Landfill Footprint. The Site is bounded by Highway 417, Carp Road and Richardson Side Road;

Site-Vicinity:.... the lands in the vicinity of the site including the Preferred Alternative Landfill Footprint, extending about 500 m in all directions; and,

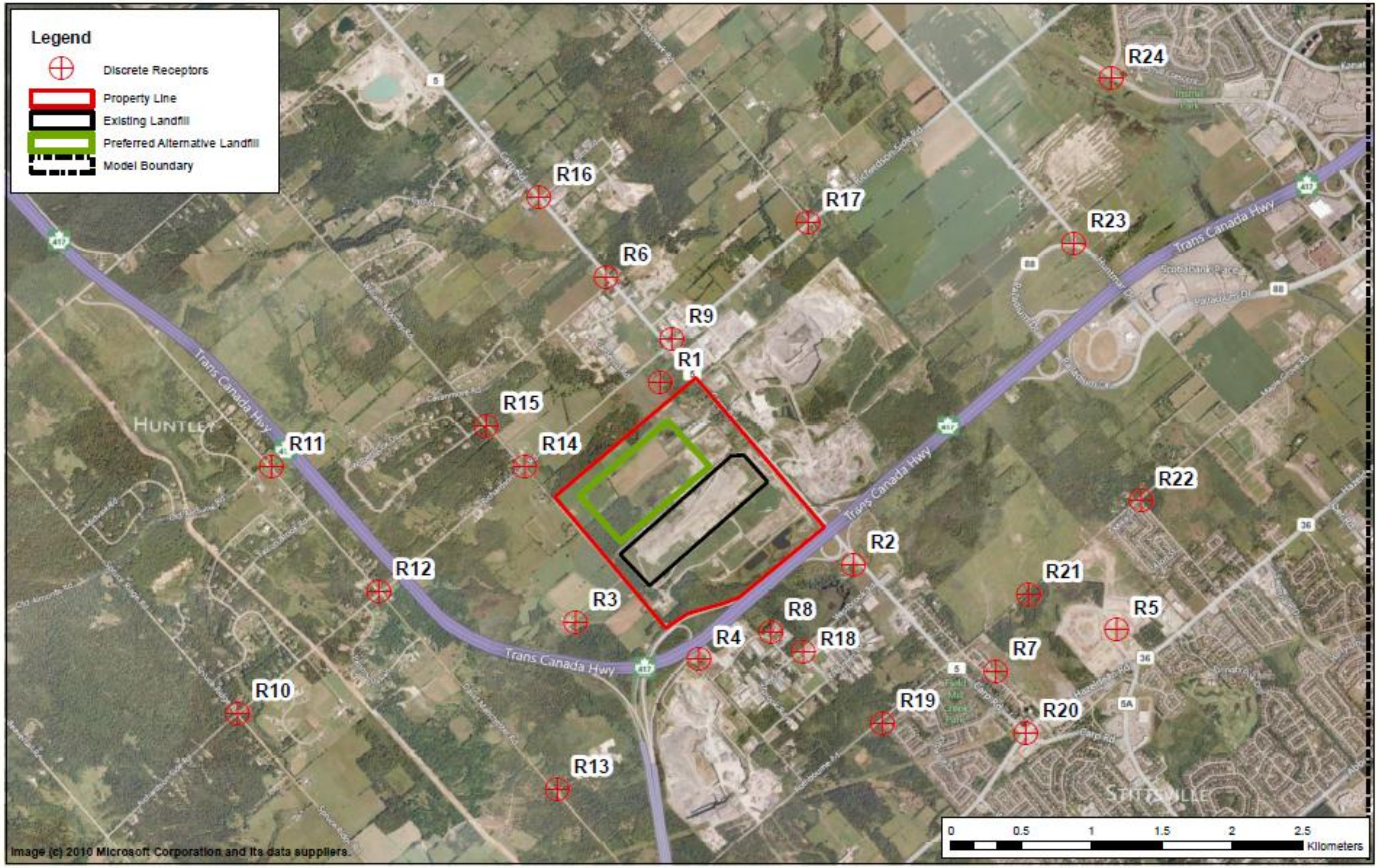
Regional:......... the lands within approximately 3 to 5 kilometres (km) of the Site and the Preferred Alternative Landfill Footprint for those discipline that require a larger analysis area (i.e., socio-economic, odour, etc.).

The evaluation considered the potential impacts from the Site sources (see **Figure 3**) including the preferred alternative landfill footprint at 24 discrete receptor locations (See **Figure 2**), representing receptors of interest in the Site-Vicinity and the Regional study areas. The discrete receptor locations considered in the dispersion model include nearby residences, schools, businesses, and other sensitive receptor locations. These sensitive receptors are considered to be representative of any current or future developments in the area. For all cases, humans were assumed to be present at these receptors for 24 hours per day.

It should be noted that there are other receptors within the On-Site, Site-Vicinity and Regional study areas. However, for the purposes of evaluation, the closest/worst-case receptors in each direction were analyzed to determine potential effects. It is assumed that mitigation applicable to the closest/worst-case receptors would also apply to all other receptors as well.

In addition, the modelling was performed using a receptor grid covering the Site-Vicinity and Regional study areas. The receptor grid covers the lands within approximately 3 to 5 km of the WCEC sources.

It should be noted that since the Draft EA was issued in March 2012, WM obtained an agreement to purchase a parcel of land located south of Richardson Side Road, east of William Mooney Road, west of Carp Road in July 2012. Given this recent property acquisition, receptor R1 no longer applies to this impact assessment.



WCEC Landfill Site Plan	True North	Drawn by: CAM	Fig: 2	RWDI
		Approx. Scale: 1:40,000		
West Carleton Environmental Centre - Detailed Impact Assessment - Ottawa, Ontario	Project #1100798	Date Revised: Dec. 21, 2011		

Figure 2. Preferred Alternative Landfill Footprint

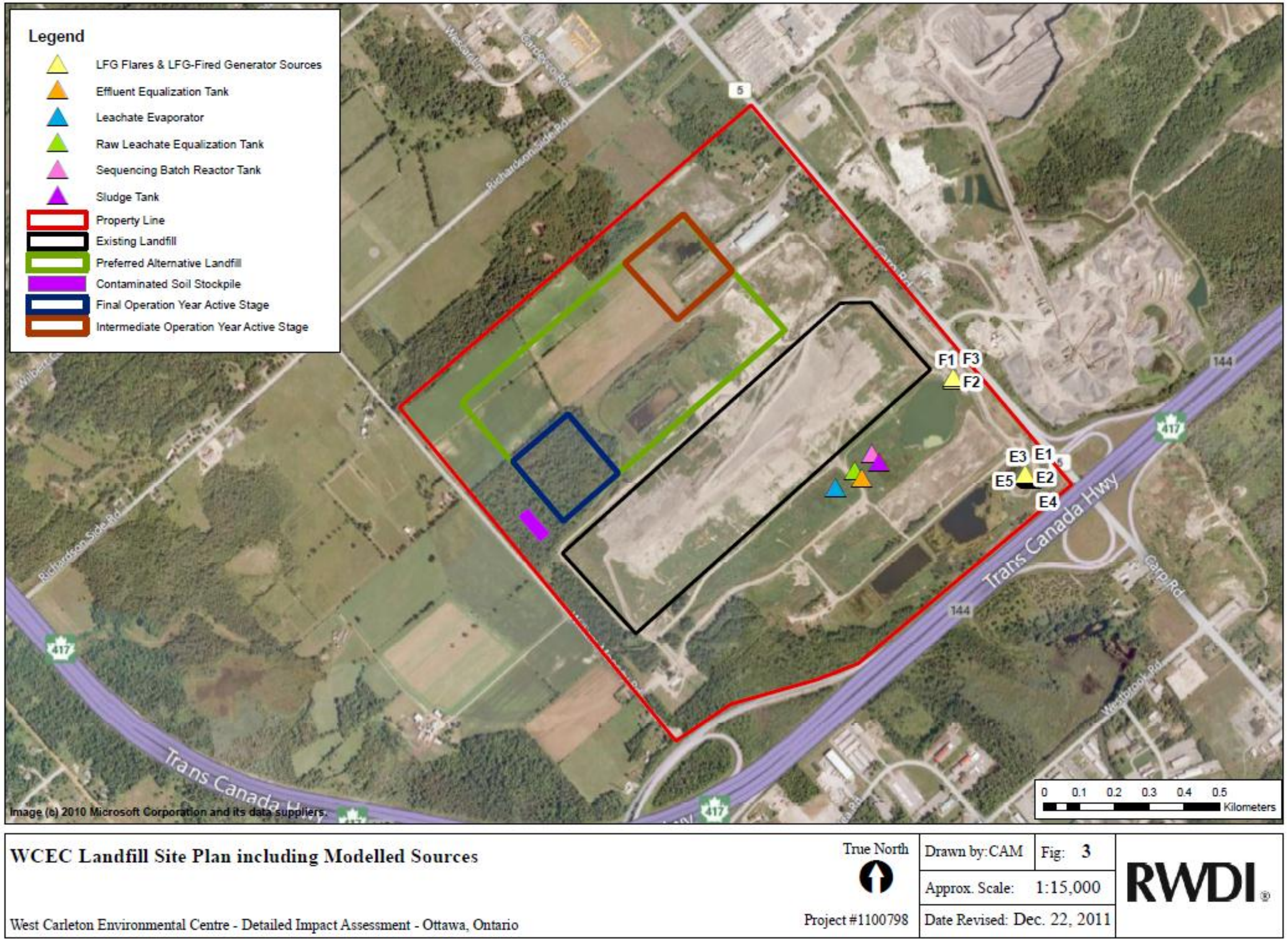


Figure 3. **WCEC Landfill Site Plan including Modelled Sources**

3. Methodology

The assessment of impacts associated with the Preferred Alternative Landfill Footprint was undertaken through a series of steps that were based, in part, on two previously prepared reports (Atmospheric Existing Conditions Report – Landfill Gas (VOC) Baseline Assessment and Atmospheric Environment Comparative Evaluation). The net effects associated with the four Alternative Landfill Footprint Options identified during the Alternative Methods phase of the EA were based on Conceptual Designs. These effects were reviewed within the context of the preliminary design plans developed for the Preferred Alternative Landfill Footprint. Additional investigations were then carried out, where necessary, in order to augment the previous work undertaken.

With these additional investigations in mind, the potential impact on the atmospheric environment of the Preferred Alternative Landfill Footprint was documented.

With a more detailed understanding of the atmospheric environment developed, the previously identified potential effects and recommended mitigation or compensation measures associated with the Preferred Alternative Landfill Footprint (documented in the Atmospheric Environment Comparative Evaluation Technical Report, September 2011) were reviewed to ensure their accuracy in the context of the preliminary design. Based on this review, the potential effects, mitigation or compensation measures, and net effects associated with the Preferred Alternative Landfill Footprint were confirmed and documented. In addition to identifying mitigation or compensation measures, potential enhancement opportunities associated with the preliminary design for the Preferred Alternative Landfill Footprint were also identified, where possible.

Following this confirmatory exercise, the requirement for monitoring in relation to net effects was identified, where appropriate. Finally, any atmospheric approvals required as part of the implementation of the Preferred Alternative Landfill Footprint were identified.

3.1 Assessment Scenarios

The potential air quality impacts that would result from the construction and operation of the proposed preferred alternative landfill were assessed at the worst case future build stages and phases of development. The future build scenarios were assessed by determining the LFG emissions from the significant emission sources in each scenario and determining the potential off-site impacts through dispersion modelling. The scenarios assessed include the intermediate operation scenario (Year 2018) and final operating year (Year 2023), as described in Section 1.7.2.

In addition to the two operation scenarios, two proposed leachate management methods used to treat the leachate, as described in Section 1.7.6 were assessed: the preferred method (SBR system only) and the contingency method (SBR system with leachate evaporator).

An overview of the modelling scenarios assessed in this study is presented in **Table 2**.

Table 2. Summary of Emission Sources Included in Each Landfill Gas Modelling Scenario

Leachate Management System	Future Build Scenarios Assessed	Sources Included in the Assessment: LFG Engine s#1 to 5- CAT 3520	LFG Engine #2 - CAT 3520	LFG Engine #3 - CAT 3520	LFG Engine #4 - CAT 3520	LFG Engine #5 - CAT 3520	LFG Flare #1	LFG Flare #2	LFG Candlestick Flare #3	Existing Landfill Mound	Proposed Preferred Alternative Landfill Mound– Phase 1	Proposed Preferred Alternative Landfill Mound– Phase 2	Active Stage of Preferred Alternative Landfill Mound (Stage 1)	Active Stage of Preferred Alternative Landfill Mound (Stage 8)	Contaminated Soil Stockpile	Raw Leachate Equalization Tank	Sequencing Batch Reactor	Effluent Equalization Tank	Sludge Tank	Evaporator Leachate Stack
Preferred Leachate Treatment Method	*Intermediate Operation Year (Year 2018)*	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	
	Final Operating Year (Year 2023)	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Contingency Leachate Treatment Method	*Intermediate Operation (Year 2018)*	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X	X
	Final Operating Year (Year 2023)	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X

Note: X – Indicates source included in modelling scenario

3.2 Emission Rate Development

The emission rate development methodology for each source is presented in the following sections. Please refer to the Appendix section for additional details and sample calculations.

3.2.1 Existing Landfill Gas Emission Rate Calculations

To predict impacts using dispersion models, emission rates for the compounds of interest must first be developed. The United States Environmental Protection Agency's (U.S. EPA) Landfill Gas Emissions Model (LANDGEM) is typically used to estimate the emission rates for the 24 target LFG compounds as outlined in the approved ToR.

In the LFG Baseline Conditions Report, the LANDGEM model was used to calculate LFG generation for the WCEC landfill for the 2010 calendar year; however, when compared to the metered LFG consumption 2010 data from the LGTE facility and the LFG flares, the amount of gas combusted exceeded the amount predicted by LANDGEM. The reason for this discrepancy is likely attributed to the unknown and estimated historical waste acceptance rate at the existing landfill. Therefore, the metered consumption data was used in combination with the estimated collection efficiency of the LFG collection system to back calculate the amount of LFG generated by the landfill in 2010 and determine a correction factor that can be applied to determine future year LFG generation from the existing landfill.

The LANDGEM model and correction factor were used to calculate LFG generation for the existing WCEC landfill for the 2018 and 2023 calendar year. For the existing landfill, the assumed percentage of the landfill with the gas collection system in place (100%), and the estimated efficiency of the LFG collection system (85%) made for the baseline assessment went unchanged for the detailed impact assessment.

On-site measurements of the twenty-four target LFG compounds were taken June 10, 2004 and April 4, 2011, with multiple samples collected on each day. Typically, the quantity of the LFG in a properly maintained and balanced well field does not greatly change from year to year. At the existing landfill, however, a number of improvements were made to the LFG collection system during the period between 2004 and 2011 and therefore additional samples were collected in 2011 to supplement the 2004 data.

The two datasets (2004 and 2011) were reviewed against each other to note any changes in the LFG composition due to the improvements to the LFG collection system. The average concentration for each individual compound was calculated separately for the 2004 samples and the 2011 samples. The 2004 and 2011 concentrations were compared to one another, and the higher of the two average concentrations was used to develop the emission rate for the 24 LFG compounds in the detailed impact assessment.

The emission rates for each of the 24 target LFG compounds from the existing landfill mound were calculated by applying the measured concentration (in milligrams per m^3) from either 2004 or 2011 to the amount of LFG released fugitively from the landfill (in m^3 per year).

Please refer to **Appendix A1** for additional details and sample calculations.

3.2.2 Preferred Alternative Landfill Gas Emission Rate Calculations

The LANDGEM model was used to calculate LFG generation for the WCEC's preferred alternative landfill for the 2018 and 2023 calendar years.

The key inputs in the LANDGEM program are the methane generation rate (k) and the methane generation capacity (L_0). The LFG generation of 0.72 m^3/s was based on the recommended k and L_0 values for Ontario landfills from Environment Canada's GHG Quantification Guidance -

Emission Factors from Canada's GHG Inventory – Waste obtained in May 2011 (k=0.045, L_0=83). These values were selected as they represent the most recent guidance for landfills in Ontario.

The range of LFG generation of 0.85 to 1.7 m^3/s stated in the FCR were based on LANDGEM default values (k=0.04, L_0=100) and United States Clean Air Act (CAA) recommended values (k=0.05, L_0=170). Neither of these sets of k and L_0 values are specific to landfills in Ontario. The FCR states that the CAA values had been found to over-estimate the LFG generation for landfills in Ontario. However, these numbers have been used as an upper limit for the WCEC site. The CAA values were used as a maximum engineering design specification for the LFG collection system, and are not necessarily to be used for assessment of off-site impacts.

The LFG collection system will be designed to accommodate the greater gas generation rate to facilitate a safety margin for good engineering design. As a consequence this will further enhance the gas collection efficiency in providing an additional measure of conservatism in our emission estimates.

A correction factor was not applied in determining the LFG generated from the preferred alternative landfill. The reason a correction factor was not applied was due to WM plans to execute diversion efforts and accept less organic material at the preferred alternative landfill, resulting in lower LFG generation rates. Also, unlike the historical waste acceptance at the existing landfill, the waste acceptance at the preferred alternative landfill will be well documented. For these reasons, it is thought that the LFG generation estimated using the LANDGEM model will be more accurate and little discrepancy will occur when compared to the future metered consumption data.

The assumed percentage of the preferred alternative landfill with the gas collection system in place is dependent on the scenario assessed, as described in Section 1.7.2. For the preferred alternative landfill footprint, the estimated gas collection efficiency of the LFG collection system varies between the portions of the landfill with final cover (85% collection) and the active stage of the landfill (50% collection).

The emission rates for each of the 24 target LFG compounds from the preferred alternative landfill mound were calculated by assuming that the concentration in the raw LFG was the same as the measured concentrations found in the raw LFG of the existing landfill.

Please refer to **Appendix A2** for additional details and sample calculations.

3.2.3 Landfill Gas-Fired Generator and Flares

Source testing was conducted for both the landfill gas-fired generators and flares. The source testing conducted on the landfill gas-fired generators were completed and summarized in the "Stack Sampling Program" prepared by RWDI AIR Inc., in November 2010. The source testing conducted on the flares were completed and summarized in the memo "Results of Stack testing on the Flare Stack, Carp Road Landfill, March Testing Program" prepared by RWDI AIR Inc., in June 2007.

The source testing results were compared to the calculated emission rates. The emission rates for each of the individual 24 LFG compounds emitted from the engine-generator sets and the LFG flares were calculated by applying the measured concentration in the LFG (in milligrams per m^3) from either 2004 or 2011 to the maximum amount of LFG that can be consumed by each piece of equipment (in m^3 per second). The calculated emissions were reduced by the destruction efficiency for each piece of equipment. Based on the final version of the AP-42 Document, Chapter 2.4 Municipal Solid Waste Landfills, dated November 1998, the destruction efficiency of the landfill gas-fired generators was estimated to be 97% and the destruction efficiency of the landfill gas-fired flares was estimated to be 98%. Between the source testing results and the calculated emission rates, the maximum emission rate for each contaminant was selected for use in the dispersion modelling. For all compounds, the calculated emission rates based on the LANDGEM total LFG emission rate and the highest concentration yielded the more conservative emission rate with the exception of benzene. The emission rate for benzene was based on the source testing results.

Please refer to **Appendix A3** for additional details and sample calculations.

3.2.4 Contaminated Soil Stockpile Emission Rate Calculations

The contaminated soil accepted and utilized at the preferred alternative landfill is expected to be similar in nature to the soil previously accepted at the existing landfill. The majority of soil used at the existing landfill was petroleum fuel-contaminated and contained fuel-related VOCs such as benzene and other light aromatic compounds. The results from a flux chamber measurement program for the existing landfill contaminated soil stockpiles were the most appropriate method to estimate the emissions for this source.

In 2004, a flux chamber measurement program, as part of the "Landfill Gas Assessment Ottawa Landfill Baseline Conditions" Report prepared by RWDI AIR Inc. (2005) was used to determine the emission rate originating from the contaminated soil stockpiles. The composition of the contaminated soil stockpiles is expected to vary based on actual soil accepted, therefore a total of six samples were collected over the course of two days; July 7 and 8, 2004, to determine "typical" concentrations of contaminants in the contaminated soil stockpiles. As emissions of VOCs from the soil will generally decrease with increasing surface exposure time, the majority of the samples were taken from piles that had been deposited less than one hour prior to the commencement of sampling. The remaining samples were collected from piles that were less than 24 hours old. Additionally the emissions are expected to be highest during the summer months, since the volatilization of VOCs will be greater at higher temperatures. The emission rates determined from the July sampling results was applied to the contaminated soil stockpiles on an annual basis.

The soil emission samples were collected using a flux chamber. This flux chamber was 71 cm in diameter, 31 cm high constructed of 14 gauge stainless steel, as per the designer specifications (Reinhart, Cooper and Walker, 1992). The flux chamber was placed on the surface of the contaminated soil pile and the bottom edge of the chamber was forced a short depth down into the surface to create a seal. The flux chamber was operated under a slight positive pressure (0.045 inches H_2O) to further prevent outside air from entering underneath the walls and into the chamber, as recommended by the designer (Reinhart, Cooper and Walker, 1992).

The flux chamber was first purged with a sweep gas of nitrogen to minimize biasing of gas emission rates and produce accurate measurements. After the flux chamber had been purged, a VOC sample was drawn from the chamber using a four-phase stainless steel absorbent tube. The sample was collected using the VOC sample train, in accordance with the U.S. EPA Method TO-17. An average flow rate of 406 mL/min was maintained for approximately 25 minutes, resulting in sample volumes ranging from 8.8 to 11.1 liters. The sample tubes were sent to OSB Laboratories in Brampton to be analyzed for all of 24 LFG species.

The sample results indicate that the most of the contaminants were not emitted from the contaminated soil stockpile in concentrations above the laboratory detection limit. Emission flux rates (in grams per square metre per second) were determined for the following eight compounds, which were found to be emitted from the contaminated soil stockpiles:

- 1,1,1-Trichloroethane;
- 1,2-Dichloroethane;
- Benzene;
- Dichloromethane;
- Octane;
- 2-Butanol;
- Tetrachloroethylene; and
- Trichloroethylene.

The contaminated soil stockpile was assumed to have a surface area of 4,000 m^2 and was placed in the southwest corner of the preferred alternative landfill.

Please refer to **Appendix B** for more details on the contaminated soil emission sampling program and calculated emission rates.

3.2.5 Leachate Management System Emission Rate Calculations

3.2.5.1 Sequencing Batch Reactor (SBR) System

The SBR System represents the preferred leachate management method. The initial proposed design for the SBR system was to treat leachate collected from the existing landfill. All emission rate calculations for the initial proposed design were used in this LFG Detailed Impact Assessment and can found in the "Ottawa Landfill Leachate Treatment Plant Upgrades – Emission Summary and Dispersion Modelling Report", prepared by RWDI AIR Inc., in October, 2010.

The U.S. EPA's wastewater treatment model WATER9 was used to estimate potential air emissions from the SBR leachate treatment system. WATER9 outputs gram per second emission rates to air by contaminant for each source. WATER9 allows the user of the model to select component equipment configurations within the plant and arrange the flows and process inputs to approximate the facility configuration, therefore allowing the user to simulate the plant virtually within the modelling program. Certain parameters were inputted to the program (i.e., temperatures, flows, influent concentrations), based on the Ottawa Landfill Leachate Treatment System Conceptual Design Report document, prepared by AECOM, as well as additional information provided by AECOM and Waste Management. Where required information was not available from either of these sources, parameters were based on the WATER9 defaults. In cases where a specific equipment configuration did not exist within the program, the most reasonably representative equipment type or configuration was chosen.

For the Ottawa Landfill facility, the SBR was represented by the "diffused air biotreatment" equipment type in the WATER9 model. This equipment type considers biological degradation of the compounds in the leachate and aeration/agitation of the leachate in the containment tank. The Equalization Tank and Effluent Equalization Tank were represented by the "storage tank" equipment type in the WATER9 model and the Sludge Tank was represented by the "mix tank" equipment type.

The water quality data for all sources at the leachate treatment plant were based on the water quality data for raw leachate. Incoming leachate quality data was based on two sources of information – sampling data from raw leachate at the existing Ottawa Landfill and maximum design leachate concentrations for a SBR system at another WM facility, the Twin Creeks landfill. The raw leachate sampling data were assessed and any contaminants that were detected were carried forward in the assessment. Those contaminants that were measured but not found in detectable amounts were dropped from the assessment. The Ottawa Landfill sampling data and the Twin Creeks design concentrations were compared, and the highest concentration for each contaminant was used to develop emission rates for the detected contaminants. This is a conservative approach, as no degradation or removal of the contaminants in the leachate was accounted for as the leachate is treated through the process. The one exception to this is ammonia, where AECOM provided inlet ammonia concentrations separately for the raw leachate (Equalization Tank and SBR), the effluent (Effluent Tank), and sludge (Sludge Tank).

The initial proposed design for the SBR system was to treat leachate collected from the existing landfill. In anticipation of the increased leachate generation due to the construction and filling of the preferred alternative landfill, the SBR system is assumed to double in capacity; therefore, as a conservative approach, the initial estimated emission rates for the raw leachate equalization tank, the effluent equalization tank, and the sludge holding tank were also doubled. The emissions from the SBR tank were not doubled, since the SBR is a batch process and maximum emissions would not occur from both SBR tanks at the same time. During the start of the proposed expansion, the leachate volumes generated will not exceed the current capacity of the SBR system. For the purposes of this Detailed Odour Impact Assessment and to obtain the most conservative emissions release estimate, the following was assumed:

1. the SBR system is operating at its maximum flow rate;
2. the leachate inlet concentration for each parameter identified is at its highest;
3. the leachate generated from the preferred alternative landfill and the existing landfill are similar in quality; and
4. the SBR tank, although a batch process, is discharging emission continuously, 24 hours per day, 7 days a week.

Therefore, having one SBR system operating 24-hours per day at the worst-case conditions is an overly conservative assumption intended to address any potential additional capacity that may be required in the future. In the unlikely event that any additions to the SBR system are required, an assessment of associated emission changes will be required as part of the ECA process. At that time, with the SBR system constructed and running, the SBR emissions can be derived by performing validated source testing.

Please refer to **Appendix C** for additional details and sample calculations.

3.2.5.2 Leachate Evaporator System

The inclusion of the leachate evaporator, in addition to the SBR system, represents the contingency leachate management method. In order to determine the emissions from the leachate evaporator, an emission sampling program was conducted on the exhaust system serving the leachate evaporator system currently installed and operating at WM's Glenn's Landfill site located in Maple City, Michigan. The leachate evaporator was processing approximately 20,000 gallons of leachate per day. This is equivalent to the amount that would be processed at the WCEC site if the contingency leachate treatment method is selected.

The emission rates for the WCEC's leachate evaporator were calculated using the average emission results from the source testing of the Glenn's Landfill leachate evaporator. The equipment design parameters for the WCEC leachate evaporator, including the exhaust flow rates, exhaust temperature, the leachate evaporator stack height and diameter, were assumed to be the same as those of the Glenn's Landfill leachate evaporator. The contaminants assessed from the leachate evaporator were the 24 LFG target compounds and ammonia. If the source testing results for the leachate evaporator indicated that a compound was found in concentrations below the method detection limit, the compound was assumed to not be emitted from the evaporator source.

Please refer to **Appendix D** for full details on the leachate evaporator source testing and results, as found in the "Voluntary Source Testing Program (Leachate Evaporator), Waste Management of Canada", prepared by RWDI AIR Inc., in 2011.

3.2.5.3 Contaminant Negligibility Assessment

The preferred leachate treatment contingency method (SBR system only) and contingency leachate treatment method (SBR system and Leachate Evaporator) were not assessed in the Landfill Gas Baseline Conditions. The leachate treatment methods are both being assessed to determine the effects of the contaminants emitted by the two leachate management methods on the atmospheric environment.

The MOE's method as outlined in Appendix B.1 of the Procedure for Preparing an ESDM Report, Version 3.0, March 2009, was used to determine whether contaminants solely emitted by the leachate management system were to be modelled. These contaminants were compared to a calculated site-specific emission threshold to evaluate whether the contaminant is significant. The Emission Threshold is calculated using a MOE conservative dispersion factor ($\mu g/m^3$ per g/s emission) and the relevant standard or guideline under O. Reg. 419/05. For chemicals without standards or guidelines under O. Reg. 419/05, the MOE *de minimus* POI concentration (24-hour average basis) was used.

Based on the negligibility assessment, ammonia is the only contaminant solely emitted from the leachate management system that needs to be assessed in the modelling. Contaminants that were emitted from the leachate collection system that were also emitted from the landfill (i.e., benzene, dichloromethane) were also assessed in the modelling.

Please refer to **Appendix E** for more details on the contaminant negligibility assessment.

3.2.5.4 Ammonia Emissions

The leachate evaporator emissions were determined through an emission sampling program on a leachate evaporator exhaust system currently serving a facility with no leachate pre-treatment system. Since the proposed contingency leachate management system will include the pre-treatment of the ammonia contained in the leachate through the SBR system, the ammonia emissions would be emitted from the SBR system before reaching the leachate evaporator. To maintain a conservative approach, the ammonia emissions were evaluated as being emitted from both the SBR system and the leachate evaporator system, which in reality will not be the case. The treatment of the leachate by the SBR system prior to the evaporator would result in much lower ammonia emissions from the evaporator.

3.3 Landfill Gas Calibration Factor

The LANDGEM Model has been developed as a LFG generation model and is not a LFG emission model. The approaches taken in this assessment also produce an estimate of LFG generation rather than LFG emission. This is a very critical distinction when assessing air quality. The effect of LFG passing through several feet of moistened soil, full of microbes and reactive minerals, greatly reduces the amount of many LFG compounds. This is particularly true for reduced sulphur compounds such as hydrogen sulphide.

As referred to in the Amended LFG (VOC) Baseline Assessment Report, dated November 2011, a Combined Assessment of Modelled and Monitored (CAMM) results indicated that it is reasonable that the hydrogen sulphide emission rate be adjusted using a calibration factor. The emission factors for the hydrogen sulphide sources (only LFG related sources) in this assessment were divided by a value of 3, the reduction factor used to obtain an adjusted emission rate. The CAMM study has been reviewed and accepted by the MOE, with the documentation included in **Appendix F.**

None of the other contaminant emission rates were adjusted through the use of a calibration factor.

3.4 Dispersion Modelling

The LFG impacts from the existing landfill and the preferred alternative landfill conditions were determined using a dispersion model and reasonable worst-case emission rates. Dispersion modelling was performed using the U.S. EPA's AERMOD dispersion model (AERMOD) to predict concentrations of LFG emitted from the WCEC preferred alternative and existing landfill at various receptors in the vicinity. The AERMOD model is an advanced dispersion model that has been approved for use in Ontario by the MOE. AERMOD is a steady-state Gaussian model that is capable of handling multiple emission sources. Within the model, receptor grids as well as discrete receptor locations of interest can be considered. The modelling assessment was conducted in accordance with MOE's Guideline A11: "Air Dispersion Modelling Guideline for Ontario", March 2009.

Additional elements of the dispersion modelling assessment are discussed in the following sections.

Electronic copies input and output modelling files are provided for review**.**

3.4.1 Compounds Modelled

The average concentration of each LFG contaminant and the LFG generation rate was used to calculate an emission flux rate for the landfill sources or an emission rate for each generator or flare. The results for eleven of the contaminants were scaled based on the uncalibrated hydrogen sulphide results, using the ratio of their corresponding measured concentrations and the hydrogen sulphide concentration.

Scaling the dispersion model results was a possibility for some contaminants, since the emissions of these contaminants from all sources are based on the concentration of contaminants within the LFG. Since the emissions from each source will maintain the same ratio to one another between contaminants, the percentage of contaminant released from each source will also be the same between contaminants. This approach allows for the scaling of the modelled results.

The remaining 14 contaminants were modelled individually using their respective calculated emission rates for each of the sources included in the model. Since these contaminants were emitted from non-LFG related sources (i.e., the leachate management system and the contaminated soil stockpile), the emissions from each source did not maintain the same ratio between all contaminants, therefore the results could not be scaled of the uncalibrated hydrogen sulphide results.

The following compounds were scaled from the uncalibrated H_2S model results:

- 1,1,2,2,-Tetrachloroethane;
- 1,1,2-Trichloroethane;
- 1,1-Dichloroethane;
- 1,2-Dichloroethene (Trans);
- Bromodichloromethane;
- Carbon Tetrachloride;
- Chloroform;
- Ethylene Dibromide;
- Methyl Mercaptan;
- Ethyl Mercaptan; and
- Dimethyl Sulphide.

3.4.2 Sources Modelled

The sources included in the dispersion model were the five landfill gas-fired engines, the three flares, the existing landfill mound, the preferred alternative landfill mound (including final cover area and active stage), the contaminated soil stockpiles, and the leachate treatment sources, as described in Section 1.7.

All five engines and three flares were assumed to be operating concurrently at maximum capacity, coupled with maximum fugitive emissions from the landfill mounds, active stage and contaminated soil stockpiles.

The SBR system and the leachate evaporator system were also assumed to be operating concurrently at maximum capacity. Although the SBR is a batch system, the sources were conservatively assumed to be emitting continuously. For the purposes of the assessment, three of the leachate treatment tanks (the raw leachate equalization tank, the effluent equalization tank, and the sludge holding tank) were assumed to be emitting contaminants simultaneously and at maximum capacity, based on doubled capacity. The SBR tank was also assumed to be emitting contaminants simultaneously, based on one batch operation (single capacity) operating continuously at maximum emission rates.

All modelled sources were assumed to emit maximum odour emissions concurrently throughout the entire modelled period.

The locations of these sources are shown in **Figure 3**.

3.4.3 Meteorological Data

Five years of local meteorological data (2006-2010) were used in the AERMOD dispersion model. The meteorological data set for the WCEC was developed by the MOE's Environmental Monitoring and Reporting Branch (EMRB). This dataset, however, was based on the MOE's regional meteorological data for Eastern Ontario, which considers surface data from the Ottawa International Airport. The Ottawa Airport, which is located approximately 25 km away from the landfill, is the nearest weather station providing the desired meteorological parameters on an hourly basis. The EMRB adjusted the regional meteorological dataset to account for local land uses surrounding the WCEC facility. The data set provided by the EMBR was used directly in the dispersion model, with no changes or alterations conducted by RWDI.

Consultation on the meteorological dataset was conducted with Jinliang (John) Liu from the EMRB. As the meteorological dataset provided by the EMRB, is still based on the regional data, rather than local data, a Section 13(1) request is not required.

3.4.4 Area of Modelling

In order to assess compliance with Schedule 3 Standards under Reg. 419, a multi-tiered receptor grid was developed with reference to Section 7.2 of the Air Dispersion Modelling Guideline for Ontario, Version 2.0, March 2009. The receptor grid represents the Site-Vicinity and Regional study areas and covers the lands within approximately 3 to 5 km of the WCEC site. In this receptor grid the interval spacing was dependent on the receptor distance from on-site sources. The interval spacing was as follows:

- Tier 1: 20 m spacing a minimum of 200 m from each source;
- Tier 2: 50 m spacing up to 300 m from Tier 1;
- Tier 3: 100 m spacing up to 500 m from Tier 2;
- Tier 4: 200 m spacing up to 1,000 m from Tier 3; and,
- Tier 5: 500 m spacing up to 3,000 m from Tier 4.

The property line of the WCEC Landfill facility was defined in the AERMOD dispersion model. In addition to the gridded receptors, discrete receptors were placed along the property line at 10 m intervals. Those receptors in the aforementioned grid that fell within the WCEC Landfill property line were eliminated from consideration in the modelling. Each receptor in this grid was positioned at grade level. This approach is consistent with MOE Air Dispersion Modelling Guideline for Ontario, Version 2.0, March 2009. The receptor grid was used to develop contour plots of mean predicted concentrations for vinyl chloride, benzene, and hydrogen sulphide as well as to assess compliance for all 25 contaminants in the study.

In addition, the evaluation considered the potential impacts from the preferred alternative landfill conditions at 24 discrete receptor locations (see **Figure 2**). For all cases, humans were assumed to be present at these receptors for 24-hours per day.

3.4.5 Terrain Data

Terrain information for the area surrounding the existing WCEC Landfill was obtained from the MOE Ontario Digital Elevation Model Data web site. The terrain data are based on the North American Datum 1983 (NAD83) horizontal reference datum. These data were run through the AERMAP terrain pre-processor to estimate base elevations for receptors and to help the model account for changes in elevation of the surrounding terrain.

3.4.6 Building Information

The Building Profile Input Program (BPIP) is used to calculate the effects of building downwash on point sources, such as stacks. The proposed leachate evaporator enclosure, the landfill-gas-to-energy building and the flare building were included in the modelling, as these structures have the potential to affect emissions from the leachate evaporator, engines and flares. The SBR system tanks were also included in the modelling as buildings, as the tanks have the potential to affect emission from the tank vent sources. The BPIP model was run prior to running the AERMOD model in order to incorporate the potential building downwash effects.

The potential building downwash effects were only evaluated for the point sources within the dispersion model. Although the existing and proposed preferred alternative landfill mounds may be considered “structures”, dispersion modelling tests were completed including these landfill mound “structures” and it was found that the effects of mound downwash have insignificant impacts on the maximum off-site concentrations. The effects of the mound downwash are insignificant as the sloping features of the mound do not act as a solid block building.

3.4.7 Averaging Periods Used

Emissions were modelled for 24-hour and 1-hour averaging times, to correspond with the POI Limits for the various compounds. This approach is consistent with the MOE’s Schedule 3 standards. Those compounds that do not have POI Limits were modelled using a 24-hour averaging period.

For certain compounds, the model output was scaled to produce results for the 10-minute averaging times, in order to be directly comparable to the relevant odour based criteria. The scaling factors were determined using Equation 1 below:

$$X_s = X_1 \left(\frac{t_p}{t_s}\right)^n$$ Equation 1

Where: X_s = 10-minute averaging period concentration;
X_p = 60-minute averaging period concentration;
t_l = long time interval (60-minute);
t_s = short time interval (10-minute); and
n = atmospheric stability-dependant exponent (n=0.28).

4. Additional Investigations

The WCEC is the only significant source in the area of most of the LFG compounds and ammonia. The exception to this was benzene and other light aromatic compounds that are emitted from motor vehicles. No additional investigations were performed to quantify off-site contributions of any of the 25 target compounds in the LFG assessment.

5. Detailed Description of the Environment Potentially Affected

5.1 Preferred Leachate Management System

This section describes the predicted air quality impacts that would result from the construction and operation of the proposed preferred alternative landfill with the preferred leachate management system (SBR system only). To determine the effect of the additional waste on the air quality conditions surrounding the site, a modelling assessment of the future build stages, as previously described, was completed.

5.1.1 On-Site and in the Vicinity

The future build stages were constructed and operated using the practices currently in place at the WCEC facility. The maximum predicted concentrations for all of the compounds of interest were predicted to be within their applicable criteria at all receptors in the area. Detailed analysis of maximum concentrations for all compounds is included in Table 3. Predicted concentrations for all of the contaminants were found to be less than their respective standard or guideline in the Site Vicinity, or lands within approximately 3 to 5 km of the WCEC sources.

Table 3. Summary of Maximum Predicted 24-Hour Concentrations Off-site for Each Future Build Scenario

CAS #	Compounds	Average Sample Concentration (mg/m³)	Averaging Period (hours)	MOE POI Limit (µg/m³)	2018 – Future Build		2023 – Future Build	
					Maximum Predicted Concentration (µg/m³)	Percentage of MOE POI Limit (%)	Maximum Predicted Concentration (µg/m³)	Percentage of MOE POI Limit (%)
71-55-6	1,1,1-Trichloroethane	0.16	24 Hour	115,000	2.77E-03	<0.1%	2.53E-03	<0.1%
79-34-5	1,1,2,2-Tetrachloroethane	0.017	n/a	n/a	2.91E-04	n/a	2.65E-04	n/a
79-00-5	1,1,2-Trichloroethane	0.02	24 Hour	0.31	3.61E-04	0%	3.29E-04	0%
75-34-3	1,1-Dichloroethane	4.1	24 Hour	165	7.20E-02	<0.1%	6.56E-02	<0.1%
75-35-4	1,1-Dichloroethylene	0.17	24 Hour	10	6.06E-01	6%	6.06E-01	6%
107-06-2	1,2-Dichloroethane	0.02	24 Hour	2	1.58E-01	8%	1.58E-01	8%
156-59-2	1,2-Dichloroethene (Cis)	9.63	24 Hour	105	1.22E+01	12%	1.22E+01	12%
156-60-5	1,2-Dichloroethene (Trans)	0.45	24 Hour	105	7.97E-03	<0.1%	7.27E-03	<0.1%
71-43-2	**Benzene**	**3.62**	**24 Hour**	**2.3**	**4.31E-01**	**19%**	**4.29E-01**	**19%**
75-27-4	Bromodichloromethane	0.002	n/a	n/a	2.70E-05	n/a	2.46E-05	n/a
56-23-5	Carbon Tetrachloride	0.03	24 Hour	2.4	4.64E-04	<0.1%	4.23E-04	<0.1%
75-00-3	Chloroethane	1.34	24 Hour	5600	2.44E-01	<0.1%	2.44E-01	<0.1%
67-66-3	Chloroform/Trichloromethane	0.29	24 Hour	1	5.02E-03	1%	4.58E-03	0%
75-09-2	Dichloromethane	2.43	24 Hour	220	5.89E+01	27%	5.89E+01	27%
106-93-4	Ethylene Dibromide	0.01	24 Hour	3	9.42E-05	<0.1%	8.59E-05	<0.1%
04/06/7783	**Hydrogen sulphide**	**288**	**24 Hour**	**7**	**1.68E+00**	**24%**	**1.53E+00**	**22%**
78-92-2	sec-Butyl Alcohol/2-Butanol (as n-Butanol)	45.7	24 Hour	920	8.23E-01	<0.1%	8.39E-01	<0.1%
127-18-4	Tetrachloroethylene	8.36	24 Hour	360	5.80E-01	0%	5.75E-01	0%
79-01-6	Trichloroethylene	2.76	24 Hour	12	1.39E+00	12%	1.39E+00	12%
75-01-4	**Vinyl Chloride/Chloroethene**	**5.11**	**24 Hour**	**1**	**7.35E-01**	**73%**	**7.32E-01**	**73%**
7664-41-7	Ammonia	n/a	24 Hour	100	1.28E+01	13%	1.28E+01	13%

Notes: [1] Predicted concentrations at or beyond the property line.
[2] Hydrogen Sulphide is the only compound concentration to which a calibration factor of 3 was applied.

Two contaminants, 1,1,2,2-tetrachloroethane and bromodichloromethane, do not have standards or criteria available for comparison. The 24-hour average concentrations are also presented for these two compounds.

Since the maximum predicted concentrations did not exceed the applicable standards for any of the 25 contaminants of interest, contour plots have not been presented.

The maximum predicted off-site concentrations associated with the construction and operation of the preferred alternative landfill including the preferred leachate management system is predicted to occur in 2018 scenario near the northeast corner of the facility. The vinyl chloride concentrations are predicted to be the highest concentrations relative to the corresponding limit. The maximum predicted 24-hour vinyl chloride concentration was 0.73 µg/m^3, which represents

73% of the Schedule 3 Standard of 1 µg/m^3. The predicted vinyl chloride concentration was influenced by both emissions from the landfill mound as well as emissions from the leachate treatment system (SBR).

Hydrogen sulphide was the only contaminant which had the calibration factor applied. The maximum predicted calibrated hydrogen sulphide 24-hour concentration at any off-site location in 2018 was 1.68 µg/m^3, which represents 24% of the Schedule 3 Standard of 7 µg/m^3.

The maximum predicted concentration of hydrogen sulphide in 2018 is influenced by the close proximity of the most recently developed stage (Stage 1), to the property line. For conservative purposes, it was assumed that the installation of the LFG collection system in Stage 1 in 2018 is not complete and the gas collection efficiency is approximately 50% for this Stage. Landfill sources with such reduced gas collection efficiency are generally the most dominant in causing off-site impacts. Although the preferred alternative landfill in the 2023 scenario generates more LFG and also has an active stage (Stage 8) with a reduced gas collection, the location Stage 8 is not as close in proximity to the property and therefore the 2023 scenario concentration is not as influenced by this source as it is in the 2018 scenario. Consequently, the maximum concentrations predicted throughout the future operating scenarios occurred in 2018.

To compare the maximum off-site benzene concentration to the future benzene standard set out by the MOE in the O. Reg. 419/05, which will take effect on July 1, 2016, the dispersion model was run for each year of meteorological data (2006-2010) and each year's results were compared to determine the maximum annual benzene concentration. The maximum off-site concentrations are less than the applicable Standards and therefore the WCEC facility will be in compliance with the future benzene standards.

Table 4. Summary of Maximum Benzene Predicted Annual Concentrations

CAS #	Compounds	Average Sample Concentration (mg/m³)	Averaging Period (hours)	MOE POI Limit (µg/m³)	Maximum Predicted Concentration (µg/m³)	Percentage of MOE POI Limit (%)
71-43-2	Benzene	3.62	Annual	0.45	0.29	64%

5.1.2 Discrete Receptors

A dispersion modelling analysis was completed for all 24 LFG compounds and ammonia at each of the 24 discrete receptors. A summary of the predicted maximum concentrations for all compounds is included in **Tables 5** and **6.** A more detailed summary table for the predicted maximum concentration at each of the 24 sensitive receptors for vinyl chloride, benzene and hydrogen sulphide can be found in Tables 7, 8 and 9.

Predicted 24-hour vinyl chloride, benzene and hydrogen sulphide concentrations did not exceed the POI limit or criteria at any of the receptors. The predicted 10-minute hydrogen sulphide concentrations at the discrete receptors did not exceed the POI limit or criteria at any of the receptors. The hydrogen sulphide concentrations were evaluated against the 10-minute averaging standards only at the discrete receptors, in accordance with the MOE's "Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines under O. Reg. 419/05" Technical Bulletin.

Maximum concentrations are predicted to occur at Receptor 2 (southeast corner of the WCEC facility) for most of the time, with exception of the 10-minute hydrogen sulphide maximum concentration which occurs at Receptor 3 (west of the WCEC facility) for the all future build years.

Table 5. Summary of Maximum Predicted 24-Hour Concentrations at Discrete Receptor for Each Future Build Scenario

CAS #	Compounds	Average Sample Concentration (mg/m^3)	Averaging Period (hours)	MOE POI Limit (µg/m^3)	2018		2023	
					Maximum Predicted Concentration (µg/m^3)	Percentage of MOE POI Limit (%)	Maximum Predicted Concentration (µg/m^3)	Percentage of MOE POI Limit (%)
71-55-6	1,1,1-Trichloroethane	0.16	24 Hour	115,000	1.50E-03	<1%	1.46E-03	<1%
79-34-5	1,1,2,2-Tetrachloroethane	0.017	n/a	n/a	1.62E-04	n/a	1.57E-04	n/a
79-00-5	1,1,2-Trichloroethane	0.02	24 Hour	0.31	1.90E-04	<1%	1.84E-04	<1%
75-34-3	1,1-Dichloroethane	4.10	24 Hour	165	3.90E-02	<1%	3.78E-02	<1%
75-35-4	1,1-Dichloroethylene	0.17	24 Hour	10	1.91E-01	2%	1.91E-01	2%
107-06-2	1,2-Dichloroethane	0.02	24 Hour	2	4.94E-02	2%	4.94E-02	2%
156-59-2	1,2-Dichloroethene (Cis)	9.63	24 Hour	105	3.85E+00	4%	4.77E+00	5%
156-60-5	1,2-Dichloroethene (Trans)	0.45	24 Hour	105	4.28E-03	<1%	4.15E-03	<1%
78-92-2	2-Butanol (as n-Butanol)	45.70	24 Hour	920	4.34E-01	<1%	4.21E-01	<1%
71-43-2	Benzene	3.62	24 Hour	2.3	1.43E-01	6%	1.43E-01	6%
75-27-4	Bromodichloromethane	0.002	n/a	n/a	1.90E-05	n/a	1.84E-05	n/a
56-23-5	Carbon Tetrachloride	0.03	24 Hour	2.4	2.85E-04	<1%	2.77E-04	<1%
75-00-3	Chloroethane	1.34	24 Hour	5600	7.95E-02	<1%	7.97E-02	<1%
67-66-3	Chloroform/Trichloromethane	0.29	24 Hour	1	2.76E-03	<1%	2.67E-03	<1%
75-09-2	Dichloromethane	2.43	24 Hour	220	1.84E+01	8%	1.84E+01	8%
106-93-4	Ethylene Dibromide	0.01	24 Hour	3	9.51E-05	<1%	9.22E-05	<1%
7783-06-4	Hydrogen sulphide [2]	288	24 Hour	7	9.13E-01	13%	8.85E-01	13%
127-18-4	Tetrachloroethylene	8.36	24 Hour	360	1.98E-01	n/a	2.00E-01	n/a
79-01-6	Trichloroethylene	2.76	24 Hour	12	4.42E-01	4%	4.43E-01	4%
75-01-4	Vinyl Chloride/Chloroethene	5.11	24 Hour	1	2.41E-01	24%	2.42E-01	24%
7664-41-7	Ammonia	n/a	24 Hour	100	3.73E+00	4%	3.73E+00	4%

Notes: *[1] Predicted concentrations at the worst-case discrete receptor location.*
[2] Hydrogen Sulphide is the only compound concentration to which a calibration factor of 3 was applied.

Table 6. Summary of Maximum Predicted 10-Minute Concentrations at Discrete Receptor for Each Future Build Scenario

CAS #	Compounds	Average Sample Concentration (mg/m^3)	Averaging Period (hours)	MOE POI Limit (µg/m^3)	2018		2023	
					Maximum Predicted Concentration (µg/m^3)	Percentage of MOE POI Limit (%)	Maximum Predicted Concentration (µg/m^3)	Percentage of MOE POI Limit (%)
74-93-1	Methyl Mercaptan (as Total Mercaptans)	0.005	10-Min	13	2.02E-04	<1%	1.72E-04	<1%
75-08-1	Ethyl Mercaptan (as Mercaptans)	7.75	10-Min	13	3.13E-01	2%	2.66E-01	2%
111-65-9	Octane	5.47	10-Min	61,800	3.50E-01	<1%	3.18E-01	<1%
75-18-3	Dimethyl Sulphide	2.35	10-Min	30	9.48E-02	<1%	8.08E-02	<1%
7783-06-4	Hydrogen Sulphide [2]	288	10-Min	13	3.87	30%	3.30	25%

Notes: [1] Predicted concentrations at the worst-case discrete receptor location.
[2] Hydrogen Sulphide is the only compound concentration to which a calibration factor of 3 was applied.

Table 7. Maximum Predicted 24-Hour Vinyl Chloride Concentrations at Discrete Receptors for Each Future Build Scenario – Preferred Leachate Management System

Receptor No.	2018		2023	
	Maximum Predicted Concentration (µg/m^3)	Percentage of POI Limit[1] (%)	Maximum Predicted Concentration (µg/m^3)	Percentage of POI Limit[1] (%)
1	9.21E-02	9%	9.17E-02	9%
2	**2.41E-01**	**24%**	**2.42E-01**	**24%**
3	9.26E-02	9%	9.41E-02	9%
4	1.78E-01	18%	1.77E-01	18%
5	3.46E-02	3%	3.48E-02	3%
6	4.01E-02	4%	3.92E-02	4%
7	5.78E-02	6%	5.82E-02	6%
8	2.16E-01	22%	2.14E-01	21%
9	6.94E-02	7%	6.80E-02	7%
10	2.39E-02	2%	2.34E-02	2%
11	2.92E-02	3%	3.02E-02	3%
12	5.17E-02	5%	5.17E-02	5%
13	8.37E-02	8%	8.32E-02	8%
14	8.22E-02	8%	8.69E-02	9%
15	7.15E-02	7%	7.38E-02	7%
16	2.49E-02	2%	2.45E-02	2%
17	4.59E-02	5%	4.57E-02	5%
18	1.56E-01	16%	1.54E-01	15%
19	4.48E-02	4%	4.42E-02	4%
20	3.53E-02	4%	3.54E-02	4%
21	4.38E-02	4%	4.39E-02	4%
22	4.60E-02	5%	4.63E-02	5%
23	3.08E-02	3%	3.01E-02	3%
24	1.75E-02	2%	1.71E-02	2%

Notes: Shaded– highest modelled concentration and percentage of POI Limit or AAQC
[1] 24-Hour POI limit for vinyl chloride is 1 µg/m^3

Table 8. Maximum Calibrated[1] Predicted 10-Minute Hydrogen Sulphide Concentrations for Each Future Build Scenario

Receptor No.	2018		2023	
	Maximum Predicted Concentration ($\mu g/m^3$)	Percentage of POI Limit[1] (%)	Maximum Predicted Concentration ($\mu g/m^3$)	Percentage of POI Limit[1] (%)
1	3.4	26%	3.1	24%
2	1.9	15%	1.9	15%
3	**3.9**	**30%**	**3.1**	**24%**
4	2.3	18%	2.5	19%
5	0.9	7%	1.0	8%
6	1.6	12%	1.6	13%
7	1.1	8%	1.1	8%
8	2.2	17%	2.0	15%
9	2.6	20%	2.4	18%
10	1.2	10%	1.2	9%
11	1.4	11%	1.7	13%
12	1.5	11%	1.6	12%
13	2.1	16%	2.0	16%
14	2.6	20%	3.3	25%
15	2.0	15%	2.3	18%
16	1.1	9%	1.2	10%
17	1.3	10%	1.2	9%
18	1.9	14%	1.7	13%
19	1.3	10%	1.2	10%
20	1.0	7%	1.0	8%
21	1.1	9%	1.2	9%
22	1.0	8%	1.2	9%
23	1.3	10%	1.1	9%
24	1.0	7%	0.8	6%

Notes: Shaded– highest modelled concentration and percentage of POI Limit or AAQC
[1] A calibration factor of 3 was applied to all hydrogen sulphide concentrations
[2] 10-Minute POI limit for hydrogen sulphide is 13 $\mu g/m^3$

Table 9. Maximum Calibrated[1] Predicted Hydrogen Sulphide 24-Hour Concentrations for Each Future Build Scenario

Receptor No.	2018		2023	
	Maximum Predicted Concentration ($\mu g/m^3$)	Percentage of POI Limit[1] (%)	Maximum Predicted Concentration ($\mu g/m^3$)	Percentage of POI Limit[1] (%)
1	**0.9**	**13%**	**0.9**	**13%**
2	0.4	6%	0.4	5%
3	0.7	10%	0.6	9%
4	0.4	6%	0.4	6%
5	0.1	2%	0.1	2%
6	0.2	3%	0.3	4%
7	0.2	2%	0.2	3%
8	0.4	5%	0.3	5%
9	0.6	8%	0.5	8%
10	0.1	1%	0.1	1%

Receptor No.	2018		2023	
	Maximum Predicted Concentration (µg/m³)	Percentage of POI Limit[1] (%)	Maximum Predicted Concentration (µg/m³)	Percentage of POI Limit[1] (%)
11	0.1	2%	0.2	2%
12	0.2	3%	0.2	3%
13	0.2	3%	0.2	3%
14	0.5	6%	0.6	8%
15	0.3	5%	0.4	5%
16	0.1	2%	0.1	2%
17	0.2	2%	0.1	2%
18	0.2	4%	0.2	3%
19	0.1	2%	0.1	2%
20	0.1	2%	0.1	2%
21	0.1	2%	0.2	2%
22	0.2	2%	0.2	2%
23	0.1	2%	0.1	2%
24	0.1	1%	0.1	1%

Notes: Shaded– highest modelled concentration and percentage of POI Limit or AAQC

Table 10. Maximum Predicted 24-Hour Benzene Concentrations for All Future Build Scenario

Receptor No.	2018		2023	
	Maximum Predicted Concentration (µg/m³)	Percentage of POI Limit[1] (%)	Maximum Predicted Concentration (µg/m³)	Percentage of POI Limit[1] (%)
1	5.66E-02	2%	5.63E-02	2%
2	**1.43E-01**	**6%**	**1.43E-01**	**6%**
3	6.20E-02	3%	6.31E-02	3%
4	1.04E-01	5%	1.03E-01	4%
5	2.09E-02	1%	2.11E-02	1%
6	2.43E-02	1%	2.36E-02	1%
7	3.45E-02	2%	3.48E-02	2%
8	1.24E-01	5%	1.23E-01	5%
9	4.08E-02	2%	3.98E-02	2%
10	1.51E-02	1%	1.47E-02	1%
11	1.81E-02	1%	1.88E-02	1%
12	3.41E-02	1%	3.41E-02	1%
13	4.98E-02	2%	4.95E-02	2%
14	5.05E-02	2%	5.46E-02	2%
15	4.33E-02	2%	4.50E-02	2%
16	1.49E-02	1%	1.46E-02	1%
17	2.73E-02	1%	2.72E-02	1%
18	9.29E-02	4%	9.17E-02	4%
19	2.64E-02	1%	2.59E-02	1%
20	2.15E-02	1%	2.16E-02	1%
21	2.64E-02	1%	2.64E-02	1%
22	2.86E-02	1%	2.88E-02	1%
23	1.87E-02	1%	1.83E-02	1%
24	1.06E-02	0%	1.04E-02	0%

Notes: Shaded– highest modelled concentration and percentage of POI Limit or AAQC
[1] 24-Hour AAQC for benzene is 2.3 µg/m³

6. Detailed Description of the Environment Potentially Affected with Contingency Leachate Management Method

6.1 Contingency Leachate Management System

This section describes the predicted air quality impacts that would result from the construction and operation of the proposed preferred alternative landfill with the contingency leachate management system (SBR system and leachate evaporator system).

Not all of the 25 contaminants of interest are emitted from the leachate evaporator system, the only additional source to be included as part of the contingency leachate management system. The concentrations that will be affected by the additional emissions from the leachate evaporator exhausting to the atmosphere will be the following contaminants:

- Benzene;
- Dichloromethane; and
- Ammonia.

The results for the above three contaminants were presented in the following sections. None of the other contaminant concentrations will be affected by the operation of the leachate evaporator system.

6.1.1 On-site and in the Vicinity

The future build stages were constructed and operated using the practices currently in place at the WCEC facility. The maximum predicted concentrations for all of the compounds of interest were predicted to be within their applicable criteria. A summary of the maximum predicted off-site concentrations for benzene, dichloromethane and ammonia compared to their respective limits and criteria is presented in **Table 11**.

The maximum off-site concentrations associated with the construction and operation of the preferred alternative landfill and contingency leachate management system are predicted to occur in both 2018 and 2023, near the southeast corner of the facility. The predicted benzene 24-hour concentration in 2018 and 2023 is 2.1 µg/m^3, which represents 92% of the AAQC of 2.3 µg/m^3. The maximum annual average concentration is 0.24 µg/m^3, which represents 53% of the annual POI limit of 0.45 µg/m^3.

Table 11. Maximum Predicted Concentrations Off-site for Each Future Build Scenario – Contingency Leachate Option

CAS #	Compounds	Averaging Period (hours)	MOE POI Limit (µg/m³)	2018		2023	
				Maximum Predicted Concentration (µg/m³)	Percentage of MOE POI Limit (%)	Maximum Predicted Concentration (µg/m³)	Percentage of MOE POI Limit (%)
71-43-2	Benzene	24 Hour	2.3	2.1	92%	2.1	92%
		annual	0.45	0.24	53%	0.24	53%
75-09-2	Dichloromethane	24 Hour	220	59	27%	59	27%
7664-41-7	Ammonia	24 Hour	100	15	15%	15	15%

The maximum predicted concentration of benzene is influenced by the high emission rate of benzene from the evaporator stack (0.24 g/s) and the close proximity of the proposed leachate evaporator to the property line. There are no changes in the emissions associated with the leachate evaporator stack between the 2018 and 2023 future build scenarios. Consequently, the maximum concentrations predicted throughout the future operating scenarios occurred in both 2018 and 2023.

6.2 Discrete Receptors

Dispersion modelling analysis was completed for benzene, dichloromethane and ammonia at each of the 24 discrete receptors. Predicted 24-hour benzene, dichloromethane and ammonia concentration and predicted annual benzene concentrations, summarized in Table 12, did not exceed the POI limit or criteria at any of the receptors.

Table 12. Maximum Predicted Concentrations at Discrete Receptors for Each Future Build Scenario – Contingency Leachate Management System

CAS #	Compounds	MOE POI Limit (µg/m³)	Receptor at which Maximum Concentration Occurs	Maximum Predicted Concentration (µg/m³)	Percentage of MOE POI Limit (%)
71-43-2	Benzene	2.3	R2	0.77	34%
		0.45	R2	0.08	19%
75-09-2	Dichloromethane	220	R2	18	8%
7664-41-7	Ammonia	100	R2	5	5%

7. Environmental Air Quality Net Effects

As mentioned, the previously identified potential effects and recommended mitigation or compensation measures associated with the selection of the Preferred Alternative Landfill Footprint were reviewed to ensure their accuracy in the context of the preliminary design of the Preferred Alternative Landfill Footprint, based on the more detailed understanding of the atmospheric environment developed through the additional investigations. With this in mind, the confirmed potential effects, mitigation or compensation measures, and net effects are summarized in **Table 13** and described in further detail in the sections below.

7.1 Potential Effects on Atmospheric Environment

Through comparison of the modelling results from the baseline condition and the conditions presented due to the preferred alternative landfill, summarized in Tables 12 and 13, it is possible to determine the net effect of the proposed landfill expansion on the Site Vicinity and community based discrete receptors. The impact of the expansion is evaluated based on the maximum predicted concentration and number of hours the predicted concentration exceeds the POI Limit.

For both the preferred leachate management system and the contingency leachate management system, the maximum predicted concentrations are less than the applicable standards or criteria at all receptors in the area, including both the discrete receptors and the receptor grid. Consequently, the impact of the expansion is considered low at all discrete receptors for all future build scenarios.

7.2 Additional Mitigation and/or Compensation Measures

The LFG assessment considered several mitigation measures that are part of the design of the preferred landfill alternative. These mitigation measures include the following:

- Development of an LFG Best Management Practices (BMP) Plan;
- Progressive installation of the LFG collection system for the preferred alternative landfill;
- Flaring or otherwise combusting all collected LFG;
- Increase in stack height of the leachate evaporator to a minimum of 22 m above grade (should the contingency leachate management system be installed);

- Maintaining the leachate collection system under negative pressure and sending the collected gas to the LFG collection system;
- Minimizing the size of the working face; and,
- Daily covering of the working face.

These mitigation measures were considered in the assessment and, as such, the predicted impacts presented in Section 7.1 incorporate the effect of these measures. In addition to these mitigation measures that were considered in the modelling, additional mitigation measures may be undertaken to further reduce odour impacts. These additional mitigation measures will be specified in the LFG BMP Plan.

7.3 Potential Impacts on the Environment with Additional Mitigation Measures

Additional mitigation measures will be applied, if necessary, to further reduce the LFG impacts. These additional mitigation measures will be outlined in the LFG BMP Plan. The effect of additional mitigation measures have not been quantified at this time.

7.4 Net Effects

Through comparison of the modelling results from the baseline scenario (please refer to the LFG Baseline Conditions Report) and the expansion scenarios (Section 3.1) it is possible to determine the net effect of the proposed landfill expansion on the community based discrete receptors. Tables 13 and 14 present a comparison of the maximum predicted concentrations for the preferred landfill alternative (considering both the preferred and contingency leachate management systems) to the maximum predicted concentrations from the baseline assessment. The comparison indicates that the proposed landfill expansion will result in increased concentrations of the LFG compounds at the discrete receptors, relative to baseline conditions; however, the maximum predicted concentrations are within MOE guidelines for all receptors and all off-site locations.

The predicted concentrations at the discrete receptors and all other off-site locations do not exceed the applicable standards or criteria under the preferred leachate management system or the contingency leachate management system. Consequently, the impact of the expansion is considered low at all discrete receptors for all future build scenarios. A summary of the net effects at each discrete receptor is presented in Table 15.

Table 13. Summary of Baseline and Future Build Maximum Predicted Concentrations Impacts at the Property Line

CAS #	Compounds	Averaging Period (hours)	Baseline Condition	Preferred Alternative Landfill	
				2018 - Future Build	2023 - Future Build
			Maximum Predicted Concentration (µg/m³)	Maximum Predicted Concentration (µg/m³)	Maximum Predicted Concentration (µg/m³)
71-55-6	1,1,1-Trichloroethane	24 Hour	5.12E-04	1.50E-03	1.46E-03
79-34-5	1,1,2,2-Tetrachloroethane	24 Hour	5.37E-05	1.58E-04	1.53E-04
79-00-5	1,1,2-Trichloroethane	24 Hour	6.66E-05	1.95E-04	1.90E-04
75-34-3	1,1-Dichloroethane	24 Hour	1.33E-02	0.04	0.04
75-35-4	1,1-Dichloroethylene	24 Hour	5.43E-04	0.6	0.6
107-06-2	1,2-Dichloroethane	24 Hour	5.23E-05	0.2	0.2
156-59-2	1,2-Dichloroethene (Cis)	24 Hour	3.12E-02	12	12
156-60-5	1,2-Dichloroethene (Trans)	24 Hour	1.47E-03	4.32E-03	4.19E-03
71-43-2	Benzene	24 Hour	1.17E-02	**2.1**	**2.1**
75-27-4	Bromodichloromethane	24 Hour	4.98E-06	1.46E-05	1.42E-05
56-23-5	Carbon Tetrachloride	24 Hour	8.57E-05	2.52E-04	2.44E-04
75-00-3	Chloroethane	24 Hour	4.32E-03	0.2	0.2
67-66-3	Chloroform/Trichloromethane	24 Hour	9.27E-04	2.72E-03	2.64E-03
75-09-2	Dichloromethane	24 Hour	7.88E-03	59	59
106-93-4	Ethylene Dibromide	24 Hour	1.74E-05	5.11E-05	4.95E-05
06/04/7783	Hydrogen Sulphide[1]	24 Hour	3.11E-01	**1.7**	**1.5**
78-92-2	sec-Butyl Alcohol/2-Butanol (as n-Butanol)	24 Hour	1.48E-01	0.8	0.7
127-18-4	Tetrachloroethylene	24 Hour	2.71E-02	0.6	0.6
79-01-6	Trichloroethylene	24 Hour	8.94E-03	1.4	1.4
75-01-4	Vinyl Chloride/Chloroethene	24 Hour	0.0166	**0.73**	**0.73**
7664-41-7	Ammonia	24 Hour	0.00E+00	15	15

Table 14. Summary of Baseline and Future Build Maximum Predicted Concentrations Impacts at the Worst-Case Receptor

CAS #	Compounds	Averaging Period (hours)	Baseline Condition	Preferred Alternative Landfill	
				2018 - Future Build	2023 - Future Build
			Maximum Predicted Concentration (µg/m³)	Maximum Predicted Concentration (µg/m³)	Maximum Predicted Concentration (µg/m³)
71-55-6	1,1,1-Trichloroethane	24 Hour	1.27E-03	1.50E-03	1.46E-03
79-34-5	1,1,2,2-Tetrachloroethane	n/a	1.33E-04	1.62E-04	1.57E-04
79-00-5	1,1,2-Trichloroethane	24 Hour	1.65E-04	1.90E-04	1.84E-04
75-34-3	1,1-Dichloroethane	24 Hour	3.29E-02	3.90E-02	3.78E-02
75-35-4	1,1-Dichloroethylene	24 Hour	1.35E-03	1.91E-01	1.91E-01
107-06-2	1,2-Dichloroethane	24 Hour	1.30E-04	4.94E-02	4.94E-02
156-59-2	1,2-Dichloroethene (Cis)	24 Hour	7.73E-02	3.85E+00	4.77E+00
156-60-5	1,2-Dichloroethene (Trans)	24 Hour	3.65E-03	4.28E-03	4.15E-03

Table 14. Summary of Baseline and Future Build Maximum Predicted Concentrations Impacts at the Worst-Case Receptor

CAS #	Compounds	Averaging Period (hours)	Baseline Condition	Preferred Alternative Landfill	
				2018 - Future Build	2023 - Future Build
			Maximum Predicted Concentration (µg/m^3)	Maximum Predicted Concentration (µg/m^3)	Maximum Predicted Concentration (µg/m^3)
71-43-2	Benzene	24 Hour	2.90E-02	4.34E-01	4.21E-01
75-27-4	Bromodichloromethane	n/a	1.23E-05	7.75E-01	7.75E-01
56-23-5	Carbon Tetrachloride	24 Hour	2.12E-04	1.90E-05	1.84E-05
75-00-3	Chloroethane	24 Hour	1.07E-02	2.85E-04	2.77E-04
67-66-3	Chloroform/Trichloromethane	24 Hour	2.30E-03	7.95E-02	7.97E-02
75-09-2	Dichloromethane	24 Hour	1.95E-02	2.76E-03	2.67E-03
106-93-4	Ethylene Dibromide	24 Hour	4.31E-05	1.85E+01	1.85E+01
6/4/7783	Hydrogen sulphide [1]	24 Hour	7.71E-01	9.51E-05	9.22E-05
78-92-2	sec-Butyl Alcohol/2-Butanol (as n-Butanol)	24 Hour	3.67E-01	9.13E-01	8.85E-01
127-18-4	Tetrachloroethylene	24 Hour	6.71E-02	1.98E-01	2.00E-01
79-01-6	Trichloroethylene	24 Hour	2.22E-02	4.42E-01	4.43E-01
75-01-4	Vinyl Chloride/Chloroethene	24 Hour	4.11E-02	2.41E-01	2.42E-01
7664-41-7	Ammonia	24 Hour	0.00E+00	5.02E+00	5.02E+00

Table 15. Potential Effects, Proposed Mitigation and Compensation Measures, and Resulting Net Effects

ID #	Potential Effect	Mitigation/ Compensation	Net Effect
1.	Maximum predicted concentration less than applicable criteria for all contaminants.	• Development of an LFG BMP Plan 43– including additional mitigation measures as required; • Progressive installation of the LFG collection system for the preferred alternative landfill; • Flaring or otherwise combusting all collected LFG; • Increase in stack height of the leachate evaporator to a minimum of 22 m above grade; • Maintaining the leachate collection system under negative pressure and sending the collected gas to the LFG collection system; • Minimizing the size of the working face; and, • Daily covering of the working face.	Further reduced LFG impacts
2.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
3.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
4.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
5.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
6.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
7.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
8.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
9.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
10.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
11.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts

ID #	Potential Effect	Mitigation/ Compensation	Net Effect
12.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
13.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
14.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
15.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
16.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
17.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
18.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
19.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
20.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
21.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
22.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
23.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts
24.	Maximum predicted concentration less than applicable criteria for all contaminants.		Further reduced LFG impacts

8. Impact Analysis of Other WCEC Facilities

Of the WCEC facilities, only the landfill-gas-to-energy facility has the potential to emit LFG emissions. The landfill-gas-to-energy facility was included in the assessment of site-wide impacts from the overall WCEC operations.

The other WCEC facilities, such as the material and recycling facility, the organic processing facility construction and demolition material recycling facility, the residential diversion facility, the community lands for parks and recreation, and the greenhouses, do not have emissions of LFG compounds or ammonia associated with the activities that they house. These activities do not significantly contribute to the potential LFG or ammonia impacts of the construction and operation of the preferred alternative landfill; therefore, an impact analysis of the other WCEC facilities was not performed in this LFG Detailed Impact Assessment.

9. Monitoring and Commitments for the Undertaking

To ensure that the mitigation measures identified in **Section 7** are implemented as envisioned, a strategy and schedule was developed for monitoring environmental effects. With these mitigation or compensation measures and monitoring requirements in mind, commitments have also been proposed for ensuring that they are carried out as part of the construction, operation, and maintenance of the landfill.

9.1 Monitoring Strategy and Schedule

As mentioned, a monitoring strategy and schedule was developed based on the Atmospheric Impact Assessment carried out for the Preferred Alternative Landfill Footprint to ensure that (1) predicted net negative effects are not exceeded, (2) unexpected negative effects are addressed, and (3) the predicted benefits are realized.

9.1.1 Environmental Effects Monitoring

Monitoring will aid in identifying and correcting problems before they cause off-site impacts. The following monitoring measures are recommended for the WCEC facility:

- Total hydrocarbon or hydrogen sulphide surface surveys of both the existing and proposed alternative landfill mounds, as well as leachate collection manholes, to identify any cracks, fissures, or other hot-spots for escaping LFG;
- Continuous monitoring for temperature and flow on the LFG flares and the LGTE engine-generator sets to ensure proper operation;
- Volatile organic compound and hydrogen sulphide ambient air quality monitoring programs to continue to track annual emissions and identify increases in emissions over time;
- Source testing of the SBR and leachate evaporator for source validation.

9.1.2 Development of an Environmental Management Plan

An Environmental Management Plan (EMP) or Plans (i.e., LFG BMP Plan) will be developed following approval of the undertaking by the Minister of the Environment and prior to construction. The EMP will be developed as part of the ECA process and will include a description of the proposed mitigation measures, commitments, and monitoring.

9.2 Commitments

The following commitments have been proposed for ensuring that the identified mitigation or compensation measures and monitoring requirements are carried out as part of the construction, operation, and maintenance of the undertaking:

a) Increase stack height of leachate evaporator stack to a minimum of 22 m above grade, should the contingency leachate management system be installed.

10. Environmental Air Quality Approvals Required for the Undertaking

WM currently has ECA approvals #7816-7C9JMR and #7025-7F4PN5 in place, covering the operation of their flares, the current configuration of the landfill gas-fired engines, and an emergency diesel generator. WM also has additional ECAs under review by the MOE to cover the SBR leachate treatment process as well as amendments to the landfill gas-fired engines. WM may need to seek additional approvals or amend or consolidate their existing ECAs to incorporate future changes at the facility, which may include:

- Proposed landfill expansion operations;
- Changes to the SBR leachate treatment;
- Installation of the leachate evaporator (if contingency is adopted); and,
- Development of any of the other on-site diversion facilities.

Some sources, such as the emergency diesel generators, may need to be registered under the MOE's Environmental Activities and Sector Registry.

Report Prepared By:

Brad Bergeron, A.Sc.T., d.E.T.
Senior Project Manager

Report Reviewed By:

John DeYoe, B.A., d.E.T.
Project Director

11. References

MOE, 1992:
Interim Guide to Estimate and Assess Landfill Air Impacts, Ontario Ministry of the Environment – Air Resources Branch, October 1992.

MOE, 2008:
Summary of Standards and Guidelines to support Ontario Regulation 419: Air Pollution – Local Air Quality, Ontario Ministry of the Environment, February 2008.

MOE, 2009:
Air Dispersion Modelling Guideline for Ontario: Guidance for Demonstrating Compliance with The Air Dispersion Modelling Requirements set out in Ontario Regulation 419/05 – Local Air Quality, Ontario Ministry of the Environment, March 2009.

MOE, 2009:
Procedure for Preparing an Emission Summary and Dispersion Modelling Report: Guidance for Demonstrating Compliance with Ontario Regulation 419: Air Pollution – Local Air Quality, Ontario Ministry of the Environment, March 2009.

Reinhart, D.R., D.C. Cooper and B.L. Walker, 1992:
"Flux Chamber Design and Operation for the Measurement of Solid Waste Landfill Gas Emission Rates." Journal of Air and Waste Management Association. 42-1067, 1992.

RWDI, 2005:
Landfill Gas Assessment Ottawa Landfill Baseline Conditions, Ottawa, Ontario, RWDI #W04-1491A.

RWDI, 2007:
Results of Stack testing on the Flare Stack, Carp Road Landfill, March Testing Program Memo, RWDI #W07-5143A

RWDI, 2010:
Ottawa Landfill Leachate Treatment Plant Upgrades Emission Summary and Dispersion Modelling Report, Ottawa, Ontario, RWDI# 1100036.

RWDI, 2010:
Source Sampling Program, Waste Management of Canada, Ottawa, Ontario, RWDI# 1101628

RWDI, 2011:
Voluntary Source Testing Program (Leachate Evaporator), Waste Management of Canada, Ottawa, Ontario, RWDI # 1102113

RWDI, 2011:
Amended Atmospheric Existing Conditions Report Landfill Gas (VOC) Baseline Assessment, as part of the Environmental Assessment for a New Landfill Footprint at the West Carleton Environmental Centre, Ottawa, Ontario

RWDI, 2011:
Alternative Landfill Footprint Options – Atmospheric Environment, as part of the Environmental Assessment for a New Landfill Footprint at the West Carleton Environmental Centre, Ottawa, Ontario

US EPA, 2008:
AP-42 Chapter 2.4 Municipal Solid Waste Landfills, Environmental Protection Act, 2008.

Tables

WCEC Landfill Gas Source Summary Table: Intermediate Operation Year (2018)

RWDI Project #1100798

Source ID [1]	Source Type [1]	Source Description	Source Data					LFG			Emission Data				
			Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
E1	Point	LFG Engine #1 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424756	5014676	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%
E2	Point	LFG Engine #2 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424760	5014671	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%

Source ID [1]	Source Type [1]	Source Description	Source Data / LFG: Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
E3	Point	LFG Engine #3 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424764	5014667	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%
E4	Point	LFG Engine #4 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424768	5014663	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%

WCEC Landfill Gas Source Summary Table: Intermediate Operation Year (2018) RWDI Project #1100798

Source ID [1]	Source Type [1]	Source Description	Source Data – LFG: Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
E5	Point	LFG Engine #5 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424772	5014660	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%
F1	Point	LFG Flare #1	31.3	871	2.1	9.0	12.19	n/a	424557	5014950	1,1,1-Trichloroethane	71-55-6	1.80E-06	24	3%
											1,1,2,2-Tetrachloroethane	79-34-5	1.89E-07	24	3%
											1,1,2-Trichloroethane	79-00-5	2.34E-07	24	3%
											1,1-Dichloroethane	75-34-3	4.68E-05	24	3%
											1,1-Dichloroethylene	75-35-4	1.91E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.84E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	1.10E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	5.18E-06	24	3%
											Benzene	71-43-2	4.12E-05	24	<1%
											Bromodichloromethane	75-27-4	1.75E-08	24	3%
											Carbon Tetrachloride	56-23-5	3.02E-07	24	3%
											Chloroethane	75-00-3	1.52E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	3.26E-06	24	3%
											Dichloromethane	75-09-2	2.77E-05	24	<1%
											Dimethyl sulfide	75-18-3	2.67E-05	24	3%
											Ethyl Mercaptan	75-08-1	8.83E-08	24	3%
											Ethylene Dibromide	106-93-4	6.13E-08	24	3%
											Hydrogen sulfide	04-06-7783	3.28E-03	24	3%
											Methyl Mercaptan	74-93-1	5.48E-08	24	3%
											Octane	111-65-9	9.91E-05	24	3%
											sec-Butyl Alcohol/2-Butanol	78-92-2	5.21E-04	24	3%
											Tetrachloroethylene	127-18-4	9.53E-05	24	1%
											Trichloroethylene	79-01-6	3.15E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	5.83E-05	24	<1%

Source ID [1]	Source Type [1]	Source Description	Source Data LFG								Emission Data				
			Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
F2	Point	LFG Flare #2	57.3	900	2.7	10.0	12.2	n/a	424551	5014946	1,1,1-Trichloroethane	71-55-6	3.29E-06	24	5%
											1,1,2,2-Tetrachloroethane	79-34-5	3.45E-07	24	6%
											1,1,2-Trichloroethane	79-00-5	4.28E-07	24	6%
											1,1-Dichloroethane	75-34-3	8.53E-05	24	6%
											1,1-Dichloroethylene	75-35-4	3.49E-06	24	<1%
											1,2-Dichloroethane	107-06-2	3.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	2.00E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	9.46E-06	24	6%
											Benzene	71-43-2	7.52E-05	24	<1%
											Bromodichloromethane	75-27-4	3.20E-08	24	6%
											Carbon Tetrachloride	56-23-5	5.50E-07	24	6%
											Chloroethane	75-00-3	2.78E-05	24	1%
											Chloroform/Trichloromethane	67-66-3	5.96E-06	24	6%
											Dichloromethane	75-09-2	5.06E-05	24	<1%
											Dimethyl sulfide	75-18-3	4.88E-05	24	6%
											Ethyl Mercaptan	75-08-1	1.61E-07	24	6%
											Ethylene Dibromide	106-93-4	1.12E-07	24	6%
											Hydrogen sulfide	04-06-7783	5.99E-03	24	6%
											Methyl Mercaptan	74-93-1	9.99E-08	24	6%
											Octane	111-65-9	1.81E-04	24	5%
											sec-Butyl Alcohol/2-Butanol	78-92-2	9.51E-04	24	6%
											Tetrachloroethylene	127-18-4	1.74E-04	24	2%
											Trichloroethylene	79-01-6	5.74E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	1.06E-04	24	1%
F3	Point	Candlestick LFG Flare	1.0	900	0.2	31.8	10.4	n/a	424551	5014952	1,1,1-Trichloroethane	71-55-6	3.17E-06	24	5%
											1,1,2,2-Tetrachloroethane	79-34-5	3.32E-07	24	5%
											1,1,2-Trichloroethane	79-00-5	4.11E-07	24	5%
											1,1-Dichloroethane	75-34-3	8.21E-05	24	5%
											1,1-Dichloroethylene	75-35-4	3.36E-06	24	<1%
											1,2-Dichloroethane	107-06-2	3.23E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	1.93E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	9.09E-06	24	5%
											Benzene	71-43-2	7.23E-05	24	<1%
											Bromodichloromethane	75-27-4	3.08E-08	24	5%
											Carbon Tetrachloride	56-23-5	5.29E-07	24	5%
											Chloroethane	75-00-3	2.67E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	5.73E-06	24	5%
											Dichloromethane	75-09-2	4.87E-05	24	<1%
											Dimethyl sulfide	75-18-3	4.69E-05	24	5%
											Ethyl Mercaptan	75-08-1	1.55E-07	24	5%
											Ethylene Dibromide	106-93-4	1.07E-07	24	5%
											Hydrogen sulfide	04-06-7783	5.76E-03	24	5%
											Methyl Mercaptan	74-93-1	9.61E-08	24	5%
											Octane	111-65-9	1.74E-04	24	5%
											sec-Butyl Alcohol/2-Butanol	78-92-2	9.14E-04	24	5%
											Tetrachloroethylene	127-18-4	1.67E-04	24	2%
											Trichloroethylene	79-01-6	5.52E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	1.02E-04	24	1%

Source ID [1]	Source Type [1]	Source Description	Source Data: Stack Volumetric Flow Rate (Am^3/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	LFG Source Coordinates X (m)	LFG Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
LM_EX	Area	Existing Landfill Mound	n/a	n/a	n/a	n/a	n/a	n/a	423470	5014385	1,1,1-Trichloroethane	71-55-6	3.07E-05	24	51%
											1,1,2,2-Tetrachloroethane	79-34-5	3.22E-06	24	52%
											1,1,2-Trichloroethane	79-00-5	3.99E-06	24	52%
											1,1-Dichloroethane	75-34-3	7.95E-04	24	52%
											1,1-Dichloroethylene	75-35-4	3.25E-05	24	<1%
											1,2-Dichloroethane	107-06-2	3.13E-06	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	1.87E-03	24	1%
											1,2-Dichloroethene (Trans)	156-60-5	8.81E-05	24	52%
											Benzene	71-43-2	7.01E-04	24	<1%
											Bromodichloromethane	75-27-4	2.98E-07	24	52%
											Carbon Tetrachloride	56-23-5	5.13E-06	24	52%
											Chloroethane	75-00-3	2.59E-04	24	10%
											Chloroform/Trichloromethane	67-66-3	5.55E-05	24	52%
											Dichloromethane	75-09-2	4.72E-04	24	<1%
											Dimethyl sulfide	75-18-3	4.55E-04	24	52%
											Ethyl Mercaptan	75-08-1	1.50E-06	24	52%
											Ethylene Dibromide	106-93-4	1.04E-06	24	52%
											Hydrogen sulfide	04-06-7783	5.59E-02	24	52%
											Methyl Mercaptan	74-93-1	9.31E-07	24	52%
											Octane	111-65-9	1.69E-03	24	51%
											sec-Butyl Alcohol/2-Butanol	78-92-2	8.86E-03	24	52%
											Tetrachloroethylene	127-18-4	1.62E-03	24	20%
											Trichloroethylene	79-01-6	5.35E-04	24	4%
											Vinyl Chloride/Chloroethene	75-01-4	9.91E-04	24	11%
LM_PP	Area	Proposed Preferred Alternative Landfill Mound	n/a	n/a	n/a	n/a	n/a	n/a	423148	5014878	1,1,1-Trichloroethane	71-55-6	9.52E-06	24	16%
											1,1,2,2-Tetrachloroethane	79-34-5	9.98E-07	24	16%
											1,1,2-Trichloroethane	79-00-5	1.24E-06	24	16%
											1,1-Dichloroethane	75-34-3	2.47E-04	24	16%
											1,1-Dichloroethylene	75-35-4	1.01E-05	24	<1%
											1,2-Dichloroethane	107-06-2	9.72E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	5.79E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	2.74E-05	24	16%
											Benzene	71-43-2	2.18E-04	24	<1%
											Bromodichloromethane	75-27-4	9.25E-08	24	16%
											Carbon Tetrachloride	56-23-5	1.59E-06	24	16%
											Chloroethane	75-00-3	8.03E-05	24	3%
											Chloroform/Trichloromethane	67-66-3	1.72E-05	24	16%
											Dichloromethane	75-09-2	1.46E-04	24	<1%
											Dimethyl sulfide	75-18-3	1.41E-04	24	16%
											Ethyl Mercaptan	75-08-1	4.66E-07	24	16%
											Ethylene Dibromide	106-93-4	3.23E-07	24	16%
											Hydrogen sulfide	04-06-7783	1.73E-02	24	16%
											Methyl Mercaptan	74-93-1	2.89E-07	24	16%
											Octane	111-65-9	5.23E-04	24	16%
											sec-Butyl Alcohol/2-Butanol	78-92-2	2.75E-03	24	16%
											Tetrachloroethylene	127-18-4	5.03E-04	24	6%
											Trichloroethylene	79-01-6	1.66E-04	24	1%
											Vinyl Chloride/Chloroethene	75-01-4	3.08E-04	24	3%

Source ID [1]	Source Type [1]	Source Description	Source Data: Stack Volumetric Flow Rate (Am^3/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	LFG Source Coordinates X (m)	Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
AS	Area	Active Stage of Preferred Alternative Landfill Mound	n/a	n/a	n/a	n/a	n/a	n/a	423763	5015112	1,1,1-Trichloroethane	71-55-6	4.33E-06	24	7%
											1,1,2,2-Tetrachloroethane	79-34-5	4.54E-07	24	7%
											1,1,2-Trichloroethane	79-00-5	5.63E-07	24	7%
											1,1-Dichloroethane	75-34-3	1.12E-04	24	7%
											1,1-Dichloroethylene	75-35-4	4.59E-06	24	<1%
											1,2-Dichloroethane	107-06-2	4.42E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	2.64E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	1.24E-05	24	7%
											Benzene	71-43-2	9.90E-05	24	<1%
											Bromodichloromethane	75-27-4	4.21E-08	24	7%
											Carbon Tetrachloride	56-23-5	7.24E-07	24	7%
											Chloroethane	75-00-3	3.66E-05	24	1%
											Chloroform/Trichloromethane	67-66-3	7.84E-06	24	7%
											Dichloromethane	75-09-2	6.66E-05	24	<1%
											Dimethyl sulfide	75-18-3	6.42E-05	24	7%
											Ethyl Mercaptan	75-08-1	2.12E-07	24	7%
											Ethylene Dibromide	106-93-4	1.47E-07	24	7%
											Hydrogen sulfide	04-06-7783	7.89E-03	24	7%
											Methyl Mercaptan	74-93-1	1.32E-07	24	7%
											Octane	111-65-9	2.38E-04	24	7%
											sec-Butyl Alcohol/2-Butanol	78-92-2	1.25E-03	24	7%
											Tetrachloroethylene	127-18-4	2.29E-04	24	3%
											Trichloroethylene	79-01-6	7.56E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	1.40E-04	24	2%
CSS	Area	Contaminated Soil Stockpile	n/a	n/a	n/a	n/a	n/a	n/a	423373	5014476	1,1,1-Trichloroethane	71-55-6	5.13E-07	24	<1%
											1,2-Dichloroethane	107-06-2	3.19E-06	24	<1%
											Benzene	71-43-2	1.35E-04	24	<1%
											Dichloromethane	75-09-2	2.70E-05	24	<1%
											Octane	111-65-9	6.38E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	6.40E-07	24	<1%
											Tetrachloroethylene	127-18-4	5.38E-06	24	<1%
											Trichloroethylene	79-01-6	5.87E-06	24	<1%
EVAP [1]	Point	Leachate Evaporator Stack	13.3	84	0.9	20.9	18.2	1	424216	5014634	Ammonia	7664-41-7	1.35E+00	24	87%
											Benzene	71-43-2	2.40E-01	24	97%
											Dichloromethane	75-09-2	3.80E-02	24	7%
RAWLEACH	Point	Raw Leachate Equalization Tank	0.0001	25	0.2	0.003	6.6	0.6	424269	5014684	1,1-Dichloroethylene	75-35-4	1.29E-04	24	2%
											1,2-Dichloroethane	107-06-2	1.64E-05	24	1%
											Ammonia	7664-41-7	3.06E-04	24	<1%
											Benzene	71-43-2	5.48E-05	24	<1%
											Chloroethane	75-00-3	3.96E-05	24	1%
											Vinyl Chloride/Chloroethene	75-01-4	1.25E-04	24	1%
											1,2-Dichloroethene (Cis)	156-59-2	6.80E-04	24	<1%
											Dichloromethane	75-09-2	2.76E-03	24	<1%
											Tetrachloroethylene	127-18-4	1.04E-04	24	1%
											Trichloroethylene	79-01-6	2.04E-04	24	2%

WCEC Landfill Gas Source Summary Table: Intermediate Operation Year (2018)

RWDI Project #1100798

Source ID [1]	Source Type [1]	Source Description	Source Data – LFG: Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
SBR	Point	Sequencing Batch Reactor Tank	0.0001	32	0.2	0.003	6.6	0.6	424317	5014732	1,1-Dichloroethylene	75-35-4	1.19E-03	24	21%
											1,2-Dichloroethane	107-06-2	7.26E-05	24	5%
											Ammonia	7664-41-7	2.06E-01	24	13%
											Benzene	71-43-2	2.90E-04	24	<1%
											Chloroethane	75-00-3	4.54E-04	24	17%
											Vinyl Chloride/Chloroethene	75-01-4	2.24E-03	24	25%
											1,2-Dichloroethene (Cis)	156-59-2	5.18E-02	24	39%
											Dichloromethane	75-09-2	7.56E-02	24	13%
											Tetrachloroethylene	127-18-4	1.06E-03	24	13%
											Trichloroethylene	79-01-6	1.93E-03	24	14%
EFFLUENT	Point	Effluent Equalization Tank	0.0001	25	0.2	0.003	6.6	0.6	424290	5014662	1,1-Dichloroethylene	75-35-4	8.78E-05	24	2%
											1,2-Dichloroethane	107-06-2	8.50E-06	24	<1%
											Ammonia	7664-41-7	5.08E-06	24	<1%
											Benzene	71-43-2	3.12E-05	24	<1%
											Chloroethane	75-00-3	2.44E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	8.24E-05	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	3.92E-04	24	<1%
											Dichloromethane	75-09-2	1.62E-03	24	<1%
											Tetrachloroethylene	127-18-4	6.62E-05	24	<1%
											Trichloroethylene	79-01-6	1.22E-04	24	<1%
SLUDGE	Point	Sludge Tank	0.0001	25	0.2	0.003	6.6	0.6	424340	5014708	1,1-Dichloroethylene	75-35-4	4.22E-03	24	74%
											1,2-Dichloroethane	107-06-2	1.23E-03	24	92%
											Ammonia	7664-41-7	1.64E-03	24	<1%
											Benzene	71-43-2	3.18E-03	24	1%
											Chloroethane	75-00-3	1.69E-03	24	62%
											Vinyl Chloride/Chloroethene	75-01-4	4.62E-03	24	51%
											Trichloroethylene	79-01-6	1.01E-02	24	75%

Source ID [1]	Source Type [1]	Source Description	Source Data / LFG: Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
Total	- -	Total of all Listed Sources	- -	- -	- -	- -	- -	- -	- -	- -	1,1,1-Trichloroethane	71-55-6	6.00E-05	- -	100%
											1,1,2,2-Tetrachloroethane	79-34-5	6.23E-06	- -	100%
											1,1,2-Trichloroethane	79-00-5	7.72E-06	- -	100%
											1,1-Dichloroethane	75-34-3	1.54E-03	- -	100%
											1,1-Dichloroethylene	75-35-4	5.69E-03	- -	100%
											1,2-Dichloroethane	107-06-2	1.33E-03	- -	100%
											1,2-Dichloroethene (Cis)	156-59-2	1.31E-01	- -	100%
											1,2-Dichloroethene (Trans)	156-60-5	1.71E-04	- -	100%
											Ammonia	7664-41-7	1.56E+00	- -	100%
											Benzene	71-43-2	2.46E-01	- -	100%
											Bromodichloromethane	75-27-4	5.77E-07	- -	100%
											Carbon Tetrachloride	56-23-5	9.94E-06	- -	100%
											Chloroethane	75-00-3	2.71E-03	- -	100%
											Chloroform/Trichloromethane	67-66-3	1.08E-04	- -	100%
											Dichloromethane	75-09-2	5.61E-01	- -	100%
											Dimethyl sulfide	75-18-3	8.81E-04	- -	100%
											Ethyl Mercaptan	75-08-1	2.91E-06	- -	100%
											Ethylene Dibromide	106-93-4	2.02E-06	- -	100%
											Hydrogen sulfide	04-06-7783	1.08E-01	- -	100%
											Methyl Mercaptan	74-93-1	1.80E-06	- -	100%
											Octane	111-65-9	3.33E-03	- -	100%
											sec-Butyl Alcohol/2-Butanol	78-92-2	1.72E-02	- -	100%
											Tetrachloroethylene	127-18-4	8.20E-03	- -	100%
											Trichloroethylene	79-01-6	1.34E-02	- -	100%
											Vinyl Chloride/Chloroethene	75-01-4	8.99E-03	- -	100%

Notes:
[1] For the preferred leachate management method, the emissions associated with the leachate evaporator were not included in the modelling.

Source ID [1]	Source Type [1]	Source Description	Source Data: Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	LFG Source Coordinates X (m)	Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
E1	Point	LFG Engine #1 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424756	5014676	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%
E2	Point	LFG Engine #2 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424760	5014671	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%

Source ID [1]	Source Type [1]	Source Description	Source Data					LFG			Emission Data				
			Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
E3	Point	LFG Engine #3 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424764	5014667	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%
E4	Point	LFG Engine #4 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424768	5014663	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%

Source ID [1]	Source Type [1]	Source Description	Source Data – LFG: Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
E5	Point	LFG Engine #5 - CAT 3520	6.48	445	0.4	51.6	13.4	5.5	424772	5014660	1,1,1-Trichloroethane	71-55-6	1.33E-06	24	2%
											1,1,2,2-Tetrachloroethane	79-34-5	1.39E-07	24	2%
											1,1,2-Trichloroethane	79-00-5	1.73E-07	24	2%
											1,1-Dichloroethane	75-34-3	3.45E-05	24	2%
											1,1-Dichloroethylene	75-35-4	1.41E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	8.09E-05	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	3.82E-06	24	2%
											Benzene	71-43-2	3.07E-04	24	<1%
											Bromodichloromethane	75-27-4	1.29E-08	24	2%
											Carbon Tetrachloride	56-23-5	2.22E-07	24	2%
											Chloroethane	75-00-3	1.12E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	2.41E-06	24	2%
											Dichloromethane	75-09-2	2.04E-05	24	<1%
											Dimethyl sulfide	75-18-3	1.97E-05	24	2%
											Ethyl Mercaptan	75-08-1	6.51E-08	24	2%
											Ethylene Dibromide	106-93-4	4.51E-08	24	2%
											Hydrogen sulfide	04-06-7783	2.42E-03	24	2%
											Methyl Mercaptan	74-93-1	4.04E-08	24	2%
											Octane	111-65-9	7.31E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	3.84E-04	24	2%
											Tetrachloroethylene	127-18-4	7.02E-05	24	<1%
											Trichloroethylene	79-01-6	2.32E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	4.30E-05	24	<1%
F1	Point	LFG Flare #1	31.3	871	2.1	9.0	12.19	n/a	424557	5014950	1,1,1-Trichloroethane	71-55-6	1.80E-06	24	3%
											1,1,2,2-Tetrachloroethane	79-34-5	1.89E-07	24	3%
											1,1,2-Trichloroethane	79-00-5	2.34E-07	24	3%
											1,1-Dichloroethane	75-34-3	4.68E-05	24	3%
											1,1-Dichloroethylene	75-35-4	1.91E-06	24	<1%
											1,2-Dichloroethane	107-06-2	1.84E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	1.10E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	5.18E-06	24	3%
											Benzene	71-43-2	4.12E-05	24	<1%
											Bromodichloromethane	75-27-4	1.75E-08	24	3%
											Carbon Tetrachloride	56-23-5	3.02E-07	24	3%
											Chloroethane	75-00-3	1.52E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	3.26E-06	24	3%
											Dichloromethane	75-09-2	2.77E-05	24	<1%
											Dimethyl sulfide	75-18-3	2.67E-05	24	3%
											Ethyl Mercaptan	75-08-1	8.83E-08	24	3%
											Ethylene Dibromide	106-93-4	6.13E-08	24	3%
											Hydrogen sulfide	04-06-7783	3.28E-03	24	3%
											Methyl Mercaptan	74-93-1	5.48E-08	24	3%
											Octane	111-65-9	9.91E-05	24	3%
											sec-Butyl Alcohol/2-Butanol	78-92-2	5.21E-04	24	3%
											Tetrachloroethylene	127-18-4	9.53E-05	24	1%
											Trichloroethylene	79-01-6	3.15E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	5.83E-05	24	<1%

WCEC Landfill Gas Source Summary Table: Final Operation Year (2023) RWDI Project #1100798

Source ID [1]	Source Type [1]	Source Description	Source Data – LFG: Stack Volumetric Flow Rate (Am^3/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
F2	Point	LFG Flare #2	57.3	900	2.7	10.0	12.2	n/a	424551	5014946	1,1,1-Trichloroethane	71-55-6	3.29E-06	24	5%
											1,1,2,2-Tetrachloroethane	79-34-5	3.45E-07	24	5%
											1,1,2-Trichloroethane	79-00-5	4.28E-07	24	5%
											1,1-Dichloroethane	75-34-3	8.53E-05	24	5%
											1,1-Dichloroethylene	75-35-4	3.49E-06	24	<1%
											1,2-Dichloroethane	107-06-2	3.36E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	2.00E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	9.46E-06	24	5%
											Benzene	71-43-2	7.52E-05	24	<1%
											Bromodichloromethane	75-27-4	3.20E-08	24	5%
											Carbon Tetrachloride	56-23-5	5.50E-07	24	5%
											Chloroethane	75-00-3	2.78E-05	24	1%
											Chloroform/Trichloromethane	67-66-3	5.96E-06	24	5%
											Dichloromethane	75-09-2	5.06E-05	24	<1%
											Dimethyl sulfide	75-18-3	4.88E-05	24	5%
											Ethyl Mercaptan	75-08-1	1.61E-07	24	5%
											Ethylene Dibromide	106-93-4	1.12E-07	24	5%
											Hydrogen sulfide	04-06-7783	5.99E-03	24	5%
											Methyl Mercaptan	74-93-1	9.99E-08	24	5%
											Octane	111-65-9	1.81E-04	24	5%
											sec-Butyl Alcohol/2-Butanol	78-92-2	9.51E-04	24	5%
											Tetrachloroethylene	127-18-4	1.74E-04	24	2%
											Trichloroethylene	79-01-6	5.74E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	1.06E-04	24	1%
F3	Point	Candlestick LFG Flare	1.0	900	0.2	31.8	10.4	n/a	424551	5014952	1,1,1-Trichloroethane	71-55-6	3.17E-06	24	5%
											1,1,2,2-Tetrachloroethane	79-34-5	3.32E-07	24	5%
											1,1,2-Trichloroethane	79-00-5	4.11E-07	24	5%
											1,1-Dichloroethane	75-34-3	8.21E-05	24	5%
											1,1-Dichloroethylene	75-35-4	3.36E-06	24	<1%
											1,2-Dichloroethane	107-06-2	3.23E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	1.93E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	9.09E-06	24	5%
											Benzene	71-43-2	7.23E-05	24	<1%
											Bromodichloromethane	75-27-4	3.08E-08	24	5%
											Carbon Tetrachloride	56-23-5	5.29E-07	24	5%
											Chloroethane	75-00-3	2.67E-05	24	<1%
											Chloroform/Trichloromethane	67-66-3	5.73E-06	24	5%
											Dichloromethane	75-09-2	4.87E-05	24	<1%
											Dimethyl sulfide	75-18-3	4.69E-05	24	5%
											Ethyl Mercaptan	75-08-1	1.55E-07	24	5%
											Ethylene Dibromide	106-93-4	1.07E-07	24	5%
											Hydrogen sulfide	04-06-7783	5.76E-03	24	5%
											Methyl Mercaptan	74-93-1	9.61E-08	24	5%
											Octane	111-65-9	1.74E-04	24	5%
											sec-Butyl Alcohol/2-Butanol	78-92-2	9.14E-04	24	5%
											Tetrachloroethylene	127-18-4	1.67E-04	24	2%
											Trichloroethylene	79-01-6	5.52E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	1.02E-04	24	1%

Source ID [1]	Source Type [1]	Source Description	Source Data / LFG: Stack Volumetric Flow Rate (Am^3/s)	Stack Exit Gas Temp. (°C)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
LM_EX	Area	Existing Landfill Mound	n/a	n/a	n/a	21.6	n/a	n/a	423470	5014385	1,1,1-Trichloroethane	71-55-6	2.45E-05	24	40%
											1,1,2,2-Tetrachloroethane	79-34-5	2.57E-06	24	40%
											1,1,2-Trichloroethane	79-00-5	3.18E-06	24	40%
											1,1-Dichloroethane	75-34-3	6.35E-04	24	40%
											1,1-Dichloroethylene	75-35-4	2.60E-05	24	<1%
											1,2-Dichloroethane	107-06-2	2.50E-06	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	1.49E-03	24	1%
											1,2-Dichloroethene (Trans)	156-60-5	7.04E-05	24	40%
											Benzene	71-43-2	5.60E-04	24	<1%
											Bromodichloromethane	75-27-4	2.38E-07	24	40%
											Carbon Tetrachloride	56-23-5	4.10E-06	24	40%
											Chloroethane	75-00-3	2.07E-04	24	8%
											Chloroform/Trichloromethane	67-66-3	4.43E-05	24	40%
											Dichloromethane	75-09-2	3.77E-04	24	<1%
											Dimethyl sulfide	75-18-3	3.63E-04	24	40%
											Ethyl Mercaptan	75-08-1	1.20E-06	24	40%
											Ethylene Dibromide	106-93-4	8.32E-07	24	40%
											Hydrogen sulfide	04-06-7783	4.46E-02	24	40%
											Methyl Mercaptan	74-93-1	7.44E-07	24	40%
											Octane	111-65-9	1.35E-03	24	39%
											sec-Butyl Alcohol/2-Butanol	78-92-2	7.07E-03	24	40%
											Tetrachloroethylene	127-18-4	1.29E-03	24	16%
											Trichloroethylene	79-01-6	4.27E-04	24	3%
											Vinyl Chloride/Chloroethene	75-01-4	7.92E-04	24	9%
LM_PP	Area	Proposed Preferred Alternative Landfill Mound	n/a	n/a	n/a	n/a	n/a	n/a	423148	5014878	1,1,1-Trichloroethane	71-55-6	1.71E-05	24	28%
											1,1,2,2-Tetrachloroethane	79-34-5	1.79E-06	24	28%
											1,1,2-Trichloroethane	79-00-5	2.23E-06	24	28%
											1,1-Dichloroethane	75-34-3	4.44E-04	24	28%
											1,1-Dichloroethylene	75-35-4	1.82E-05	24	<1%
											1,2-Dichloroethane	107-06-2	1.75E-06	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	1.04E-03	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	4.92E-05	24	28%
											Benzene	71-43-2	3.91E-04	24	<1%
											Bromodichloromethane	75-27-4	1.66E-07	24	28%
											Carbon Tetrachloride	56-23-5	2.86E-06	24	28%
											Chloroethane	75-00-3	1.44E-04	24	5%
											Chloroform/Trichloromethane	67-66-3	3.10E-05	24	28%
											Dichloromethane	75-09-2	2.63E-04	24	<1%
											Dimethyl sulfide	75-18-3	2.54E-04	24	28%
											Ethyl Mercaptan	75-08-1	8.39E-07	24	28%
											Ethylene Dibromide	106-93-4	5.82E-07	24	28%
											Hydrogen sulfide	04-06-7783	3.12E-02	24	28%
											Methyl Mercaptan	74-93-1	5.20E-07	24	28%
											Octane	111-65-9	9.41E-04	24	28%
											sec-Butyl Alcohol/2-Butanol	78-92-2	4.95E-03	24	28%
											Tetrachloroethylene	127-18-4	9.05E-04	24	11%
											Trichloroethylene	79-01-6	2.99E-04	24	2%
											Vinyl Chloride/Chloroethene	75-01-4	5.53E-04	24	6%

Source ID [1]	Source Type [1]	Source Description	Source Data: Stack Volumetric Flow Rate (Am³/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	LFG Source Coordinates X (m)	Y (m)	Emission Data: Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
AS	Area	Active Stage of Preferred Alternative Landfill Mound	n/a	n/a	n/a	n/a	n/a	n/a	423438	5014540	1,1,1-Trichloroethane	71-55-6	4.33E-06	24	7%
											1,1,2,2-Tetrachloroethane	79-34-5	4.54E-07	24	7%
											1,1,2-Trichloroethane	79-00-5	5.63E-07	24	7%
											1,1-Dichloroethane	75-34-3	1.12E-04	24	7%
											1,1-Dichloroethylene	75-35-4	4.59E-06	24	<1%
											1,2-Dichloroethane	107-06-2	4.42E-07	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	2.64E-04	24	<1%
											1,2-Dichloroethene (Trans)	156-60-5	1.24E-05	24	7%
											Benzene	71-43-2	9.90E-05	24	<1%
											Bromodichloromethane	75-27-4	4.21E-08	24	7%
											Carbon Tetrachloride	56-23-5	7.24E-07	24	7%
											Chloroethane	75-00-3	3.66E-05	24	1%
											Chloroform/Trichloromethane	67-66-3	7.84E-06	24	7%
											Dichloromethane	75-09-2	6.66E-05	24	<1%
											Dimethyl sulfide	75-18-3	6.42E-05	24	7%
											Ethyl Mercaptan	75-08-1	2.12E-07	24	7%
											Ethylene Dibromide	106-93-4	1.47E-07	24	7%
											Hydrogen sulfide	04-06-7783	7.89E-03	24	7%
											Methyl Mercaptan	74-93-1	1.32E-07	24	7%
											Octane	111-65-9	2.38E-04	24	7%
											sec-Butyl Alcohol/2-Butanol	78-92-2	1.25E-03	24	7%
											Tetrachloroethylene	127-18-4	2.29E-04	24	3%
											Trichloroethylene	79-01-6	7.56E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	1.40E-04	24	2%
CSS	Area	Contaminated Soil Stockpile	n/a	n/a	n/a	n/a	n/a	n/a	423373	5014476	1,1,1-Trichloroethane	71-55-6	5.13E-07	24	<1%
											1,2-Dichloroethane	107-06-2	3.19E-06	24	<1%
											Benzene	71-43-2	1.35E-04	24	<1%
											Dichloromethane	75-09-2	2.70E-05	24	<1%
											Octane	111-65-9	6.38E-05	24	2%
											sec-Butyl Alcohol/2-Butanol	78-92-2	6.40E-07	24	<1%
											Tetrachloroethylene	127-18-4	5.38E-06	24	<1%
											Trichloroethylene	79-01-6	5.87E-06	24	<1%
EVAP [1]	Point	Leachate Evaporator Stack	13.3	84	0.9	20.9	18.2	1	424216	5014634	Ammonia	7664-41-7	1.35E+00	24	87%
											Benzene	71-43-2	2.40E-01	24	97%
											Dichloromethane	75-09-2	3.80E-02	24	7%
RAWLEACH	Point	Raw Leachate Equalization Tank	0.0001	25	0.2	0.003	6.6	0.6	424269	5014684	1,1-Dichloroethylene	75-35-4	1.29E-04	24	2%
											1,2-Dichloroethane	107-06-2	1.64E-05	24	1%
											Ammonia	7664-41-7	3.06E-04	24	<1%
											Benzene	71-43-2	5.48E-05	24	<1%
											Chloroethane	75-00-3	3.96E-05	24	1%
											Vinyl Chloride/Chloroethene	75-01-4	1.25E-04	24	1%
											1,2-Dichloroethene (Cis)	156-59-2	6.80E-04	24	<1%
											Dichloromethane	75-09-2	2.76E-03	24	<1%
											Tetrachloroethylene	127-18-4	1.04E-04	24	1%
											Trichloroethylene	79-01-6	2.04E-04	24	2%

Source ID [1]	Source Type [1]	Source Description	Source Data LFG								Emission Data				
			Stack Volumetric Flow Rate (Am^3/s)	Stack Exit Gas Temp. (ºC)	Stack Inner Diameter (m)	Stack Exit Velocity (m/s)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates X (m)	Source Coordinates Y (m)	Contaminant	CAS Number	Maximum Emission Rate (g/s)	Averaging Period (hours)	% of Overall Emissions (%)
SBR	Point	Sequencing Batch Reactor Tank	0.0001	32	0.2	0.003	6.6	0.6	424317	5014732	1,1-Dichloroethylene	75-35-4	1.19E-03	24	21%
											1,2-Dichloroethane	107-06-2	7.26E-05	24	5%
											Ammonia	7664-41-7	2.06E-01	24	13%
											Benzene	71-43-2	2.90E-04	24	<1%
											Chloroethane	75-00-3	4.54E-04	24	17%
											Vinyl Chloride/Chloroethene	75-01-4	2.24E-03	24	25%
											1,2-Dichloroethene (Cis)	156-59-2	5.18E-02	24	39%
											Dichloromethane	75-09-2	7.56E-02	24	13%
											Tetrachloroethylene	127-18-4	1.06E-03	24	13%
											Trichloroethylene	79-01-6	1.93E-03	24	14%
EFFLUENT	Point	Effluent Equalization Tank	0.0001	25	0.2	0.003	6.6	0.6	424290	5014662	1,1-Dichloroethylene	75-35-4	8.78E-05	24	2%
											1,2-Dichloroethane	107-06-2	8.50E-06	24	<1%
											Ammonia	7664-41-7	5.08E-06	24	<1%
											Benzene	71-43-2	3.12E-05	24	<1%
											Chloroethane	75-00-3	2.44E-05	24	<1%
											Vinyl Chloride/Chloroethene	75-01-4	8.24E-05	24	<1%
											1,2-Dichloroethene (Cis)	156-59-2	3.92E-04	24	<1%
											Dichloromethane	75-09-2	1.62E-03	24	<1%
											Tetrachloroethylene	127-18-4	6.62E-05	24	<1%
											Trichloroethylene	79-01-6	1.22E-04	24	<1%
SLUDGE	Point	Sludge Tank	0.0001	25	0.2	0.003	6.6	0.6	424340	5014708	1,1-Dichloroethylene	75-35-4	4.22E-03	24	74%
											1,2-Dichloroethane	107-06-2	1.23E-03	24	92%
											Ammonia	7664-41-7	1.64E-03	24	<1%
											Benzene	71-43-2	3.18E-03	24	1%
											Chloroethane	75-00-3	1.69E-03	24	62%
											Vinyl Chloride/Chloroethene	75-01-4	4.62E-03	24	51%
											Trichloroethylene	79-01-6	1.01E-02	24	75%

Source ID [1]	Source Type [1]	Source Description	Source Data						LFG		Emission Data				
			Stack Volumetric Flow Rate	Stack Exit Gas Temp.	Stack Inner Diameter	Stack Exit Velocity	Stack Height Above Grade	Stack Height Above Roof	Source Coordinates X	Source Coordinates Y	Contaminant	CAS Number	Maximum Emission Rate	Averaging Period	% of Overall Emissions
			(Am³/s)	(ºC)	(m)	(m/s)	(m)	(m)	(m)	(m)			(g/s)	(hours)	(%)
Total	- -	Total of all Listed Sources	- -	- -	- -	- -	- -	- -	- -	- -	1,1,1-Trichloroethane	71-55-6	6.14E-05	- -	100%
											1,1,2,2-Tetrachloroethane	79-34-5	6.38E-06	- -	100%
											1,1,2-Trichloroethane	79-00-5	7.91E-06	- -	100%
											1,1-Dichloroethane	75-34-3	1.58E-03	- -	100%
											1,1-Dichloroethylene	75-35-4	5.69E-03	- -	100%
											1,2-Dichloroethane	107-06-2	1.33E-03	- -	100%
											1,2-Dichloroethene (Cis)	156-59-2	1.31E-01	- -	100%
											1,2-Dichloroethene (Trans)	156-60-5	1.75E-04	- -	100%
											Ammonia	7664-41-7	1.56E+00	- -	100%
											Benzene	71-43-2	2.46E-01	- -	100%
											Bromodichloromethane	75-27-4	5.91E-07	- -	100%
											Carbon Tetrachloride	56-23-5	1.02E-05	- -	100%
											Chloroethane	75-00-3	2.72E-03	- -	100%
											Chloroform/Trichloromethane	67-66-3	1.10E-04	- -	100%
											Dichloromethane	75-09-2	5.61E-01	- -	100%
											Dimethyl sulfide	75-18-3	9.02E-04	- -	100%
											Ethyl Mercaptan	75-08-1	2.98E-06	- -	100%
											Ethylene Dibromide	106-93-4	2.07E-06	- -	100%
											Hydrogen sulfide	04-06-7783	1.11E-01	- -	100%
											Methyl Mercaptan	74-93-1	1.85E-06	- -	100%
											Octane	111-65-9	3.41E-03	- -	100%
											sec-Butyl Alcohol/2-Butanol	78-92-2	1.76E-02	- -	100%
											Tetrachloroethylene	127-18-4	8.27E-03	- -	100%
											Trichloroethylene	79-01-6	1.34E-02	- -	100%
											Vinyl Chloride/Chloroethene	75-01-4	9.03E-03	- -	100%

Notes:

[1] For the preferred leachate management method, the emissions associated with the leachate evaporator were not included in the modelling.

Appendix A

Appendix A1

Existing Landfill Mound LFG Emission Rates – Based on Scaling 2010 Flow Data

Appendix A1 - Existing Landfill Mound LFG Emission Rates - Based on Scaling 2010 Flow Data

Landfill Gas Consumed (2010)	48,911,689	m^3/year (from flowmeter data as provided in 2010 NPRI Info)
% of LM_EX with Gas Collection System in Place	100%	
Estimated Efficiency of LFG Collection System	85%	
Overall Gas Collection	85%	
Total Landfill Gas Generated	57,543,164	m^3/year (based on gas consumed & overall gas collection)
Total Landfill Gas Released	8,631,475	m^3/year (based on gas generated & overall gas collection)
Continuous Emission Rate	0.27	m^3/s

Emission Flux Rate from Landfill

Landfill Area	355,013	m^2 (actual area)
Landfill Area	365,726	m^2 (modelled area)

Notes:

[1] Using flowmeter data provided in 2010 NPRI Info and Landgem LFG Output, a ratio was calculated and applied to other years to predict actual LFG generation rates

Ratio Gas Generated/LANDGEM Prediction = 1.64

Scenario	Year	LANDGEM Emissions (m^3/year)	Total Landfill Gas Generated	Collection Efficiencies	Total Landfill Gas Released (m^3/s)	Continuous Emission Rate (m^3/s)
--	2010	35,067,853	57,543,164	0.85	8,631,475	0.274
Intermediate Operation Year	2018	24,834,505	40,751,168	0.85	6,112,675	0.194
Final Operation Year	2023	19,830,755	32,540,469	0.85	4,881,070	0.155

				2018		2023	
		Collection Efficiency		0.850		0.850	
		Flow Rate (m^3/s)		0.194		0.155	
	DESCRIPTION	Average Concentration [1]		Emission Rate	Emission Flux Rate	Emission Rate	Emission Flux Rate
CAS #	COMPOUND	mg/m^3	g/m^3	g/s	$g/m^2/s$	g/s	$g/m^2/s$
71-55-6	1,1,1-Trichloroethane	0.158	1.58E-04	3.07E-05	8.39E-11	2.45E-05	6.70E-11
79-34-5	1,1,2,2-Tetrachloroethane	0.017	1.66E-05	3.22E-06	8.79E-12	2.57E-06	7.02E-12
79-00-5	1,1,2-Trichloroethane	0.021	2.06E-05	3.99E-06	1.09E-11	3.18E-06	8.70E-12
75-34-3	1,1-Dichloroethane	4.10	4.10E-03	7.95E-04	2.17E-09	6.35E-04	1.74E-09
75-35-4	1,1-Dichloroethylene	0.17	1.68E-04	3.25E-05	8.89E-11	2.60E-05	7.10E-11
107-06-2	1,2-Dichloroethane	0.016	1.62E-05	3.13E-06	8.57E-12	2.50E-06	6.84E-12
156-59-2	1,2-Dichloroethene (Cis)	9.63	9.63E-03	1.87E-03	5.10E-09	1.49E-03	4.08E-09
156-60-5	1,2-Dichloroethene (Trans)	0.45	4.55E-04	8.81E-05	2.41E-10	7.04E-05	1.92E-10
71-43-2	Benzene	3.62	3.62E-03	7.01E-04	1.92E-09	5.60E-04	1.53E-09
75-27-4	Bromodichloromethane	0.002	1.54E-06	2.98E-07	8.15E-13	2.38E-07	6.51E-13
56-23-5	Carbon Tetrachloride	0.026	2.65E-05	5.13E-06	1.40E-11	4.10E-06	1.12E-11
75-00-3	Chloroethane	1.34	1.34E-03	2.59E-04	7.08E-10	2.07E-04	5.65E-10
67-66-3	Chloroform/Trichloromethane	0.29	2.86E-04	5.55E-05	1.52E-10	4.43E-05	1.21E-10
75-09-2	Dichloromethane	2.43	2.43E-03	4.72E-04	1.29E-09	3.77E-04	1.03E-09
75-18-3	Dimethyl sulfide [2]	2.35	2.35E-03	4.55E-04	1.24E-09	3.63E-04	9.93E-10
75-08-1	Ethyl Mercaptan	0.008	7.75E-06	1.50E-06	4.11E-12	1.20E-06	3.28E-12
106-93-4	Ethylene Dibromide	0.01	5.37E-06	1.04E-06	2.85E-12	8.32E-07	2.27E-12
04-06-7783	Hydrogen sulfide [2]	288.15	2.88E-01	5.59E-02	1.53E-07	4.46E-02	1.22E-07
74-93-1	Methyl Mercaptan	0.005	4.80E-06	9.31E-07	2.55E-12	7.44E-07	2.03E-12
111-65-9	Octane	8.70	8.70E-03	1.69E-03	4.61E-09	1.35E-03	3.68E-09
78-92-2	sec-Butyl Alcohol/2-Butanol	45.70	4.57E-02	8.86E-03	2.42E-08	7.07E-03	1.93E-08
127-18-4	Tetrachloroethylene	8.36	8.36E-03	1.62E-03	4.43E-09	1.29E-03	3.54E-09
79-01-6	Trichloroethylene	2.76	2.76E-03	5.35E-04	1.46E-09	4.27E-04	1.17E-09
75-01-4	Vinyl Chloride/Chloroethene	5.11	5.11E-03	9.91E-04	2.71E-09	7.92E-04	2.16E-09

Notes:

[1] Average Concentrations are based on the LFG Analysis results of measurements taken in 2004 and in 2011.
The resulting concentrations were averaged for the 2004 and 2011 period.
The highest average concentration was used to estimate the emission rates and emission flux rate

[2] Sulphur Compounds concentrations were highest in 2011 and are an average of six sample concentration results

REPORT OF ANALYSIS: EPA624/TO-14 Target Compounds in mg/m³

REPORT: 11017 (Method - SCAN ATD-GC-MSD Cryogenic Oven Control)

	DESCRIPTION	**11042003**	**11042004**	**11042005**	**11042006**	
CAS #	**COMPOUND**	**No.1-VOC 4/19/11 V=5.0mL**	**No.1-VOC 4/19/11 V=15mL**	**No.2-VOC 4/19/11 V=15mL**	**No.3-VOC 4/19/11 V=15mL**	**POI (Ontario) (ug/m³)**
	Target Compounds					
74-93-1	Methyl Mercaptan	**0.011**	**0.003**	**0.003**	**0.003**	-
75-01-4	Vinyl Chloride	4.53	4.25	5.88	5.80	3
75-08-1	Ethyl Mercaptan	**0.017**	**0.005**	**0.005**	**0.004**	-
75-00-3	Chloroethane	**0.083**	0.153	0.200	0.198	-
75-18-3	Dimethyl Sulfide	**0.014**	**0.004**	**0.004**	**0.003**	30
75-35-4	1,1-Dichloroethylene	0.047	0.049	0.072	0.066	30
75-09-2	Dichloromethane	0.592	0.592	0.831	0.797	5300
156-60-5	1,2-Dichloroethene (trans)	0.274	0.348	0.531	0.505	315
75-34-3	1,1-Dichloroethane	0.992	1.015	1.451	1.378	600
78-92-2	2-Butanol	**0.025**	**0.007**	**0.006**	**0.006**	-
156-59-2	1,2-Dichloroethene (cis)	7.75	8.15	11.58	11.04	315
67-66-3	Chloroform	0.056	0.072	0.103	0.100	300
56-23-5	Carbon Tetrachloride	**0.059**	**0.017**	**0.016**	**0.014**	1800
71-55-6	1,1,1-Trichloroethane	0.093	0.143	0.206	0.191	350000
71-43-2	Benzene	2.33	2.45	3.68	3.44	1
107-06-2	1,2-Dichloroethane	**0.036**	**0.010**	**0.010**	**0.009**	6
79-01-6	Trichloroethylene	1.37	1.45	2.23	2.10	3500
75-27-4	Bromodichloromethane	**0.003**	**0.001**	**0.001**	**0.001**	-
111-65-9	Octane	4.67	4.53	6.60	6.07	45400
79-00-5	1,1,2-Trichloroethane	**0.046**	**0.013**	**0.012**	**0.011**	-
127-18-4	Tetrachloroethylene	3.90	4.39	6.72	6.31	10000
106-93-4	1,2-Dibromoethane	**0.012**	**0.003**	**0.003**	**0.003**	-
79-34-5	1,1,2,2-Tetrachloroethane	**0.037**	**0.011**	**0.010**	**0.009**	-
	TVOCs (Toluene)	552	381	661		

POI = Half Hour Point of Impingement (Ontario Ministry of Environment)

V = Volume of air sampled

NB - Values in bold represent "Less Thans"

Maxxam Job #: B153692
Report Date: 2011/04/21

RWDI West Inc
Client Project #: WM OTTAWA
Project name:
Your P.O. #: 1100798
Sampler Initials:

COMPRESSED GAS PARAMETERS (AIR)

Maxxam ID		JG2672	JG2672	JG2673		JG2674	JG2674		
Sampling Date		19/04/2011	19/04/2011	19/04/2011		19/04/2011	19/04/2011		
COC Number		na	na	na		na	na		
	Units	**SAMPLE1**	**SAMPLE1 Lab-Dup**	**SAMPLE 2**	**RDL**	**SAMPLE 3**	**SAMPLE 3 Lab-Dup**	**RDL**	**QC Batch**
Oxygen	% v/v	5.2	N/A	2.9	0.1	2.9	2.9	0.1	2464878
Nitrogen	% v/v	19.5	N/A	12.0	0.1	11.9	12.0	0.1	2464878
Methane	% v/v	45.0	N/A	50.7	0.1	50.6	51.1	0.1	2464878
Carbon Dioxide	% v/v	30.8	N/A	34.8	0.1	34.9	35.2	0.1	2464878
Carbon Monoxide	% v/v	ND	N/A	ND	0.1	ND	ND	0.1	2464878
Hydrogen sulfide	ppmv	170	180	180	1.5	290	N/A	2.5	2464828
Carbonyl sulfide	ppmv	ND	ND	ND	0.40	ND	N/A	0.40	2464828
Methyl mercaptan	ppmv	0.96	0.90	0.90	0.80	1.1	N/A	0.80	2464828
Ethyl mercaptan	ppmv	0.55	0.43	ND	0.40	0.47	N/A	0.40	2464828
Dimethyl sulfide	ppmv	1.4	1.6	1.6	0.80	1.7	N/A	0.80	2464828
Dimethyl disulfide	ppmv	ND	ND	ND	0.80	ND	N/A	0.80	2464828

ND = Not detected
N/A = Not Applicable
RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
EDL = Estimated Detection Limit
QC Batch = Quality Control Batch

AirZOne
Comprehensive Air Quality Services

RWDI Air
Att: Brad Bergeron
650 Woodlawn Road
Guelph ON, N1K 1B8

Sample Analysis Report

Project Number:	J11061
Client #	1100798
Report Date:	30-Apr-11
Analysis Date:	29-Apr-11
Receipt Date	29-Apr-11
Analytical Method:	Gas Chromatography/Flame Photometric Detection/ (GC/FPD)
Unit:	All results reported in mole ppm by volume
Sample Type:	Tedlar Bag

Results	Detection Limit	TRS-1	TRS-2	TRS-3
Marix gases				
CO	100	<100	<100	<100
O2	100	31439	22240	20985
CO2	100	415403	446814	427069
CH4	100	428771	440616	465959
N2	100	124213	90146	85803
Sulfur Compounds				
Hydrogensulfide	0.01	173	183	182
Methyl mercaptan	0.01	0.55	0.58	0.56
Ethyl Mercaptan	0.01	0.26	0.29	0.26
Dimethyl Sulfide	0.01	0.18	0.20	0.18
Dimethyl Disulfide	0.01	0.05	0.06	0.05
Carbonyl Sulfide	0.01	<0.01	<0.01	<0.01

Analyst	Quang Tran, M. Sc.
Manager Air Monitoring	Philip Fellin, M.Sc.

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Airzone One 222 Matheson Boulevard East Mississauga, Ontario L4Z 1X1
Tel: (905) 890-6957 Fax: (905) 890-8629 www.airzoneone.com

REPORT OF ANALYSIS: Selected and Target Compounds in mg/m³

REPORT: 04024 (Methods 1c, 3a, 5b, 6b)

	DESCRIPTION	04061105	04061106	04061107	0
CAS #	**COMPOUND**	**VOC1 V=5mL**	**VOC2 V=5mL**	**VOC3 V=5mL**	**POI (Ontario) (mg/m³)**
	Target Compounds				
74-93-1	Methyl Mercaptan	ND	ND	ND	0.02
75-08-1	Ethyl Mercaptan	ND	ND	ND	0.02
75-01-4	Vinyl Chloride/Chloroethene	3.74	3.65	3.88	0.003
75-00-3	Chloroethane	1.218	1.361	1.427	-
75-35-4	1,1-Dichloroethylene	0.1704	0.1632	0.1698	0.03
75-18-3	Dimethyl Sulphide	2.27	2.34	2.46	0.03
75-09-2	Dichloromethane	2.61	2.29	2.40	5.3
156-60-5	1,2-Dichloroethene (Trans)	0.448	0.453	0.463	0.315
75-34-3	1,1-Dichloroethane	4.09	4.00	4.22	0.6
156-59-2	1,2-Dichloroethene (Cis)	8.00	7.70	8.11	0.315
78-92-2	sec-Butyl Alcohol/2-Butanol	45.3	43.9	47.9	-
67-66-3	Chloroform/Trichloromethane	0.307	0.281	0.271	0.3
71-55-6	1,1,1-Trichloroethane	0.1231	0.1053	0.1199	350
56-23-5	Carbon Tetrachloride	ND	ND	ND	0.0072
71-43-2	Benzene	3.67	3.51	3.67	
107-06-2	1,2-Dichloroethane	ND	ND	ND	0.006
79-01-6	Trichloroethylene	2.83	2.66	2.79	3.5
75-27-4	Bromodichloromethane	ND	ND	ND	-
111-65-9	Octane	8.88	8.26	8.95	45.4
79-00-5	1,1,2-Trichloroethane	ND	ND	ND	-
127-18-4	Tetrachloroethylene	8.36	8.16	8.56	10
106-93-4	Ethylene Dibromide	ND	ND	ND	0.009
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	ND	-
	Selected Compounds				
15-07-1/74-98	1-Propene/Propane	48.2	49.3	49.4	-
75-28-5	2-Methyl Propane/Isobutane	17.80	16.83	17.87	-
115-11-7	Isobutene/2-Methyl-1-Propene	7.69	7.53	8.24	-
67-56-1	Methanol	2.58	2.31	3.73	12
78-78-4	2-Methyl Butane	5.82	5.74	6.57	-
75-69-4	Trichlorofluoromethane(11)	0.995	1.033	1.155	18
9-67-1/1191-9	1-Pentene/Ethyl Cyclopropane	0.323	0.279	0.298	-
109-66-0	Pentane	5.15	4.73	5.28	-
64-17-5	Ethanol	76.3	77.7	81.6	19
123-38-6	Propanal	1.270	1.272	1.414	0.007
67-64-1	Acetone	17.66	17.73	18.26	48
75-15-0	Carbon Disulphide	0.814	U	0.473	0.33
67-63-0	Isopropyl Alcohol	25.7	25.6	26.8	24
75-05-8	Acetonitrile	0.1199	0.209	0.1349	-
79-29-8	2,3-Dimethyl Butane	0.512	0.573	0.649	-
79-20-9	Methyl Acetate	1.041	1.361	1.400	-
107-83-5	2-Methyl Pentane	4.16	4.08	4.24	-
96-14-0	3-Methyl Pentane	3.51	3.35	3.57	-
2-41-6/763-29	1-Hexene/2-Methyl-1-Pentene	0.416	0.355	0.370	-
110-54-3	Hexane	7.85	7.78	8.17	35
71-23-8	n-Propanol	38.1	38.2	39.8	48
534-22-5	2-Methyl Furan	1.188	1.149	1.062	-
123-72-8	n-Butanal	4.94	4.91	4.68	-
96-37-7	Methyl Cyclopentane	3.63	3.37	3.22	-
78-93-3	MEK/2-Butanone	41.0	39.7	41.1	30
141-78-6	Ethyl Acetate	14.33	13.39	13.88	19
109-99-9	Tetrahydrofuran	6.36	5.95	5.75	93
591-76-4	2-Methyl Hexane	5.8	5.82	5.72	-
589-34-4	3-Methyl Hexane	9.78	9.80	9.87	-
565-59-3	2,3-Dimethyl Pentane	2.95	2.81	2.75	-

REPORT OF ANALYSIS: Selected and Target Compounds in mg/m³

REPORT: 04024 (Methods 1c, 3a, 5b, 6b)

	DESCRIPTION	04061105	04061106	04061107	0
CAS #	COMPOUND	VOC1 V=5mL	VOC2 V=5mL	VOC3 V=5mL	POI (Ontario) (mg/m³)
78-83-1	Isobutyl Alcohol/2-Methyl-1-Pr	5.92	5.61	5.23	-
142-82-5	Heptane	13.47	13.78	14.12	33
71-36-3	n-Butanol	41.2	41.4	44.7	2.278
108-87-2	Methyl Cyclohexane	19.60	19.43	19.92	-
592-27-8	2-Methyl Heptane	6.18	5.92	6.12	-
589-53-7	4-Methyl Heptane	2.11	2.01	6.17	-
589-81-1	3-Methyl Heptane	5.27	5.13	5.11	-
108-10-1	4-Methyl-2-Pentanone/MIBK	8.30	8.00	8.61	1.2
108-88-3	Toluene	65.4	61.9	62.3	2
123-86-4	Butyl Acetate	16.01	15.49	16.57	0.735
108-90-7	Chlorobenzene	3.45	3.36	3.45	4.2
100-41-4	Ethyl Benzene	31.9	29.3	29.2	3
8-38-3/106-42	m/p-Xylene	73.7	65.9	67.1	2.3*
95-47-6	o-Xylene	26.5	24.0	24.8	2.3*
1678-92-8	Propyl Cyclohexane	41.1	42.2	43.6	-
98-82-8	Cumene/Isopropyl Benzene	6.36	5.87	6.13	0.1
79-92-5	Camphene	41.6	40.9	42.2	-
103-65-1	Propyl Benzene	7.36	6.64	7.10	-
0-14-4/622-96	m/p-Ethyl Toluene	25.1	22.7	23.9	-
124-18-5	Decane	70.1	63.5	66.2	-
611-14-3	o-Ethyl Toluene	14.14	12.70	13.40	-
95-63-6	1,2,4-Trimethyl Benzene	20.9	18.83	19.88	0.5
13466-78-9	3-Carene	3.54	3.64	4.01	-
3-86-3/5989-2	Limonene/D-Limonene	64.5	58.1	59.7	-
99-87-6	p-Cymene	36.1	32.6	33.4	-
106-46-7	1,4-Dichlorobenzene	14.04	12.18	13.02	-
1120-21-4	Undecane	23.9	21.4	23.1	-
541-02-6	Decamethyl Cyclopentasiloxar	11.91	11.69	14.13	-
112-40-3	Dodecane	2.59	2.31	2.70	-
540-97-6	Dodecamethyl Cyclohexasilox	6.61	6.25	6.16	-
-	Aromatics	76.4	58.3	70.6	
-	Aliphatics	244	228	243	
-	Cycloaliphatics	109.0	101.0	116.7	
-	Oxygenates	403	406	324	
-	Complex	176.4	129.8	209	
	TVOCs (Toluene)	1408	1315	1379	

POI = Half Hour Point of Impingement (Ontario Ministry of Environment)
U = Unresolved due to co-elution
< (ND) = Characteristic ions are not present therefore Not Detected
* & ** = Sum of all isomers
V = Volume of air sampled

MaXXam Analytics Inc

·DRIVEN BY SERVICE AND SCIENCE·
www.maxxamanalytics.com

Rowan Williams Davies & Irwin Inc
(RWDI)
650 Woodlawn Rd W
Guelph, ON
N1K 1B8

Report Date: 2004/06/18

Attention: John Devoe

ANALYTICAL REPORT

MAXXAM JOB #: A426911
Received: 2004/06/11, 09:43

Sample Matrix: GASES
Samples Received: 3

Analyses	Number of Tests	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Matrix Gases	3	2004/06/18	2004/06/11	Ont SOP 0289	GC/TCD
Sulphur Compounds In Gaseous Samples (1)	3	2004/06/18	2004/06/11	Ont SOP 0598, 288	GC/FPD Direct Inject

MAXXAM ANALYTICS INC.

Tom Mitchell

TOM MITCHELL, B.Sc
Air Quality Services
(1) GC/FPD (Gas Chromatography/Flame Photometric Detection)

Total pages: 1

MaxXam Analytics Inc

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www.maxxamanalytics.com

REPORT DATE: 2004/06/18

MAXXAM JOB #: A426911

RESULTS OF CHEMICAL ANALYSES OF GASES

Maxxam ID		C92810	C92811	C92812	
Parameter	Units	#1	#2	#3	MDL
Oxygen	%	0.7	0.7	0.6	0.1
Nitrogen	%	6.2	5.9	5.7	0.1
Methane	%	54.3	54.7	54.4	0.1
Carbon Dioxide	%	38.9	38.9	38.8	0.1
Carbon Monoxide	%	ND	ND	ND	0.1
Hydrogen Sulfide/Carbonyl Sulfide	ppmv	36.3	41.1	44.2	2.0
Methyl Mercaptan	ppmv	1.00	1.10	1.20	0.10
Ethyl Mercaptan/Dimethyl Sulfide	ppmv	0.60	0.60	0.70	0.10
Dimethyl Disulfide	ppmv	ND	ND	ND	0.10
Carbon Disulfide	ppmv	ND	ND	ND	0.040

ND = Not detected
MDL = METHOD DETECTION LIMIT

CATHY LI, Air Quality Services

5540 McAdam Road, Mississauga, Ontario, Canada L4Z 1P1 Tel: (905) 890-2555 Toll Free: (800) 563-6266 Fax: (905) 890-0370

Appendix A2

Preferred Alternative Landfill Mound and Active Stage Emission Rates – Based on LANDGEM data

Appendix A2 - Alternative Preferred Landfill Mound and Active Stage Emission Rates - Based on LANDGEM Data

Modelled Landfill Area (m^2)	Preferred Alternative Landfill Footprint	Active Stage
Intermediate Operation Year (2018)	323715	47,250
Final Operation Year (2023)	323908	47,250

Notes: No actual change in landfill area, change is due to adjustments made to the preferred alternative landfill polygon source to accommodate the change of the active stage placement

Proposed Landfill

Scenario	Year	LANDGEM Emissions (m^3/year)	Collection Efficiencies	Total Landfill Gas Released (m^3/s)	Continuous Emission Rate (m^3/s)
Intermediate Operation Year	2018	12,649,667	0.85	1,897,450	0.060
Final Operation Year	2023	22,750,632	0.85	3,412,595	0.108

Active Stage

Scenario	Year	LANDGEM Emissions (m^3/year)	Collection Efficiencies	Total Landfill Gas Released (m^3/s)	Continuous Emission Rate (m^3/s)
Intermediate Operation Year	2018	1,726,619	0.5	863,310	0.027
Final Operation Year	2023	1,726,619	0.5	863,310	0.027

Notes:
The waste deposit in each stages (8) and for both phases is assumed to be placed in 16 equal portions
Total waste placed (400,000 Mg per year, 4,000,000 Mg total)
Approximately 250,000 Mg waste per portion
LANDGEM Emission for the active stage is based on the placement of 250,000 Mg of waste, with no historic cumulation from previous waste deposited
This is the maximum amount of gas that would be emitted from that waste (i.e. 1 year after its placement)

PREFERRED ALTERNATIVE LANDFILL EMISSION RATES

				2018		2023	
		Collection Efficiency		0.850		0.850	
		Flow Rate (m^3/s)		0.060		0.108	
CAS #	DESCRIPTION	Average Concentration [1]		Emission Rate	Emission Flux Rate	Emission Rate	Emission Flux Rate
	COMPOUND	mg/m^3	g/m^3	g/s	$g/m^2/s$	g/s	$g/m^2/s$
71-55-6	1,1,1-Trichloroethane	0.158	1.58E-04	9.52E-06	2.94E-11	1.71E-05	5.29E-11
79-34-5	1,1,2,2-Tetrachloroethane	0.017	1.66E-05	9.98E-07	3.08E-12	1.79E-06	5.54E-12
79-00-5	1,1,2-Trichloroethane	0.021	2.06E-05	1.24E-06	3.82E-12	2.23E-06	6.87E-12
75-34-3	1,1-Dichloroethane	4.10	4.10E-03	2.47E-04	7.63E-10	4.44E-04	1.37E-09
75-35-4	1,1-Dichloroethylene	0.17	1.68E-04	1.01E-05	3.12E-11	1.82E-05	5.61E-11
107-06-2	1,2-Dichloroethane	0.016	1.62E-05	9.72E-07	3.00E-12	1.75E-06	5.40E-12
156-59-2	1,2-Dichloroethene (Cis)	9.63	9.63E-03	5.79E-04	1.79E-09	1.04E-03	3.22E-09
156-60-5	1,2-Dichloroethene (Trans)	0.45	4.55E-04	2.74E-05	8.45E-11	4.92E-05	1.52E-10
71-43-2	Benzene	3.62	3.62E-03	2.18E-04	6.72E-10	3.91E-04	1.21E-09
75-27-4	Bromodichloromethane	0.002	1.54E-06	9.25E-08	2.86E-13	1.66E-07	5.14E-13
56-23-5	Carbon Tetrachloride	0.026	2.65E-05	1.59E-06	4.92E-12	2.86E-06	8.84E-12
75-00-3	Chloroethane	1.34	1.34E-03	8.03E-05	2.48E-10	1.44E-04	4.46E-10
67-66-3	Chloroform/Trichloromethane	0.29	2.86E-04	1.72E-05	5.32E-11	3.10E-05	9.57E-11
75-09-2	Dichloromethane	2.43	2.43E-03	1.46E-04	4.52E-10	2.63E-04	8.13E-10
75-18-3	Dimethyl sulfide [2]	2.35	2.35E-03	1.41E-04	4.36E-10	2.54E-04	7.84E-10
75-08-1	Ethyl Mercaptan	0.008	7.75E-06	4.66E-07	1.44E-12	8.39E-07	2.59E-12
106-93-4	Ethylene Dibromide	0.01	5.37E-06	3.23E-07	9.99E-13	5.82E-07	1.80E-12
04-06-7783	Hydrogen sulfide [2]	288.15	2.88E-01	1.73E-02	5.36E-08	3.12E-02	9.63E-08
74-93-1	Methyl Mercaptan	0.005	4.80E-06	2.89E-07	8.93E-13	5.20E-07	1.61E-12
111-65-9	Octane	8.70	8.70E-03	5.23E-04	1.62E-09	9.41E-04	2.91E-09
78-92-2	sec-Butyl Alcohol/2-Butanol	45.70	4.57E-02	2.75E-03	8.49E-09	4.95E-03	1.53E-08
127-18-4	Tetrachloroethylene	8.36	8.36E-03	5.03E-04	1.55E-09	9.05E-04	2.79E-09
79-01-6	Trichloroethylene	2.76	2.76E-03	1.66E-04	5.13E-10	2.99E-04	9.22E-10
75-01-4	Vinyl Chloride/Chloroethene	5.11	5.11E-03	3.08E-04	9.51E-10	5.53E-04	1.71E-09

Notes:
[1] Average Concentrations are based on the LFG Analysis results of measurements taken in 2004 and in 2011.
The resulting concentrations were averaged for the 2004 and 2011 period.
The highest average concentration was used to estimate the emission rates and emission flux rate
[2] Sulphur Compounds concentrations were highest in 2011 and are an average of six sample concentration results

ACTIVE STAGE EMISSION RATES

				2018		2023	
		Collection Efficiency		0.500		0.500	
		Flow Rate (m^3/s)		0.027		0.027	
	DESCRIPTION	Average Concentration [1]		Emission Rate	Emission Flux Rate	Emission Rate	Emission Flux Rate
CAS #	COMPOUND	mg/m^3	g/m^3	g/s	$g/m^2/s$	g/s	$g/m^2/s$
71-55-6	1,1,1-Trichloroethane	0.158	1.58E-04	4.33E-06	9.17E-11	4.33E-06	9.17E-11
79-34-5	1,1,2,2-Tetrachloroethane	0.017	1.66E-05	4.54E-07	9.61E-12	4.54E-07	9.61E-12
79-00-5	1,1,2-Trichloroethane	0.021	2.06E-05	5.63E-07	1.19E-11	5.63E-07	1.19E-11
75-34-3	1,1-Dichloroethane	4.10	4.10E-03	1.12E-04	2.38E-09	1.12E-04	2.38E-09
75-35-4	1,1-Dichloroethylene	0.17	1.68E-04	4.59E-06	9.72E-11	4.59E-06	9.72E-11
107-06-2	1,2-Dichloroethane	0.016	1.62E-05	4.42E-07	9.36E-12	4.42E-07	9.36E-12
156-59-2	1,2-Dichloroethene (Cis)	9.63	9.63E-03	2.64E-04	5.58E-09	2.64E-04	5.58E-09
156-60-5	1,2-Dichloroethene (Trans)	0.45	4.55E-04	1.24E-05	2.63E-10	1.24E-05	2.63E-10
71-43-2	Benzene	3.62	3.62E-03	9.90E-05	2.10E-09	9.90E-05	2.10E-09
75-27-4	Bromodichloromethane	0.002	1.54E-06	4.21E-08	8.91E-13	4.21E-08	8.91E-13
56-23-5	Carbon Tetrachloride	0.026	2.65E-05	7.24E-07	1.53E-11	7.24E-07	1.53E-11
75-00-3	Chloroethane	1.34	1.34E-03	3.66E-05	7.74E-10	3.66E-05	7.74E-10
67-66-3	Chloroform/Trichloromethane	0.29	2.86E-04	7.84E-06	1.66E-10	7.84E-06	1.66E-10
75-09-2	Dichloromethane	2.43	2.43E-03	6.66E-05	1.41E-09	6.66E-05	1.41E-09
75-18-3	Dimethyl sulfide [2]	2.35	2.35E-03	6.42E-05	1.36E-09	6.42E-05	1.36E-09
75-08-1	Ethyl Mercaptan	0.008	7.75E-06	2.12E-07	4.49E-12	2.12E-07	4.49E-12
106-93-4	Ethylene Dibromide	0.01	5.37E-06	1.47E-07	3.11E-12	1.47E-07	3.11E-12
04-06-7783	Hydrogen sulfide [2]	288.15	2.88E-01	7.89E-03	1.67E-07	7.89E-03	1.67E-07
74-93-1	Methyl Mercaptan	0.005	4.80E-06	1.32E-07	2.78E-12	1.32E-07	2.78E-12
111-65-9	Octane	8.70	8.70E-03	2.38E-04	5.04E-09	2.38E-04	5.04E-09
78-92-2	sec-Butyl Alcohol/2-Butanol	45.70	4.57E-02	1.25E-03	2.65E-08	1.25E-03	2.65E-08
127-18-4	Tetrachloroethylene	8.36	8.36E-03	2.29E-04	4.84E-09	2.29E-04	4.84E-09
79-01-6	Trichloroethylene	2.76	2.76E-03	7.56E-05	1.60E-09	7.56E-05	1.60E-09
75-01-4	Vinyl Chloride/Chloroethene	5.11	5.11E-03	1.40E-04	2.96E-09	1.40E-04	2.96E-09

Notes:
[1] Average Concentrations are based on the LFG Analysis results of measurements taken in 2004 and in 2011.
The resulting concentrations were averaged for the 2004 and 2011 period.
The highest average concentration was used to estimate the emission rates and emission flux rate
[2] Sulphur Compounds concentrations were highest in 2011 and are an average of six sample concentration results

Appendix A3

LFG-Fired Generators and Flares Emission Rates

Appendix A3 - LFG-Fired Generators and Flares Emission Rates

				Point Sources							
		Max Equipment Capacity (m^3/s)		0.57	1.04	1	0.28	0.28	0.28	0.28	0.28
		Destruction Efficiency		0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97
		Equipment ID		F1	F2	F3	E1	E2	E3	E4	E5
	DESCRIPTION	Average Concentration [1]		Emission Rate	Emission Rate	Emission Rate	Emission Rate	Emission Rate	Emission Rate	Emission Rate	Emission Rate
CAS #	COMPOUND	mg/m^3	g/m^3	g/s	g/s	g/s	g/s	g/s	g/s	g/s	g/s
71-55-6	1,1,1-Trichloroethane	0.158	1.58E-04	1.80E-06	3.29E-06	3.17E-06	1.33E-06	1.33E-06	1.33E-06	1.33E-06	1.33E-06
79-34-5	1,1,2,2-Tetrachloroethane	0.017	1.66E-05	1.89E-07	3.45E-07	3.32E-07	1.39E-07	1.39E-07	1.39E-07	1.39E-07	1.39E-07
79-00-5	1,1,2-Trichloroethane	0.021	2.06E-05	2.34E-07	4.28E-07	4.11E-07	1.73E-07	1.73E-07	1.73E-07	1.73E-07	1.73E-07
75-34-3	1,1-Dichloroethane	4.10	4.10E-03	4.68E-05	8.53E-05	8.21E-05	3.45E-05	3.45E-05	3.45E-05	3.45E-05	3.45E-05
75-35-4	1,1-Dichloroethylene	0.17	1.68E-04	1.91E-06	3.49E-06	3.36E-06	1.41E-06	1.41E-06	1.41E-06	1.41E-06	1.41E-06
107-06-2	1,2-Dichloroethane	0.016	1.62E-05	1.84E-07	3.36E-07	3.23E-07	1.36E-07	1.36E-07	1.36E-07	1.36E-07	1.36E-07
156-59-2	1,2-Dichloroethene (Cis)	9.63	9.63E-03	1.10E-04	2.00E-04	1.93E-04	8.09E-05	8.09E-05	8.09E-05	8.09E-05	8.09E-05
156-60-5	1,2-Dichloroethene (Trans)	0.45	4.55E-04	5.18E-06	9.46E-06	9.09E-06	3.82E-06	3.82E-06	3.82E-06	3.82E-06	3.82E-06
71-43-2	Benzene [1]	3.62	3.62E-03	4.12E-05	7.52E-05	7.23E-05	3.07E-04	3.07E-04	3.07E-04	3.07E-04	3.07E-04
75-27-4	Bromodichloromethane	0.002	1.54E-06	1.75E-08	3.20E-08	3.08E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08
56-23-5	Carbon Tetrachloride	0.026	2.65E-05	3.02E-07	5.50E-07	5.29E-07	2.22E-07	2.22E-07	2.22E-07	2.22E-07	2.22E-07
75-00-3	Chloroethane	1.34	1.34E-03	1.52E-05	2.78E-05	2.67E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05
67-66-3	Chloroform/Trichloromethane	0.29	2.86E-04	3.26E-06	5.96E-06	5.73E-06	2.41E-06	2.41E-06	2.41E-06	2.41E-06	2.41E-06
75-09-2	Dichloromethane	2.43	2.43E-03	2.77E-05	5.06E-05	4.87E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05
75-18-3	Dimethyl sulfide [2]	2.35	2.35E-03	2.67E-05	4.88E-05	4.69E-05	1.97E-05	1.97E-05	1.97E-05	1.97E-05	1.97E-05
75-08-1	Ethyl Mercaptan	0.008	7.75E-06	8.83E-08	1.61E-07	1.55E-07	6.51E-08	6.51E-08	6.51E-08	6.51E-08	6.51E-08
106-93-4	Ethylene Dibromide	0.01	5.37E-06	6.13E-08	1.12E-07	1.07E-07	4.51E-08	4.51E-08	4.51E-08	4.51E-08	4.51E-08
04-06-7783	Hydrogen sulfide	288.15	2.88E-01	3.28E-03	5.99E-03	5.76E-03	2.42E-03	2.42E-03	2.42E-03	2.42E-03	2.42E-03
74-93-1	Methyl Mercaptan	0.005	4.80E-06	5.48E-08	9.99E-08	9.61E-08	4.04E-08	4.04E-08	4.04E-08	4.04E-08	4.04E-08
111-65-9	Octane	8.70	8.70E-03	9.91E-05	1.81E-04	1.74E-04	7.31E-05	7.31E-05	7.31E-05	7.31E-05	7.31E-05
78-92-2	sec-Butyl Alcohol/2-Butanol	45.70	4.57E-02	5.21E-04	9.51E-04	9.14E-04	3.84E-04	3.84E-04	3.84E-04	3.84E-04	3.84E-04
127-18-4	Tetrachloroethylene	8.36	8.36E-03	9.53E-05	1.74E-04	1.67E-04	7.02E-05	7.02E-05	7.02E-05	7.02E-05	7.02E-05
79-01-6	Trichloroethylene	2.76	2.76E-03	3.15E-05	5.74E-05	5.52E-05	2.32E-05	2.32E-05	2.32E-05	2.32E-05	2.32E-05
75-01-4	Vinyl Chloride/Chloroethene	5.11	5.11E-03	5.83E-05	1.06E-04	1.02E-04	4.30E-05	4.30E-05	4.30E-05	4.30E-05	4.30E-05

<u>**Notes:**</u> [1] Benzene emission rates for the generators are taken from 2010 Source Testing Results, as they are more conservative than the LANDGEM results

Appendix B

Contaminated Soil Stockpile Emission Rates

Appendix B - Contaminated Soil Stockpile Emission Rates

Contaminated Soil Stockpile Surface Area:

CAS #	DESCRIPTION	Emission Flux Rate [1]	Emission Rate
	COMPOUND	$g/m^2/s$	g/s
71-55-6	1,1,1-Trichloroethane	1.28E-10	5.13E-07
79-34-5	1,1,2,2-Tetrachloroethane	N/A	N/A
79-00-5	1,1,2-Trichloroethane	N/A	N/A
75-34-3	1,1-Dichloroethane	N/A	N/A
75-35-4	1,1-Dichloroethylene	N/A	N/A
107-06-2	1,2-Dichloroethane	7.97E-10	3.19E-06
156-59-2	1,2-Dichloroethene (Cis)	N/A	N/A
156-60-5	1,2-Dichloroethene (Trans)	N/A	N/A
71-43-2	Benzene	3.38E-08	1.35E-04
75-27-4	Bromodichloromethane	N/A	N/A
56-23-5	Carbon Tetrachloride	N/A	N/A
75-00-3	Chloroethane	N/A	N/A
67-66-3	Chloroform/Trichloromethane	N/A	N/A
75-09-2	Dichloromethane	6.75E-09	2.70E-05
75-18-3	Dimethyl sulfide	N/A	N/A
75-08-1	Ethyl Mercaptan	N/A	N/A
106-93-4	Ethylene Dibromide	N/A	N/A
04-06-7783	Hydrogen sulfide	N/A	N/A
74-93-1	Methyl Mercaptan	N/A	N/A
111-65-9	Octane	1.59E-08	6.38E-05
78-92-2	sec-Butyl Alcohol/2-Butanol	1.60E-10	6.40E-07
127-18-4	Tetrachloroethylene	1.34E-09	5.38E-06
79-01-6	Trichloroethylene	1.47E-09	5.87E-06
75-01-4	Vinyl Chloride/Chloroethene	N/A	N/A

Notes: [1] The results were obtained from a contaminated soil emission sampling conducted July 7 and July 8, 2004 calibrated scale. For the purposes of this assessment a 500 ppb scale was used. Along with the sample result, the equipment's zero and span values were also recorded for each sample day. The analyzer was calibrated prior to the start of the sampling program and each sample day using zero/span checks.

2.4 Contaminated Soil Emission Sampling

The Ottawa Landfill receives contaminated soil from off-site locations for use as daily cover. The majority of this soil is petroleum fuel-contaminated and contains fuel-related VOCs such as benzene and other light aromatic compounds. A flux chamber measurement program was used to determine the emission rates originating from the contaminated soil stockpiles.

A total of six samples were collected over the course of two days; July 7 and 8, 2004. Since loads of contaminated soil that originate from separate locations may differ in contaminant type and concentration, only one sample was taken from a particular load or pile. Emissions of VOCs from the soil will generally decrease with increasing surface exposure time. The majority of the samples (4 of 6) were taken from piles that had been deposited less than one hour prior to the commencement of sampling. The remaining samples were collected from piles that were less than 24 hours old. No samples were collected from piles that had been deposited more than 24 hours prior to sampling.

The soil emission samples were collected using a stainless steel flux chamber. This flux chamber was 71 cm in diameter, 31 cm high, and constructed of 14 gauge stainless steel, as per the designers specifications[6]. All interior and exterior fittings were stainless steel and all lines were made from Teflon tubing. The flux chamber was equipped with five exit ports, air and soil temperature probes, and a chamber differential pressure gauge. The flux chamber was placed on the surface of the contaminated soil pile and the bottom edge of the chamber was forced a short depth into the surface to create a seal. The flux chamber was operated under a slight positive

[6] Reinhart, D.R., D.C. Cooper and B.L. Walker. "*Flux Chamber Design and Operation for the Measurement of Solid Waste Landfill Gas Emission Rates.*" Journal of Air and Waste Management Association. 42-1067-70. 1992.

pressure (0.045 inches H_2O) to further prevent outside air from entering underneath the walls and into the chamber, as recommended by the designer[6].

The flux chamber was operated within parameters recommended by the designers to minimize biasing of gas emission rates and produce accurate measurements[6]. The flux chamber was purged with a sweep gas of nitrogen for 35 minutes at a rate of 15.38 L/min (2.563 x 10^{-4} m^3/s). This sweep gas essentially displaced any residual outside air present in the chamber after it was placed on the surface of the contaminated soil. The purpose of introducing air into the chamber at a fixed rate was to establish equilibrium between VOC emissions from the sample surface and the sweep gas entering the chamber. The sweep gas was introduced into the flux chamber using Teflon tubing. The flow of purge gas (sweep rate) was regulated using a Matheson rotameter. The rotameter was calibrated using a Gilian automated bubble meter, which is a primary standard air flow calibrator. The total amount of purged gas introduced into the chamber was such that about 99% of the original air was purged from the flux chamber prior to sampling.

After the flux chamber had been purged, a VOC sample was drawn from the chamber using a four-phase stainless steel adsorbent tube. The sample was collected using the VOC sample train, in accordance to the U.S. EPA Method TO-17. An average sample flow rate of 406 mL/min was maintained for approximately 25 minutes, resulting in sample volumes ranging from 8.8 to 11.1 liters. The sample tubes were sent to OSB Labs in Brampton to be analyzed for all of the VOC species defined in the MOE target list (See Table 1.2.1). The emission flux rate ($g/m^2/s$) for each compound was determined using Equation 1.

Equation 1:

$$E = \frac{C * Q}{A}$$

Where: E = VOC flux rate ($g/m^2/s$);

C = VOC concentration (g/m^3);

Q = sweep rate of gas into the flux chamber (m^3/s); and

A = surface area enclosed by the flux chamber (m^2).

As with the ambient VOC samples, a blank sample tube (travel blank) was submitted for analysis at OSB Labs for quality assurance purposes.

2.5 Quality Assurance Measures

A number of quality assurance (QA) measures were implemented during the sampling program to ensure the integrity of the results. These measures include detailed documentation of all field activities, calibration of all samplers, analyses of unexposed samples (blanks), and a number of laboratory-related measures including sample handling procedures and instrument calibrations.

Field notes were completed for all sampling activities. All activities and observations were documented on written field data sheets, including sampler locations, general weather conditions, and equipment settings. All field data sheets have been kept on file for future reference.

All of the samplers were bench-tested and calibrated in RWDI's Guelph office prior to field deployment and calibrated again in the field before use. Field notes related to the calibration activities were also documented and filed.

Chain of Custody forms were completed and submitted to the laboratory along with the exposed samples. Copies of these forms have been filed for future reference. Exposed VOC sample tubes were packed in coolers for the duration of transport, as required by the method. As well, the raw landfill gas samples were placed in opaque bags immediately following collection in order to prevent the breakdown of VOC components due to light exposure. All sampling media were provided or prepared by the laboratory responsible for its subsequent analysis. As outlined above, field and travel blanks representing approximately 10% of the total number of samples were submitted for both the ambient VOC and flux chamber measurement programs.

3.3 Ambient H_2S Sampling Results

Samples for ambient H_2S were collected from the landfill site. These samples were collected concurrently with the ambient VOC samples and analyzed on-site immediately after collection. The sample locations can be found in Figures A1-A25. Prior to installation, the analyzer was calibrated by the supplier using a standard 3-point test. The raw concentration readings from the analyzer were adjusted relative to the zero and span values for each particular day in order to obtain the corrected H_2S concentration results. The corrected H_2S results are presented in Table 3.3.1 for the downwind samples and in Table 3.3.2 for the upwind samples. Both of these tables can be found in the Tables section of the report.

For the downwind samples, the maximum measured H_2S concentration was 8.14 $\mu g/m^3$ (5.5 ppb) on August 17, 2004. This concentration represents 27.1% of the 30 $\mu g/m^3$ POI Limit for H_2S. In terms of the upwind results, the maximum measured concentration was 6.46 $\mu g/m^3$ (4.4 ppb), which represents 21.5% of the POI Limit.

3.4 Contaminated Soil Emissions Sampling Results

Flux chamber samples of the contaminated soil pad area were analyzed against the target list of VOC compounds. The results are presented in Tables 3.4.1a and 3.4.1b and can be found in the Tables section. The results obtained from the lab were converted into flux rates ($g/m^2/s$) by entering the appropriate variables into Equation 1, as outlined in Section 2.4 of this report.

The VOC compound with the maximum measured concentration was trichloroethylene (TCE) at 59.53 $\mu g/m^3$, with a corresponding flux rate of 3.81×10^{-8} $g/m^2/s$, from sample OF-Flux-3, taken on July 7, 2004. The remaining 5 samples, however, had significantly lower levels of TCE. This high TCE value is therefore taken to be atypical of the general contaminated soil emissions. A high benzene emission rate was found in sample OF-Flux-2 with a concentration of 52.69 $\mu g/m^3$. The total VOCs (TVOCs) measured on these days were also high, relative to the other samples. Overall, the compounds with the highest average flux rates were benzene, with a maximum rate of 3.38×10^{-8} $g/m^2/s$ and an average rate of 1.23×10^{-8} $g/m^2/s$, and octane with a maximum of 1.59×10^{-8} and an average of 1.00×10^{-8} $g/m^2/s$. These light aromatics are typical of compounds found in petroleum fuel-contaminated soil.

4. EMISSION RATE DEVELOPMENT

4.1 LANDGEM

In order to predict impacts using numerical models, emission rates for the compounds of interest must first be developed. The United States Environmental Protection Agency's (U.S. EPA) Landfill Gas Emissions Model (LANDGEM) was used to estimate the emission rates for the 23 target landfill gas compounds[5]. This model is currently recommended by the MOE to assess gas generation from municipal solid waste (MSW) landfills in Ontario. Emission estimates from LANDGEM have been previously found to be conservative in some cases. A previous study completed by RWDI suggests that LANDGEM overestimates by a factor of 2.5 [7]. Site-specific concentrations of landfill gas generated non-methane organic carbons (NMOCs), which in this case included both VOCs and reduced sulphur species, were used in the model to replace the default values, and thus more accurately reflect the on-site conditions.

To determine NMOC emission rates from MSW landfills using LANDGEM, the U.S. EPA developed a three-tier approach, which is outlined below:

Tier 1: NMOC emissions are determined by using the default values provided by the model, which include the landfill gas generation rate and concentration of NMOCs within the landfill. Site-specific landfill characteristics such as the capacity of the landfill site and the waste deposition history are required for Tier 1;

Tier 2: Sampling probes are installed at the landfill to measure NMOC concentrations within the waste mounds. NMOC emission rates are often based on the site-specific measured NMOC levels; and,

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7 Rowan Williams Davies and Irwin Inc. *Proposed Canadian Waste Services Inc. Approach to Calculate Non-Methane Organic Compounds from Non-Hazardous Landfills in Ontario.* Dated September 4, 2001.

Table 3.4.1a: Flux Chamber V0C Sampling Results - Contaminated Soil

CAS #	Compound	July 7, 2004 OF-Flux-1			July 7, 2004 OF-Flux-2			July 7, 2004 OF-Flux-3		
		Mass (ng)	Concentration (μg/m³)	Flux Rate (μg/m²/s)	Mass (ng)	Concentration (μg/m³)	Flux Rate (μg/m²/s)	Mass (ng)	Concentration (μg/m³)	Flux Rate (μg/m²/s)
75-01-4	Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-00-3	Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-35-4	1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-09-2	Dichloromethane	14.6	1.65	1.06E-03	94	10.54	6.75E-03	58	6.39	4.10E-03
156-60-5	1,2-Dichloroethene (Trans)	ND	ND	ND	ND	ND	ND	1.7	0.19	1.20E-04
75-34-3	1,1-Dichloroethane	ND	ND	ND	1.6	0.18	1.15E-04	2.2	0.24	1.55E-04
78-92-2	2-Butanol	2.2	0.25	1.59E-04	2.2	0.25	1.58E-04	2.2	0.24	1.55E-04
156-59-2	1,2-Dichloroethene (Cis)	ND	ND	ND	1.2	0.13	8.62E-05	87	9.59	6.15E-03
67-66-3	Chloroform	U	U	U	U	U	U	U	U	U
56-23-5	Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-55-6	1,1,1-Trichloroethane	1.5	0.17	1.09E-04	1.1	0.12	7.90E-05	0.2	0.02	1.41E-05
71-43-2	Benzene	15.6	1.76	1.13E-03	470	52.69	3.38E-02	18.8	2.07	1.33E-03
107-06-2	1,2-Dichloroethane	1.8	0.20	1.30E-04	11.1	1.24	7.97E-04	0.6	0.07	4.24E-05
79-01-6	Trichloroethylene	0.7	0.08	5.07E-05	1.1	0.12	7.90E-05	540	59.54	3.82E-02
75-27-4	Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-88-3	Toluene	78	8.82	5.65E-03	66	7.40	4.74E-03	34	3.75	2.40E-03
111-65-9	Octane	220	24.89	1.59E-02	210	23.54	1.51E-02	83	9.15	5.86E-03
79-00-5	1,1,2-Trichloroethane	U	U	U	U	U	U	U	U	U
127-18-4	Tetrachloroethylene	2.4	0.27	1.74E-04	4.1	0.46	2.95E-04	6.6	0.73	4.66E-04
106-93-4	Ethylene Dibromide	U	U	U	U	U	U	U	U	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
-	TVOCs (Toluene)	144000	16289.59	1.04E+01	298000	33408.07	2.14E+01	173000	19073.87	1.22E+01
	Sample Tube:	SS24			SS28			SS31		
	Sample Duration (min):	25			23			22		
	Sample Volume (L):	8.84			8.92			9.07		

Notes:
U - Unresolved due to co-elution
Blank - Below integration threshold but presence or absence was not verified by manual search
ND - Characteristic ions are not present therefore Not Detected
* - Sum of all isomers

Table 3.4.1a: Flux Chamber V0C Sampling Results - Contaminated Soil

CAS #	Compound	July 7, 2004 OF-Flux-1			July 7, 2004 OF-Flux-2			July 7, 2004 OF-Flux-3		
		Mass (ng)	Concentration (μg/m^3)	Flux Rate (μg/m^2/s)	Mass (ng)	Concentration (μg/m^3)	Flux Rate (μg/m^2/s)	Mass (ng)	Concentration (μg/m^3)	Flux Rate (μg/m^2/s)
75-01-4	Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-00-3	Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-35-4	1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-09-2	Dichloromethane	14.6	1.65	1.06E-03	94	10.54	6.75E-03	58	6.39	4.10E-03
156-60-5	1,2-Dichloroethene (Trans)	ND	ND	ND	ND	ND	ND	1.7	0.19	1.20E-04
75-34-3	1,1-Dichloroethane	ND	ND	ND	1.6	0.18	1.15E-04	2.2	0.24	1.55E-04
78-92-2	2-Butanol	2.2	0.25	1.59E-04	2.2	0.25	1.58E-04	2.2	0.24	1.55E-04
156-59-2	1,2-Dichloroethene (Cis)	ND	ND	ND	1.2	0.13	8.62E-05	87	9.59	6.15E-03
67-66-3	Chloroform	U	U	U	U	U	U	U	U	U
56-23-5	Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-55-6	1,1,1-Trichloroethane	1.5	0.17	1.09E-04	1.1	0.12	7.90E-05	0.2	0.02	1.41E-05
71-43-2	Benzene	15.6	1.76	1.13E-03	470	52.69	3.38E-02	18.8	2.07	1.33E-03
107-06-2	1,2-Dichloroethane	1.8	0.20	1.30E-04	11.1	1.24	7.97E-04	0.6	0.07	4.24E-05
79-01-6	Trichloroethylene	0.7	0.08	5.07E-05	1.1	0.12	7.90E-05	540	59.54	3.82E-02
75-27-4	Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-88-3	Toluene	78	8.82	5.65E-03	66	7.40	4.74E-03	34	3.75	2.40E-03
111-65-9	Octane	220	24.89	1.59E-02	210	23.54	1.51E-02	83	9.15	5.86E-03
79-00-5	1,1,2-Trichloroethane	U	U	U	U	U	U	U	U	U
127-18-4	Tetrachloroethylene	2.4	0.27	1.74E-04	4.1	0.46	2.95E-04	6.6	0.73	4.66E-04
106-93-4	Ethylene Dibromide	U	U	U	U	U	U	U	U	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND
-	TVOCs (Toluene)	144000	16289.59	1.04E+01	298000	33408.07	2.14E+01	173000	19073.87	1.22E+01
	Sample Tube:	SS24			SS28			SS31		
	Sample Duration (min):	25			23			22		
	Sample Volume (L):	8.84			8.92			9.07		

Notes:
U - Unresolved due to co-elution
Blank - Below integration threshold but presence or absence was not verified by manual search
ND - Characteristic ions are not present, therefore, not detected
* - Sum of all isomers

Table 3.4.1b: Flux Chamber VOC Sampling Results - Contaminated Soil

CAS #	Compound	July 7, 2004 OF-Flux-4			July 8, 2004 OF-Flux-5			July 8, 2004 OF-Flux-6			July 7, 2004 (Blank)
		Mass (ng)	Concentration (μg/m³)	Flux Rate (μg/m²/s)	Mass (ng)	Concentration (μg/m³)	Flux Rate (μg/m²/s)	Mass (ng)	Concentration (μg/m³)	Flux Rate (μg/m²/s)	Mass (ng)
75-01-4	Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-00-3	Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-35-4	1,1-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
75-09-2	Dichloromethane	32	3.63	2.33E-03	14.4	1.30	8.34E-04	29	2.77	1.77E-03	6.3
156-60-5	1,2-Dichloroethene (Trans)	ND	ND	ND	1.9	0.17	1.10E-04	1.3	0.12	7.95E-05	ND
75-34-3	1,1-Dichloroethane	0.7	0.08	5.09E-05	53	4.79	3.07E-03	36	3.44	2.20E-03	ND
78-92-2	2-Butanol	2.2	0.25	1.60E-04	2.2	0.20	1.27E-04	2.2	0.21	1.35E-04	2.2
156-59-2	1,2-Dichloroethene (Cis)	0.4	0.05	2.91E-05	10.6	0.96	6.14E-04	58	5.53	3.55E-03	ND
67-66-3	Chloroform	U	U	U	U	U	U	U	U	U	U
56-23-5	Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-55-6	1,1,1-Trichloroethane	1.6	0.18	1.16E-04	1.6	0.14	9.27E-05	2.1	0.20	1.28E-04	ND
71-43-2	Benzene	32	3.63	2.33E-03	15.5	1.40	8.98E-04	22	2.10	1.35E-03	6.9
107-06-2	1,2-Dichloroethane	0.5	0.06	3.64E-05	0.5	0.05	2.90E-05	1.5	0.14	9.17E-05	ND
79-01-6	Trichloroethylene	1.4	0.16	1.02E-04	8.7	0.79	5.04E-04	24	2.29	1.47E-03	ND
75-27-4	Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
108-88-3	Toluene	58	6.58	4.22E-03	49	4.43	2.84E-03	43	4.10	2.63E-03	16.8
111-65-9	Octane	12.5	1.42	9.09E-04	44	3.98	2.55E-03	121	11.55	7.40E-03	0.7
79-00-5	1,1,2-Trichloroethane	U	U	U	U	U	U	U	U	U	U
127-18-4	Tetrachloroethylene	3.8	0.43	2.76E-04	9.4	0.85	5.45E-04	22	2.10	1.35E-03	1.6
106-93-4	Ethylene Dibromide	U	U	U	U	U	U	U	U	U	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
-	TVOCs (Toluene)	7500	851.31	5.46E-01	36000	3254.97	2.09E+00	116000	11068.70	7.09E+00	480
	Sample Tube:	SS26			SS25			SS29			
	Sample Duration (min):	21			25			25			
	Sample Volume (L):	8.81			11.06			10.48			

Notes:
U - Unresolved due to co-elution
Blank - Below integration threshold but presence or absence was not verified by manual search
ND - Characteristic ions are not present, therefore, not detected
* - Sum of all isomers

Appendix C

Appendix C1

Comparison of Leachate Influent Characteristics – All Measured Leachate Contaminants at Ottawa Landfill

C1: Comparison of Leachate Influent Characteristics - All Measured Leachate Contaminants at Ottawa Landfill

Contaminant	Ottawa Landfill Raw Leachate Jan. 6, 2010 (ug/L)	Ottawa Landfill Raw Leachate Jan. 6, 2010 (mg/L)	Ottawa Landfill Raw Leachate Jan. 15, 2010 (ug/L)	Ottawa Landfill Raw Leachate Jan. 15, 2010 (mg/L)	Maximum Measured Ottawa Landfill Raw Leachate (mg/L)	Twin Creeks Landfill Estimated Influent Characteristics (SBR) (mg/L)
Methane	3600	3.6	1900	1.9	3.6	
Ammonia	1600000	1600	1600000	1600	1600	800
Inorganics						
Total BOD	- -	1200	- -	1600	1600	1750
Total Kjeldahl Nitrogen (TKN)	- -	1600	- -	1800	1800	960
pH	- -	7.6	- -	7.5 (pH)	7.6	6.8-7.5
Phenols-4AAP	- -	0.42	- -	0.22	0.42	1
Total Phosphorus	- -	11	- -	12	12	3
Total Suspended Solids	- -	61	- -	140	140	150
Dissolved Sulphate (SO4)	- -	200	- -	200	200	500
Sulphide	- -	1.5	- -	4.2	4.2	
Total Cyanide (CN)	- -	0.017	- -			
Metals						
Mercury (Hg)	3	0.003	3	0.003	0.003	0.005
Total Aluminum (Al)	800	0.8	1900	1.9	1.9	4.09
Total Antimony (Sb)	14	0.014	13	0.013	0.014	
Total Arsenic (As)	67	0.067	63	0.063	0.067	<0.11
Total Bismuth (Bi)	5	0.005	10	0.01	0.01	
Total Boron (B)	18000	18	16000	16	18	50
Total Cadmium (Cd)	1	0.001	1	0.001	0.001	0.12
Total Chromium (Cr)	250	0.25	220	0.22	0.25	0.5
Total Cobalt (Co)	80	0.08	87	0.087	0.087	<0.115
Total Copper (Cu)	20	0.02	20	0.02	0.02	0.1
Total Lead (Pb)		0	28	0.028	0.028	1.38
Total Manganese (Mn)	1200	1.2	780	0.78	1.2	1
Total Molybdenum (Mo)	37	0.037	30	0.03	0.037	<0.06
Total Nickel (Ni)	300	0.3	320	0.32	0.32	0.5
Total Selenium (Se)	50	0.05	50	0.05	0.05	<0.100
Total Silver (Ag)	0.5	0.0005	1	0.001	0.001	
Total Tin (Sn)	47	0.047	48	0.048	0.048	
Total Titanium (Ti)	280	0.28	330	0.33	0.33	0.29
Total Vanadium (V)	59	0.059	47	0.047	0.059	0.115
Total Zinc (Zn)	640	0.64	2400	2.4	2.4	0.3
Volatile Organics						
Benzene	10	0.01	6	0.006	0.006	0.046
Bromodichloromethane	10	0.01	2	0.002	0.01	
Bromoform	20	0.02	4	0.004	0.02	
Bromomethane	50	0.05	10	0.01	0.05	
Carbon Tetrachloride	10	0.01	2	0.002	0.01	
Chlorobenzene	10	0.01	7	0.007	0.007	
Chloroform	10	0.01	2	0.002	0.01	
Dibromochloromethane	20	0.02	4	0.004	0.02	
1,2-Dichlorobenzene	20	0.02	4	0.004	0.02	
1,3-Dichlorobenzene	20	0.02	4	0.004	0.02	
1,4-Dichlorobenzene	25	0.025	22	0.022	0.025	0.023
1,1-Dichloroethane	10	0.01	2	0.002	0.01	
1,2-Dichloroethane	20	0.02	4	0.004	0.02	0.035
1,1-Dichloroethylene	10	0.01	2	0.002	0.01	0.046
cis-1,2-Dichloroethylene	10	0.01	6	0.006	0.006	
trans-1,2-Dichloroethylene	10	0.01	2	0.002	0.01	
1,2-Dichloroethylene	- -	- -	- -	0.008	0.008	1.104
1,2-Dichloropropane	10	0.01	2	0.002	0.01	
cis-1,3-Dichloropropene	20	0.02	4	0.004	0.02	
trans-1,3-Dichloropropene	20	0.02	4	0.004	0.02	
Ethylbenzene	50	0.05	40	0.04	0.05	0.391
Ethylene Dibromide	20	0.02	4	0.004	0.02	
Methylene Chloride(Dichloromethane)	50	0.05	10	0.01	0.05	7.59
Styrene	20	0.02	4	0.004	0.02	
1,1,2,2-Tetrachloroethane	20	0.02	4	0.004	0.02	
Tetrachloroethylene	10	0.01	2	0.002	0.01	0.046
Toluene	250	0.25	120	0.12	0.25	2.21
1,1,1-Trichloroethane	10	0.01	2	0.002	0.01	
1,3,5-Trimethylbenzene	20	0.02	7	0.007	0.007	
1,1,2-Trichloroethane	20	0.02	4	0.004	0.02	
Trichloroethylene	10	0.01	2	0.002	0.01	0.127
Vinyl Chloride	20	0.02	4	0.004	0.02	0.127
p+m-Xylene	97	0.097	90	0.09	0.097	1.3
o-Xylene	40	0.04	40	0.04	0.04	0.529
Xylene (Total)	140	0.14	130	0.13	0.14	1.829
Chloroethane	20	0.02	4	0.004	0.02	
Chloromethane	50	0.05	10	0.01	0.05	
Trichlorofluoromethane (FREON 11)	20	0.02	4	0.004	0.02	

C1: Comparison of Leachate Influent Characteristics - All Measured Leachate Contaminants at Ottawa Landfill

Contaminant	Ottawa Landfill Raw Leachate Jan. 6, 2010 (ug/L)	Ottawa Landfill Raw Leachate Jan. 6, 2010 (mg/L)	Ottawa Landfill Raw Leachate Jan. 15, 2010 (ug/L)	Ottawa Landfill Raw Leachate Jan. 15, 2010 (mg/L)	Maximum Measured Ottawa Landfill Raw Leachate (mg/L)	Twin Creeks Landfill Estimated Influent Characteristics (SBR) (mg/L)
Semivolatile Organics						
Acenaphthene	4	0.004	1	0.001	0.004	
Acenaphthylene	4	0.004	1	0.001	0.004	
Di-N-butyl phthalate	30	0.03	10	0.01	0.03	
3,3'-Dichlorobenzidine	10	0.01	4	0.004	0.01	
Pentachlorophenol	20	0.02	5	0.005	0.02	
Phenanthrene	4	0.004	2	0.002	0.004	
Anthracene	4	0.004	1	0.001	0.004	
Fluoranthene	4	0.004	1	0.001	0.004	
Pyrene	4	0.004	1	0.001	0.004	
Benzo(a)anthracene	4	0.004	1	0.001	0.004	
Chrysene	4	0.004	1	0.001	0.004	
Benzo(b/j)fluoranthene	4	0.004	1	0.001	0.004	
Benzo(k)fluoranthene	4	0.004	1	0.001	0.004	
Benzo(a)pyrene	4	0.004	1	0.001	0.004	
Indeno(1,2,3-cd)pyrene	8	0.008	3	0.003	0.008	
Dibenz(a,h)anthracene	8	0.008	3	0.003	0.008	
Fluorene	30	0.03	4	0.004	0.03	
Benzo(g,h,i)perylene	8	0.008	3	0.003	0.008	
1-Methylnaphthalene	30	0.03	4	0.004	0.03	
2-Methylnaphthalene	30	0.03	4	0.004	0.03	
Dibenzo(a,i)pyrene	8	0.008	3	0.003	0.008	
Naphthalene	42	0.042	10	0.01	0.042	
Benzo(e)pyrene	4	0.004	1	0.001	0.004	
Hexachlorobenzene	80	0.08	10	0.01	0.08	
Perylene	4	0.004	1	0.001	0.004	
Dibenzo(a,j)acridine	8	0.008	3	0.003	0.008	
7H-Dibenzo(c,g)Carbazole	8	0.008	3	0.003	0.008	
1,6-Dinitropyrene	8	0.008	3	0.003	0.008	
1,3-Dinitropyrene	8	0.008	3	0.003	0.008	
1,8-Dinitropyrene	8	0.008	3	0.003	0.008	
Benzyl butyl phthalate	80	0.08	10	0.01	0.08	
Bis(2-chloroethoxy)methane	80	0.08	10	0.01	0.08	
Bis(2-ethylhexyl)phthalate	120	0.12	65	0.065	0.12	
Di-N-butyl phthalate	300	0.3	40	0.04	0.3	
Di-N-octyl phthalate	100	0.1	20	0.02	0.1	
Diethyl phthalate	200	0.2	20	0.02	0.2	
Indole	200	0.2	20	0.02	0.2	
Calculated Parameters		0				
Total PAHs (18 PAHs)	8	0.008	3	0.003	0.008	

<-- note: shaded values were presented in the lab report as less than (<) the indicated amount.

Appendix C2

Comparison of Leachate Influent Characteristics – Detected and/or Matching Twin Creeks Contaminants

C2: Comparison of Leachate Influent Characteristics - Detected and/or Matching Twin Creeks Contaminants

Contaminant	Maximum Measured Ottawa Landfill Raw Leachate (mg/L)	Twin Creeks Landfill Estimated Influent Characteristics (SBR) (mg/L)	Maximum Value (mg/L)	Source of Maximum Value
Methane	3.6	- -	3.6	Ottawa
Ammonia	1600	800	1600	Ottawa
Inorganics				
Total BOD	1600	1750	1750	Twin Creeks
Total Kjeldahl Nitrogen (TKN)	1800	960	1800	Ottawa
pH	7.6	6.8-7.5	7.6	Ottawa
Phenols-4AAP	0.42	1	1	Twin Creeks
Total Phosphorus	12	3	12	Ottawa
Total Suspended Solids	140	150	150	Twin Creeks
Sulphide	4.2	- -	4.2	Ottawa
Volatile Organics				
Benzene	0.006	0.046	0.046	Twin Creeks
Chlorobenzene	0.007	- -	0.007	Ottawa
1,4-Dichlorobenzene	0.025	0.023	0.025	Ottawa
cis-1,2-Dichloroethylene	0.006	- -	0.006	Ottawa
1,2-Dichloroethylene	0.008	1.104	1.104	Twin Creeks
Ethylbenzene	0.05	0.391	0.391	Twin Creeks
Toluene	0.25	2.21	2.21	Twin Creeks
1,3,5-Trimethylbenzene	0.007	- -	0.007	Ottawa
p+m-Xylene	0.097	1.3	1.3	Twin Creeks
o-Xylene	0.04	0.529	0.529	Twin Creeks
Xylene (Total)	0.14	1.829	1.829	Twin Creeks
Chloroethane	0.02	- -	0.02	Ottawa
Chloromethane	0.05	- -	0.05	Ottawa
Semivolatile Organics				
Phenanthrene	0.004	- -	0.004	Ottawa
Naphthalene	0.042	- -	0.042	Ottawa
Bis(2-ethylhexyl)phthalate	0.12	- -	0.12	Ottawa

(purple)	= compound reported as less than the indicated amount
(orange)	= compound listed in Water9 program

Appendix C3

Raw Leachate Equalization Tank Emissions from Water9 – Based on Concentrations in Raw Leachate

C3: Raw Leachate Equalization Tank
Emissions from Water9 - based on Concentrations in Raw Leachate

WASTEWATER TREATMENT SUMMARY I 10-22-2010 16:31:48

Project C:\Documents and Settings\sjp\Desktop\05 Water9\ottawa_equal 24/09/2010 10:47:11 AM

COMPOUND	RATE (g/s)	Fraction				error
		Air	Removal	Exit	Adsorb	
AMMONIA *	3.06E-04	0.00004	.	1	0	0
METHANE	1.66E-02	0.95693	.	0.0431	0	0
PHENOL	9.44E-07	0.0002	.	0.9998	0	0
SULFIDE *	0.00E+00	.	.	1	0	0
PHOSPHORUS	0.00E+00	.	.	1	0	0
BENZENE	5.48E-05	0.24656	.	0.7534	0	0
CHLOROBENZENE	9.90E-06	0.29309	.	0.7069	0	0
CHLOROETHANE (ethyl chloride)	3.96E-05	0.41018	.	0.5898	0	0
1,4 DICHLOROBENZENE (-p)	2.62E-05	0.21746	.	0.7825	0	0
DICHLOROETHYLENE(1,2) cis	6.80E-04	0.12764	.	0.8724	0	0
ETHYLBENZENE	4.46E-04	0.23621	.	0.7638	0	0
METHYLENE CHLORIDE, dichloromethane	2.76E-03	0.07533	.	0.9247	0	0
TOLUENE	1.74E-03	0.16266	.	0.8373	0	0
TRIMETHYLBENZENE (1,3,5)	1.27E-05	0.3763	.	0.6237	0	0
XYLENE	1.59E-03	0.18024	.	0.8198	0	0
BIS(2-ETHYLHEXYL)PHTHALATE	3.04E-07	0.00052	.	0.9995	0	0
NAPHTHALENE	2.04E-05	0.10015	.	0.8999	0	0
PHENANTHRENE	3.70E-07	0.0192	.	0.9808	0	0

Appendix C4

SBR Tank Emissions from Water9 – Based on Concentrations in Raw Leachate

C4: SBR Tank
Emissions from Water9 - based on Concentrations in Raw Leachate

WASTEWATER TREATMENT SUMMARY I 10-22-2010 16:32:38

Project C:\Documents and Settings\sjp\Desktop\05 Water9\ottawa_sbr 24/09/2010 10:49:10 AM

COMPOUND	RATE (g/s)	Fraction				error
		Air	Removal	Exit	Adsorb	
AMMONIA	2.06E-01	0.00226	.	0.9977	0	0
METHANE	2.02E-01	0.9859	0.0124	0.0017	0	0
PHENOL	1.30E-07	.	0.9979	0.0021	0	0
SULFIDE	1.91E-17	.	.	1	0	0
PHOSPHORUS	5.46E-17	.	.	1	0	0
BENZENE	2.90E-04	0.11094	0.8717	0.0174	0	0
CHLOROBENZENE	5.06E-06	0.01272	0.9845	0.0028	0	0
CHLOROETHANE (ethyl chloride)	4.54E-04	0.39965	0.5673	0.033	0	0
1,4 DICHLOROBENZENE (-p)	6.72E-05	0.04737	0.9397	0.0129	0	0
DICHLOROETHYLENE(1,2) cis	5.18E-02	0.827	.	0.173	0	0
ETHYLBENZENE	2.54E-03	0.114	0.8734	0.0126	0	0
METHYLENE CHLORIDE, dichloromethane	7.56E-02	0.17557	0.7711	0.0533	0	0
TOLUENE	1.02E-02	0.08109	0.908	0.0109	0	0
TRIMETHYLBENZENE (1,3,5)	1.81E-05	0.04563	0.9462	0.0081	0	0
XYLENE	8.58E-03	0.08253	0.9023	0.0152	0	0
BIS(2-ETHYLHEXYL)PHTHALATE	5.08E-06	0.00075	0.7587	0.2406	0	0
NAPHTHALENE	1.03E-04	0.04319	0.9276	0.0292	0	0
PHENANTHRENE	8.46E-08	0.00037	0.9774	0.0223	0	0

Appendix C5

Effluent Equalization Tank Emissions from Water9 – Based on Concentrations in Raw Leachate

C5: Effluent Equalization Tank
Emissions from Water9 - based on Concentrations in Raw Leachate

WASTEWATER TREATMENT SUMMARY I 10-22-2010 16:29:58

Project C:\Documents and Settings\sjp\Desktop\05 Water9\ottawa_effluent 24/09/2010 10:44:31 AM

COMPOUND	RATE (g/s)	Fraction				error
		Air	Removal	Exit	Adsorb	
AMMONIA	5.08E-06	0.00004	.	1	0	0
METHANE	1.53E-02	0.91733	.	0.0827	0	0
PHENOL	4.48E-07	0.0001	.	0.9999	0	0
SULFIDE	0.00E+00	.	.	1	0	0
PHOSPHORUS	0.00E+00	.	.	1	0	0
BENZENE	3.12E-05	0.14703	.	0.853	0	0
CHLOROBENZENE	5.58E-06	0.17279	.	0.8272	0	0
CHLOROETHANE (ethyl chloride)	2.44E-05	0.26363	.	0.7364	0	0
1,4 DICHLOROBENZENE (-p)	1.44E-05	0.12471	.	0.8753	0	0
DICHLOROETHYLENE(1,2) cis	3.92E-04	0.07667	.	0.9233	0	0
ETHYLBENZENE	2.64E-04	0.14596	.	0.854	0	0
METHYLENE CHLORIDE, dichloromethane	1.62E-03	0.04613	.	0.9539	0	0
TOLUENE	1.03E-03	0.10133	.	0.8987	0	0
TRIMETHYLBENZENE (1,3,5)	7.52E-06	0.23232	.	0.7677	0	0
XYLENE	9.50E-04	0.11239	.	0.8876	0	0
BIS(2-ETHYLHEXYL)PHTHALATE	1.42E-07	0.00026	.	0.9997	0	0
NAPHTHALENE	1.05E-05	0.05423	.	0.9458	0	0
PHENANTHRENE	1.76E-07	0.0095	.	0.9905	0	0

Appendix C6

Sludge Tank Emissions from Water9 – Based on Concentrations in Raw Leachate

C6: Sludge Tank
Emissions from Water9 - based on Concentrations in Raw Leachate

WASTEWATER TREATMENT SUMMARY I 10-22-2010 16:33:39

Project C:\Documents and Settings\sjp\Desktop\05 Water9\ottawa_sludge 24/09/2010 10:50:44 AM

COMPOUND	RATE	Fraction				error
	(g/s)	Air	Removal	Exit	Adsorb	
AMMONIA	1.64E-03	0.00065	.	0.9994	0	0
METHANE	3.62E-01	0.99676	.	0.0032	0	0
PHENOL	3.22E-05	0.00032	.	0.9997	0	0
SULFIDE	9.34E-18	.	.	1	0	0
PHOSPHORUS	2.68E-17	.	.	1	0	0
BENZENE	3.18E-03	0.68477	.	0.3152	0	0
CHLOROBENZENE	3.96E-04	0.55916	.	0.4408	0	0
CHLOROETHANE (ethyl chloride)	1.69E-03	0.83612	.	0.1639	0	0
1,4 DICHLOROBENZENE (-p)	8.96E-04	0.3545	.	0.6455	0	0
DICHLOROETHYLENE(1,2) cis	7.48E-02	0.67122	.	0.3288	0	0
ETHYLBENZENE	2.50E-02	0.63158	.	0.3684	0	0
METHYLENE CHLORIDE, dichloromethane	4.42E-01	0.57601	.	0.424	0	0
TOLUENE	1.48E-01	0.66133	.	0.3387	0	0
TRIMETHYLBENZENE (1,3,5)	2.38E-04	0.33693	.	0.6631	0	0
XYLENE	1.12E-01	0.6041	.	0.3959	0	0
BIS(2-ETHYLHEXYL)PHTHALATE	2.42E-06	0.0002	.	0.9998	0	0
NAPHTHALENE	7.44E-04	0.17555	.	0.8244	0	0
PHENANTHRENE	6.72E-07	0.00166	.	0.9983	0	0

Appendix D

Appendix D1

Leachate Evaporator Sampling Summary – Flow Characteristics

Appendix D1: Leachate Evaporator Sampling Summary - Flow Characteristics

Stack Gas Parameter		Test No. 1			Test No. 2			Test No. 3			TOTAL AVERAGE
		SVOC[1]	TPM[2]	Average	SVOC[1]	TPM[2]	Average	SVOC[1]	TPM[2]	Average	
Testing Date											-
Stack Temperature	°F	183	182	183	184	182	183	185	182	184	183
	°C	84	84	84	84	83	84	85	83	84	84
Moisture	%	0.482	0.5	0.474	0.469	0.5	0.471	0.466	0.5	0.47	0.5
Velocity	ft/s	67.6	61.8	64.7	65.5	57.9	61.7	63.8	58.8	61.3	62.6
	m/s	20.6	18.8	19.7	19.9	17.7	18.8	19.5	17.9	18.7	19.1
Actual Flow Rate	CFM	16,700	15,300	16,000	16,200	14,300	15,300	15,800	6,390	11,100	14,100
Referenced Flow Rate[3]	CFM	7,230	6,840	7,040	7,160	6,310	6,740	7,020	181	3,600	5,790
	m^3/s	3.41	3.2	3.3	3.38	3.0	3.2	3.31	3.0	3.2	3.2
Sampling Isokinetic Rate	%	99	94.7	96.8	96	98	97	97	98	97.5	97

Notes:
[1] SVOC = Sampling for PAH's, Dioxins, and Furans
[2] TPM = Sampling for total particulate matter and metals
[3] Referenced flow rate expressed as dry at 101.3 kPa, 25 °C, and Actual Oxygen

Appendix D2

Leachate Evaporator Volatile Organic Compounds – Average Results

Appendix D2: Leachate Evaporator Volatile Organic Compounds[1] - Average Results

Parameter	Concentration[2] (mg/m^3)	Emission Rate (g/s)
Chloromethane	< 7.4	< 0.025
Vinyl Chloride	< 3.7	< 0.012
Bromomethane	< 4.4	< 0.015
Chloroethane[3]	< 2.4	< 0.008
Acetone (2-Propanone)	130	0.43
1,1-Dichloroethylene[3]	< 3.0	< 0.0098
Carbon Disulfide	< 9.1	< 0.03
Methylene Chloride(Dichloromethane)	11.0	0.038
1,1-Dichloroethane[3]	< 3.2	< 0.011
trans-1,2-Dichloroethylene[3]	< 2.7	< 0.0089
cis-1,2-Dichloroethylene[3]	< 2.7	< 0.0089
Chloroform[3]	< 3.0	< 0.0098
1,2-Dichloroethane[3]	< 1.9	< 0.0063
Methyl Ethyl Ketone (2-Butanone)	32.0	0.11
1,1,1-Trichloroethane[3]	< 3.8	< 0.013
Carbon Tetrachloride[3]	< 4.3	< 0.014
Benzene	74.0	0.24
1,1,2-Trichloroethane[3]	< 4.3	< 0.014
1,2-Dichloropropane[3]	< 3.0	< 0.0098
Trichloroethylene[3]	< 3.0	< 0.0098
Dibromomethane[3]	< 2.7	< 0.0089
cis-1,3-Dichloropropene[3]	< 2.7	< 0.0089
trans-1,3-Dichloropropene[3]	< 1.9	< 0.0063
Dibromochloromethane[3]	< 2.4	< 0.008
Methyl Isobutyl Ketone	< 14.0	< 0.045
Methyl Butyl Ketone (2-Hexanone)	< 11.0	< 0.036
Toluene	300.0	0.98
Tetrachloroethylene[3]	< 4.8	< 0.016
Chlorobenzene	< 3.1	< 0.01
Ethylbenzene	< 10.0	< 0.034
m / p-Xylene	24.0	0.081
Styrene	18.0	0.06
o-Xylene	< 7.7	< 0.026
Bromoform[3]	< 3.8	< 0.013
1,1,2,2-Tetrachloroethane[3]	< 3.8	< 0.013

Notes:

[1] Sampling followed NCASI Method 98.01; average of three tests

[2] Concentration values are expressed at 101.3 kPa and 25 °C

"<" = laboratory analysis was below the detection limit, the detection limit was used to calculate concentration and emission rate

Appendix D3

Ammonia – Average Results

Appendix D3: Ammonia[1] - Average Results

Parameter	Concentration[2] (mg/m^3)	Emission Rate (g/s)
Ammonia[3] (NH_3)	449.0	1.35

Notes:

[1] Sampling followed USEPA Method 26 (non-isokinetic); average of three tests

[2] Concentration values are expressed at 101.3 kPa and 25 °C

[3] Ammonium (NH_4, 18 g/mol) is measured by the Lab, it is reported as Ammonia (17 g/mol) for compliance purposes

"<" = laboratory analysis was below the detection limit, the detection limit was used to calculate concentration and emission rate

Appendix E

Supporting Information for Assessment of Negligibility – Ottawa Landfill Leachate Management System Based on SBR System and Leachate Evaporator System

Supporting Information for Assessment of Negligibility - Ottawa Landfill Leachate Management System
Based on SBR System and Leachate Evaporator System

Contaminant Name	Contaminant CAS Number	Source ID	Source Description	Contaminant Emission Rate (by source) (g/s)	Distance to Property Line [2] (m)	Reg. 419 Standard or Guideline (µg/m³)	Criteria [1] 50% of Standard or de minimus (µg/m³)	Regulation Schedule #	Criteria Averaging Time (hours)	Limiting Effect	Table B-1 1-hour Dispersion Factor for Shortest Distance to Property Line [2] (µg/m³ / g/s)	Table B-1 Dispersion Factor Converted to Criteria Averaging Time (µg/m³ / g/s)	Predicted Concentration (µg/m³)	Contaminant Negligible?
1,1 Dichloroethene (vinylidene chloride)	75-35-4		total leachate management plant	5.63E-03	380	10	5	3	24	health	1700	680	3.83E+00	yes
1,2 Dichloroethane	107-06-2		total leachate management plant	1.32E-03	380	2	1	3	24	health	1700	680	9.00E-01	yes
1,3,5 Trimethylbenzene	108-67-8		total leachate management plant	2.76E-04	380	220	110	3	24	heath	1700	680	1.88E-01	yes
1,4 Dichlorobenzene (-p)	106-46-7		total leachate management plant	1.00E-03	380	95	47.5	3	24	health	1700	680	6.83E-01	yes
1-Methylnaphthalene	90-12-0		total leachate management plant	6.24E-06	380	12	6	JSL	24	--	1700	680	4.24E-03	yes
1-Methylphenanthrene	832-69-9		total leachate management plant	1.15E-06	380	0.1	0.05	de minimus	24	--	1700	680	7.82E-04	yes
2-Methylnaphthalene	91-57-6		total leachate management plant	3.90E-06	380	10	5	JSL	24	--	1700	680	2.65E-03	yes
Acenaphthylene	120-12-7		total leachate management plant	1.42E-06	380	0.2	0.1	JSL	24	--	1700	680	9.66E-04	yes
Acetone (2-Propanone)	67-64-1		total leachate management plant	4.80E-01	380	11800	5900	3	24	health	1700	680	3.26E+02	yes
Aluminum	7429-90-5		total leachate management plant	3.40E-04	380	4.8	2.4	JSL	24	health	1700	680	2.31E-01	yes
Ammonia	7664-41-7		total leachate management plant	1.35E+03	380	100	50	3	24	health	1700	680	9.18E+05	no
Antimony	7440-36-0		total leachate management plant	9.5E-20	380	25	12.5	3	24	health	1700	680	6.46E-17	yes
Arsenic	7440-38-2		total leachate management plant	7.46E-19	380	0.3	0.15	24-hr guideline	24	health	1700	680	5.07E-16	yes
Benzene	71-43-2		total leachate management plant	2.44E-01	380	2.3	1.15	(annual equivalen	24	health	1700	680	1.66E+02	no
Biphenyl	92-52-4		total leachate management plant	2.25E-06	380	60	30	24-hr guideline	1	odour	1700	680	1.53E-03	yes
Bis(2-Ethylhexyl)Phthalate	117-81-7		total leachate management plant	7.95E-06	380	50	25	3	24	health	1700	680	5.40E-03	yes
Boron	7440-42-8		total leachate management plant	7.32E-04	380	120	60	3	24	particulate	1700	680	4.98E-01	yes
Cadmium	7440-43-9		total leachate management plant	8.14E-19	380	0.025	0.0125	3	24	health	1700	680	5.54E-16	yes
Carbon Monoxide	630-08-0		total leachate management plant	1.61E+00	380		0				1700	680	1.09E+03	
Calcium	7440-70-2		total leachate management plant	5.00E-03	380	0.1	0.05	de minimus	24	--	1700	680	3.40E+00	no
Chlorobenzene	108-90-7		total leachate management plant	4.17E-04	380	3500	1750	3	1	health	1700	1700	7.08E-01	yes
Chlorobenzene	108-90-7		total leachate management plant	4.17E-04	380	4500	2250	3	10-min	odour	1700	2805	1.17E+00	yes
Chloroethane (ethyl chloride)	75-00-3		total leachate management plant	2.21E-03	380	5600	2800	3	24	health	1700	680	1.50E+00	yes
Chloroethylene (vinyl chloride)	75-01-4		total leachate management plant	7.07E-03	380	1	0.5	3	24	health	1700	680	4.81E+00	no
Chloromethane (methylchloride)	74-87-3		total leachate management plant	4.97E-03	380	320	160	3	24	health	1700	680	3.38E+00	yes
Chromium (total)	7440-47-3		total leachate management plant	6.65E-02	380	0.5	0.25	24-hr guideline	24	health	1700	680	4.52E+01	no
cis-1,2 Dichloroethylene	156-59-2		total leachate management plant	1.28E-01	380	105	52.5	24-hr guideline	24	health	1700	680	8.68E+01	no
Cobalt	7440-48-4		total leachate management plant	1.70E-06	380	0.1	0.05	24-hr guideline	24	health	1700	680	1.16E-03	yes
Dioxans and Furans	n/a		total leachate management plant	1.00E-11	380		0				1700	680	6.80E-09	
Copper	7440-50-8		total leachate management plant	4.66E-05	380	50	25	3	24	health	1700	680	3.17E-02	yes
Ethylbenzene	100-41-4		total leachate management plant	2.83E-02	380	1000	500	3	24	health	1700	680	1.92E+01	yes
Fluorene	86-73-7		total leachate management plant	5.87E-07	380	0.1	0.05	de minimus	24	--	1700	680	3.99E-04	yes
Lead	7439-92-1		total leachate management plant	5.32E-05	380	0.5	0.25	3	24	health	1700	680	3.62E-02	yes
Lead	7439-92-2		total leachate management plant		380	0.7	0.35	3	30+ days	health	1700	270	0.00E+00	yes
Magnesium	7439-95-4		total leachate management plant	6.41E-04	380	0.2	0.1	JSL	24	--	1700	680	4.36E-01	no
Manganese	7439-96-5		total leachate management plant	3.82E-04	380	2.5	1.25	24-hr guideline	24	health	1700	680	2.60E-01	yes
Mercury	7439-97-6		total leachate management plant	7.14E-04	380	2	1	3	24	health	1700	680	4.86E-01	yes
Methyl Ethyl Ketone (2-Butanone)	78-93-3		total leachate management plant	1.10E-01	380	1000	500	3	24	health	1700	680	7.48E+01	yes
Methane	74-82-8		total leachate management plant	5.96E-01	380	0.1	0.05	de minimus	24	--	1700	680	4.05E+02	no
Methylene Chloride (dichloromethane)	75-09-2		total leachate management plant	5.60E-01	380	220	110	3	24	health	1700	680	3.81E+02	no
Molybdenum	7439-98-7		total leachate management plant	1.50E-05	380	120	60	24-hr guideline	24	particulate	1700	680	1.02E-02	yes
Naphthalene	91-20-3		total leachate management plant	9.01E-04	380	22.5	11.25	24-hr guideline	24	health	1700	680	6.13E-01	yes
Naphthalene	91-20-3		total leachate management plant		380	50	25	24-hr guideline	10-min	odour	1700	2805	0.00E+00	yes
Nickel	7440-02-0		total leachate management plant	1.78E-05	380	2	1	3	24	vegetation	1700	680	1.21E-02	yes
Phenanthrene	85-01-8		total leachate management plant	2.97E-06	380	0.1	0.05	de minimus	24	--	1700	680	2.02E-03	yes
Phenol	108-95-2		total leachate management plant	3.37E-05	380	30	15	3	24	health	1700	680	2.29E-02	yes
Nitrogen Oxides (as NO2)	10102-44-0		total leachate management plant	1.31E+00	380		0				1700	680	8.88E+02	
Phosphorus	7723-14-0		total leachate management plant	8.14E-17	380	0.35	0.175	de minimus	24	--	1700	680	5.54E-14	yes
Potassium	7440-09-7		total leachate management plant	2.82E-02	380	8	4	JSL	25	--	1700	680	1.92E+01	no
Quinoline	91-22-5		total leachate management plant	5.60E-06	380	0.1	0.05	de minimus	24	--	1700	680	3.81E-03	yes
Selenium	7782-49-2		total leachate management plant	6.78E-19	380	10	5	24-hr guideline	24	health	1700	680	4.61E-16	yes
Sodium	7440-23-5		total leachate management plant	7.59E-02	380	0.1	0.05	de minimus	24	--	1700	680	5.16E+01	no
Styrene	100-42-5		total leachate management plant	6.00E-02	380	400	200	3	24	health	1700	680	4.08E+01	yes
Sulphate	18785-72-3		total leachate management plant	3.39E-15	380	0.1	0.05	de minimus	24	--	1700	680	2.31E-12	yes
Tetrachloroethene	127-18-4		total leachate management plant	5.05E-03	380	360	180	3	24	health	1700	680	3.44E+00	yes
Sulphur Dioxide	7446-09-5		total leachate management plant	2.77E-01	380		0				1700	680	1.89E+02	
Tin	7440-31-5		total leachate management plant	2.66E-05	380	10	5	3	24	heath	1700	680	1.81E-02	yes
Titanium	7440-32-6		total leachate management plant	1.49E-05	380	120	60	3	24	particulate	1700	680	1.01E-02	yes
Toluene	108-88-3		total leachate management plant	1.14E+00	380	2000	1000	24-hr guideline	24	odour	1700	680	7.76E+02	yes
Total Particulate Matter	n/a		total leachate management plant	2.69E+02	380		0				1700	680	1.83E+05	
Trichloroethylene	79-01-6		total leachate management plant	1.24E-02	380	12	6	3	24	health	1700	680	8.42E+00	no
Vanadium	7440-62-2		total leachate management plant	7.80E-19	380	2	1	3	24	health	1700	680	5.30E-16	yes
Xylene	1330-20-7		total leachate management plant	2.04E-01	380	730	365	3	24	health	1700	680	1.39E+02	yes
Zinc	7440-66-6		total leachate management plant	1.63E-17	380	120	60	3	24	particulate	1700	680	1.11E-14	yes

Notes:
[1] 50% of MOE Schedule 1, 2 or 3 Standard, or de-minimus values as per Appendix B of the Guide to Preparing an ESDM Report.
[2] Use dispersion factor associated with shortest distance to property line for all sources emitting the contaminant. For the Ottawa Landfill leachate plant, the closest source to the property line has a separation distance of 680m.

Appendix F

MOE Memo

Ministry of the Environment

P.O. Box 22032
Kingston, Ontario
K7M 8S5
613/549-4000 or 1-800/267-0974
Fax: 613/548-6908

Ministère de l'Environnement

C.P. 22032
Kingston (Ontario)
K7M 8S5
613/549-4000 ou 1-800/267-0974
Fax: 613/548-6908

Ontario

M E M O R A N D U M

December 14, 2011

TO: Jeffrey Dea
Project Officer
Environmental Assessment &Approvals Branch
Toronto

FROM: Michael Ladouceur
Air Quality Analyst
Technical Support Section
Eastern Region

RE: West Carleton Environmental Centre (WCEC) EA-02-08-02

The review of the WCEC Environmental Assessment (EA) was transferred to me for completion. I have reviewed the following document, which was supplied via e-mail:

- Environmental Assessment for a New Landfill Footprint at the West Carleton Environmental Centre – Amended Atmospheric Existing Conditions Report authored by RWDI # 60191228 dated November 2011 (Report).

The Report summarizes revised modelling of the post-closure air quality impacts of the existing landfill footprint at the proposed West Carleton Environmental Centre (WCEC), which is located on the outskirts of Ottawa. The Report concludes that the existing landfill footprint at the proposed WCEC is in compliance with Ontario standards and guidelines for air quality. I agree with the conclusions presented.

The modelling that was carried out was done following Ministry of the Environment (MOE) guidance and in coordination with staff from the MOE's Environmental Monitoring and Reporting Branch.

The existing landfill footprint at the proposed WCEC was found to be producing more gas than the levels predicted by the US EPA landfill site model LANDGEM. The gas generation values from the metered flare system were used to calculate generation rates. This is appropriate and conservative.

The selection of contaminants of concern and the estimates derived from them are reasonable. The report is premised on the efficiency of the combustion systems which use the gas to power electrical generators. The gas-fired electrical generators were listed at approximately 97 percent efficiency with respect to gas utilization. The gas flare system is listed at 98 percent efficiency. The proponent is required to keep maintenance records of these systems for MOE review upon request. Inspection of these records will confirm the efficiency claims on an ongoing basis.

I noted one typographical error: page 1 paragraph 1 refers to the "Greater Review Team". This should be the Government Review Team.

Thank you for the opportunity to comment.

Original signed by

Michael Ladouceur
ML/gl

c: R. Bloxam, EMRB