Waste Management of Canada Corporation

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

ATMOSPHERIC EXISTING CONDITIONS REPORT
Odour Baseline Assessment

DRAFT FOR DISCUSSION AND COMMENT

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Project Number:
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1. Introduction

RWDI AIR Inc. (RWDI) was retained by Waste Management of Canada Corporation (WM) to determine the odour baseline condition for the existing landfill site at the proposed West Carleton Environmental Centre (WCEC) landfill site, owned by WM. The existing landfill site has reached its maximum waste capacity and is closing by September 30, 2011. This report outlines the results of the baseline assessment of odour impacts.

The purpose of this assessment was to predict the general potential for odour impacts on the surrounding area once the landfill site is closed and develop a baseline dispersion model that will be suitable for inclusion in the assessment of the future impacts. Although exposure to strong odours does not pose a potential health risk to individuals residing close to a landfill, the odours can be a considerable nuisance, if they occur frequently. The purpose of this assessment was to predict the impact of current (baseline) odour emissions from the WCEC Landfill on surrounding receptors. This assessment will establish the baseline odour conditions for use in future comparisons. In terms of scope, the assessment involved the following tasks:

- Identify potential odour sources at the landfill site;
- Estimate odour emission rates from these sources;
- Predict odour levels at receptors surrounding the landfill using numerical modelling techniques;
- Provide recommendations, where required, to mitigate any adverse impacts; and,
- Present the findings in a report.

1.1 Contaminants of Interest

The cumulative odours from the landfill were assessed as the contaminant of interest in the odour baseline assessment. The odours from the landfill are based on a mixture of compounds contained within the landfill gas.

1.2 Applicable Guidelines

Regulation 419/05 (Reg. 419) provides air quality standards for use in Ontario. However, Reg. 419 does not include a standard for “odour” as a mixture of compounds. According to Section 14 of the Ontario *Environmental Protection Act*, an odour is deemed a nuisance if it is detected and considered unpleasant. The MOE does provide some guidance regarding the assessment of odour impacts in their document “Methodology for Modelling Assessments of

Contaminants with 10-Minute Average Standards and Guidelines under O. Reg. 419/05", April 2008. This guidance document indicates that odour concentrations need only be assessed at odour-sensitive receptor locations, such as residences, commercial buildings, and outdoor parks and recreation areas. Odour impacts that are greater than 1 odour unit (OU) per cubic metre (m^3) are acceptable at sensitive receptor locations, as long as the frequency of exceedance is less than 0.5% of the time.

An odour unit is defined as the quantity of odourous substance that, when dispersed in 1 m^3 of odour free air, becomes just detectable by a "normal" human observer whose sensitivity to the odourant represents the mean of the population. The average odour detection threshold is 1 OU/m^3, although odours at this level are not necessarily a nuisance. Odour concentrations that may cause a complaint due to their ability to annoy typically range from 3 to 5 OU.

Although certain contaminants known to be present in the landfill gas, such as hydrogen sulphide, have odour-based standards under Reg. 419, these standards are not applicable to the overall mixture of compounds that form the landfill gas odours, due to the presence of other odour-causing contaminants and the potential additive, synergistic, and antagonistic effects of the individual contaminants. Comparisons of the impacts from individual contaminants to their odour-based Reg. 419 Standards are provided in the companion study – Baseline Landfill Gas Assessment.

1.3 Emission Sources

1.3.1 Historical On-Site Sources

A number of potential sources of odour were identified at the landfill site. These sources were identified during site visits in 2004 and 2007 by RWDI with consultation from WM staff. Under normal operating conditions, solid waste landfills have the potential to produce odours from several areas, including:

- Landfill gas and garbage odours from the landfill and waste acceptance activities;
- Leachate odours from the leachate collection system;
- Hydrocarbon from the use of contaminated soils as cover materials; and,
- Compost odours from the spreading of compost on the landfill mound to encourage vegetation growth.

The odours from each of these categories are unique and should not be treated as additive odours.

An operating landfill may have multiple sources of each of these odour types. These potential sources are listed below:

- **Landfill gas and garbage odours:** working face, active face, interim cover areas, final cover areas, public waste drop off areas, installation of landfill gas wells, trenching activities, and cracks/fissures in the landfill cover.
- **Leachate odours:** leachate pumphouse, leachate cleanout manholes, and leachate seepage.
- **Hydrocarbon odours:** petroleum fuel-contaminated soil stockpiles and spreading of this soil on the landfill.
- **Compost odours:** compost stockpiles and spreading of the compost on the landfill.

1.3.2 Baseline Assessment On-Site Sources

Once the existing landfill site is closed, the majority of the odour-emitting sources will be eliminated. The remaining odour sources are discussed below.

1.3.2.1 Landfill Final Cover Area

The final cover area is the portion of the landfill where waste is no longer being deposited. This area is characterized by the presence of a clay landfill cap and landfill gas collection wells. Once the existing landfill is closed, the entire landfill mound will be under final cover.

Odours from the final cover area result from the release of landfill gas through the surface of the landfill. The landfill gas collection wells in the final cover area of the landfill serve to extract the landfill gas from the mound, thus reducing the amount of landfill gas available to escape through the surface of the mound and cause odour emissions. In addition, the clay cap limits the ability of the landfill gas to be released through the surface of the landfill. However, even with the gas collection system and clay cap in place, some landfill gas is released through the atmosphere through the final cover.

1.3.2.2 Cracks/Fissures in Landfill Cap

The final cover of the landfill includes a clay cap, which limits the migration of landfill gas through the surface of the landfill. However, cracks and fissures can form in this clay layer, allowing landfill gas to pass through unchecked. These cracks and fissures can form for a variety of reasons, including the effect of freeze/thaw cycles, erosion due to surface water runoff, and heavy equipment operating on the capped area. These cracks and fissures in the landfill cap represent upset conditions and as such were not considered in the baseline assessment.

1.3.2.3 Leachate Pumphouse

The leachate pumphouse is located near the northeastern corner of the site. This building houses the equipment controlling the leachate removal from the landfill. Leachate contaminated water collected from the landfill is sent through a venturi scrubber. Once it has passed through the scrubber, the leachate contaminated water is sent to the municipal sewage treatment plant. The exhaust gases from the scrubber are sent though a cyclone and then vented outside through a gooseneck stack located on the northwest corner of the pumphouse building. Once treated with the venturi scrubber, the odour levels in the exhaust gas are assumed to be insignificant.

1.3.2.4 Leachate Cleanout Manholes

Two leachate cleanout manholes are located at the facility, one located at the northern portion of the landfill and one located at the southern portion of the landfill. These manholes are used for removing and cleaning debris that may accumulate inside the leachate collection system. Both manholes were assumed to be sealed and were therefore excluded from the baseline odour assessment.

1.3.2.5 Leachate Seepage

Leachate seepage occurs when leachate “breaks through” the cover of the landfill and pools on the surface. Leachate seepage can occur due to poor drainage, cracks and fissures in the landfill cap, or blockage of the leachate collection system. Leachate seepage represents an upset condition and as such was not considered in the baseline assessment.

1.3.3 Off-Site Sources

The odours produced by the landfill are distinctive. Therefore, only the existing landfill sources were included in the baseline assessment.

There are some asphalt batch plants in the area that do contribute to the odour baseline in the area but these were not considered.

2. Landfill Footprint Study Areas

In accordance with the approved Terms of Reference (ToR), approved by the Minister, the generic On-Site and Site-Vicinity study areas for the proposed new landfill footprint at the WCEC are listed below:

On-Site .....the lands owned or optioned by WM and required for the new landfill. The Site is bounded by Highway 417, Carp Road and Richardson Sideroad;

Site-Vicinity.....the lands in the vicinity of the site extending about 500 m in all directions; and,

Regional .....the lands within approximately 3 to 5 kilometres (km) of the Site for those disciplines that require a larger analysis area (i.e., socio-economic, odour, etc.).

The study areas identified above were presented in the approved ToR with the commitment that these generic study areas would be modified during the EA to suit the requirements of each environmental component.

For the odour assessment, the dispersion modelling considered impacts at 9 discrete receptor locations representing receptors of interest in the Site-Vicinity and the Regional study areas. Detailed results are presented for each of these 9 discrete receptor locations. The locations of these receptors are shown in Figure 1. In addition, the modelling was performed using a receptor grid covering the Site-Vicinity and Regional study areas to produce isopleths of predicted concentrations.

3. Methodology

Based on the work plans presented in Appendix C of the approved ToR, the following sections outline the methodology for detailing the odour baseline condition for the WCEC.

3.1 Available Secondary Source Information Collection and Review

No secondary sources of information were used in the preparation of this odour assessment by the Atmospheric Study Team.

3.2 Process Undertaken

3.2.1 Odour Emission Rate Calculations

The odour emission rates for fugitive emissions of landfill gas from the final cover area of the landfill mound were based on the quantity of landfill gas released by the closed landfill and the odour concentration in this gas.

The quantity of landfill gas released by the landfill was calculated based on the total landfill gas collected at the landfill, using metered data recorded from the landfill gas collection system in 2010. The 2010 data was the most recent year of data available at the time of this report, and represents conditions during the last full year of landfill activity at the existing WCEC landfill. The amount of landfill gas produced by the landfill will decrease over time as the waste decays; therefore, the use of the 2010 data are representative of the worst-case landfill gas emissions for the existing landfill in future years. The amount of landfill gas collected was used to calculate the total amount of landfill gas produced by the landfill based on an assumed collection efficiency of 85%. The remaining 15% of the landfill gas was assumed to escape from the mound as fugitive emissions. Using this approach, approximately 8.6 million m^3 of landfill gas were assumed to be released on an annual basis.

The odour emission rates were developed using the upper range odour concentration for landfill gas of 10,000 OU/m^3 as defined in the MOE Landfill Gas Interim Guideline. This odour concentration was applied to the landfill gas that was predicted to be emitted through the landfill surface. The landfill gas emission rate, in m^3/s, was used to calculate an odour emission rate, in OU/s, from the landfill as a whole. The odour emission rate from the landfill was calculated to be 2,737 OU/s. This rate was divided by the total footprint of the landfill to determine the odour flux rate in OU/m^2/s. The use of the footprint area, rather than the surface area, is a conservative approach, since the footprint area is smaller than the surface area, resulting in more concentrated emissions.

Further details are provided in Attachment A.

3.2.2 Dispersion Modelling

Dispersion modelling was performed using the U.S. EPA's AERMOD dispersion model (AERMOD) to predict concentrations of odours emitted from the WCEC 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 Ministry of the Environment (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 and the MOE's Technical Bulletin "Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines under O. Reg. 419/05", April 2008.

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

3.2.3 Sources Modelled

The only source included in the odour dispersion model was the landfill mound. The landfill mound was modelled as an area source, with a release height of 0 m above grade. The use of a 0 m release height represents a conservative approach, as this height will result in higher impacts near the landfill than would an elevated release.

3.2.4 Meteorological Conditions

Five years of local meteorological data (2006-2010) were used in the AERMOD model. The meteorological data set was developed by the MOE's Environmental Monitoring and Reporting Branch (EMRB) for the WCEC facility. The data set was based on meteorological data collected from Environment Canada's Ottawa International Airport station and local land use information. The data set provided by the EMBR was used directly in the model, with no changes or alterations conducted by RWDI.

3.2.5 Area of Modelling Coverage

Typically, when modelling odours, impacts are assessed only at odour sensitive receptor locations, not at the property line. In the MOE guidance, odour sensitive receptors are defined as "any locations where and when human activities regularly occur". A total of nine locations were considered in the modelling as odour sensitive receptors, including nearby residences, schools, businesses, and other sensitive receptor locations. For all cases, humans were assumed to be present at these receptors for 24-hours per day. These discrete receptors were modelled at flagpole heights of 1.5 m above grade. The locations of these discrete receptors are shown on Figure 1. Further details regarding the receptor locations are provided in the following table. These sensitive receptors were used to assess compliance with the MOE's odour objectives.

Table 1. Summary of Discrete Receptors

Receptor ID	Description	X-Co-ordinate	Y-Co-ordinate
R1	Nearest House - North	423721.9	5015711
R2	Nearest House - East	425095.1	5014365
R3	Nearest House - West	423121.3	5013942
R4	Nearest House - South	423998.9	5013673
R5	St. Stephen Catholic Elementary School	426965.1	5013887
R6	Huntleigh United Cemetery	423335.9	5016477
R7	Lloydalex Park	426102.9	5013580
R8	Terrace youth Residential Services	424509.68	5013872.15
R9	Nearest Sensitive Business Operation	423804	5016030

In addition, modelling was conducted using a multi-tiered grid designed to extend a minimum of 5 km from all sources located on-site. Any receptors that fell within the property boundary of the WCEC facility were removed from the model. Each receptor in this grid was positioned at a flagpole height of 1.5 m above grade, to represent typical "nose height" for an average person. This approach is consistent with MOE guidance. The receptor grid was used to develop contour plots of mean predicted concentrations; however, these receptors were not used to assess compliance.

3.2.6 Terrain Data

Terrain data were used to develop base heights for the sources, buildings, and receptors in the model. Terrain elevations were entered into the model using the MOE's Ontario Digital Elevation Model Data. These data were obtained in digital format as a 30 m resolution DEM and were processed using the U.S. EPA's AERMAP pre–processor.

3.2.7 Building Information

The Building Profile Input Program (BPIP) is used to calculate the effects of building downwash on point sources, such as stacks. Since the odour model does not contain any point sources, the effect of building downwash was not considered in the dispersion modelling.

3.2.8 Averaging Periods Used

The results from the dispersion model, which represent a 1-hour averaging period, were converted to a 10-minute averaging period for comparison with the applicable odour objectives. A conversion factor of 1.65 was used to convert 1-hour results to 10-minute averages, based on guidance provided in the MOE's "Procedure for Preparing an Emission Summary and Dispersion Modelling Report", March 2009. The use of a 10-minute averaging period for odour is consistent with MOE guidance.

4. Odour Baseline Condition

4.1 Dispersion Modelling Results

This section describes the existing odour conditions in the study area, based on the dispersion modelling for the existing landfill operations.

Under the baseline conditions, with the existing landfill under final cover, the maximum odour concentration at a discrete receptor was predicted to occur at Receptor R3 (Nearest House, West). The maximum 10-minute odour concentration at R3 was predicted to be 0.9 OU/m^3, which is less than the MOE's odour objective of 1 OU/m^3. Since the maximum predicted odour concentration did not exceed the MOE's odour objective, a frequency analysis was not performed. The maximum predicted odour concentrations at all other discrete receptors in the assessment were less than the predicted concentration at R3. Table 2, below, provides the maximum predicted concentration at each discrete receptor location, as well as the minimum, mean, and various percentile values.

Table 2. Modelling Results for Odour at Discrete Receptor Locations

	R1	R2	R3	R4	R5	R6	R7	R8	R9
Maximum	0.338	0.322	**0.920**	0.403	0.159	0.208	0.169	0.454	0.288
Minimum	0	0	0	0	0	0	0	0	0
Mean	0.007	0.005	0.006	0.004	0.001	0.002	0.001	0.002	0.005
99th Percentile	0.206	0.145	0.118	0.103	0.017	0.078	0.025	0.029	0.153
95th Percentile	0.025	0.016	0.013	0.011	0.002	0.003	0.003	0.004	0.016
90th Percentile	3.98E-03	6.50E-03	2.00E-03	4.32E-03	8.23E-04	1.95E-05	1.27E-03	5.65E-04	2.39E-03
75th Percentile	0	1.64E-03	0	8.55E-09	0	0	6.00E-07	0	0
50th Percentile	0	0	0	0	0	0	0	0	0

A contour plot showing the mean 10-minute average concentrations for odour is presented in Figure 2. These contours are based on the AERMOD modelling results over the entire receptor grid. These values are based on the mean of the concentrations predicted for each hour in the 5-year modelling period. The highest concentrations were predicted to occur at or near the property line along Carp Road. For all receptors in the grid, the mean odour concentrations are much lower than the odour detection threshold of 1 OU/m^3.

5. Conclusions

RWDI AIR Inc. (RWDI) was retained by Waste Management of Canada Corporation (WM) to determine the odour baseline condition for the existing landfill site at the proposed West Carleton Environmental Centre (WCEC) landfill site, owned by WM. The existing landfill site has reached its maximum waste capacity and is closing by September 30, 2011. This report outlines the results of the baseline assessment of odour impacts.

Once the existing landfill is closed in 2011, the only significant odour source will be the existing landfill mound, which will be completely covered with final cover (clay cap). Emissions from this source were calculated based on the predicted fugitive emissions of landfill gas through the cover system and the upper range odour concentration for landfill gas as defined in the MOE Landfill Gas Interim Guideline.

There are occasions when ground repairs occur, or where there may be issues with the leachate collection system when there will be localized odour emissions. These are upset conditions and have not been included in the analysis.

The U.S. EPA's AERMOD dispersion modelling program was used in conjunction with local meteorological data and calculated odour emission rates to develop a baseline (existing conditions) modelling scenario. The results of this modelling indicated that the maximum impacts at the nearby odour-sensitive receptor locations would be less than the MOE odour objective of 1 OU/m^3. Contours of mean odour concentrations were developed based on a grid of receptors extending 5 km from the facility. The mean odour concentration was found to be less than 1 OU/m^3 at all receptors in this grid.

6. Recommendations / Further Work

There is no further work recommended for the determination of baseline odour levels at this time.

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7. References

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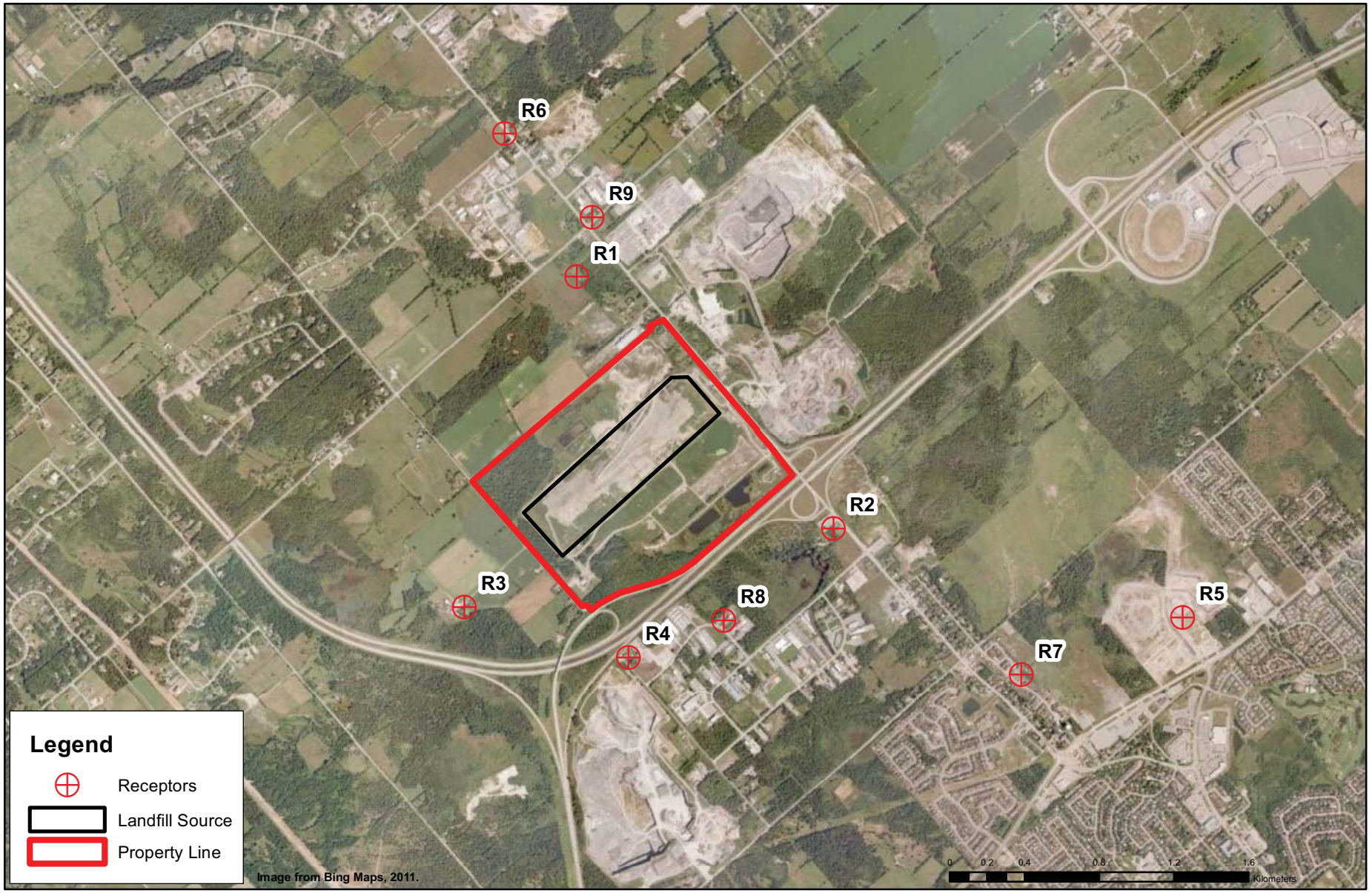
Figures



Site Plan Showing Modelled Area Source and Discrete Receptor Locations

True North

Drawn by: CAM	Fig: 1
Approx. Scale:	1:30,000
Date Revised:	Jun. 22, 2011

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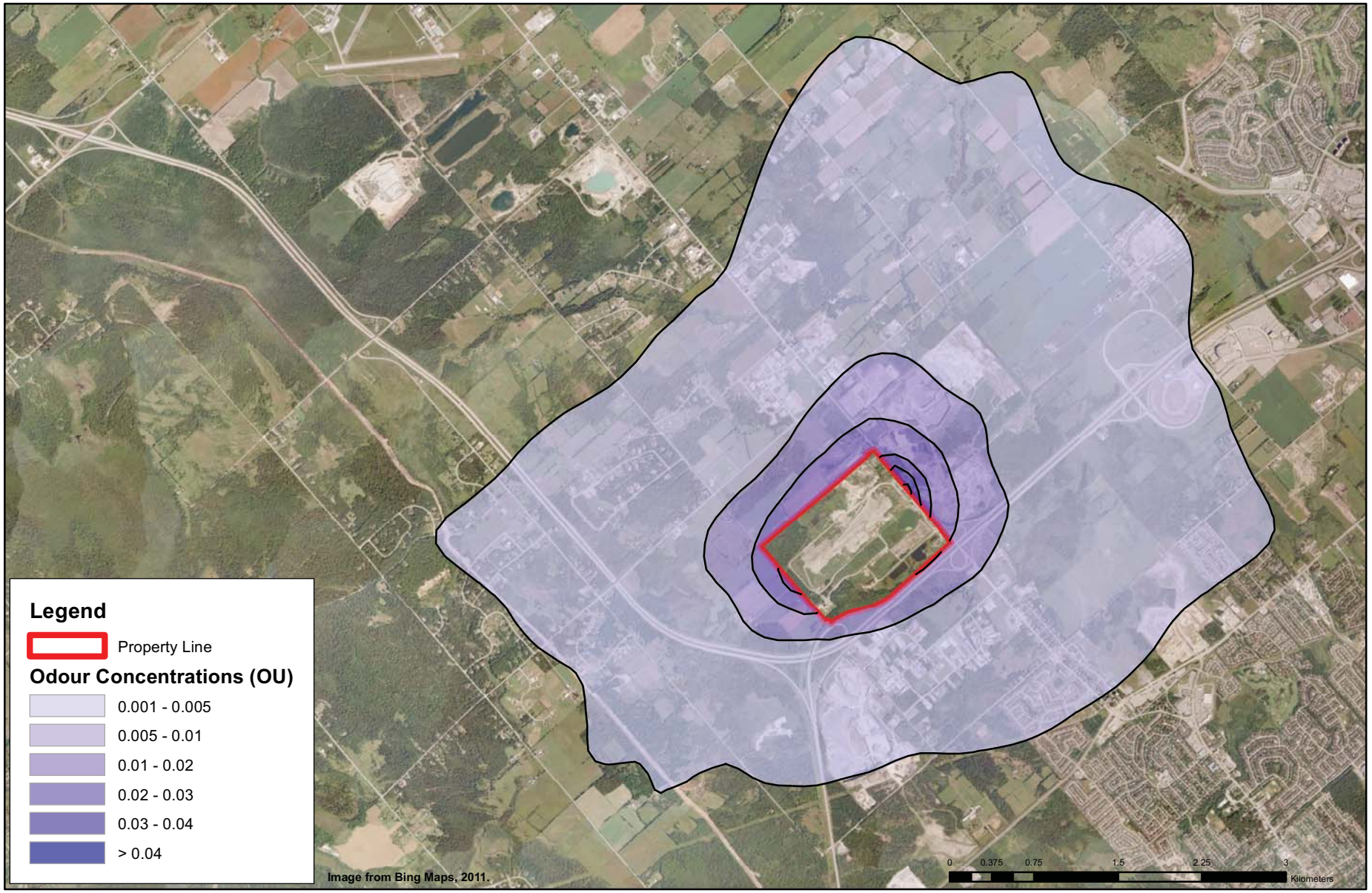

Isopleths of the Mean Predicted Odour Concentration - 10-Minute Averaging Period

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True North

Project #1100798

Drawn by: CAM	Fig: 2
Approx. Scale:	1:50,000
Date Revised:	Jun. 22, 2011

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Appendix A

WCEC Baseline Studies – Odour Emission Rates – Based on Scaling 2010 Flow Data

Attachment A: WCEC Baseline Studies - Odour 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)
Percent of Existing Landfill with Gas Collection System in Place	100%		
Estimated Efficiency of Landfill Gas 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)
Odour Concentration of Landfil Gas	10,000	OU/m^3	"upper range" estimate of odour concentrationfrom the MOE's Interim Guide to Estimate and Assess Landfill Air Impacts
Total Odour from Landfill	489,116,891,322	OU/year	based on all LFG created
	86,314,745,527	OU/year	based on LFG released (LFG created - collected)
	2,737	OU/s	

Odour Flux Rate from Landfill

Landfill Area	355,013	m^2
Odour Flux Rate	7.71E-03	$OU/m^2/s$