Roscommon County Council

Ballaghaderreen Landfill

Annual Environmental Report 2010

30 March 2011

Entec UK Limited

Comhairle Chontae Roscomáin

Roscommon County Council

Roscommon County Council

Ballaghaderreen Landfill

Annual Environmental Report 2010

30 March 2011

Entec UK Limited

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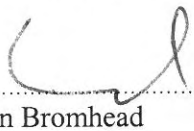

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Executive Summary

Purpose of this Report

This report meets the requirements of Condition 11.8 and Schedule F of Waste Licence No W0059-03 (dated 21 December 2009) for Ballaghaderreen Landfill which requires an annual environmental report to be undertaken at the site. The report covers the period from 01 January 2010 to 31 December 2010.

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1. Introduction

This Annual Environmental Report (AER), prepared for the Ballaghaderreen Landfill Site, County Roscommon, covers the period 1 January 2010 to 31 December 2010.

The information presented in this report has been prepared in accordance with the requirements of Waste Licence No W0059-03 (dated 21 December 2009). Entec UK Ltd (Entec) has prepared the report on behalf of Roscommon County Council, who is the licensee and operator of the facility.

2. Waste Activities Carried Out at the Facility

2.1 Waste Disposal

Table 2.1 shows the waste disposal activities that were carried out at the facility as defined in the Third Schedule of the Waste Management Act, 1996.

Table 2.1 Waste Disposal Activities carried out at Ballaghaderreen Landfill

Class	Activity
CLASS 4	**Surface impoundment, including placement of liquid or sludge discarded into pits, ponds or lagoons**: this activity is limited to the collection of leachate in a lagoon at the facility.
CLASS 5	**Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment:** this activity is limited to the disposal of waste in lined cells.
CLASS 13	**Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced:** this activity is limited to the storage of waste at the facility prior to disposal.

2.2 Waste Recovery

Table 0 shows the waste recovery activities that were carried out at the facility as defined in the Fourth Schedule of the Waste Management Act, 1996.

Table 2.2 Waste Recovery Activities carried out at Ballaghaderreen Landfill

Class	Activity
CLASS 2	**Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes):** This activity is limited to the collection of household organic/green wastes at the Recycling Facility.
CLASS 3	**Recycling or reclamation of metals and metal compounds:** this activity is limited to the collection of metals at Recycling Facility.
CLASS 4	**Recycling or reclamation of other inorganic materials:** this activity is limited to the collection of wastes at the Recycling Facility and for the recovery of inert waste as cover material and in the restoration of the facility.
CLASS 11	**Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule:** this activity is limited to the use of imported inert materials and soils in the restoration of the facility.
CLASS 13	**Storage of waste intended for submission to any activity referred to in a preceding paragraph of the Schedule, other than temporary storage, pending collection, on the premises where such waste is produced:** this activity is limited to the storage of materials prior to its removal off site for recycling/recovery.

3. Quantity and Composition of Waste Received, Disposed, and Recovered

3.1 Waste Quantity Received

The total waste quantity received at the site during 2010 was 44 791.65 tonnes.

The waste quantity received includes the waste quantity disposed of in the landfill and the waste quantity recovered from the Recycling Facility. These are detailed further in Sections 3.2, 3.3 and 3.4 below.

3.2 Waste Quantity Disposed

The total waste quantities disposed of to the landfill between January and July 2010 are detailed in Table 3.1. The quantities are as recorded at the site weighbridge. The landfill ceased accepting waste in July 2010.

Table 3.1 Waste Quantity Disposed to Landfill - 2010

EWC Code	EWC Description	Waste Description	Quantity (tonnes)
190901	Solid waste from primary filtrations and screenings	Filtration Screenings	44.16
200301	Mixed municipal waste	Mixed municipal	43,114.34
190801	Screenings	Sewerage WWTP screenings	19.44
200303	Street cleaning residues	Street cleanings	19.98
190905	Spent IE Resins	Sandy material from the treatment of potable water	4.62
191212	Wastes from the mechanical treatment of waste	Mixed municipal	1,131.92
		TOTAL	**44,334.46**

Notes: EWC European Waste Catalogue
WWTP Waste Water Treatment Plant

3.3 Waste Quantity Recovered from Recycling Facility

The waste quantities recovered from the Recycling Facility during 2010 are detailed in Table 3.2. The quantities are as recorded at the site weighbridge. These materials were removed offsite for recovery at appropriately licensed facilities.

Table 3.2 Waste Quantity Recovered at the Recycling Facility - 2010

EWC Code	EWC Description	Waste Description	Quantity (tonnes)
150104 150102	Metallic packaging/Plastics Packaging	Aluminium cans, Ferrous Metal cans, PET (mineral drink bottles), LDPE (milk bottles)	52.30[1]
160604	Alkaline batteries (except 160603)	Batteries	3.88
150101	Paper and cardboard	Cardboard/ Newspaper/ Magazines/ Milk cartons	114.48[2]
200102	Glass	Glass (clear, brown and green)	34.44
200136	Discarded electrical and electronic equipment other than those mentioned in 200121, 200123 and 200135	Discarded WEEE, (not incl. fridges) such as cookers, washing machines, TVs, kettles etc	53.43*
200123*	Discarded equipment containing chlorofluorocarbons	Fridges	*53.43
200127	Paint, inks, adhesives and resins containing dangerous substances	Hazardous waste (including fluorescent tubes and other mercury containing waste)	5.85
200140	Metals	Metals	65.82
200126*	Oil and fat other than those mentioned in 200125	Motor oil & cooking oil	2.28
200139	Plastics	Polystyrene	2.12
200111	Textiles	Textile	8.88
200138	Wood other than that mentioned in 200137	Wood	60.28
		TOTAL	**457.19**

Note:
[1] - The collections of Aluminium cans, Ferrous Metal cans, PET and LDPE packaging were amalgamated for 2010.
[2] - The collections of Cardboard, Newspaper, Magazines and Milk Cartons were amalgamated for 2010.
* - The proportions of these figures are estimates as both Fridges and other WEEE are collected together by KMK Metals.

3.4 Inert Waste Diverted from Landfill

Inert waste received for disposal at the landfill was reused for restoration and/or development purposes. The quantities of inert waste received at the site in 2010 are detailed in Table 3.3. The quantities are as recorded at the site weighbridge.

Table 3.3 Inert Waste Diverted from Landfill - 2010

EWC Code	EWC Description	Waste Description	Quantity (tonnes)
170107	Mixtures of concrete, bricks, tiles and ceramics other than mentioned in 170106	Construction and demolition rubble	849.04
170302	Bituminous mixtures other than mentioned in 170301	Construction and demolition road material	113.00
170504	Soil and stones other than mentioned in 170503	Construction and demolition soil	7,634.30
191209	C&D Fines	C&D Fines	209.14
191207	Woodchip	Woodchip	82.86
100908	Casting cores sands	Sand	135.44
		TOTAL	**9,023.78**

4. Site Survey

A topographical survey of Cell 8, the final active cell was undertaken on completion of waste inputs on 22 July 2010. Survey data outside cell 8 dates predates January 2010. A plan is included as Figure 1. Note the survey within Cell 8 was undertaken on completion of filling and prior to capping and restoration.

The survey was prepared with reference to the level datum at Malin Head and co-ordinated to the National Grid.

5. Calculated Remaining Capacity of the Facility

The landfill ceased accepting waste in July 2010. There is no remaining void space at the site.

6. Methods of Deposition of Waste

In 2010 waste deposited at the site was either to the active landfill or to the Recycling Facility.

6.1 Landfill

Following recording and acceptance at the weighbridge, waste was delivered by vehicle to the active face of the landfill and tipped for inspection. If waste was considered to be unacceptable for disposal to the landfill, it was reloaded and removed from site.

The first lift of waste placed to the base of the landfill was inspected to ensure that it did not contain materials that might adversely affect the integrity of the lining system. Typically, waste in the base of the landfill comprises municipal (black bag) waste and large, flat objects, such as mattresses.

The waste was deposited at the top of the working face and compacted to form layers working down the face. Once covered in the landfill, the waste was not disturbed or re-handled other than to allow installation of environmental protection or gas collection systems.

Daily cover, either soil or synthetic material, was placed to the active tipping areas progressively during operational hours. This was to minimise the potential for generation of wind blown litter and to deter scavenging birds.

6.2 Recycling Facility

Members of the public generally arrive at the Recycling Facility by vehicle. The Recycling Facility is located immediately adjacent to the site entrance to minimise the distance that the public travel within the facility. This also minimises the potential for waste disposal trucks and the public travelling in the same area of the site. The entrance and surfaced area within the gates are marked to direct users of the Recycling Facility to the disposal areas via a one way traffic system.

Waste receptacles within the Recycling Facility are labelled with the waste type accepted and the public sorts their waste into each skip accordingly. Refrigerators and other white goods are separately stocked. Hazardous materials (*e.g.* paint cans, fluorescent light bulbs, old batteries, *etc*.) are deposited in a dedicated, lockable container.

A member of staff supervises the site and provides help should the public require any assistance.

Waste receptacles are removed from the Recycling Facility when full.

7. Summary of Emissions

Emissions from the site, arising as a consequence of the landfill activities, include landfill gas and leachate. Dust and noise emissions may also occur as a consequence of site operations (waste placement and capping/ restoration).

7.1 Landfill Gas

Landfill gas is generated during the decomposition of biodegradable waste. The decomposition process of the waste occurs in a number of stages following deposition.

Landfill gas generation from fresh waste commences initially under aerobic conditions (*i.e.* in the presence of oxygen). Initially, carbon dioxide concentrations increase as a precursor to methane generation, which occurs only under anaerobic conditions. Methane production will continue within the waste for many decades.

The landfill gas mainly comprises methane and carbon dioxide, which are both colourless and odourless. However, the gas can contain hundreds of trace compounds which often give rise to a characteristic smell.

Typical gas production rates are commonly assumed to be approximately 10 m^3 of gas per tonne of waste per annum. Gas production rates will vary within the landfill, generally as a function of:

- The geometry of the landfill;
- The type of waste and rate of input;
- The age of the waste;
- Moisture content, pH, temperature and density of the waste;
- The nature of the cover to the landfill.

Landfill gas is generally emitted from the waste surface, driven by convection due to increased temperature within the waste mass relative to the surrounding air temperature. The ambient air pressure will affect the rate of emission. Low air pressure often results in higher emissions (as gas is driven from the waste body, where pressure has not equilibrated).

Pressure build up within the waste mass might also cause higher emissions. High gas pressures may develop where low permeability layers confine the gas. In such circumstances, the gas will move to lower pressure areas, and often this may result in lateral movement. If this occurs near the margins of the waste, it can result in high emission rates, or migration through surrounding soils.

7.1.1 Current Situation

Cells 1 to 5

Landfill gas monitoring was undertaken at the twenty gas extraction locations (LG1 – LG13 and LG34 - LG40) within Cells 1 to 5 during the reporting period. These cells form the old part of the site and have no engineered basal containment. The landfill cap constructed over Cells 1 to 5 is buried into the underlying strata along the north, east and southern margins of the waste. This is designed to minimise potential offsite emissions via the underlying strata.

Cell 6

Waste previously deposited in engineered containment Cell 6 has been capped and a landfill gas collection system (including extraction wells, collector pipework and condensate knockout pots/dewatering lances) is in operation. Five landfill gas collection wells (LG 15 - LG 19) are available for monitoring.

Cell 7

Cell 7 was predominantly capped during the last quarter of 2008 and the first quarter of 2009, during which seven gas extraction wells (LG27 - LG33) were installed in addition to the existing six wells (LG20, LG22 to LG26).

Cell 8

Eight gas wells (LG41-48) were installed in Cell 8 in August 2009 and a further 12 wells were installed in 2010 (LG49-60).

Landfill Gas Flare

The monitoring of gas concentrations at the enclosed flare was connected to the telemetry SCADA (Supervisory Control and Data Acquisition) system in the main office on the 5 September 2007. Data is stored on the facility SCADA system in graphic format. Annual flare monitoring is undertaken as per schedule D.7 of the Waste Licence.

7.1.2 Monitoring

Landfill gas is monitored at a number of locations within and around the perimeter of the landfill. Monitoring of landfill gas is discussed in Section 8.2 below.

7.2 Leachate

Leachate is produced when water percolates through deposited waste. As it passes through the waste, the water becomes contaminated as it ‘leaches’ compounds from the waste. As for landfill gas, leachate composition varies with the age of the waste from which it is generated. It also varies depending on the nature of the waste and the volume of water entering the waste amongst other factors.

Water may enter the waste from several sources:

- Rainfall;
- Surface water inflow (as run-off);

- Groundwater inflow.

Liquid may also be present in the waste on deposition.

Uncontrolled leachate discharge may adversely impact surface water and groundwater conditions around the landfill. Measures are therefore required to mitigate such potential emissions.

7.2.1 Current Situation

Cells 1 to 5

Cells 1 to 5 do not have a formal leachate collection system in the base of the landfill. This part of the site was developed as a 'dilute and disperse' landfill initially, with waste deposited direct to ground without any significant engineering or containment.

A proportion of leachate generated from this older waste in the landfill passes into the *in situ* peat deposits below the waste, where it undergoes attenuation and dilution with near surface groundwater. Further downward migration is considered unlikely due to the presence of a natural, low-permeability layer of Boulder Clay.

A perimeter leachate drain intercepts leachate migrating toward the boundary of the waste body. Collector drains are placed along the western, southern, eastern and northern side of Cells 1 to 5 underneath the capping. Leachate collected in these drains is pumped from a sump into the adjacent leachate lagoon for subsequent disposal.

A low permeability leachate barrier, constructed on the western boundary of the site acts to restrict lateral migration of leachate generated from Cells 1 to 5 and from the older waste beneath the Recycling Facility.

Cells 6 to 8

Cells 6 to 8 were constructed between 2003 and 2006 as lined cells, with engineered leachate collection and abstraction systems. Construction Quality Assurance (CQA) supervision and testing was in place during construction of the composite lining systems. It is unlikely, therefore, that there are any uncontrolled discharges via defects in the lining system.

Leachate is routinely removed from Cells 6 to 8 by pumping to the leachate lagoon where it is discharged via a pipeline to the Ballaghaderreen Waste Water Treatment Plant (WWTP). Leachate levels in the lined cells are maintained within prescribed waste licence limits by automatic pump controls set up on the site SCADA telemetry system.

Cells 6 to 8 have now all been capped. The final cell (Cell 8) was capped at the end of 2010.

Surface water runoff is collected in a series of perimeter drains, which discharge to the River Lung ~ 100 m north of the site.

Leachate Lagoon

Leachate pumped from Cells 6, 7 and 8, and collected from the sump at the end of the perimeter drains for Cells 1 to 5, is discharged to the leachate lagoon prior to disposal via pipeline to Ballaghaderreen WWTP. The engineered and lined lagoon was constructed in 2003 and is subject to CQA supervision and bund testing every three years. The most recent inspection of

the leachate lagoon and its bund walls was carried out by RPS on 19 August 2009. It is unlikely, therefore, that there are any uncontrolled discharges via defects in the lining system.

During the reporting period, it is reported that 20 297 m^3 of leachate was removed from the lagoon via the main to the local sewer. A ferric nitrate dosing system ensures that the leachate remains oxidised during transport to the WWTP and does not generate hydrogen sulphide in the sewer. Surface aerators are also used in the lagoon.

7.2.2 Monitoring

Leachate is monitored at a number of locations within and around the landfill. Monitoring of leachate is considered in Section 8.4 below.

7.3 Dust

Dust may be produced at the facility as a consequence of waste disposal operations or capping/ restoration activities, particularly during dry and windy conditions.

Dust can cause smothering and soiling (when it settles) or be a visual nuisance. Depending on particle size and composition, dust may also present a health hazard.

Four monitoring stations are provided around the facility and have been monitored at intervals during the reporting period. This is considered further in Section 8.7 below.

7.4 Noise

Noise is generated at the site from operational plant and machinery, vehicles moving on and around the site and bird scaring equipment. Due to the nature of the operations at the facility, some noise generation is inevitable. Measures are taken to mitigate noise effects and the site is monitored to ensure noise emissions are acceptable. Noise monitoring is considered in Section 8.6 below.

8. Summary of Environmental Monitoring

8.1 Scope of Monitoring

Environmental monitoring for a range of emissions is required under conditions included in the Waste Licence. The monitoring requirements are summarised in Table 8.1.

Table 8.1 Summary of Monitoring Requirements

Monitoring Requirement	Frequency
Landfill gas (in monitoring boreholes and gas extraction wells, landfill gas flare and site office)	Monthly (for boreholes and vents, *etc*.) Continuous for some parameters in flare, annually for others Continuous for site office
Surface water (in perimeter ditches and the River Lung)	Weekly - visual inspection Quarterly - general 'standard' analysis Annually - anions and cations and biological assessment
Leachate (in lagoon and landfill cells)	Quarterly - visual inspection and temperature Annually - chemical analysis Continuous - Level
Groundwater (in shallow and deep boreholes)	Monthly - level Quarterly - general 'standard' analysis Annually - anions and cations, List I and II substances
Noise (at facility entrance and nearest properties to the north, east and west of the facility)	Annually
Dust (at four locations)	Three times per year (twice between May and September)
Meteorological conditions	Daily

Roscommon County Council and the landfill site staff undertake all monitoring for the site, except for noise. A meteorological station was installed at Ballaghadereen Landfill in February 2008. Meteorological data downloaded from the station is attached in Appendix K. An annual noise survey was undertaken by F Coyle and Associates. Annual monitoring of the flare was undertaken by Odour Monitoring Ireland.

Analysis of the leachate, surface water and groundwater samples was undertaken at the ELS laboratory on behalf of Roscommon County Council.

Results of relevant testing is included in quarterly monitoring reports, copies of which are held by Roscommon County Council and the Environmental Protection Agency (EPA) at Castlebar.

Sampling and monitoring locations are shown on Figure 1.

8.2 Landfill Gas Monitoring

8.2.1 Landfill Gas Extraction Wells and Monitoring Boreholes

Gas Wells

Landfill gas monitoring was undertaken monthly at the twenty gas extraction wells (LG1 - LG13 and LG34 - LG40) across Cells 1 to 5, five landfill gas extraction wells (LG 15 - LG 19) in Cell 6, thirteen gas extraction wells (LG20 and LG22 – LG33) in Cell 7 and twenty gas extraction wells (LG41 – LG60) in Cell 8.

The monitoring results are provided in Appendix A, and are summarised in Table 8.2a and 8.2b.

Table 8.2a Summary Range of Landfill Gas Composition within Extraction Wells in Cells 1 to 5

Monitoring Location	CH4 (%v/v)		CO2 (%v/v)		O2 (%v/v)	
	min	max	min	max	min	max
LG1	0.90	38.60	1.40	24.50	5.50	19.60
LG2	3.90	66.40	7.80	38.30	0.00	14.00
LG3	0.00	28.40	0.00	21.10	4.40	20.80
LG4	4.10	28.90	3.90	11.50	6.00	16.90
LG5	0.10	44.10	0.00	19.10	7.00	20.20
LG6	2.20	62.80	4.20	38.10	0.00	16.80
LG7	0.10	35.40	2.00	24.90	0.50	17.30
LG8	12.40	66.10	18.70	31.00	0.50	4.80
LG9	5.10	71.90	6.00	35.60	0.00	13.70
LG10	21.00	70.10	0.90	36.60	0.00	3.30
LG11	10.50	66.50	6.70	33.50	0.10	13.90
LG12	6.50	69.30	3.90	33.30	0.00	18.80
LG13	36.1	49.00	20.20	32.70	0.00	5.10
LG34	0.20	65.00	0.00	40.90	0.00	20.80
LG35	6.00	47.30	14.10	30.20	0.00	15.50
LG36	4.90	60.30	13.90	35.10	0.00	4.40
LG37	4.50	69.30	12.10	32.10	0.00	3.30
LG38	15.90	69.30	15.90	69.30	0.00	10.30
LG39	15.50	41.00	20.10	29.80	0.00	12.10
LG40	15.30	60.10	18.40	39.10	0.20	10.80

Table 8.2b Summary Range of Landfill Gas Composition within Extraction Wells in Cells 6 to 8

Monitoring Location	CH4 (%v/v)		CO2 (%v/v)		O2 (%v/v)	
	min	max	min	max	min	max
Cell 6						
LG15	12.40	59.10	16.20	36.70	0.00	5.30
LG16	11.80	33.00	16.00	29.00	0.30	7.50
LG17	21.30	52.00	20.10	27.70	0.00	2.10
LG18	0.00	23.50	15.10	19.80	0.10	5.20
LG19	0.00	56.60	0.00	16.10	4.10	21.50
Cell 7						
LG20	18.10	64.50	14.10	35.40	0.50	12.00
LG22	22.40	61.90	24.80	36.50	1.70	4.80
LG23	32.80	63.40	21.80	38.50	0.00	3.90
LG24	43.50	62.30	32.50	40.50	0.00	3.00
LG25	18.10	57.50	14.10	36.50	0.30	12.10
LG26	37.30	57.50	29.00	33.90	0.10	2.80
LG27	38.90	60.10	26.10	32.80	1.40	5.50
LG28	43.30	62.00	31.00	38.40	0.00	3.00
LG29	0.60	62.80	0.40	41.30	0.00	20.60
LG30	51.00	64.20	34.60	51.90	0.00	1.90
LG31	53.10	64.10	32.90	40.90	0.00	2.50
LG32	50.10	89.00	32.00	38.40	0.00	1.10
LG33	18.00	64.90	12.70	35.10	0.00	10.90
Cell 8						
LG41	0.70	63.20	28.70	38.30	0.10	3.00
LG42	0.80	61.80	0.70	41.00	0.60	20.10
LG43	4.50	62.20	7.70	41.50	0.30	17.30
LG44	8.60	64.80	8.50	42.40	0.00	6.30
LG45	39.60	65.00	33.90	41.00	0.00	4.30
LG46	20.50	62.50	14.50	40.90	0.00	13.30
LG47	15.80	63.40	12.80	42.40	0.00	14.30
LG48	15.70	61.80	12.30	39.90	0.70	14.70
LG49	9.30	29.30	11.00	23.90	8.10	13.70
LG50	0.00	53.00	0.00	33.90	2.80	19.00
LG51	20.10	56.80	16.60	39.90	0.30	12.10
LG52	14.40	63.50	10.80	44.80	0.00	18.10

Table 8.2b (continued) Summary Range of Landfill Gas Composition within Extraction Wells in Cells 6 to 8

Monitoring Location	CH4 (%v/v)		CO2 (%v/v)		O2 (%v/v)	
	min	max	min	max	min	max
LG53	22.00	64.50	17.10	44.20	0.00	11.20
LG54	14.80	60.30	16.10	30.40	0.30	12.10
LG55	20.10	51.3	20.9	24.9	0.1	9.6
LG56	23.4	63.4	33.1	40.9	0.1	3.9
LG57	17.2	41.0	21.0	27.5	0.0	10.2
LG58	15.3	56.2	18.4	31.3	5.2	9.2
LG59	12.4	54.4	21.8	44.9	1.0	9.9
LG60	12.1	17.1	9.1	18.7	8.9	14.7

Monitoring Boreholes

There are eight gas monitoring boreholes (GM 201-GM 208) located around the perimeter of the site to monitor gas migration potential. The location of these boreholes is shown on Figure 1.

The monitoring results are provided in Appendix B, and are summarised in Table 8.2c.

Table 8.2c Summary Range of Landfill Gas Composition in Off-Site Monitoring Boreholes

Monitoring Location	CH_4 (%v/v)		CO_2 (%v/v)		O_2 (%v/v)	
	min	max	min	max	min	max
GM 201	0.0	0.0	0.0	1.4	18.5	21.2
GM 202	0.0	0.0	1.5	6.1	11.8	19.8
GM 203	0.0	0.0	0.5	7.7	10.1	20.8
GM 204	0.0	0.0	1.4	5.9	15.0	19.5
GM 205	0.0	0.0	0.6	5.3	14.2	20.5
GM 206	0.0	0.0	0.5	5.7	13.6	20.7
GM 207	0.0	0.0	0.4	1.2	17.7	20.9
GM 208	0.0	0.0	0.7	3.8	15.7	20.0

The methane trigger level of 1 % v/v was not exceeded in any of the boreholes. It is noted that during 2010 there were fifty three reported exceedences of carbon dioxide concentrations relative to the trigger level of 1.5 % v/v.

With the exception of GM 201 and GM 207, all gas monitoring boreholes indicate carbon dioxide exceeding trigger levels during 2010.

Carbon dioxide concentrations above 1.5 % v/v may be due to the presence of marsh gas (from organic matter decomposing within the peat bog) and not evidence of landfill gas migration off-site. The near surface soils for a number of the boreholes are not in direct continuity with the landfill. For example, GM 202 and GM 203 are to the west of the western perimeter ditch. Any gas migration through the near surface geology (and above the water table in the peat) in this area would be vented in the ditch. However, there is exceedance of carbon dioxide in these boreholes during the year.

8.2.2 Landfill Gas Flare

The currently installed permanent flare has a capacity of 500m^3/hr.

Odour Monitoring Ireland undertook monitoring of the emissions from the enclosed flare on 2 March 2010, the report submitted by Odour Monitoring Ireland is presented as Appendix C. The report concludes that measured parameters are within the emission limit values stated in the Waste Licence.

8.2.3 Surface Emissions Survey

A surface emissions survey was carried out over the entire capped are of Cells 1 to 8 by Odour Monitoring Ireland on 22 November 2010. The report submitted by Odour Monitoring Ireland is presented as Appendix C. The report concludes that:

- A maximum VOC concentration of 165 ppm was recorded at the boundary between Cell 8 and Cells 1 – 5;
- The average surface emissions over the capped area were 8.74 ppm (trigger level ≥ 50 ppm).

8.2.4 Site Office

Landfill gas is monitored on a continuous basis within the site office. A permanent landfill gas monitoring device monitors concentrations of methane, carbon dioxide and oxygen. There were no recorded instances where methane or carbon dioxide trigger levels were exceeded in this enclosed space during 2010.

8.3 Surface Water Monitoring

Throughout the reporting period, monitoring for a limited suite of determinands[1] was undertaken quarterly in the surface water ditches located along the eastern and western boundaries of the site at monitoring points SW 1, SW 2, SW 3, SW 4 and SW 5. Monitoring was also undertaken in the River Lung upstream and downstream of the site.

[1] The quarterly analysis considers the typical indicators for contamination and includes pH, temperature, electrical conductivity, ammoniacal nitrogen, chemical oxygen demand, biological oxygen demand and dissolved oxygen, chloride and suspended solids.

In August 2010 samples were taken for the annual suite of analyses (as included in Waste Licence W0059-03, Schedule D). Surface water quality monitoring results are included in Appendix D.

The surface water monitoring results for the year are in most cases consistent with previous data and demonstrate no significant adverse impact on surface water quality in the vicinity of the landfill.

Samples taken from the River Lung upstream and downstream of the site are consistent with those reported previously and indicate no apparent measurable impact of drainage from the landfill site on the River Lung.

Throughout 2010, the surface watercourses were inspected for visual contamination and odour on a weekly basis. There was no discernible odour from the surface water monitoring points recorded during the inspections.

The 2010 records of visual inspections of surface water monitoring points are presented in Appendix E.

8.4 Leachate Quality Monitoring

8.4.1 Leachate Levels

Leachate levels were recorded at the following monitoring locations:

- Cells 1-5 (LM 402, LM 404);
- Cell 6;
- Cell 7;
- Leachate barrier (LB 1, LB 2, LB 3).

The range of levels for the leachate monitoring points is presented in Table 8.3. Locations of monitoring points are shown on Figure 1.

Table 8.3 Range of Levels for Leachate Monitoring Points 2010

	Depth to Leachate (Metres)	
Leachate Monitoring Point	**min**	**max**
LM 402	7.56	7.66
LM 404	3.88	3.98
LB 1	Dry	0.68
LB 2	0.92	1.10
LB 3	2.58	3.88

LMP402 and LMP404 could not be monitored in the third quarter as they were reported as damaged. LM402 was reported as inaccessible in the fourth quarter. Leachate levels for the lined cells were monitored daily at the control cabinets during the year. The range of those levels is presented in Table 8.4. Summary monitoring data for the leachate levels is given in Appendix F.

Table 8.4 Range of Leachate Levels for Containment Cells 2010

Cell	Leachate Level Range (mm above cell base)
Cell 6	0 – 1855
Cell 7	0 – 5000
Cell 8	0 – 2568

Reported leachate levels in Cell 6, Cell 7 and Cell 8 were generally below the required maximum of 1.0 m above the basal lining. The breach of the 1m limit in lined Cell 6 at the beginning of January was due to frozen pipework. Exceedances in leachate level in Cell 8 in April, late May and early June were due to pump failure.

There were two breaches of the 1m limit in the lined cells in the fourth quarter: Cell 8 on 6 October 2010; and Cell 7 level sensor fault (first notified to the Agency on 24/11/10) which was rectified on 13 December 2010.

The EPA was informed of the level exceedances at the time of occurrence.

8.4.2 Leachate Quality

Qualitative leachate analysis was undertaken on samples collected from the following monitoring points on a quarterly basis:

- Cells 1-5 (LM 402, LM 404);
- Cell 6;
- Cell 7;
- Cell 8;
- Leachate barrier (LB 1, LB 2, LB 3);
- Leachate lagoon.

Quarterly monitoring is restricted to colour, odour and temperature.

In August 2010, samples were collected for the annual quantitative suite of analyses (as included in Waste Licence W0059-03, Schedule D). Samples were collected from monitoring locations LB 1, LB 2, LB 3, the leachate sump for Cells 1-5, Cell 6, Cell 7, Cell 8 and the leachate lagoon. The results of the analysis are provided in Appendix G.

8.5 Groundwater Quality Monitoring

8.5.1 Groundwater Levels

Groundwater levels were recorded at monitoring points BH 3, BH 11 BH 12 and GW 301 in the superficial deposits, and, BH 04/1, BH 102 and BH 103 in the limestone aquifer. The monitoring locations are shown on Figure 1.

Groundwater level data are summarised in Table 8.5 and presented in Appendix H.

Table 8.5 Summary Groundwater Levels 2010

		Recorded Groundwater Depths (m) during 2010	
Borehole ID	**Ground Level (mAOD)**	**min**	**max**
BH 3	76.75	0.78	2.14
BH 11	77.24	0.60	1.27
BH 12	77.41	0.60	2.39
BH 04/1	~76.50	1.47	4.48
BH 102	~78.30	2.64	4.87
BH 103	~76.90	0.22	2.58
GW 301	~75.40	Dry	1.47

The recorded groundwater levels for 2010 were generally within the previously recorded ranges.

8.5.2 Groundwater Quality

Groundwater quality has been monitored on a quarterly basis for a limited suite of determinands[2]. Groundwater samples were collected from BH 3, BH 12 and GW 301 in the superficial deposits and BH 04/1, BH 102 and the BH 103 in the limestone aquifer.

The extended annual suite of analyses (as noted in Waste Licence W0059-03, Schedule D) was carried out in samples collected in August 2010 for monitoring points BH 3, BH11 and BH 12 (Drift Deposits) and BH 04/1, BH 102 and BH 103 (limestone aquifer). Full results for the groundwater monitoring undertaken in 2010 are included in Appendix I.

During 2010 none of the trigger levels for the limestone aquifer were exceeded.

The groundwater quality data for the superficial deposits was generally within previously reported ranges with the exception of the Electrical Conductivity result of 1375 µS/cm recorded in November in borehole BH11 which was the highest ever recorded at this location. EC

[2] As for surface water monitoring, the quarterly groundwater analysis considers the typical indicators for contamination and include pH, temperature, electrical conductivity, ammoniacal nitrogen, dissolved oxygen, chloride and total organic carbon. A visual inspection and odour assessment is also made.

concentrations at BH11 have generally shown a trend of increasing concentrations with time since February 2008.

Samples from BH3, BH102 and BH04/1 were tested for VOCs, SVOC's and organochlorine pesticides in August 2010, and with the exception of phenol at BH3, none were detected. A phenol concentration of 1.6 ug/l was recorded at BH3.

8.6 Noise Monitoring

F Coyle and Associates undertook a noise survey on 6 December 2010. The noise limit in the Waste Licence is common to all monitoring points, irrespective of location and proximity to the facility operations.

The report concludes that noise emissions from the facility are within the daytime limits specified in the licence. The facility does not operate during night time hours.

A copy of the noise report is included as Appendix J.

8.7 Dust Monitoring

Monitoring for dust at the facility is required at four locations around the site as shown on Figure 1. Sampling is required on three occasions during the year in accordance with Waste Licence W0059-03.

Sampling was undertaken on three occasions during the reporting period. Unfortunately the sample containers set out in the third quarter were damaged by the courier on the way to the laboratory and the samples were unsuitable for analysis.

Gauges are set up by the facility staff and left in place for 30 days during each of the monitoring periods. The gauges are collected at the end of the monitoring period and transported to the Roscommon County Council Environmental Laboratories for analysis.

The results of the dust monitoring are detailed in Table 8.6.

Table 8.6 Dust Monitoring Results 2010

Date Sample Jar Set Out	Date Sample Jar Collected	Monitoring Results (mg/m²/day)			
		Location 1	Location 2	Location 3	Location 4
27 January	25 February	54	32	10	No result*
11 October	10 November	359	13	16	562
16 November	16 December	4	5	15	10

* The dust jar cracked due to extreme frozen conditions during the sampling period.

The dust monitoring was undertaken using the Standard Method VD12119 (Measurement of Dustfall, Determination of Dustfall using Bergerhoff Instrument (Standard Method) German Engineering Institute).

The dust deposition limit is set at 350mg/m^2/day in the waste licence.

Dust monitoring results for DM1 and DM4 exceeded the dust deposition limit in October/ November. It is noted that capping works to cell 8 were in progress at this time.

Sampling was repeated immediately and the results of the November/ December monitoring were within the licence limits.

8.8 Meteorological Monitoring

Meteorological data was downloaded from the on-site cabled V Pro 2 weather station and is attached in Appendix K. Daily values are obtained for the following parameters using standard techniques:

- Precipitation volume;
- Temperature (min/max);
- Wind speed and direction;
- Relative humidity; and
- Atmospheric pressure.

Evapotranspiration data purchased from Met Éireann from the Knock Airport monitoring station is also included as Appendix K.

9. Emissions from Facility

9.1 Pollutant Release and Transfer Register

Roscommon County Council is required to submit a Pollutant Release and Transfer Register (PRTR) in the form of a summary spreadsheet to the EPA on an annual basis. The PRTR spreadsheet is submitted electronically, a copy of the spreadsheet is included as Appendix L.

9.2 Water Balance Calculation

A water balance for the site, based was presented in the 2009 AER. Leachate production is considered in Section 9.3 below.

9.3 Assessment of Leachate Production

9.3.1 Cells 1 to 5 and Recycling Facility/ Office Area

Cells 1 to 5 and the Recycling Facility/ Office area contain waste previously tipped directly to the existing ground surface. Cells 1 to 5 are capped with a flexible geomembrane layer, and the Recycling Facility/ Office area has now been surfaced with a tarmac layer. Leachate generated in these areas is not contained by any lining system and will migrate into the underlying peat.

Leachate may be intercepted at the margins of Cells 1 to 5 in collector drains. The leachate barrier will restrict movement of leachate from the Recycling Facility/ Office area.

Leachate produced in the waste in the unlined areas will be diluted by near surface groundwater in the peat.

9.3.2 Cells 6, 7 and 8

The leachate produced in the lined Cells 6, 7 and 8 at the facility is contained by the lining system and removed to the lagoon for disposal offsite. Since the lining is effectively a very low permeability, and leachate levels are controlled within the cells, there is little potential for loss of leachate due to leakage. Groundwater levels beneath Cells 6, 7, and 8 are higher that the leachate level in the sump of each cell such that provided leachate levels are maintained below 1 m within the sumps then the leachate should be hydraulically contained. It is concluded therefore that all leachate generated in Cells 6, 7 and 8 is removed from site, or is stored in the waste and contained by the lining system.

9.4 Volume of Leachate Removed from Site

Leachate produced from the facility is collected in the leachate lagoon and removed to the Ballaghaderreen WWTP for treatment and disposal, as noted in Section 7.2 above.

Leachate was removed by pumping to the sewer during the reporting period. Relevant volumes are indicated in Table 9.1.

Table 9.1 Quantity of Leachate Removed from Site during the Reporting Period

Method of Leachate Removal	Estimated Quantity Removed (m^3)
Discharge to sewer	20,297 m^3

The leachate discharged to the sewer was measured using a flow meter.

It is assumed that, in the above figures, the volume recorded for disposal includes all the free leachate generated in Cells 6, 7 and 8. The balance is assumed to be recovered from the Cells 1 to 5 collector drain sump and drained from the lagoon during the period.

To ensure stability in and around the lagoon, the leachate level has been maintained near the base of the lagoon for much of the reporting period.

9.5 Emissions to Groundwater

There have been direct emissions of leachate to the near surface groundwater regime beneath Cells 1 to 5, as described in Section 9.3.1 above. However, it must be noted that the groundwater beneath Cells 1 to 5 is now effectively contained by the perimeter cut-off and leachate drains and is no longer in direct continuity with the groundwater in the surrounding areas.

There are no direct emissions to groundwater into the bedrock (limestone). The presence of the Boulder Clay (minimum thickness ~ 7 m) above the limestone limits the mixing of the shallow and deep groundwater beneath the facility.

9.6 Landfill Gas Emissions

The gas emissions from the site have been modelled using a GasSim (Version 2) model. The site specific data such as cell dimensions, capping and lining details and waste composition and volume are input to the model to calculate the likely gas production over the lifetime of the landfill. A copy of the GasSim output graphs for Cells 1-5, Cell 6, Cell 7 and Cell 8 are included as Appendix M.

9.6.1 Emissions from Cells 1 to 5

Waste deposition in Cells 1-5 is thought to have commenced in approximately 1980 and was completed in 2002. Capping of Cells 1 - 5 was completed during 2004. A total of 142,000 m^3 of waste is believed to have been deposited in Cell 1 - 5.

A generated volume of 62 m^3/hr of landfill gas has been extrapolated from the GasSim model for Cells 1 - 5. This equates to an annual volume of 543,120 m^3.

9.6.2 Emissions from Cell 6

Waste tipping to Cell 6 commenced during 2003 and was completed during 2004. Some 26 300 m³ of biodegradable waste has been placed in the cell. It is assumed that much of this waste is likely to be anaerobic and therefore generating gas.

The GasSim model shows that the maximum gas generation for Cell 6 would have been during 2005. The output from the model is a graph suggesting that Cell 6 will be generating gas at an approximate rate of 41 m^3/hr. This equates to an annual total of 359,160 m^3.

9.6.3 Emissions from Cell 7

Waste tipping to Cell 7 commenced during 2005 and was completed during 2008. Some 129 000 m³ of biodegradable waste has been place in the cell. It is assumed that much of this waste is likely to be anaerobic and therefore generating gas.

The GasSim model shows that the maximum gas generation for Cell 7 would have been during 2009. The output from the model is a graph suggesting that Cell 7 will be generating gas at an approximate rate of 87 m^3/hr. This equates to an annual total of 762,120 m^3.

9.6.4 Emissions from Cell 8

Waste tipping to Cell 8 commenced during 2008 and was completed during 2010. Some 81 060 m³ of biodegradable waste has been placed in the cell. It is assumed that much of this waste is likely to be anaerobic and therefore generating gas, however, some of the recently placed waste will be aerobic.

The output from the model is a graph suggesting that Cell 8 will be generating gas at an approximate rate of 43 m^3/hr. This equates to an annual total of 376,680 m^3.

9.6.5 Summary of Emissions

The landfill gas collection system has been in use throughout 2010 and site records indicate that the flare was operational for approximately 8,221 hours from 1 January 2010 to 10 December 2010 (99.6 % efficiency). Average flow rate at the flare during 2010 was 420 m^3/ hour. This equates to combustion of some 3 452 820 m^3 of landfill gas.

According to RCC the average quality at the flare for 2010 was:

- Methane 36 v/v;
- Carbon dioxide 24 % v/v;
- Oxygen 4 % v/v.

A temporary open flare was commissioned on-site on 1 March 2010 in order to treat poorer quality gas from Cell 8. The temporary open flare was operational for a maximum of 6840 hours from 1 March 2010 to 10 December 2010 (94.3 % efficiency). Average flow rate at the temporary open flare during 2010 was 400 m^3/ hour. This equates to combustion of some 2 736 000 m^3 of landfill gas.

According to RCC the average quality at the temporary open flare for 2010 was:

- Methane 35 v/v;

- Carbon dioxide 26 % v/v;
- Oxygen 5 % v/v.

The total volume of bulk gas produced by the site, extrapolated from the GasSim model for the site, for 2010 is approximately 2 037 190 m^3.

9.6.6 Future Emissions

The collection efficiency of landfill gas systems depends on a number of factors (including the integrity of lining and capping systems). The unlined waste has been capped and active extraction of gas is continuing. Gas collection from lined cells 6 to 8 is also in progress. All cells have been fully capped and gas extraction will continue at the site for a number of years.

Gas combustion for electricity generation schemes generally requires a gas flow rate of more than 500 m³/hour. The average flow rate for 2010 was 420 m^3/hr. Assuming landfilling ceases by the end of 2010 it is unlikely that flow rates will increase much above 500 m^3/hr. Gas generation in the completed cells is likely to decrease as production increases to its maximum in the lined cells (predicted to be 2011 in Cell 8).

In addition sites of less than 200 000 tonnes of biodegradable waste are unlikely to produce sufficient landfill gas to generate more than 0.75 MW, and are therefore of limited commercial interest. Based on this criterion, it is unlikely that landfill gas utilisation would be viable at the Ballaghaderreen site.

Landfill gas is therefore likely to be flared for the foreseeable future.

10. Review of Nuisance Controls

10.1 Rodents

Rodents, particularly rats, can be attracted to landfill sites as a source of food. They can cause damage to landfill infrastructure (including control cabling and landfill lining/ capping systems) by gnawing and burrowing. They also have the potential to spread waste beyond the boundary of the facility and can harbour disease.

Eco-lab Services is contracted by Roscommon County Council to provide rodent control services. The facility was treated once a month with a rodenticide ("Bromadioline") during the reporting period.

Eco-lab Services visited the site on 6 occasions in 2010. Eco-lab Services compile a report after each visit, which is filed in the site office. A copy of the site reports is included as Appendix N. Evidence of rodent activity at the site was reported on 9 of 12 occasions[3] during 2010.

10.2 Birds

Birds are generally attracted to landfill sites as a potential source of food. The use of Void Saver 70 (a woven polypropylene material) as an alternative daily cover in the active areas of the landfill, and soil materials as a longer term temporary cover, reduces the attractiveness of the site for scavenging and loafing birds.

When waste was being accepted at the site bird counting was undertaken by a member of staff on a daily basis. The number of birds on site was monitored in the morning and afternoon. A record of the bird counting is kept on site.

When waste was being accepted at the site Roscommon County Council contracted the services of a bird management company, Bird Control Ireland, for the management and control of bird numbers on the site. This service was provided from June 2004. Bird Control Ireland visited the site once a week and was also on call if required.

Bird Control Ireland used a combination of the following techniques for the management of bird numbers on the site:

- Birds of prey;
- Heli-Kites;
- Pyrotechnics;
- Shooting;

[3] Rodent activity was reported during visits on 26/01/10, 22/02/10, 24/03/10, 30/04/010, 31/05/10, 29/06/10, 19/07/10, 27/08/10, 29/09/10, 29/10/10, 30/11/10 & 10/12/10

- Bird distress calls.

Bird Control Ireland compiled a report after each visit to the site which was filed in the site office.

10.3 Flies

Flies are attracted to waste at the landfill as a breeding ground. Following egg laying, larvae can emerge within 24 hours in warm weather or longer in cold weather.

Roscommon County Council contract AOK's Pest Control Services for management of flies at the facility.

AOK's Pest Control Services undertake fly spraying using Fendona 6SC at the facility when needed. Fendona 6SC is a broad-spectrum residual insecticide for the control of crawling and flying insects. Fly control was carried out six times during the reporting period, on 2nd June, 23rd June, 15th and 17th July, 28th July and 4th August 2010.

10.4 Odour

Odour from the facility is predominately from landfill gas and exposed waste. The landfill gas collection and flaring infrastructure has been in operation throughout the year. The only exposed waste during the first six months of 2010 was in Cell 8. The site has now been capped and no wastes are exposed.

Leachate generation may also give rise to odour production. Roscommon County Council is using an oxidising agent and aerators to reduce the leachate odour. Previous manually applied odour eliminators and masking agents used at the leachate lagoon and the leachate sump have been replaced with a ferric nitrate dosing pump. Combined with continuous pumping of leachate (which ensures a continuous flow in the pumped main), this ensures the leachate remains aerobic in the pumped main and has eliminated generation of hydrogen sulphide, which has previously given rise to complaints. Handling and usage of the ferric nitrate chemical onsite is undertaken in accordance with documented site operating procedures.

The ferric nitrate storage container is located in a surfaced and bunded area adjacent to the leachate lagoon. The storage area is profiled to ensure drainage from its concrete surface is into the lagoon, ensuring no direct discharge occurs to the surrounding ground.

10.5 Litter

Litter is controlled by fencing which was installed around the landfill footprint as specified in the Waste Licence. Portable litter fencing was also used at the working face, which was moved to various points around the working face depending on the wind direction. As part of operational controls all litter was collected at the end of each working day.

Good operational practices on site are the main controls to avoid nuisances. All waste deposited was covered by the end of each working day. Adequate daily cover reduces the risk of odour, wind blown litter, vermin, flies and birds.

11. Energy Use and Resource Consumption on Site

Energy use and resource consumption in the period has been limited to the use of fuel for site plant, and the electricity supply to the office and pumps. Details of quantities used are provided in the sections below.

11.1 Fuel

The use of fuel on site is limited to the operation of site plant and miscellaneous pumps. The approximate quantity of diesel fuel used throughout the year is 32,480 litres. This value was less than reported in previous years because the landfill closed in July 2010. Table 11.1 provides a breakdown of the use of diesel fuel.

Table 11.1 Fuel Quantity Used on Site

Site Plant	Litres of Diesel used per Week	Litres of Diesel used per Year
Track Excavator	600	16,800
Compactor	560	15,680
Total		32,480

11.2 Electricity

Electricity use on site is limited to supply for use in the site office, weighbridge, landfill gas flare and mechanical pumps. Based on the meter records, total consumption of electricity during the period was ~164,272 kWh.

11.3 Imported Aggregates

In 2010 aggregates were imported into the Ballaghaderreen Landfill for engineering purposes such as road building. A total of 1,257.14 tonnes of type 804 (crushed road base), and 602.82 tonnes of broken stone were used at the facility during the reporting period.

12. Development of the Facility

12.1 Development Completed During Reporting Period

The following development work was undertaken at the facility during 2010:

1. Cell 8 Capping Works - Cell 8 capping works were completed in the final quarter of 2010. Development works included waste regrading, application of regulating layer, installation of a geosynthetic gas drainage layer, a geomembrane and a geosynthetic drainage layer. Restoration soil placement is ongoing in 2011.
2. Cell 8 Landfill Gas Extraction - All waste accepted on-site in the first half of 2010 was disposed of in Cell 8. Gas was being extracted from Cell 8 throughout 2010. 12 extraction wells were installed in Cell 8 during 2010.
3. Installation of temporary open flare - A temporary open flare was commissioned on site in March 2010 in order to treat poorer quality gas from Cell 8.

12.2 Proposed Development

The restoration of Cell 8 will be completed in 2011.

13. Tank, Pipeline and Bund Testing and Inspection

13.1 Tanks

There are no storage tanks installed on site. No tanks are proposed for the future.

Waste oil is collected in a double-lined bunded container, located within the recycling facility area on the hardstanding area. Surface water run-off from this area passes through an oil trap, which can be isolated if spillage occurs. This tank is inspected regularly for signs of damage and the level of oil contained is checked. No problems with the oil container have been reported during the period.

Ferric nitrate is stored in an Intermediate Bulk Container (IBC) in a surfaced area adjacent to the lagoon. The IBC is removed when empty and replaced with a full container by the supplier. No significant spillage has occurred outside of the storage area during the period.

13.2 Pipelines

No pipelines were installed in 2010.

13.3 Bunds

No bunds were constructed or tested during 2010.

14. Restoration of Completed Cells/ Phases

14.1 Restoration Completed During Reporting Period

Restoration of Cell 8 commenced in August 2010 and is due to be completed by the end of April 2011.

14.2 Future Restoration

With the exception of Cell 8, all cells have now been permanently restored.

15. Progress on 2010 Schedule of Environmental Objectives and Targets

15.1 Previous Year's Objectives

Environmental objectives for the reporting period are detailed in Table 15.1. Progress toward achieving these objectives is noted.

Table 15.1 Progress on 2010 Environmental Objectives

Objective	Target	Timescale	Method	Responsibility	Progress
Maintain low environmental impacts from operations.	No significant environmental impact.	Ongoing during period.	Continual monitoring of environmental parameters.	Site management	Capping of Cell 8completed in final quarter of 2010
Enhance public safety.	No injuries to public or third party property damage.	Ongoing during period.	Improved signs, clear access and parking, improved arrangements for tipping of waste from domestic users.	Site management	No injuries to public or third parties reported
Provide general advice on waste reduction and recycling.	Increased awareness of waste issues for facility users.	Ongoing during period.	Open-days, visits and documents for the public.	Roscommon County Council	General advice continues to be provided on waste reduction and recycling.
Improve visual appearance of the facility	Complete landscaping of Cell 7	Ongoing during period.	Native tree planting	Site Management/RCC	Grass seeding undertaken in Spring 2009. Native tree planting planned to be carried out in conjunction with restoration of Cell 8
Install additional gas extraction wells in Cell 8	Improve gas extraction in Cell 8	Ongoing during period.	Installation of wells	Site management	12 extraction wells were installed in Cell 8 during 2010.
Reduce BMW to landfill	Continued reductions	Ongoing during period.	Increased reduce, reuse, recycling. Encourage home composting	Site management	Landfilling now complete at the site
Reduce recyclable content of landfilled waste.	Continued reductions	Ongoing during period.	Increased reduce, reuse, recycling.	Site management	Landfilling now complete at the site

16. Schedule of Environmental Objectives and Targets for 2011

16.1 Environmental Targets and Objectives

Table 16.1 details the environmental targets and objectives for the 2011 reporting period.

Table 16.1 2011 Environmental Objectives

Objective	Target	Timescale	Method	Responsibility
Improve visual appearance of the facility	Complete landscaping of Cell 8	Ongoing during period.	Plant grass and trees.	Site Management/RCC
Enhance public safety.	No injuries to public or third party property damage.	Ongoing during period.	Improved signs, clear access and parking, improved arrangements for tipping of waste from domestic users.	Site management
Provide general advice on waste reduction and recycling.	Increased awareness of waste issues for facility users.	Ongoing during period.	Open-days, visits and documents for the public.	Roscommon County Council

17. Reported Incidents and Complaints

17.1 Complaints

Roscommon County Council maintains a register of complaints received regarding Ballaghaderreen Landfill, in compliance with the facility's Waste Licence. A total of 117 complaints, from 16 different complainants, were received during the 2010 reporting period. These are summarised in Appendix O. The majority of the complaints were odour related.

17.2 Incidents

Table 17.1 contains the details of incidents reported to the EPA occurred during the 2010 reporting period, of which there were 12 incidents reported. There were 5 incidents relating to the failure of the facility's landfill gas flare and 7 incidents related to leachate management.

Table 17.1 Incidents Reported to the EPA in 2010

Incident Number	Incident Date	Incident Description	Follow up Action
I10-01	06/01/10	C6 leachate level	1.00m level breach due to frozen pipe-work
I10-02	13/01/10	Flare failure	Failure caused by power failure
I10-03	17/02/10	Failure of auto gas analyser	Faulty CH4 cell
I10-04	22/03/10	Cell 8 leachate level	Exceptional rainfall event above pump capacity. Enquiries made to upgrade size of pump.
I10-05	16/11/09	Cell 8 leachate level	Pump upgraded to a larger 1.5kw Homer pump
I10-06	31/05/10	Cell 8 leachate level	Pump failure resulted in leachate level breach. Pump fixed
I10-07	19/07/10	Flare failure	Excess O2 ingress caused by a faulty fitting.
I10-08	02/09/10	Temporary Open Flare failure	Flare failed to re-start due to faulty electrical component. Component replaced
I10-09	06/10/10	Cell 8 leachate level	Exceedance of 1.00m licence limit caused by faulty cable. Cable replaced
I10-10	15/11/10	Leachate Lagoon Discharge Pump Failure	Pump and motor replaced
I10-11	24/11/10	Cell 7 Leachate level sensor failure	Cable found to be responsible and replaced
I10-12	06/12/10	Enclosed flare auto-analyser failure	Recalibration

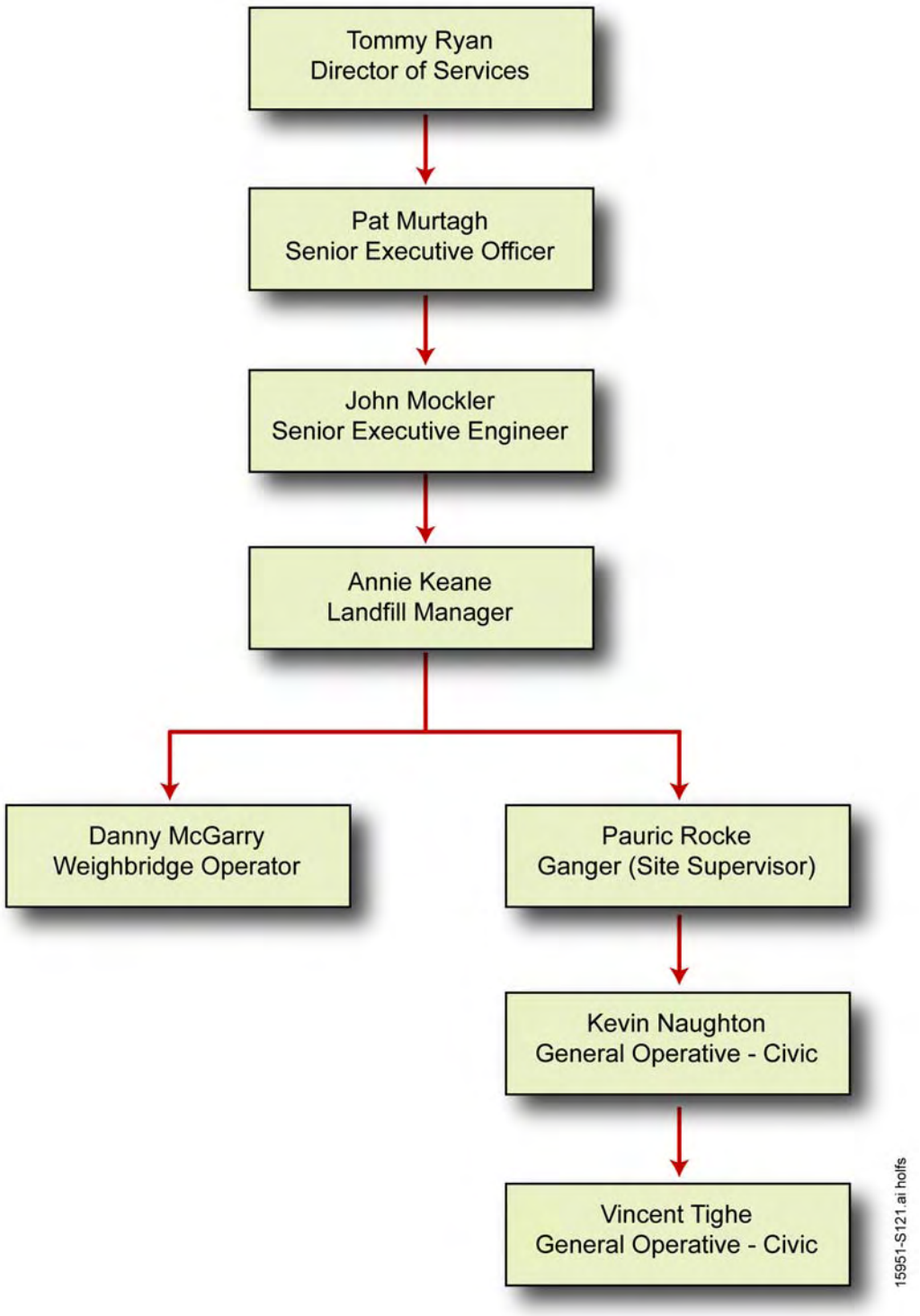
18. Financial Provision

Roscommon County Council is committed to the long-term management, restoration and aftercare of the facility as agreed with the EPA.

Finance for this will be made available from Central Government funds by way of loans from Central Government.

19. Management and Staffing Structure

Ballaghaderreen Landfill Site Management Structure and Personnel 2010



20. Programme for Public Information

20.1 Council Annual Report

Roscommon County Council's annual report includes a section on the operation and condition of the landfills within the County. This includes information relevant to the Ballaghaderreen Landfill.

20.2 Website

A page in the Roscommon County Council Website is currently provided for the Ballaghaderreen Landfill. This provides details of current site opening times, tipping charges, *etc*. The web page can be found at the following web address;

http://www.roscommoncoco.ie/services/environment/wastemanagement.html

20.3 School Visits

There were no school visits during 2010.

21. Report on Training Staff

21.1 Formal Training

Ballaghaderreen landfill site staff have undertaken training courses provided by Roscommon County Council. The following courses have been completed by the site staff during 2010:

- Safe Pass program;
- Manual Handling refresher training;
- Core Time User Acceptance training;
- Code of Practice – Waste Water Treatment & Disposal Systems;
- Irish On-site Wastewater Association Conference;
- Energy Awareness;
- Workshop on Agricultural Inspections;
- Workforce Planning Briefing Session;
- Abrasive wheels.

Table 21.1 summarises the training completed by relevant staff during the reporting period.

Table 21.1 Staff Training -2010

Training Course	Tim Jessop	Annie Keane	Danny McGarry	Pauric Rocke	Kevin Naughton	Vincent Tighe
Safe Pass program.	√			√	√	√
Manual Handling			√	√	√	√
Core time user Acceptance			√			
Code of practice – waatewater treatment & disposal systems		√				
Irish on-site wastewater association conference		√				
Energy awareness		√				
Workshop on agricultural inspections		√				
Workforce planning briefing sessions	√					
Abrasive wheels						√

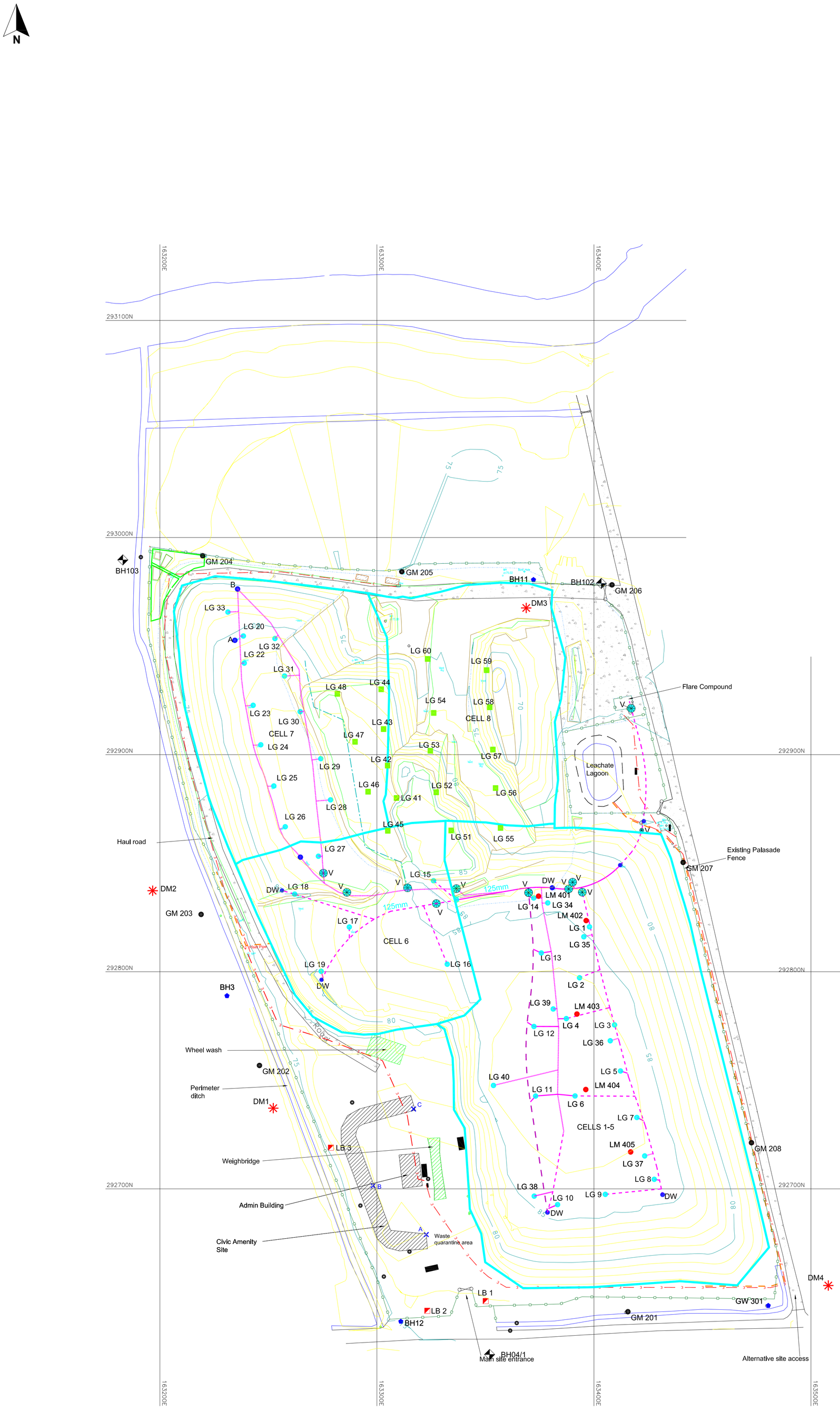
22. Procedures Developed

There were no new procedures developed in the 2010 reporting period.

23. Biological Assessment of the River Lung

A biological assessment of the River Lung is a requirement of the Waste Licence in condition 8.11, however, in 2008 it was determined by the EPA that the River Lung was unsuitable for this type of testing. A biological assessment of the River Lung was therefore not completed during the 2010 reporting period. Communication between the EPA and Roscommon County Council has been provided as Appendix P.

Figure



Key

- Cell Boundary
- Stone Suface
- Existing Steel Palisade Fencing
- Security Gate
- Survey Station
- Power Cable
- Leachate Pipe
- DW — Existing Dewatering Lance
- Existing Landfill Gas Suction Pipework (above ground)
- Existing Pipeline (below ground) - assumed location
- Existing Decommissioned Pipeline (below ground)
- V — Existing Isolation Valve
- Existing Landfill Gas Extraction Well
- Existing Knock Out Pot
- BH4 — Deep groundwater monitoring
- LB 3 — Leachate barrier monitoring
- 1 — Dust monitoring gauge
- GM 202 — Landfill gas monitoring
- GW 301 — Shallow groundwater monitoring
- LG 60 — Landfill gas extraction well

Survey Station Co-ordinates

	Easting	Northing	Level
A	163322.7	292679.0	77.14
B	163298.2	292701.5	77.47
C	163316.9	292736.8	78.30

Bench Mark 78.20 M.S.L.

0 m — 50 m

Scale 1:1000 @ A1

Roscommon County Council
Ballaghaderreen Landfill
AER Report

Figure 1
General Arrangement

March 2011
15951-S120.dwg holfs

Entec

Appendix A
Landfill Gas Monitoring Results

17 Pages

Landfill Gas - 27/01/2010															
	LG 1	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 15**	**LG 16**
Sampling Time	10.00	10.05	10.10	10.15	10.20	10.25	10.30	10.35	10.40	10.45	10.50	10.55	11.00	11.05	11.10
Methane (CH_4) % v/v	38.60	28.50	24.40	13.70	44.10	26.30	11.60	40.50	71.90	64.20	24.90	65.20	44.10	36.70	13.70
Carbon Dioxide (CO_2) % v/v	24.50	18.90	18.10	11.40	13.60	9.40	24.90	26.60	25.30	32.20	17.50	32.30	29.90	29.00	17.60
Oxygen (O_2) % v/v	5.50	6.90	7.20	12.10	11.90	13.20	1.20	2.60	0.70	3.30	8.30	3.00	0.80	2.50	7.50
Atmpospheric Pressure (mbars)	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022
Temperature (°C)	8.50	8.50	6.50	5.50	5.50	5.50	5.40	5.50	5.70	5.80	5.80	5.40	5.50	5.70	5.60
Landfill Gas - 25/02/2010															
	LG 1	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 15**	**LG 16**
Sampling Time	12.00	12.05	12.10	12.15	12.20	12.25	12.30	12.35	12.40	12.45	12.50	12.55	13.00	13.05	13.10
Methane (CH_4) % v/v	10.30	26.40	28.40	14.10	29.60	38.40	14.50	66.10	70.50	63.40	31.80	10.00	46.30	59.10	19.70
Carbon Dioxide (CO_2) % v/v	6.10	15.80	21.10	11.30	18.70	25.10	11.60	30.90	29.80	33.20	21.00	5.10	30.30	36.70	20.50
Oxygen (O_2) % v/v	17.00	9.60	4.40	12.00	7.10	0.10	10.60	1.10	0.10	1.80	8.70	17.90	1.50	1.50	5.40
Atmpospheric Pressure (mbars)	976	976	976	976	976	976	976	976	976	976	976	976	976	976	976
Temperature (°C)	7.40	8.40	7.80	6.20	5.80	5.50	5.10	4.60	4.10	4.20	4.40	4.30	5.00	5.10	4.60
Landfill Gas - 31/03/2010															
	LG 1	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 15**	**LG 16**
Sampling Time	11.00	11.03	11.06	11.09	11.12	11.15	11.18	11.21	11.24	11.27	11.30	11.33	11.36	11.45	11.48
Methane (CH_4) % v/v	10.1	25.8	27.9	28.9	14.0	29.3	35.4	15.5	63.1	70.1	62.4	9.8	45.3	58.1	19.8
Carbon Dioxide (CO_2) % v/v	6.1	16.0	20.1	11.5	19.1	24.3	11.9	30.3	29.6	31.2	21.5	4.9	30.1	36.1	20.5
Oxygen (O_2) % v/v	17.1	9.0	4.6	12.5	7.0	0.5	10.3	1.4	0.3	1.5	8.9	17.8	1.4	1.3	5.2
Atmpospheric Pressure (mbars)	990	990	990	990	990	990	990	990	990	990	990	990	990	990	990
Temperature (°C)															

Landfill Gas - 27/01/2010															
	LG 17	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**	**LG 30**	**LG 31**	**LG 32**
Sampling Time	11.15	11.20	11.25	11.30	11.35	11.40	11.45	11.50	11.55	12.00	12.05	12.10	12.15	12.20	12.25
Methane (CH_4) % v/v	45.10	14.60	0.10	64.50	52.40	61.20	62.30	57.50	54.80	60.10	61.80	61.60	63.10	63.10	50.10
Carbon Dioxide (CO_2) % v/v	27.70	17.50	0.00	35.40	32.10	35.90	38.20	35.40	33.00	32.50	36.80	38.70	34.60	34.60	32.00
Oxygen (O_2) % v/v	1.80	5.20	21.30	0.50	2.60	3.90	0.40	1.40	1.70	3.00	0.70	0.80	0.30	0.70	0.60
Atmpospheric Pressure (mbars)	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022
Temperature (°C)	5.40	5.70	5.40	7.80	7.90	8.00	7.80	8.40	7.90	8.50	8.60	8.50	8.50	8.50	8.30
Landfill Gas - 25/02/2010															
	LG 17	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**	**LG 30**	**LG 31**	**LG 32**
Sampling Time	13.15	13.20	13.25	13.30	13.35	13.40	13.45	13.50	13.55	14.00	14.05	14.10	14.15	14.20	14.25
Methane (CH_4) % v/v	**37.20**	17.60	0.00	57.00	47.00	50.10	57.50	51.30	42.10	54.60	55.90	50.10	62.10	60.30	55.40
Carbon Dioxide (CO_2) % v/v	25.90	**16.50**	0.00	33.50	30.40	36.90	37.60	34.20	30.70	31.90	38.40	33.00	38.10	32.90	33.40
Oxygen (O_2) % v/v	2.00	0.10	21.50	2.00	4.20	0.30	1.60	1.60	1.40	2.60	1.80	4.60	0.50	0.40	1.10
Atmpospheric Pressure (mbars)	976	976	976	976	976	976	976	976	976	976	976	976	976	976	976
Temperature (°C)	3.90	4.00	4.40	4.10	4.40	7.30	4.30	5.20	3.70	3.50	3.40	4.90	5.90	6.00	4.30
Landfill Gas - 31/03/2010															
	LG 17	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**	**LG 30**	**LG 31**	**LG 32**
Sampling Time	11.51	11.54	11.57	12.00	12.04	12.07	12.10	12.13	12.16	12.19	12.22	12.25	12.28	12.31	12.34
Methane (CH_4) % v/v	**37.2**	18.1	0.0	57.2	44.3	60.6	61.0	55.7	57.5	52.6	62.0	60.1	59.5	62.8	57.1
Carbon Dioxide (CO_2) % v/v	**26.1**	15.9	0.0	32.7	29.0	35.0	36.3	34.3	33.0	29.6	37.1	37.3	36.5	36.3	34.7
Oxygen (O_2) % v/v	2.1	0.5	21.5	2.5	4.1	1.8	3.0	1.7	1.6	5.5	0.7	2.9	1.9	2.5	0.6
Atmpospheric Pressure (mbars)	990	990	990	990	990	990	990	990	990	990	990	990	990	990	990
Temperature (°C)				6.8	8.5	7.4	7.8	8.7	2.3	7.3	7.0	8.3	7.4	6.7	9.5

Landfill Gas - 27/01/2010															
	LG 33	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**	**LG 44**	**LG 45**	**LG 46**	**LG 47**
Sampling Time	12.30	12.35	12.40	12.45	12.50	12.55	13.00	13.05	13.10	13.15	13.20	13.25	13.30	13.35	13.40
Methane (CH_4) % v/v	62.10	25.20	27.50	48.50	68.80	52.40	31.40	30.50	62.20	8.70	4.50	35.10	60.10	20.50	61.40
Carbon Dioxide (CO_2) % v/v	35.10	18.90	18.90	20.50	31.70	28.60	24.70	24.90	38.30	36.40	7.70	29.20	36.30	14.50	40.50
Oxygen (O_2) % v/v	0.70	8.90	6.40	1.10	0.30	6.50	2.30	2.40	1.00	2.10	17.30	4.80	3.50	13.30	0.20
Atmpospheric Pressure (mbars)	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022	1022
Temperature (°C)	8.20	4.60	8.50	6.00	5.00	5.80	5.10	5.50	5.20	6.10	5.20	6.20	5.90	5.20	4.30
Landfill Gas - 25/02/2010															
	LG 33	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**	**LG 44**	**LG 45**	**LG 46**	**LG 47**
Sampling Time	14.30	14.35	14.40	14.45	14.50	14.55	15.00	15.05	15.10	15.15	15.20	15.25	15.30	15.35	15.40
Methane (CH_4) % v/v	48.40	12.70	26.20	34.80	69.30	62.10	33.00	34.20	63.20	58.00	33.30	42.20	60.50	48.50	61.90
Carbon Dioxide (CO_2) % v/v	32.60	9.00	16.80	25.60	31.70	34.50	26.70	25.40	28.70	29.80	34.50	36.90	38.60	27.40	39.10
Oxygen (O_2) % v/v	2.10	4.60	8.50	0.70	0.30	2.10	2.50	0.40	0.80	0.90	2.90	4.40	1.90	10.30	0.40
Atmpospheric Pressure (mbars)	976	976	976	976	976	976	976	976	976	976	976	976	976	976	976
Temperature (°C)	3.90	5.20	8.20	6.20	5.00	6.00	5.90	5.70	3.60	4.20	6.60	3.60	3.60	3.70	5.50
Landfill Gas - 31/03/2010															
	LG 33	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**	**LG 44**	**LG 45**	**LG 46**	**LG 47**
Sampling Time	12.37	12.40	12.43	12.46	12.49	12.52	12.55	12.58	13.01	13.04	13.07	13.10	13.13	13.16	13.19
Methane (CH_4) % v/v	48.1	48.5	12.6	26.0	33.8	69.3	33.9	32.1	63.0	56.6	40.0	46.2	58.0	35.1	63.4
Carbon Dioxide (CO_2) % v/v	31.6	12.9	25.9	35.1	31.8	34.0	27.1	25.0	37.6	37.3	26.3	32.3	34.5	24.3	38.6
Oxygen (O_2) % v/v	2.8	4.1	8.1	0.6	0.3	2.2	2.6	0.5	0.9	0.7	2.9	3.7	3.5	10.1	0.2
Atmpospheric Pressure (mbars)	990	990	990	990	990	990	990	990	990	990	990	990	990	990	990
Temperature (°C)	8.5	7.9	8.0	7.6	6.9	7.1	7.3	6.8	11.3	14.2	13.9	9.5	11.1	8.4	13.5

Landfill Gas - 27/01/2010							
	LG 48	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**
Sampling Time	13.45						
Methane (CH_4) % v/v	46.70						
Carbon Dioxide (CO_2) % v/v	31.00						
Oxygen (O_2) % v/v	5.50						
Atmpospheric Pressure (mbars)	1022						
Temperature (°C)	5.50						
Landfill Gas - 25/02/2010							
	LG 48	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**
Sampling Time	15.45						
Methane (CH_4) % v/v	30.60						
Carbon Dioxide (CO_2) % v/v	23.50						
Oxygen (O_2) % v/v	7.20						
Atmpospheric Pressure (mbars)	976						
Temperature (°C)	4.40						
Landfill Gas - 31/03/2010							
	LG 48	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**
Sampling Time	13.22	13.25	13.28	13.31	13.34	13.37	13.40
Methane (CH_4) % v/v	46.2	10.8	20.2	40.0	26.7	31.1	14.8
Carbon Dioxide (CO_2) % v/v	31.7	13.3	18.2	30.0	22.9	26.3	16.1
Oxygen (O_2) % v/v	1.0	11.2	10.7	5.3	8.4	9.2	12.1
Atmpospheric Pressure (mbars)	990	990	990	990	990	990	990
Temperature (°C)	9.1	11.9	9.8	12.4	8.1	9.0	7.7

Landfill Gas - 15/04/2010																					
	LG 1	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 14**	**LG 15**	**LG 16**	**LG 17**	**LG 18**	**LG 19**	**LG 20**	**LG 21**	**LG 22**
Methane (CH_4) % v/v	5.0	10.3	3.2	11.3	5.3	2.2	21.2	65.0	59.1	53.5	14.9	6.5	39.6		12.4	17.2	52.0	23.5	18.5	61.2		48.7
Carbon Dioxide (CO_2) % v/v	3.6	7.8	4.3	10.2	4.9	4.2	22.5	30.0	29.8	30.9	11.8	4.0	27.9		16.2	20.2	26.1	18.3	11.8	34.0		30.7
Oxygen (O_2) % v/v	18.0	13.9	17.0	10.9	16.7	16.8	0.5	1.3	2.2	0.2	11.6	18.4	1.2		5.3	1.7	1.3	2.0	9.1	1.3		2.8
Atmpospheric Pressure (mbars)	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015		1015	1015	1015	1015	1015	1015		1015
Temperature (°C)	17.7	16.8	18.1	16.4	17.5	11.6	8.9	9.9	9.7	9.8	9.9	17.2	16.0		21.6	20.2	13.2	12.9		12.0		13.1
Landfill Gas - 18/05/2010																						
Methane (CH_4) % v/v	0.9	3.9	0.2	4.1	0.2	62.8	1.4	62.6	15.0	26.6	63.9	7.8	44.3		25.5	11.8	**48.1**	19.2	4.9	58.8		46.3
Carbon Dioxide (CO_2) % v/v	1.4	8.8	0.9	3.9	0.1	34.6	9.9	27.2	12.8	29.0	31.6	4.5	29.6		18.1	16.0	26.4	**17.0**	3.7	32.9		30.0
Oxygen (O_2) % v/v	19.6	13.0	18.2	16.9	20.2	0.3	9.1	0.5	9.5	0.5	1.0	17.9	0.4		4.8	5.0	0.2	3.2	18.2	1.2		2.5
Atmpospheric Pressure (mbars)	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016		1016	1016	1016	1016	1016	1016		1016
Temperature (°C)	17.1	16.8	16.6	16.1	16.6	16.2	16.4	16.5	17.2	17.6	22.2	16.2	17.2		15.8	16.6	17.4	17.0	18.9	16.2		16.7
Landfill Gas - 30/06/2010																						
Methane (CH_4) % v/v	6.0	3.9	1.0	5.1	0.1	62.2	1.0	12.4	5.4	21.2	66.5	68.6	36.7		52.8	15.9	**27.3**	18.1	0.0	59.9		61.9
Carbon Dioxide (CO_2) % v/v	4.1	8.6	0.1	4.0	0.0	37.1	2.4	18.7	6.6	21.8	33.5	33.3	28.8		36.4	18.3	**24.3**	15.8	0.0	35.1		31.5
Oxygen (O_2) % v/v	16.8	10.9	19.0	16.1	19.2	0.0	17.3	1.8	13.7	2.4	0.1	0.0	0.3		0.0	3.7	0.0	3.3	21.0	0.9		2.1
Atmpospheric Pressure (mbars)	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0		1005.0	1005	1005.0	1005	1005.0	1005		1005
Temperature (°C)	22.3	23.0	22.8	21.4	22.3	20.4	21.5	20.7	20.9	21.0	20.5	21.3	22.9		23.8	22.7	25.0	23.3	22.9	22.0		22.6

Landfill Gas - 15/04/2010																					
	LG 23	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**	**LG 30**	**LG 31**	**LG 32**	**LG 33**	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**
Methane (CH_4) % v/v	62.2	62.0	55.5	54.1	54.7	59.4	49.4	60.8	62.4	61.3	54.3	1.2	19.6	57.1	66.9	62.5	26.3	27.4	63.0	56.8	25.4
Carbon Dioxide (CO_2) % v/v	36.6	37.7	34.8	33.9	31.4	35.5	30.1	36.8	36.4	35.5	32.6	1.0	15.4	30.8	29.4	33.0	22.8	23.7	37.7	37.7	21.4
Oxygen (O_2) % v/v	0.5	0.4	1.4	0.6	2.7	0.5	5.0	0.5	0.7	0.3	0.4	19.9	7.7	0.7	0.4	0.8	0.5	1.8	3.0	0.6	8.9
Atmpospheric Pressure (mbars)	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015
Temperature (°C)	12.1	10.8	11.6	10.0	10.0	13.9	13.8	13.6		12.0	17.6	19.2	18.6	18.1	9.4	10.3	15.6	11.0	15.6	35.3	42.5
Landfill Gas - 18/05/2010																					
Methane (CH_4) % v/v	61.1	61.7	54.0	45.6	56.7	58.7	0.6	61.4	62.7	56.8	45.8	0.2	33.4	11.6	9.2	59.9	18.6	60.1	62.7	50.2	16.5
Carbon Dioxide (CO_2) % v/v	36.6	37.1	34.0	30.6	32.3	35.4	0.4	37.3	36.8	33.8	32.9	0.0	24.1	17.8	14.7	31.8	20.8	28.1	37.7	35.5	13.5
Oxygen (O_2) % v/v	0.0	0.0	0.8	1.2	1.8	0.8	20.6	0.0	0.1	0.8	0.1	20.8	1.4	1.1	3.3	0.4	0.5	0.3	0.1	0.8	12.1
Atmpospheric Pressure (mbars)	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016
Temperature (°C)	16.3	16.9	16.2	17.4	16.1	16.6	15.7	16.4	16.7	17.2	16.6	15.5	16.2	16.4	16.5	16.1	16.3	16.2	17.0	17.5	16.9
Landfill Gas - 30/06/2010																					
Methane (CH_4) % v/v	63.4	53.9	49.0	52.3	54.5	52.7	60.3	62.3	60.9	51.8	18.4	18.4	21.4	6.3	4.5	58.1	15.5	24.8			
Carbon Dioxide (CO_2) % v/v	38.5	40.5	36.5	33.7	31.3	37.1	41.3	40.2	38.4	38.4	34.4	12.7	21.9	13.9	19.7	31.5	20.1	23.1			
Oxygen (O_2) % v/v	0.0	0.0	0.4	0.6	2.3	0.0	0.0	0.1	0.0	0.0	10.9	0.6	4.2	0.4	0.0	0.0	0.0	2.4			
Atmpospheric Pressure (mbars)	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005	1005.0	1005			
Temperature (°C)	21.2	21.4	21.9	21.4	21.6	19.9	20.2	20.8	21.1	22.1	21.6	22.2	22.6	22.2	21.7	20.7	22.0	20.6			

Landfill Gas - 15/04/2010											
	LG 44	**LG 45**	**LG 46**	**LG 47**	**LG 48**	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**
Methane (CH_4) % v/v	50.4	60.7	60.9	62.8	61.8	18.2	18.6	25.7	23.1	22.0	26.6
Carbon Dioxide (CO_2) % v/v	33.4	36.5	35.0	38.0	37.2	14.1	12.9	18.0	17.8	17.1	21.3
Oxygen (O_2) % v/v	3.1	0.9	1.3	0.4	0.7	12.8	13.5	11.5	11.0	11.2	10.0
Atmpospheric Pressure (mbars)	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015	1015
Temperature (°C)	24.1	15.5	14.5	18.2	15.1	21.4	21.2	27.7	32.2	35.7	28.2
Landfill Gas - 18/05/2010											
Methane (CH_4) % v/v	45.6	61.1	56.2	61.7	51.0	15.5	13.5	23.5	14.4	28.5	31.0
Carbon Dioxide (CO_2) % v/v	32.0	36.5	39.2	37.6	32.9	12.0	9.1	16.6	10.8	21.5	24.0
Oxygen (O_2) % v/v	2.7	0.9	1.4	0.2	2.0	13.7	15.0	12.1	14.5	9.5	3.1
Atmpospheric Pressure (mbars)	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016	1016
Temperature (°C)	17.0	18.0	16.5	16.8	17.1	16.9	17.1	18.1	19.0	16.8	16.6
Landfill Gas - 30/06/2010											
Methane (CH_4) % v/v								29.9	63.5	64.5	35.0
Carbon Dioxide (CO_2) % v/v								22.5	43.9	44.2	30.4
Oxygen (O_2) % v/v								8.5	0.0	0.0	5.1
Atmpospheric Pressure (mbars)								1005.0	1005	1005.0	1005
Temperature (°C)								18.1	16.7	16.6	18.2

Landfill Gas - 30 July															
	LG 1	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 15**	**LG 16**
Methane (CH4) % v/v	5.9	4.0	0.1	5.3	1.0	61.0	0.1	12.5	5.6	21.0	63.0	69.3	36.8	50.9	15.3
Carbon Dioxide (CO2) % v/v	4.0	8.3	0.2	4.1	0.0	37.8	2.0	18.9	6.5	21.7	33.4	33.0	28.9	36.3	18.2
Oxygen (O2) % v/v	16.9	10.3	19.1	16.1	19.2	0.0	17.3	1.8	12.3	2.1	0.2	0.0	0.3	0.0	3.5
Atmpospheric Pressure (mbars)	997	997	997	997	997	997	997	997	997	997	997	997	997	997	997
Temperature (°C)	20.9	21.0	22.0	21.3	20.9	18.9	19.0	19.6	20.3	20.9	21.3	20.9	21.3	18.9	20.3
Landfill Gas - 31 August															
	LG 1	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 15**	**LG 16**
Methane (CH4) % v/v	5.0	4.0	0.2	5.4	2.0	60.1	0.1	12.9	5.1	21.9	63.1	65.0	36.1	50.1	15.9
Carbon Dioxide (CO2) % v/v	4.9	8.1	0.1	5.3	0.0	38.1	2.1	19.5	6.0	21.8	33.1	33.0	28.1	35.1	18.0
Oxygen (O2) % v/v	16.5	10.0	19.0	6.0	9.1	0.0	17.1	1.1	12.9	2.0	0.3	0.0	0.3	0.0	3.1
Atmpospheric Pressure (mbars)	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001
Temperature (°C)	20.9	18.4	18.9	20.1	20.0	20.1	19.8	19.7	19.9	20.0	20.0	17.8	18.1	19.1	19.0
Landfill Gas - 21 September															
	LG 1	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 15**	**LG 16**
Methane (CH4) % v/v	13.7	66.4	8.6	7.2	0.2	7.4	21.0	48.1	62.7	62.0	14.0	15.3	48.6		33.9
Carbon Dioxide (CO2) % v/v	12.0	38.3	7.4	5.8	0.0	7.7	14.8	30.2	35.6	36.6	9.5	7.6	**32.7**		28.7
Oxygen (O2) % v/v	10.9	0.0	13.9	15.4	19.1	3.5	11.6	0.6	0.7	0.0	13.0	14.9	**0.0**		1.6
Atmpospheric Pressure (mbars)	999	999	999	999	999	999	999	999	999	999	999	999	999		999
Temperature (°C)	18.1	17.4	17.8	18.1	17.7	18.0	17.7	17.9	18.0	17.9	18.1	17.9	17.7		18.1

Landfill Gas - 30 July															
	LG 17	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**	**LG 30**	**LG 31**	**LG 32**
Methane (CH4) % v/v	27.5	13.0	0.0	58.9	47.3	62.0	61.8	52.3	48.2	52.5	53.8	62.8	60.1	60.3	51.9
Carbon Dioxide (CO2) % v/v	24.1	15.9	0.0	35.0	31.5	38.3	40.4	36.5	33.7	31.3	37.9	41.2	40.3	38.3	34.0
Oxygen (O2) % v/v	0.2	3.9	20.8	0.8	2.0	0.0	0.0	0.3	0.6	2.5	0.0	0.0	0.0	0.2	0.0
Atmpospheric Pressure (mbars)	997	997	997	997	997	997	997	997	997	997	997	997	997	997	997
Temperature (°C)	21.3	21.9	22.0	23.9	24.0	23.0	22.9	22.5	22.6	21.9	22.0	23.9	24.1	20.3	21.0
Landfill Gas - 31 August															
	LG 17	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**	**LG 30**	**LG 31**	**LG 32**
Methane (CH4) % v/v	28.1	13.9	0.0	62.6	35.7	32.8	43.5	48.7	44.3	42.2	55.8	55.8	61.6	64.1	61.2
Carbon Dioxide (CO2) % v/v	20.1	15.1	0.0	35.3	26.6	24.5	32.5	33.8	31.8	28.7	35.8	37.3	40.4	39.7	37.6
Oxygen (O2) % v/v	0.1	4.1	21.0	1.0	1.7	3.0	0.0	1.0	0.1	2.4	0.6	0.9	0.0	0.0	0.7
Atmpospheric Pressure (mbars)	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001
Temperature (°C)	19.8	19.9	20.1	17.4	19.4	22.2	19.3	22.0	21.9	19.3	16.6	16.8	17.2	19.0	17.7
Landfill Gas - 21 September															
	LG 17	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**	**LG 30**	**LG 31**	**LG 32**
Methane (CH4) % v/v	33.0	21.3	0.0	56.6	43.4	57.8	58.5	48.7	40.7	39.0	45.9	43.3	56.2	64.2	55.6
Carbon Dioxide (CO2) % v/v	**27.1**	19.2	0.0	34.6	29.7	36.6	38.9	34.0	30.0	26.3	31.2	30.9	39.0	40.9	37.2
Oxygen (O2) % v/v	0.6	4.1	21.0	2.1	3.5	0.5	0.0	1.6	2.8	4.9	3.0	4.2	0.0	0.0	0.7
Atmpospheric Pressure (mbars)	999	999	999	999	999	999	999	999	999	999	999	999	999	999	999
Temperature (°C)	17.9	17.5	18.1	17.7	17.3	16.3	17.4	17.3	17.1	17.5	17.5	17.5	17.4	17.7	18.1

Landfill Gas - 30 July												
	LG 33	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**	**LG 44**
Methane (CH4) % v/v	18.0	20.9	6.3	4.9	59.1	15.9	24.8	24.3		32.3	30.1	13.1
Carbon Dioxide (CO2) % v/v	12.7	20.3	14.1	18.3	31.9	20.1	23.0	23.1		21.0	19.6	30.1
Oxygen (O2) % v/v	0.0	10.1	0.5	4.4	0.3	10.3	12.1	10.8		3.6	5.8	0.0
Atmpospheric Pressure (mbars)	997	997	997	997	997	997	997	997		997	997	997
Temperature (°C)	19.8	19.8	20.1	20.9	20.3	20.5	20.9	19.9		22.0	23.0	19.1
Landfill Gas - 31 August												
	LG 33	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**	**LG 44**
Methane (CH4) % v/v	28.4	20.1	6.0	4.9	58.1	16.3	25.0	24.3		32.1	42.0	36.6
Carbon Dioxide (CO2) % v/v	28.3	20.1	14.9	18.1	31.7	20.1	21.3	31.3		21.0	36.4	38.5
Oxygen (O2) % v/v	0.0	10.1	0.5	4.1	0.3	0.4	12.1	10.1		3.6	2.7	0.7
Atmpospheric Pressure (mbars)	1001	1001	1001	1001	1001	1001	1001	1001		1001	1001	1001
Temperature (°C)	20.0	17.1	17.4	18.1	19.1	19.4	18.9	18.7		18.0	17.6	17.1
Landfill Gas - 21 September												
	LG 33	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**	**LG 44**
Methane (CH4) % v/v	52.6	64.9	43.2	28.2	43.4	65.9	35.8	22.2		0.7	59.0	61.8
Carbon Dioxide (CO2) % v/v	33.5	40.0	30.2	27.5	12.1	35.6	29.8	23.0		0.7	40.8	42.4
Oxygen (O2) % v/v	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.3		19.0	0.5	0.5
Atmpospheric Pressure (mbars)	999	999	999	999	999	999	999	999		999	999	999
Temperature (°C)	18.0	18.3	16.0	17.7	17.6	18.0	17.9	18.1		17.9	17.0	18.0

Landfill Gas - 30 July															
	LG 45	**LG 46**	**LG 47**	**LG 48**	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**					
Methane (CH4) % v/v	50.2	58.3	59.3		29.3	25.9	20.1	16.9	28.3	29.1					
Carbon Dioxide (CO2) % v/v	33.9	36.9	31.8		23.9	22.8	20.9	20.3	23.9	23.5					
Oxygen (O2) % v/v	0.3	0.1	0.0		8.1	8.3	0.3	18.1	5.3	0.3					
Atmpospheric Pressure (mbars)	997	997	997		997	997	997	997	997	997					
Temperature (°C)	19.3	19.4	19.3		20.2	20.3	20.0	19.8	20.1	20.9					
Landfill Gas - 31 August															
	LG 45	**LG 46**	**LG 47**	**LG 48**	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**	**LG 55**	**LG 56**	**LG 57**	**LG 58**	**LG 59**
Methane (CH4) % v/v	63.8	49.8	61.9		10.4	0.0	34.8	63.0	25.9	24.7	22.0	40.7	26.6	34.1	54.4
Carbon Dioxide (CO2) % v/v	40.3	34.3	41.9		11.0	0.0	25.9	44.8	25.8	20.4	23.1	33.1	22.0	31.3	43.4
Oxygen (O2) % v/v	4.3	0.0	12.8		12.8	19.0	7.4	0.0	5.6	9.8	4.9	3.9	9.6	5.2	1.9
Atmpospheric Pressure (mbars)	1001	1001	1001		1001	1001	1001	1001	1001	1001	1001	1001	1001	1001	1001
Temperature (°C)	17.4	18.2	21.6		21.7	21.2	10.1	15.5	18.3	16.6	20.2	20.0	20.3	19.5	19.7
Landfill Gas - 21 September															
	LG 45	**LG 46**	**LG 47**	**LG 48**	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**	**LG 55**	**LG 56**	**LG 57**	**LG 58**	**LG 59**
Methane (CH4) % v/v	64.8	61.0	62.5		19.1	9.3	53.0		23.7	26.2	22.0	51.3	23.4	17.2	56.2
Carbon Dioxide (CO2) % v/v	41.0	40.9	41.8		17.0	7.3	39.3		22.9	18.6	21.1	40.9	21.4	18.8	44.1
Oxygen (O2) % v/v	0.0	0.5	1.7		10.7	16.2	1.9		7.3	10.2	9.6	1.5	10.2	9.2	1.3
Atmpospheric Pressure (mbars)	999	999	999		999	999	999		999	999	999	999	999	999	999
Temperature (°C)	18.1	18.2	16.8		17.8	17.9	19.3		15.9	17.2	14.8	13.9	14.1	13.6	13.6

Landfill Gas - 30 July	
Methane (CH4) % v/v	
Carbon Dioxide (CO2) % v/v	
Oxygen (O2) % v/v	
Atmpospheric Pressure (mbars)	
Temperature (°C)	
Landfill Gas - 31 August	
Methane (CH4) % v/v	
Carbon Dioxide (CO2) % v/v	
Oxygen (O2) % v/v	
Atmpospheric Pressure (mbars)	
Temperature (°C)	
Landfill Gas - 21 September	
	LG 60
Methane (CH4) % v/v	12.4
Carbon Dioxide (CO2) % v/v	9.3
Oxygen (O2) % v/v	14.7
Atmpospheric Pressure (mbars)	999
Temperature (°C)	13.2

Appendix A

Landfill Gas - 29 October 2010	**LG 1**	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 14**
Methane (CH_4) % v/v	17.8	17.3	18.1	17.0	0.8	18.5	17.0	47.9	58.0	48.1	13.0	15.1	49.0	
Carbon Dioxide (CO_2) % v/v	13.1	18.1	19.1	5.8	0.1	7.7	21.9	31.0	31.8	31.9	10.1	7.9	31.9	
Oxygen (O_2) % v/v	10.9	10.0	11.0	6.1	19.0	5.8	14.8	0.7	0.0	0.0	13.9	15.8	0.0	
Atmospheric Pressure (mbars)	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	
Temperature (°C)	15.1	15.8	15.2	15.0	15.1	15.1	15.5	15.9	15.8	16.0	15.1	15.0	15.3	
Landfill Gas - 30 November 2010	**LG 1**	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 14**
Methane (CH_4) % v/v	23.1	17.8	8.9	11.5	19.5	12.9	14.8	25.5	34.5	30.1	18.2	46.0	41.0	
Carbon Dioxide (CO_2) % v/v	18.1	33.9	3.5	4.8	5.1	13.8	18.1	22.1	24.8	0.9	6.7	20.1	**20.2**	
Oxygen (O_2) % v/v	10.1	0.3	16.9	14.8	16.1	16.3	7.8	4.8	1.1	3.2	0.8	0.8	**5.1**	
Atmospheric Pressure (mbars)	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	
Temperature (°C)	5.1	4.1	4.2	4.8	4.3	-4.1	-3.7	-3.9	-4.1	-4.0	-4.0	-4.1	-4.0	
Landfill Gas - 31 December 2010	**LG 1**	**LG 2**	**LG 3**	**LG 4**	**LG 5**	**LG 6**	**LG 7**	**LG 8**	**LG 9**	**LG 10**	**LG 11**	**LG 12**	**LG 13**	**LG 14**
Methane (CH_4) % v/v	28.7	12.0	0.0	8.1	17.0	3.0	9.5	29.8	46.5	28.9	10.5	7.0	43.5	
Carbon Dioxide (CO_2) % v/v	20.6	9.0	0.0	7.2	13.9	6.2	13.1	24.9	29.3	26.9	12.6	3.9	30.2	
Oxygen (O_2) % v/v	8	14.0	20.8	15.0	9.8	15.8	10.6	0.7	3.5	2.6	11.1	18.8	0.2	
Atmospheric Pressure (mbars)	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	
Temperature (°C)	5.7	4.2	4.2	4.8	4.4	5.4	4.6	4.8	5.4	5.2	5.8	5.0	4.7	

Appendix A

Landfill Gas - 29 October 2010	**LG 15**	**LG 16**	**LG 17**	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**
Methane (CH_4) % v/v		32.0	33.9	21.0	0.0	56.8	40.0	57.7	58.1	49.0	41.0	38.9	46.3	43.0
Carbon Dioxide (CO_2) % v/v		29.0	26.9	18.3	0.0	34.0	28.9	38.0	38.9	34.1	30.1	26.1	31.0	30.9
Oxygen (O_2) % v/v		1.4	0.5	3.9	21.0	1.8	3.1	0.0	0.0	1.6	2.1	4.9	2.9	3.9
Atmospheric Pressure (mbars)		1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0
Temperature (°C)		15.4	15.0	15.7	15.1	15.2	15.3	15.5	15.1	15.2	15.3	15.1	15.0	15.1
Landfill Gas - 30 November 2010	**LG 15**	**LG 16**	**LG 17**	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**
Methane (CH_4) % v/v	20.3	18.4	23.0	20.1	15.8	18.1	28.9	44.0	45.9	18.1	53.1	46.8	53.5	54.2
Carbon Dioxide (CO_2) % v/v	23.1	22.5	**20.9**	19.8	16.1	14.1	24.8	33.0	35.8	14.1	29.1	32.8	33.1	39.0
Oxygen (O_2) % v/v	0.6	0.3	0.5	4.1	4.1	12.0	3.8	0.3	0.0	12.1	1.9	1.8	1.2	0.3
Atmospheric Pressure (mbars)		1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011
Temperature (°C)		-4.0	-3.9	-4.2	-4.0	-4.1	-4.0	-3.8	-3.6	-3.7	-3.7	-3.8	-4.0	-4.0
Landfill Gas - 31 December 2010	**LG 15**	**LG 16**	**LG 17**	**LG 18**	**LG 19**	**LG 20**	**LG 22**	**LG 23**	**LG 24**	**LG 25**	**LG 26**	**LG 27**	**LG 28**	**LG 29**
Methane (CH_4) % v/v	16.4	22.1	24.6	15.6	0.0	58.8	22.4	45.6	49.0	34.2	37.3	53.8	45.0	58.5
Carbon Dioxide (CO_2) % v/v	22.0	24.3	22.7	17.9	0.0	29.1	36.5	21.8	34.5	36.3	29.0	30.9	34.2	32.7
Oxygen (O_2) % v/v	0.9	0.6	0.4	2.9	20.9	0.7	4.8	0.4	0.6	3.5	1.4	1.4	1.9	0.2
Atmospheric Pressure (mbars)	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011
Temperature (°C)	6.1	4.7	4.8	4.9	5.3	5.3	5.2	4.9	4.8	4.9	5.6	5.0	6.7	4.8

Appendix A

Landfill Gas - 29 October 2010	LG 30	LG 31	LG 32	LG 33	LG 34	LG 35	LG 36	LG 37	LG 38	LG 39	LG 40	LG 41	LG 42	LG 43
Methane (CH_4) % v/v	56.9	63.9	55.1	53.1	65.0	43.9	28.3	43.4	66.0	22.3	36.0		0.8	58.1
Carbon Dioxide (CO_2) % v/v	51.9	40.1	37.3	32.0	40.9	30.1	26.9	32.1	35.5	23.9	24.1		0.9	40.1
Oxygen (O_2) % v/v	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2		20.1	0.3
Atmospheric Pressure (mbars)	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0		1010.0	1010.0
Temperature (°C)	15.0	15.9	15.0	15.3	15.1	15.1	15.0	15.5	16.3	16.0	16.0		15.8	15.9
Landfill Gas - 30 November 2010	**LG 30**	**LG 31**	**LG 32**	**LG 33**	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**
Methane (CH_4) % v/v	51.0	53.1	89.0	40.1	8.3	30.1	16.7	18.4	63.0	29.6	17.9		61.8	8.1
Carbon Dioxide (CO_2) % v/v	35.9	34.1	37.5	30.7	6.0	22.1	19.3	23.3	34.8	24.0	39.1		41.0	8.9
Oxygen (O_2) % v/v	0.2	0.2	0.1	2.4	0.0	15.5	2.5	1.1	1.0	0.2	0.3		0.6	6.1
Atmospheric Pressure (mbars)	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011		1011	1011
Temperature (°C)	-4.3	-4.3	-4.0	-4.1	-4.0	-4.1	-4.3	-3.9	-4.0	-3.9	-4.0		-3.8	-4.1
Landfill Gas - 31 December 2010	**LG 30**	**LG 31**	**LG 32**	**LG 33**	**LG 34**	**LG 35**	**LG 36**	**LG 37**	**LG 38**	**LG 39**	**LG 40**	**LG 41**	**LG 42**	**LG 43**
Methane (CH_4) % v/v	60.6	54.2	59.7	42.0	2.4	47.3	60.3	20.1	63.4	41.0	15.3		61.1	62.2
Carbon Dioxide (CO_2) % v/v	40.6	35.1	37.8	33.1	2.2	29.3	24.1	24.9	35.1	27.5	18.4		39.4	41.5
Oxygen (O_2) % v/v	0.4	1.8	0.2	0.2	19.7	0.5	2.0	0.1	0.1	0.0	6.2		0.9	0.7
Atmospheric Pressure (mbars)	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011		1011	1011
Temperature (°C)	4.8	4.9	4.7	4.8	4.5	4.3	4.6	5.7	4.9	4.9	5.2		5.2	4.9

Appendix A

Landfill Gas - 29 October 2010	LG 44	LG 45	LG 46	LG 47	LG 48	LG 49	LG 50	LG 51	LG 52	LG 53	LG 54	LG 55	LG 56	LG 57
Methane (CH_4) % v/v	61.9	65.0	60.0	61.8	51.9	19.1	9.3	52.8	51.0	23.7	26.0	21.9	51.0	23.4
Carbon Dioxide (CO_2) % v/v	40.8	40.1	39.8	42.4	39.9	17.8	7.3	38.8	31.8	21.8	18.9	21.0	40.1	21.0
Oxygen (O_2) % v/v	0.4	0.1	0.5	0.0	1.0	10.8	16.8	1.8	2.4	6.9	9.8	6.1	1.3	9.8
Atmospheric Pressure (mbars)	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0	1010.0
Temperature (°C)	15.8	15.0	15.0	15.1	15.2	15.3	15.1	15.0	15.5	15.4	15.3	15.2	15.3	15.0
Landfill Gas - 30 November 2010	**LG 44**	**LG 45**	**LG 46**	**LG 47**	**LG 48**	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**	**LG 55**	**LG 56**	**LG 57**
Methane (CH_4) % v/v	40.4	55.2	29.0	15.8	16.3	19.1	9.3	53.8	55.0	23.1	26.0	21.0	51.8	23.9
Carbon Dioxide (CO_2) % v/v	33.5	39.0	34.1	12.8	13.5	17.9	7.9	38.1	31.6	21.9	18.1	20.9	40.0	21.8
Oxygen (O_2) % v/v	2.8	1.3	9.3	14.3	13.9	10.9	16.3	1.9	2.4	6.8	9.9	6.4	1.5	9.9
Atmospheric Pressure (mbars)	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011
Temperature (°C)	-4.0	-4.0	-4.0	-4.3	-4.3	-3.9	-4.0	-4.1	-4.1	-3.9	-4.0	-4.0	-4.1	-4.1
Landfill Gas - 31 December 2010	**LG 44**	**LG 45**	**LG 46**	**LG 47**	**LG 48**	**LG 49**	**LG 50**	**LG 51**	**LG 52**	**LG 53**	**LG 54**	**LG 55**	**LG 56**	**LG 57**
Methane (CH_4) % v/v	8.6	39.6	56.8	29.7	15.7	16.5	39.6	56.8	29.7	47.3	60.3	20.1	63.4	41.0
Carbon Dioxide (CO_2) % v/v	8.5	33.9	39.9	23.0	12.3	13.9	33.9	39.9	23.0	29.3	24.1	24.9	35.1	27.5
Oxygen (O_2) % v/v	6.3	2.8	1.3	9.6	14.7	13.6	2.8	1.3	9.6	0.5	2.0	0.1	0.1	0.0
Atmospheric Pressure (mbars)	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011	1011
Temperature (°C)	5.1	5.2	5.0	6.1	5.7	4.2	4.2	4.8	4.4	5.4	4.6	5.7	4.9	4.9

Appendix A

Landfill Gas - 29 October 2010	**LG 58**	**LG 59**	**LG 60**
Methane (CH_4) % v/v	17.0	51.9	12.1
Carbon Dioxide (CO_2) % v/v	18.9	44.9	9.9
Oxygen (O_2) % v/v	8.1	1.0	14.1
Atmospheric Pressure (mbars)	1010.0	1010.0	1010.0
Temperature (°C)	15.1	15.0	15.1
Landfill Gas - 30 November 2010	**LG 58**	**LG 59**	**LG 60**
Methane (CH_4) % v/v	17.1	51.8	12.9
Carbon Dioxide (CO_2) % v/v	18.7	44.5	9.1
Oxygen (O_2) % v/v	8.9	1.3	14.3
Atmospheric Pressure (mbars)	1011	1011	1011
Temperature (°C)	-4.2	-4.2	-4.3
Landfill Gas - 31 December 2010	**LG 58**	**LG 59**	**LG 60**
Methane (CH_4) % v/v	15.3	23.9	17.1
Carbon Dioxide (CO_2) % v/v	18.4	21.8	18.7
Oxygen (O_2) % v/v	6.2	9.9	8.9
Atmospheric Pressure (mbars)	1011	1011	1011
Temperature (°C)	5.2	5.3	7.6

Appendix B
Landfill Gas Off-site Migration Monitoring Results

2 Pages

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Ballaghaderreen Perimeter Landfill Gas Monitoring - 26 January

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pressure (mbars)	Temp (°C)
GM 201	0.00	0.40	20.70	1033	4.80
GM 202	0.00	3.30	17.50	1033	3.70
GM 203	0.00	4.40	16.20	1033	6.20
GM 204	0.00	1.40	19.40	1033	5.50
GM 205	0.00	1.40	19.90	1033	5.20
GM 206	0.00	1.10	19.60	1033	5.10
GM 207	0.00	0.40	20.80	1033	5.20
GM 208	0.00	0.70	19.90	1033	4.30

Ballaghaderreen Perimeter Landfill Gas Monitoring - 31 March

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	0.2	21.2	990	6.4
GM 202	0.0	1.5	19.8	990	6.8
GM 203	0.0	0.6	20.8	990	7.0
GM 204	0.0	1.9	19.5	990	4.5
GM 205	0.0	0.6	20.5	990	5.1
GM 206	0.0	0.5	20.7	990	5.3
GM 207	0.0	0.7	20.9	990	7.6
GM 208	0.0	1.1	20.0	990	7.5

Ballaghaderreen Perimeter Landfill Gas Monitoring - 15 April

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	0.7	20.1	1015	19.8
GM 202	0.0	4.2	16.8	1015	15.8
GM 203	0.0	3.0	18.7	1015	16.8
GM 204	0.0	3.2	17.6	1015	18.1
GM 205	0.0	2.4	18.7	1015	16.9
GM 206	0.0	1.5	19.1	1015	18.1
GM 207	0.0	1.2	19.5	1015	16.6
GM 208	0.0	1.8	18.9	1015	16.4

Ballaghaderreen Perimeter Landfill Gas Monitoring - 19 May

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	1.1	19.5	1016	17.0
GM 202	0.0	3.4	16.5	1016	17.5
GM 203	0.0	3.7	16.8	1016	16.9
GM 204	0.0	3.8	17.0	1016	17.0
GM 205	0.0	2.4	18.1	1016	18.0
GM 206	0.0	4.2	15.9	1016	16.5
GM 207	0.0	0.9	19.3	1016	16.8
GM 208	0.0	2.4	18.6	1016	17.0

Ballaghaderreen Perimeter Landfill Gas Monitoring - 30 June

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	0.0	19.0	1005.0	19.4
GM 202	0.0	2.2	16.8	1005	21.1
GM 203	0.0	0.5	18.8	1005.0	20.7
GM 204	0.0	2.3	16.7	1005.0	21.2
GM 205	0.0	2.9	16.4	1005	22.1
GM 206	0.0	5.0	13.6	1005.0	22.1
GM 207	0.0	1.1	17.7	1005	22.9
GM 208	0.0	3.6	15.7	1005.0	21.9

Ballaghaderreen Perimeter Landfill Gas Monitoring - 29 July

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	0.5	18.5	1006	20.2
GM 202	0.0	2.9	16.6	1006	21.5
GM 203	0.0	2.7	16.8	1006	19.3
GM 204	0.0	3.5	16.0	1006	17.8
GM 205	0.0	5.3	14.2	1006	21.2
GM 206	0.0	5.0	14.9	1006	18.8
GM 207	0.0	1.0	18.2	1006	19.1
GM 208	0.0	1.7	17.6	1006	18.6

Ballaghaderreen Perimeter Landfill Gas Monitoring - 24 August

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	14.00	0.4	19.1	991	18.2
GM 202	14.02	5.8	11.8	991	18.3
GM 203	14.04	7.3	10.1	991	14.2
GM 204	14.06	5.9	15.0	991	15.1
GM 205	14.08	3.6	16.8	991	14.8
GM 206	14.10	5.7	14.8	991	14.7
GM 207	14.12	1.2	18.5	991	14.7
GM 208	14.14	3.8	15.7	991	12.2

Ballaghaderreen Perimeter Landfill Gas Monitoring - 30 September

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	0.2	18.8	1000	17.70
GM 202	0.0	1.5	17.9	1000	17.10
GM 203	0.0	7.7	13.7	1000	17.70
GM 204	0.0	3.7	16.3	1000	16.70
GM 205	0.0	1.3	17.8	1000	15.70
GM 206	0.0	4.2	16.2	1000	17.80
GM 207	0.0	0.6	18.9	1000	17.20
GM 208	0.0	2.3	17.6	1000	18.40

Ballaghaderreen Perimeter Landfill Gas Monitoring - 29 October

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	1.4	20.0	1010.0	15.0
GM 202	0.0	6.1	15.8	1010.0	14.9
GM 203	0.0	3.0	17.0	1010.0	15.3
GM 204	0.0	4.1	16.9	1010.0	15.3
GM 205	0.0	4.5	17.1	1010.0	15.0
GM 206	0.0	4.0	16.7	1010.0	15.1
GM 207	0.0	1.2	18.5	1010.0	15.3
GM 208	0.0	3.0	19.0	1010.0	15.4

Ballaghaderreen Perimeter Landfill Gas Monitoring - 30 November

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	0.3	19.8	1011	-2.7
GM 202	0.0	5.3	15.1	1011	-1.7
GM 203	0.0	5.8	13.5	1011	-1.3
GM 204	0.0	2.1	18.0	1011	-0.7
GM 205	0.0	1.5	18.3	1011	-1.9
GM 206	0.0	0.5	18.4	1011	-1.8
GM 207	0.0	1.1	19.6	1011	-2.4
GM 208	0.0	1.0	20.0	1011	-2.1

Ballaghaderreen Perimeter Landfill Gas Monitoring - 31 December

Sampling Point	CH4 % v/v	CO2 % v/v	O2 % v/v	Atmpospheric Pres	Temp (°C)
GM 201	0.0	0.4	20.2	1011	7.6
GM 202	0.0	4.6	14.7	1011	10.7
GM 203	0.0	3.9	16.3	1011	7.7
GM 204	0.0	2.4	18.0	1011	6.4
GM 205	0.0	1.5	19.9	1011	6.5
GM 206	0.0	1.5	19.4	1011	7.7
GM 207	0.0	0.4	20.8	1011	7.8
GM 208	0.0	1.2	19.6	1011	9.1

Appendix C
Odour Monitoring Ireland Reports

31 Pages

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AIR EMISSION TESTING OF LANDFILL FLARE LOCATED IN BALLAGHADERREEN RESIDUAL LANDFILL FACILITY, BALLAGHADERREEN, CO. ROSCOMMON

PREPARED BY:	Dr. John Casey
ATTENTION:	Mr. Tim Jessop
WASTE LICENCE:	W00059-02
DATE:	18th March 2010
REPORT NUMBER:	2010A92(2)
REVIEWERS:	

TABLE OF CONTENTS

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1. Introduction

This report has been prepared by Odour Monitoring Ireland and contains the results of emission testing carried out on 1 No. Enclosed ground flare at Ballaghaderreen landfill facility, Ballaghaderreen, Co. Roscommon. The emission testing was carried out in compliance with the requirements of Waste licence 59-02.

Odour Monitoring Ireland was requested by Ballaghaderreen Landfill facility to perform emission testing of the one enclosed flare, located within Ballaghaderreen landfill facility, Ballaghaderreen, Co. Roscommon. The parameters listed in *Table 1.1* were monitored using the appropriate instrumentation as illustrated in *Table 1.1*.

Table 1.1. Monitored parameters and techniques for Ballaghaderreen landfill facility 1 No. Enclosed flare, Ballaghaderreen, Co. Roscommon.

Sample location	Parameter	Analytical method
Inlet Landfill Flare	Methane, Carbon dioxide, Oxygen	Landfill gas analyser GA2000
Exhaust Landfill Flare	Oxides of nitrogen (NO_X), Oxygen (O_2)	Flue gas analyser, Testo 350/454 MXL
1 Landfill Flares	Total organic carbon	Indirect Sorbent tubes in conjunction with SKC pumps and a BIOS primary flow calibrator
Exhaust Landfill Flare	Volumetric airflow rate & Temperature (^0C)	MGO coated K type thermocouple and theoretical calculation
1 Landfill Flare	Hydrogen Fluoride & Hydrogen Chloride	Impinger train containing 0.10 molar sodium hydroxide and deionised water solution in accordance EN1911 and EPA 26A

This report presents details of this monitoring programme. This environmental monitoring was carried out by Dr. John Casey, Odour Monitoring Ireland on the 02nd March 2010. Methodology, Results, Discussion and Conclusions are presented herein.

2. Materials and Methods

This section provides brief details of the methodology employed to perform emission testing of the one-landfill flare stack located in Ballaghaderreen landfill facility, Ballaghaderreen, Co. Roscommon.

2.1 Volumetric flow rate and temperature measurement

The inlet volumetric flow rate of the landfill flare was taken from the CEMS system and exhaust volumetric airflow volume was theoretically calculated. A magnesium oxide coated K type thermocouple was used for measuring temperature in the landfill flares.

2.2 In stack analysis

Flue gas analysis was performed using a pre-calibrated Testo 350 MXL/454 flue gas analyser. Concentrations of oxygen and oxides of nitrogen were measured using electrochemical cells within the analyser box and all data was logged electronically in 1-minute intervals during the sampling exercise. Data was downloaded from the control handheld using the Com soft software and average concentrations calculated are presented within. All results presented are at 273.15 K, 101.3 kPa on a dry gas basis.

2.3 Total organic carbon (TOC)

Total organic carbon (TOC's) gas concentrations on the landfill flare was determined using charcoal tubes placed in series. A high temperature-sampling probe was placed within the flare stack and sample air was drawn through a heated PTFE sample line and charcoal tubes. Sorbent tubes were sealed and transported to a UKAS accredited laboratory for analysis (RPS Analytical laboratory, Manchester, UK). Results are presented at standard conditions of 273.15 K and 101.3 kPa.

2.4 Hydrogen chloride (HCL) and Hydrogen fluoride (HF) analysis

Volatile chloride and fluoride gas concentrations were determined using an impinger train containing 0.10 molar sodium hydroxide and deionised water solution, in which such gases are readily soluble. The sampling methodology was based upon USEPA Method 26 and the European Standard, EN 1911. Small sorption liquid volumes were used to attain lower limits of detection. Impingers were placed in series to ensure effective trapping of chloride and fluoride gas concentrations.

The sampling probe was placed within the stack and sample air was drawn through a heated sample line and two glass midget impingers containing 0.10 molar Sodium hydroxide positioned in series. Sampled solutions were sealed and transported to the UKAS accredited laboratory for analysis via ion chromatography (RPS Analytical laboratory, Manchester, UK). The results of mg m^{-3} have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa.

3. Results-Emission testing.

3.1 Sampling time

Table 3.1 summarises the time sampling was carried out on the stack. The landfill flare was operating at a total extraction capacity of 298 m^3 hr^{-1} of landfill gas during the monitoring schedule as taken from the landfill flare CEMS. *Table 3.2* illustrates the landfill flare inlet gas parameters as characterised from the CEMS analyser system (airflow rate only) operating within the landfill flare control building. Additionally, manual monitoring for CH_4, CO_2, O_2 and balance was performed using a GA2000 landfill gas analyser.

All outlet gas samples were taken approximately 1.80 metres below the top of the stack for the landfill flare. All sampling was performed through the existing 25 and 100 mm sampling ports. A one-plane oxygen and temperature traverse was performed to assess any difference in oxygen concentrations and temperature. Temperature and Oxygen differences were less than the 15% deviation level as recommended by the UK Environmental Agency (Guidance for monitoring enclosed Landfill flares, 2002).

3.2 Flue gas concentrations

Flue gas concentrations were monitored using a pre-calibrated Testo 350/454 MXL flue gas analyser. The results of NO_x as NO_2 + NO, and O_2 are presented in *Table 3.4*. The results of ppm have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa, on a dry gas basis with correction for oxygen content. In accordance with EPA flare monitoring requirements, Oxygen correction to 3% should be performed for landfill gas flare. The average temperature of the gas analyser on the day of sampling was 280.15 K.

3.3 Total Organic Carbon (TOC)

TOC concentrations were monitored using charcoal tubes placed in series and analysed via GCFID. The results of total TOC's (i.e. THC) are presented in *Table 3.4*. The results are expressed in mg Nm^{-3} at the reference standard conditions of 273.15 K, 101.3 kPa, with correction for oxygen content (3% (v/v). For the concentration of TOC adsorbed on to the charcoal tube, the mass amount of absorbed TOC was measured using gas chromatography flame ionisation detector (GC-FID). Once the sampled volume is known then the mass concentration of TOC within the sampled gas could be calculated.

3.4 Hydrogen chloride (HCL) and Hydrogen fluoride (HF)

Hydrogen chloride and hydrogen fluoride concentrations were monitored using an impinger train containing 0.10 molar sodium hydroxide and deionised water solution, in which such gases are readily soluble. The results of hydrogen chloride and hydrogen fluoride are presented in *Table 3.4.* The results of mg m^{-3} have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa with correction for oxygen content. In accordance with EPA flare/gas utilisation engine monitoring requirements, Oxygen correction to 3% should be performed for landfill gas flares.

Table 3.1. Sampling time runs on the 02nd March 2010.

Parameter	Approx. Sampling period for 1 landfill flare
Inlet CH_4, CO_2, O_2,	40 minutes
Volumetric air flow rate	Theoretically calculated
NO_x as NO_2	40 minutes
O_2	40 minutes
Stack gas temp	40 minutes
TOC	40 minutes
HCL/HF	40 minutes

Table 3.2. Characteristics of raw inlet gas to the 1 No. Landfill flare gas burner.

Inlet compound identity	Compound Loading Landfill flare 1	Unit values
CH_4	34	%
CO_2	16	%
O_2	6.2	%
Total volumetric flow rate	298	$m^3\ hr^{-1}$

Table 3.3. Theoretically and manually calculated landfill gas exhaust volume and physical characteristics from 1 No. Landfill flare.

Identity[1]	**Flare No. 1**
Total Volumetric landfill gas loading (m^3 hr^{-1})	298
Total Volumetric methane gas loading (m^3 hr^{-1})	101
Total Volumetric Oxygen loading (m^3 hr^{-1})	18.4
Ratio to complete combustion of methane assuming no excess Oxygen	9.57
Oxygen concentration level in flue gas (%)	6.2
Flue gas temperature (Kelvin)[2]	1433
Theoretical calculated Volumetric exhaust airflow rate (m^3 h^{-1})	1541
Normalised average exhaust airflow rate (m^3 Nh^{-1})[3]	293

Notes: [1] denotes data from 02nd March 2010.
[2] denoted converted from degrees Celsius to Kelvin (^0C + 273.15);
[3] denotes normalised to 273.15 Kelvin and 101.3 kPa.

Table 3.4. Emission value results from landfill gas flare burner No. 1 monitored at Ballaghaderreen landfill facility, Ballaghaderreen, Co. Roscommon.

Flare unit 1	Conc.	Units[1]	Adjusted units (mg/m^3)	Normalised Emission conc. (mgN/m^3)	Oxygen corrected emission conc. to 3 % (mgN/m^3)	Emission limit Values
Total Organic Carbon	1.23	mg/m^3	1.97	293.74	2.08	<10 mg/Nm^3
HCL	3.17	mg/m^3	3.17	293.74	4.58	<50 mg/Nm^3 >0.3 kg/hr
HF	0.89	mg/m^3	0.89	293.74	1.28	<5 mg/Nm^3 >0.05 kg/hr
Temperature	1160	^0C	1433K	293.74	-	>1000 ^0C
CO	1	ppm	1.25	293.74	1.32	<50 mg/Nm^3
O_2	3.96	%	3.96	293.74	-	-
Total NO_X	46	ppm	94.46	293.74	99.82	<150 mg/Nm^3
SO_2	68	ppm	194.29	293.74	205.30	-
CO_2	12.94	%	12.94	293.74	-	-
Exhaust methane conc.	1.11	ppm	1.78	293.74	1.88	-
Methane destruction efficiency (%)	>99	-	-	-	-	-

Notes: [1] denotes units as measured.

4. Discussion of results

Tables 3.1 to *3.4* present the results of the emission monitoring carried out on the one-landfill flare stack burner located in Ballaghaderreen landfill facility, Ballaghaderreen, Co. Roscommon

There was very little variation at one traverse in oxygen and flue gas temperature profiles across the stack during the monitoring exercise (i.e. less than 15% as recommended by the Environment Agency, UK (Environment Agency, 2002)).

Correction of data to 3% oxygen was performed. Due to possible inaccuracies in airflow rate measurement, it was not possible to determine the oxygen intake of the flare through the louver system using measurement. Since the volume of intake air required for complete combustion was known and the oxygen concentration in the exhaust flue gas was known, the volume of intake excess fuel air could be theoretically calculated through numerous iterations using the Solver program (Microsoft Excel). This allow for the calculation of the volume of intake excess air through the louver landfill flare intake system. These calculations were validated through use of the published Environment Agency equation (Environment Agency, 2002).

All relevant parameters measured were in compliance with the emission limit values contained in Waste licence W0059-02.

5. Conclusion

The following conclusions can be drawn from this study:

- A theoretically exhaust flue gas volume was calculated for the landfill flares No. 1.
- CO, NO_x as NO_2, HF, HCL and TOC monitoring and analysis was carried out in accordance with specified requirements;
- All data was standardised to 273.15 Kelvin, 101.3 kPa;
- Measured CO was in compliance with schedule C5 of Waste licence 59-02.
- Temperature was greater than the required level of 1000 degrees (1273 K).
- Oxygen values in the flue gas were low suggesting that adjustment of the louver fresh air intake system is required.
- All other parameters monitored were within specified emission limit values as per schedule C5 of waste licence 59-02,
- All data is presented as Oxygen corrected to 3% (v/v) using the appropriate equations.
- The landfill flare is achieving a methane destruction efficiency of greater than 99%.

6. References

1. Environment Agency. (2002). Guidance for Monitoring Enclosed Landfill Gas Flares. www.environment-agency.co.uk
2. McVay, M., (2003). Personal communication. Wales, UK.

7. *Appendix I* - Sampling, analysis and calculation details

7.1.1 Location of Sampling

Ballaghaderreen landfill facility, Ballaghaderreen, Co. Roscommon

7.1.2 Date & Time of Sampling

02nd March 2010

7.1.3 Personnel Present During Sampling

Dr. John Casey, Odour Monitoring Ireland, Trim, Co. Meath.

7.1.4 Instrumentation

Testo 350 MXL/454 in stack analyser;
Federal Method 2 S type pitot and MGO coated thermocouple;
Testo 400 handheld and appropriate probes.
Impinger and TOC sampling train.
Ceramic and Inconel 625 sampling probes.

7.1.5 Software

Microsoft Excel and VBA applications.
Microsoft Word

Appendix D
Surface Water Quality Results

3 Pages

Ballaghaderreen Landfill Surface Water Quality Monitoring - 17 February 2010

Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	Upstream	Downstream
Ammonical Nitrogen (mg/l)	0.05	0.39	0.07	0.02	0.16	0.05	0.06
BOD (mg/l)	1.1	0.9	1.1	1.0	1.3	0.9	1.0
Chloride (mg/l)	11.6	16.6	10.8		16.0	17.2	17.2
COD (mg/l)	53.0	32.0	44.0	59.0	41.0	27.0	32.0
Dissolved Oxygen (mg/l)	12.0	10.4	13.1	21.3	12.6	12.5	12.9
Electrical Conductivity (EC) (µS/cm)	59.6	55.7	140.4	236.0	219.0	403.0	399.0
pH	7.0	10.4	7.3	7.1	7.3	7.8	7.7
Temperature (°C)	1.8	5.2	1.7	1.3	2.4	3.4	3.9
Total Suspended Solids (mg/l)	15.0	2.0	3.0	4.0	3.0	6.0	7.0

Ballaghaderreen Landfill Surface Water Quality Monitoring - 26 May 2010

Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	Upstream	Downstream
Ammonical Nitrogen (mg/l)	0.31	0.88	0.06	0.10	BLD	0.02	BLD
BOD (mg/l)	3.7	1.3	1.1	2.0	1.4	1.0	1.0
Chloride (mg/l)	37.7	19.9	9.1	12.5	31.1	15.9	15.8
COD (mg/l)	100.0	64.0	76.0	59.0	59.0	36.0	20.0
Dissolved Oxygen (mg/l)	29.6	10.1	13.8	28.9	30.5	26.3	24.3
Electrical Conductivity (EC) (µS/cm)	542.0	686.0	225.0	453.0	499.0	470.0	473.0
pH	7.9	7.3	7.3	7.2	7.7	8.2	8.2
Temperature (°C)	18.9	16.4	13.7	17.2	14.2	18.2	18.0
Total Suspended Solids (mg/l)	11.0	7.0	7.0	7.0	7.0	7.0	8.0

Ballaghaderreen Landfill Surface Water Quality Monitoring - 18 August 2010

Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	Upstream	Downstream
Ammonical Nitrogen (mg/l)	0.07	1.07	0.02	0.04	BLD	0.04	0.02
BOD (mg/l)	2.0	5.0	6.0	9.0	1.0	4.0	BLD
Chloride (mg/l)	17.5	20.3	11.8	14.5	17.6	14.9	15.1
COD (mg/l)	52	54	188	140	59	41	27
Dissolved Oxygen (mg/l)	9.8	10.9	10.6	6.8	8.9	11.3	11.5
Electrical Conductivity (EC) (µS/cm)	291	616	152	397	298	365	378
pH	7.59	7.33	7.60	7.42	7.62	7.98	7.98
Temperature (°C)	13.0	13.6	13.8	13.4	12.8	15.3	15.1
Total Suspended Solids (mg/l)	BLD	8	BLD	BLD	BLD	19	BLD
Boron (µg/l)	0.04	0.04	0.02	0.03	0.03	0.03	0.03
Cadmium (µ/mg)	BLD	BLD	0.1	0.4	BLD	BLD	BLD
Calcium (mg/l)	41.2	44.6	25	57	41.4	37.2	37
Copper (µ/mg)	BLD	BLD	BLD	5	3	5	3
Iron (µ/mg)	1018	10930	1901	7302	602.8	1102	748.2
Lead (µ/mg)	1.2	2	4.8	32.8	1.1	1.2	1
Magnesium (mg/l)	3.5	7.9	1.8	5.3	3.1	4.4	3.9
Manganese (µ/mg)	201.3	222.2	39.6	2067.6	31.2	204	48.5
Mercury (µ/mg)	0.11	0.06	0.07	0.07	0.09	0.1	0.1
Nickel (µ/mg)	3.2	7.7	3.3	7.4	3.4	3.8	2.7
Potassium (mg/l)	2.8	2.2	0.6	2.8	2.7	2.7	1.4
Sodium (mg/l)	11.4	15.8	8.2	8.8	11.7	9.1	8.7
Sulphate (mg/l) SO_4	22.2	17.6	5.5	27.5	21	9.9	10
Total Alkalinity (mg/l) $CaCO_3$	121.3	417.1	64.3	193.1	123.6	190.4	197.1
Total Chromium (µ/mg)	3.8	4.4	3.5	4.6	3.3	4.3	4.2
Orthophosphate (mg/l) P	0.027	0.017	0.011	BLD	0.025	0.005	BLD
Total Oxidised Nitrogen (mg/l) N	0.712	0.013	0.052	0.11	0.601	0.175	0.283
Zinc (µ/mg)	13.3	11.2	15	25.7	12.7	13.5	14.9

Ballaghaderreen Landfill Surface Water Quality Monitoring - 23 November 2010

Parameter	SW 1	SW 2	SW 3	SW 4	SW 5	Upstream	Downstream
Ammonical Nitrogen (mg/l)	0.19	0.05	0.11	BLD	BLD	BLD	0.02
BOD (mg/l)	2.4	1.8	2.2	1.4	1.7	1.8	1.7
Chloride (mg/l)	14.3	14.4	14.0	9.6	14.6	13.7	13.6
COD (mg/l)	26	59	79	25	33	32	20
Dissolved Oxygen (mg/l)	13.5	18.4	18.5	11.2	13.9	16.7	16.8
Electrical Conductivity (EC) (µS/cm)	237	149	105	433	303	340	341
pH	7.67	7.53	7.15	7.73	7.68	8.00	8.03
Temperature (°C)	3.4	2.0	1.7	4.1	2.5	2.5	3.9
Total Suspended Solids (mg/l)	BLD	BLD	BLD	BLD	BLD	BLD	BLD

BLD = Below Limit of Detection

Appendix E
Surface Water Visual Inspection/Odour Results

5 Pages

Surface Water Visual Inspection - 08/01/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	9.00	9.10	9.15	9.20	9.30	9.35	9.40
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 15/01/2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.10	14.20	14.25	14.30	14.35	14.40
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 22/01/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.10	14.15	14.20	14.25	14.30	14.40
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 29/01/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	8.30	8.35	8.40	8.55	8.50	9.00	9.10
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 05/02/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.30	14.40	14.50	14.55	14.58	15.00	15.10
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 12/02/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.10	14.15	14.25	14.30	14.34	14.40
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 17/02/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	8.30	8.35	8.40	8.45	8.50	8.55	9.00
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 26/02/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	26-Feb-10	26-Feb-10	26-Feb-10	26-Feb-10	26-Feb-10	26-Feb-10	26-Feb-10
Inspection Time	14.00	14.10	14.20	14.25	14.35	14.45	14.55
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 04/03/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	15.00	15.25	15.35	15.45	15.55	15.58	16.00
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 10/03/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.20	14.30	14.35	14.45	14.55	15.00
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 18/03/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	12.00	12.10	12.20	12.35	12.45	12.50	12.55
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 26/03/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.10	14.15	14.20	14.30	14.35	14.45
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None

Surface Water Visual Inspections - 04/04/10							
04/04/2010	**SW 1**	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.05	14.10	14.15	14.20	14.30	14.35
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 16/04/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	10.45	10.50	10.55	11.00	11.03	11.10	11.15
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 23/04/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.05	14.10	14.15	14.20	14.30	14.35
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 30/04/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	10.30	10.35	10.40	10.45	10.50	10.55	11.00
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 07/05/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	10.45	10.50	10.55	11.00	11.10	11.15	11.20
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 14/05/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	15.00	15.05	15.10	15.20	15.25	15.30	15.40
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 21/05/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	15.30	15.35	15.45	15.50	15.58	16.00	16.05
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 28/05/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	14.00	14.05	14.10	14.15	14.20	14.30	14.35
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 01/06/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	10.00	10.05	10.10	10.20	10.28	10.35	10.45
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 11/06/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	11.30	11.35	11.40	11.45	11.50	11.55	12.00
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 18/06/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	12.30	12.35	12.45	12.55	12.58	13.00	13.05
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 25/06/10							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Time	11.30	11.35	11.40	11.45	11.50	11.55	12.00
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None

Surface Water Visual Inspection - 8 July							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	8-Jul-10	8-Jul-10	8-Jul-10	8-Jul-10	8-Jul-10	8-Jul-10	8-Jul-10
Inspection Time	10.00	10.05	10.10	10.15	10.20	10.25	10.30
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 16 July							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	16-Jul-10	16-Jul-10	16-Jul-10	16-Jul-10	16-Jul-10	16-Jul-10	16-Jul-10
Inspection Time	11.15	11.20	11.23	11.25	11.30	11.35	11.40
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 23 July							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	23-Jul-10	23-Jul-10	23-Jul-10	23-Jul-10	23-Jul-10	23-Jul-10	23-Jul-10
Inspection Time	14.30	14.35	14.40	14.45	14.50	14.55	14.60
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 30 July							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	30-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10	30-Jul-10
Inspection Time	14.00	14.05	14.10	14.15	14.20	14.25	14.30
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 6 August							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	6-Aug-10	6-Aug-10	6-Aug-10	6-Aug-10	6-Aug-10	6-Aug-10	6-Aug-10
Inspection Time	15.00	15.05	15.10	15.15	15.20	15.25	15.30
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 13 August							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	13-Aug-10	13-Aug-10	13-Aug-10	13-Aug-10	13-Aug-10	13-Aug-10	13-Aug-10
Inspection Time	12.00	12.05	12.10	12.15	12.20	12.25	12.30
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 20 August							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10	20-Aug-10
Inspection Time	14.05	14.10	14.15	14.20	14.25	14.30	14.35
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 27 August							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10	27-Aug-10
Inspection Time	10.30	10.35	10.40	10.45	10.50	10.55	10.60
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 3 September							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	3-Sep-10	3-Sep-10	3-Sep-10	3-Sep-10	3-Sep-10	3-Sep-10	3-Sep-10
Inspection Time	11.00	11.05	11.10	11.15	11.20	11.25	11.30
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 10 September							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	10-Sep-10	10-Sep-10	10-Sep-10	10-Sep-10	10-Sep-10	10-Sep-10	10-Sep-10
Inspection Time	14.00	14.05	14.15	14.22	14.29	14.37	14.44
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 17 September							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	17-Sep-10	17-Sep-10	17-Sep-10	17-Sep-10	17-Sep-10	17-Sep-10	17-Sep-10
Inspection Time	14.00	14.05	14.10	14.15	14.20	14.25	14.30
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None

Surface Water Visual Inspection - 24 September							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	24-Sep-10	24-Sep-10	24-Sep-10	24-Sep-10	24-Sep-10	24-Sep-10	24-Sep-10
Inspection Time	15.00	15.10	15.20	15.30	15.40	15.50	15.60
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 28 August							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Inspection Date	28-Sep-10	28-Sep-10	28-Sep-10	28-Sep-10	28-Sep-10	28-Sep-10	28-Sep-10
Inspection Time	8.30	8.35	8.40	8.45	8.50	8.55	8.60
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None

Appendix C

Surface Water Visual Inspection - 8 October 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 14 October 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 22 October 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 29 October 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 5 November 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 12 November 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 19 November 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 26 November 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 3 December 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 10 December 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 15 December 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 20 December 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None
Surface Water Visual Inspection - 31 December 2010							
	SW 1	**SW 2**	**SW 3**	**SW 4**	**SW 5**	**Upstream**	**Downstream**
Visual Inspection	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour Results	None	None	None	None	None	None	None

Appendix F
Leachate Levels

1 Page

Ballaghaderreen Landfill Leachate Level Monitoring

Leachate Monitoring Points	Depth to Leachate (Metres below Top of Casing)			
	31 March	**15 April**	**18 August**	**23 November**
LB 1	0.49	Dry	0.68	0.51
LB 2	0.92	1.10	1.07	1.01
LB 3	2.58	2.90	2.80	2.48
LM 402	7.56	7.66	Damaged	Inaccessible
LM 404	3.92	3.98	Damaged	3.88

Cell	Depth of Leachate (m above base of Cell)			
	31 March	**15 April**	**18 August**	**23 November**
Cell 6	0.74	0.62	0.74	0.75
Cell 7	0.76	0.78	0.68	0.68
Cell 8	0.88	0.08	0.73	0.61

Appendix G
Leachate Quality Results

4 Pages

Entec
An AMEC company

Ballaghaderreen Landfill Leachate Quality Visual Assessment

Sampling Date: 31 March 2010

Monitoring Point	Observation
LM 402	Dark in colour, moderate odour
LM 404	Dark in colour, moderate odour
LB 1	Clear, no odour
LB 2	Clear, no odour
LB 3	Clear, no odour
Cells 1-5 Sump	Dark in colour, strong odour
Cell 6 Sump	Dark in colour, strong odour
Cell 7 Sump	Dark in colour, strong odour
Cell 8 Sump	Dark in colour, strong odour
Leachate Lagoon	Dark in colour, moderate odour

Sampling Date: 15 April 2010

Monitoring Point	Observation
LM 402	Dark in colour, moderate odour
LM 404	Dark in colour, moderate odour
LB 1	Clear, no odour
LB 2	Clear, no odour
LB 3	Clear, no odour
Cells 1-5 Sump	Dark in colour, strong odour
Cell 6 Sump	Dark in colour, strong odour
Cell 7 Sump	Dark in colour, strong odour
Cell 8 Sump	Dark in colour, strong odour
Leachate Lagoon	Dark in colour, moderate odour

Sampling Date: 18 August 2010

Monitoring Point	Observation
LM 402	Inaccessible
LM 404	Inaccessible
LB 1	Clear, no odour
LB 2	Clear, no odour
LB 3	Clear, no odour
Cells 1-5 Sump	Dark in colour, strong odour
Cell 6 Sump	Dark in colour, strong odour
Cell 7 Sump	Dark in colour, strong odour
Cell 8 Sump	Dark in colour, strong odour
Leachate Lagoon	Dark in colour, moderate odour

Sampling Date: 23 November 2010

Monitoring Point	Observation
LM402	Dark in colour, moderate odour
LM404	Dark in colour, moderate odour
LB1	Clear, no odour
LB2	Clear, no odour
LB3	Clear, no odour
Cells 1-5 Sump	Dark in colour, strong odour
Cell 6 Sump	Dark in colour, strong odour
Cell 7 Sump	Dark in colour, strong odour
Cell 8 Sump	-
Leachate Lagoon	Dark in colour, moderate odour

Ballaghaderreen Landfill Leachate Quality Annual Schedule. Sampling Date: 18 August 2010

	LB 1	LB 2	LB 3	Leachate Lagoon	Cells 1-5 Sump	Cell 6 Sump	Cell 7 Sump	Cell 8 Sump
Temperature (°C)	12.3	11.8	12.6	15.8	13.5	22.8	15.2	21.1
Ammonical Nitrogen (mg/l)	0.704	2.12	28.6	BLD	12.23	BLD	0.044	BLD
BOD (mg/l)	6	1	20	131	4	23	182	410
Boron (µ/mg)	0.07	0.08	0.21	2.84	0.16	0.85	2.48	2.26
Cadmium (µ/mg)	0.3	BLD	0.2	0.5	0.1	BLD	0.8	0.2
Calcium (mg/l)	130.8	142.6	93	71.5	105.9	23.1	73	80.5
Chloride (mg/l)	7.4	8.4	256	1567	77	649	2065	2033
COD (mg/l)	20	20	89	2200	20	508	3090	3440
Copper (µ/mg)	13	8	41	66	17	15	130	50
Electrical Conductivity (µS/cm)	1136	1051	1887	12610	1429	5720	17301	17600
Fluoride (mg/l)	0.12	0.21	0.17	0.39	0.23	0.25	0.76	22.6
Iron (µ/mg)	689.1	5175	43190	2427	631.7	1619	14960	762.5
Lead (µ/mg)	3.4	2.1	13.1	7.1	2.8	2	12.3	4.6
Magnesium (mg/l)	13.1	12.7	22.2	112.1	19.2	38.2	106.5	85.4
Manganese (µ/mg)	85.7	1394	1914	365.3	121.2	922	730.3	283.1
Mercury (µ/mg)	0.08	0.06	0.07	0.22	0.1	0.11	0.25	0.13
Nickel (µ/mg)	8.2	10.4	4.9	183.8	10.5	36.4	240.4	120
pH	7.2	7.17	6.84	8.62	7.85	7.15	7.64	7.68
Potassium (mg/l)	4.3	4.4	41	RNV	45.3	409	111	3939

Ballaghaderreen Landfill Leachate Quality Annual Schedule. Sampling Date: 18 August 2010 (continued)

	LB 1	LB 2	LB 3	Leachate Lagoon	Cells 1-5 Sump	Cell 6 Sump	Cell 7 Sump	Cell 8 Sump
Sodium (mg/l)	11	12.7	244	1363	93.2	680	223	138.5
Sulphate (mg/l) SO_4	263	259	BLD	346	294	242	1884	102
Total Chromium (µ/mg)	5.5	3.9	5.2	338.4	6.5	40.6	389.2	205.3
Orthophosphate (mg/l) P	0.175	BLD	BLD	6.44	0.007	1.66	4.83	10.64
Total Oxidised Nitrogen (mg/l) N	1.836	BLD	BLD	0.992	6.405	0.045	BLD	0.062
Zinc (µ/mg)	3.4	2.4	13.1	7.1	2.8	2	12.3	4.6

BLD = Below Limit of Detection

Appendix H
Groundwater Levels

2 Pages

Ballaghaderreen Groundwater Depth Monitoring (Metres below Top of Casing)

Q1 2010

Borehole ID	Ground Level (mAD)	22 January	17 February	31 March
BH 3	76.75	0.78	0.91	0.80
BH 11	77.24	0.66	0.70	0.76
BH 12	77.41	1.33	1.74	1.26
GW 301	~76.50	0.69	0.70	0.67
BH 04/1	~78.30	1.90	2.81	1.47
BH 102	~76.90	2.64	3.80	2.69
BH 103	~75.40	1.05	0.87	0.90

Q2 2010

Borehole ID	Ground Level (mAD)	15 April	26 May	30 June
BH 3	76.75	1.07	2.10	2.41
BH 11	77.24	0.90	0.60	1.27
BH 12	77.41	1.65	0.60	2.39
GW 301	~76.50	0.79	Dry	1.47
BH 04/1	~78.30	3.51	3.70	4.48
BH 102	~76.90	4.52	4.80	4.87
BH 103	~75.40	1.90	2.50	2.58

Q3 2010

Borehole ID	Ground Level (mAD)	29 July	27 August	20 September
BH 3	76.75	1.36	0.90	0.84
BH 11	77.24	1.10	0.85	0.74
BH 12	77.41	2.16	1.71	1.55
GW 301	~76.50	1.09	Dry	0.80
BH 04/1	~78.30	4.10	3.01	2.13
BH 102	~76.90	4.70	3.89	3.66
BH 103	~75.40	1.33	0.98	0.81

Q4 2010

Borehole ID	Ground Level (mAD)	29 October	23 November	31 December
BH3	76.75	0.95	1.00	1.00
BH11	77.24	0.76	0.80	0.76
BH12	77.41	1.50	1.53	1.49
GW301	~76.50	0.77	0.77	0.72
BH04/1	~78.30	2.04	2.22	2.05
BH102	~76.90	3.60	3.69	3.35
BH103	~75.40	0.75	0.82	0.22

Notes: mAD - metres above datum.

Appendix I
Groundwater Quality Results

11 Pages

Ballaghaderreen Landfill Groundwater Quality Monitoring – 17 February 2010

Parameter	Borehole ID						
	Superficial Deposits				Limestone Aquifer		
	BH 3	BH 11	BH 12	GW 301	BH 04/1	BH 102	BH103
Ammoniacal Nitrogen (mg/l)	0.622	0.351	5.78	0.122	0.094 *(3.00)*	0.879 *(3.00)*	0.75 *(3.00)*
Chloride (mg/l)	12.08	19.83	66.47	15.82	33.95 *(100)*	15.6 *(100)*	19.77 *(100)*
Dissolved Oxygen (mg/l)	3.22	5.81	3.95	3.00	3.8	3.8	4.36
Electrical Conductivity (EC) (µS/cm)	669	1359	1146	508	871	531	661
pH	7.25	7.06	6.81	7.04	7.14	7.14	7.17
Temperature (°C)	7.1	5.7	7.9	5.2	8.1	9.0	5.2
Total Organic Carbon (mg/l)	24.8	9.5	10.6	24.3	5.0 *(80)*	6.6 *(80)*	24.3 *(80)*
Observation	Clear, No odour	Dark in colour, No odour	Slightly cloudy, No odour	Cloudy, No odour	Clear, No odour	Cloudy, No odour	Clear, No odour

Ballaghaderreen Landfill Groundwater Quality Monitoring – 26 May 2010

Parameter	Borehole ID						
	Superficial Deposits				Limestone Aquifer		
	BH 3	BH 11	BH 12	GW 301	BH 04/1	BH 102	BH103
Ammoniacal Nitrogen (mg/l)	0.243	1.025	5.52	Dry	0.063 *(3.00)*	0.89 *(3.00)*	0.734 *(3.00)*
Chloride (mg/l)	12. 8	19.2	55.3		26.4 *(100)*	14.6 *(100)*	14.72 *(100)*
Dissolved Oxygen (mg/l)	8.6	16.4	8.77		13.25	19.9	10.25
Electrical Conductivity (EC) (µS/cm)	726	1174	1388		1178	739	654
pH	6.87	7.07	6.35		6.37	6.44	6.98
Temperature (°C)	9.4	13.6	11.7		11.3	11.0	13.5
Total Organic Carbon (mg/l)	52.4	10.4	10.8		8.9 *(80)*	6.2 *(80)*	5.5 *(80)*
Observation	Clear, No odour	Dark in colour, No odour	Slightly cloudy, No odour		Clear, No odour	Cloudy, No odour	Clear, No odour

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010

Parameter	Borehole ID						
	Superficial Deposits				Limestone Aquifer		
	BH 3	BH 11	BH 12	GW 301	BH 04/1	BH 102	BH103
Ammoniacal Nitrogen (mg/l)	3.61	0.75	6.73	Dry	0.11 *(3.00)*	1.15 *(3.00)*	1.78 *(3.00)*
Chloride (mg/l)	14.1	27.6	50.5		30.1 *(100)*	15.4 *(100)*	15.6 *(100)*
Dissolved Oxygen (mg/l)	4.2	4.9	6.1		5.9	6.9	5.7
Electrical Conductivity (EC) (µS/cm)	712	999	1033		797	634	615
pH	7.02	7.22	6.79		7.14	7.21	7.48
Temperature (°C)	10.8	11.5	11.3		11.9	10.9	10.6
Total Organic Carbon (mg/l)	56.6	29	12.1		5.2 *(80)*	5.6 *(80)*	7.3 *(80)*
Observation	Clear, no odour	Dark colour, no odour	Slightly cloudy, no odour		Clear, no odour	Cloudy, no odour	Clear, no odour
Boron (µ/mg)	0.03		0.05		0.04	0.03	0.03
Cadmium (µ/mg)	0.5	0.7	0.5		0.1	0.2	0.1
Calcium (mg/l)	52.4	139	70		43.1	34.4	37.6
Copper (µ/mg)	10	11	13		11	4	7
Fluoride (mg/l)	0.54	0.25	0.12		0.32	0.8	0.35

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010 (continued)

Parameter	Borehole ID						
	Superficial Deposits				Limestone Aquifer		
	BH 3	BH 11	BH 12	GW 301	BH 04/1	BH 102	BH103
Iron (µ/mg)	7635	6501	37370		6469	5378	6794
Lead (µ/mg)	5.5	35.6	11		69	2.4	8.5
Magnesium (mg/l)	6.20	17.30	8.50		13.60	5.50	5.20
Manganese (µ/mg)	514.50	203.80	1328.00		258.30	217.10	258.40
Mercury (µ/mg)	0.04	0.03	0.09		0.12	0.06	0.08
Nickel (µ/mg)	19.00	24.10	23.40		13.90	9.10	8.20
Potassium (mg/l)	1.30	4.50	4.00		2.20	3.20	3.30
Sodium (mg/l)	6.80	31.40	52.10		21.60	14.80	11.40
Sulphate (mg/l) SO_4	12.7	492.9	BLD		BLD	4.9	BLD
Total Alkalinity (mg/l) $CaCO_3$	408.5	258.4	500.6		422.6	344.2	333.5
Total Chromium (µ/mg)	7.40	15.90	10.00		5.90	4.00	4.60

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010 (continued)

Parameter	Borehole ID						
	Superficial Deposits				Limestone Aquifer		
	BH 3	BH 11	BH 12	GW 301	BH 04/1	BH 102	BH103
Orthophosphate (mg/l) P	0.124	BLD	BLD		BLD	BLD	0.144
Total Oxidised Nitrogen (mg/l) N	BLD	0.529	BLD		0.17	BLD	0.233
Zinc (µ/mg)	28	57.9	26.8		38.1	13.3	19.6

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010

VOLATILE ORGANIC COMPOUNDS (ug/l)	BH3	BH102	BH04/1
Chloromethane	<0.5	<0.5	<0.5
Vinyl chloride	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<0.5
Trichlorofluoromethane	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.5
Methylene chloride	<5.0	<5.0	<5.0
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5
Bromochloromethane	<0.5	<0.5	<0.5
Chloroform	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	<0.5	<0.5	<0.5
Carbon tetrachloride	<0.5	<0.5	<0.5
1,1-Dichloropropene	<0.5	<0.5	<0.5
Benzene	<0.1	<0.1	<0.1
1,2-Dichloroethane	<0.1	<0.1	<0.1
Trichloroethene	<0.1	<0.1	<0.1
1,2-Dichloropropane	<0.5	<0.5	<0.5
Dibromomethane	<0.5	<0.5	<0.5
Bromodichloromethane	<2.0	<2.0	<2.0
cis-1,3-Dichloropropene	<2.0	<2.0	<2.0
Toluene	<2.0	<2.0	<2.0
trans-1,3-Dichloropropene	<2.0	<2.0	<2.0
1,1,2-Trichloroethane	<0.5	<0.5	<0.5
Tetrachloroethene	<0.1	<0.1	<0.1
1,3-Dichloropropane	<0.5	<0.5	<0.5
Dibromochloromethane	<1.0	<1.0	<1.0
1,2-Dibromoethane	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<0.5
Ethylbenzene	<0.5	<0.5	<0.5
1,1,1,2-Tetrachloroethane	<2.0	<2.0	<2.0
m+p-Xylene	<0.5	<0.5	<0.5
o-Xylene	<0.5	<0.5	<0.5
Styrene	<2.0	<2.0	<2.0

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010 (continued)

Volatile Organic Compounds (ug/l)	**BH3**	**BH102**	**BH04/1**
Bromoform	<1.01	<1.01	<1.01
iso-Propylbenzene	<0.5	<0.5	<0.5
Bromobenzene	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5
n-Propylbenzene	<0.5	<0.5	<0.5
1,2,3-Trichloropropane	<2.0	<2.0	<2.0
4-Chlorotoluene	<0.5	<0.5	<0.5
2-Chlorotoluene	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	<0.5	<0.5	<0.5
tert-Butylbenzene	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	<0.5	<0.5	<0.5
sec-Butylbenzene	<0.5	<0.5	<0.5
p-Isopropyltoluene	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	<0.5	<0.5
n-Butylbenzene	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5
1,2-Dibromo-3-chloropropane	<2.0	<2.0	<2.0
Semi-volatile Organic Compounds (ug/l)	**BH3**	**BH102**	**BH04/1**
Phenol	106	<1	<1
Bis (2-chloroethyl)ether	<4	<1	<1
2-Chlorophenol	<4	<1	<1
1,3-Dichlorobenzene	<4	<1	<1
1,4-Dichlorobenzene	<4	<1	<1
1,2-Dichlorobenzene	<4	<1	<1
Bis (2-chloroisopropyl)ether	<4	<1	<1
2-Methylphenol	<4	<1	<1
3/4-Methylphenol	<4	<1	<1
Hexachloroethane	<4	<1	<1
Nitrobenzene	<4	<1	<1
Isophorone	<4	<1	<1
2-Nitrophenol	<4	<1	<1
2,4-Dimethylphenol	<4	<1	<1
Bis(2-chloroethoxy) Methane	<4	<1	<1

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010 (continued)

Semi-volatile Organic Compounds (ug/l)	BH3	BH102	BH04/1
2,4-Dichlorophenol	<4	<1	<1
1,2,4-Trichlorobenzene	<4	<1	<1
Naphthalene	<8	<2	<2
4-Chloroaniline	<4	<1	<1
Hexachlorobutadiene	<4	<1	<1
4-Chloro-3-methyl phenol	<4	<1	<1
2-Methyl naphthalene	<4	<1	<1
Hexachlorocyclopentadiene	<4	<1	<1
2,4,6-Trichlorophenol	<4	<1	<1
2,4,5-Trichlorophenol	<4	<1	<1
2-Chloronaphthalene	<4	<1	<1
2-Nitroaniline	<4	<1	<1
Dimethyl phthalate	<4	<1	<1
Acenaphthylene	<4	<1	<1
2,6-dinitrotoluene	<4	<1	<1
Acenaphthene	<4	<1	<1
3-Nitroaniline	<4	<1	<1
2,4-Dinitrophenol	<4	<1	<1
Dibenzofuran	<4	<1	<1
4-Nitrophenol	<20	<5	<5
2,4-Dinitrotoluene	<4	<1	<1
Diethyl phthalate	<4	<1	<1
Fluorene	<4	<1	<1
4-Chlorophenylphenyl ether	<4	<1	<1
4-Nitroaniline	<4	<1	<1
Azobenzene	<4	<1	<1
4-Bromophenylphenyl ether	<4	<1	<1
Hexachlorobenzene	<4	<1	<1
Pentachlorophenol	<4	<1	<1
Phenanthrene	<4	<1	<1
Anthracene	<4	<1	<1
Carbazole	<4	<1	<1
Dibutyl phthalate	<4	<1	<1
Fluoranthrene	<4	<1	<1
Pyrene	<4	<1	<1

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010 (continued)

Semi-volatile Organic Compounds (ug/l)	**BH3**	**BH102**	**BH04/1**
Butyl benzyl phthalate	<4	<1	<1
Benzo (a) anthracene	<4	<1	<1
Chrysene	<4	<1	<1
Bis (2-ethylhexyl)phthalate	<20	<5	<5
Di-n-octylphthalate	<4	<1	<1
Benzo (b/k) fluoranthrene	<4	<1	<1
Benzo (a) pyrene	<4	<1	<1
Indeno (123-cd) pyrene	<4	<1	<1
Dibenz (ah) anthracene	<4	<1	<1
Benzo (ghi) perylene	<4	<1	<1
Organochlorine Pesticides (ug/L)	**BH3**	**BH102**	**BH04/1**
o,p - DDE	<0.02	<0.004	<0.004
o,p DDT	<0.02	<0.004	<0.004
o,p TDE	<0.02	<0.004	<0.004
Chlordane-alpha	<0.04	<0.008	<0.008
p,p - DDE	<0.02	<0.004	<0.004
p,p DDT	<0.02	<0.004	<0.004
p,p TDE	<0.02	<0.004	<0.004
Isodrin	<0.04	<0.008	<0.008
Endosulphan beta	<0.04	<0.008	<0.008
HCH - gamma	<0.03	<0.006	<0.006
Heptachlor Epoxide	<0.02	<0.004	<0.004
Tecnazene	<0.1	<0.02	<0.02
Triallate	<0.1	<0.02	<0.02
Trifluralin	<0.3	<0.06	<0.06
1,2,4-Trichlorobenzene	<0.1	<0.02	<0.02
Hexachlorobutadiene	<0.07	<0.014	<0.014
123-Trichlorobenzene	<0.1	<0.02	<0.02
Chlordane-gamma	<0.02	<0.004	<0.004
Hexachlorobenzene	<0.02	<0.004	<0.004
Endrin	<0.04	<0.008	<0.008
HCH-beta	<0.03	<0.006	<0.006
135-Trichlorobenzene	<0.1	<0.02	<0.02
Dieldrin	<0.04	<0.008	<0.008

Ballaghaderreen Landfill Groundwater Quality Monitoring – 18 August 2010 (continued)

Organochlorine Pesticides (ug/L)	BH3	BH102	BH04/1
Endosulphan alpha	<0.04	<0.008	<0.008
HCH-alpha	<0.04	<0.008	<0.008
Aldrin	<0.04	<0.008	<0.008
Dichlorobenil	<0.02	<0.004	<0.004

Table 4.2 Groundwater Quality – 23 November 2010

Parameter	Borehole ID						
	Superficial Deposits				Limestone Aquifer		
	BH3	BH11	BH12	GW301	BH04/1	BH102	BH103
Ammoniacal Nitrogen (mg/l)	1.46	0.457	6.77	0.486	0.038 (3.00)	1.12 (3.00)	1.58 (3.00)
Chloride (mg/l)	7.36	25.22	50.84	9	29.16 *(100)*	13.6 *(100)*	21.69 *(100)*
Dissolved Oxygen (mg/l)	7.55	7.45	9.05	11.6	9.13	7.4	6.65
Electrical Conductivity (EC) (µS/cm)	711	1375	975	457	776	595	763
pH	7.82	7.04	6.77	-	8.1	-	-
Temperature (°C)	10.3	8.5	10.4	9.4	10.3	8.8	9.9
Total Organic Carbon (mg/l)	33.91	16.23	10.32	18.5	7.28 *(80)*	12.49 *(80)*	7.42 *(80)*
Observation	Clear	Dark in Colour	Slightly cloudy	Cloudy	Clear	Cloudy	Clear

Note: trigger levels in brackets.

Appendix J
Noise Monitoring Report

11 Pages

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An AMEC company

F.J. Coyle & Associates

Civil & Environmental Consultants

Client	Roscommon County Council					
Project Title	Noise Monitoring at Landfill Facility, Aghalustia, Ballaghaderreen Co. Roscommon.					
Document Title	Scope of Works for Assessment of Noise Emissions due to Landfill Activities for 2010					
Document No.						
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	X	X	✓	✓	✓	2

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
	Final	CF	OF	F.J.C.	Monaghan	19th January 2011

Table of Contents

1.0 Introduction

The following report presents the findings of an environmental noise survey carried out in the environs of the Ballaghaderreen Landfill Facility, Aghalustia, Ballaghaderreen, County Roscommon.

The survey was carried out on behalf of **Roscommon County Council**, by *FJ Coyle & Associates*, to meet the Noise monitoring conditions of the facilities Waste licence, W0 059-02.

The waste licence for the facility specifies that the noise level from within the premises, measured at noise sensitive locations in the vicinity shall not exceed:

(a) an L_{Aeq} value of 55dB(A) during the period 0800 hours to 2200 hours

(b) an L_{Aeq} level of 45dB(A) during the period 2200 hours to 0800 hours

The noise survey was undertaken on 6th December 2010. Weather conditions during the survey were good for the completion of the survey, cold and dry with negligible wind.

2.0 Methodology

Continuous noise measurements were taken at four locations (NSL01, NSL02, NSL03 & NSL04), as prescribed in the Waste Licence (*see Licence table D1.1*) using environmental noise analysers with data logging facilities set on real time, the logged data was later downloaded via a personal computer using *Proscon* software.
1/3 octave band frequency analysis was undertaken at each location.

Location code	**Description**
N2	Facility entrance
N3	Residence to the North
N4	Residence to the East
N5	Residence to the West

All measurements were carried out in accordance with ISO1996, Part 1 (Description and Measurement of Environmental Noise - Part 1:Basic Quantities and Procedures).

2.1 Instrumentation used

The following instrumentation was used in the survey:

- 2 No. Larson Davis 820 Type 1, Precision Integrating Sound Level Analyser/Data logger with 1/2" Condenser Microphone
- 2 No. Larson Davis 870 Precision Integrating Sound Level Analyser/Data logger with 900B Pre-amplifier and 1/2" Condenser Microphone Type 2541.
- Larson Davis 824 Precision Integrating Sound Level Analyser (SLM and RTA) with a 1/1 and 1/3 octave analysis.

All acoustic instrumentation was calibrated before and after each survey and no drift of calibration was observed (calibration level 114dB at 250HZ).

The Sound Level Meters (SLM) were positioned at each noise measurement point with the microphone mounted, at a height of 1.5 meters above ground level, on a tripod.

3.0 Noise Survey Results

The detailed results of the noise levels recorded in the study are provided in *Appendix i*. The recorded mean values of L_{Aeq} , L_{10} and L_{90} are shown in Table 1.0.

Table 1.0 Mean Noise Results

Location I.D	Day-time		
	Leq (30 min) dB(A)	L10 (30 min) dB(A)	L90 (30 min) dB(A)
NSL01	51.6	40.2	39.5
NSL02	54.2	52.9	40.3
NSL03	53.8	50	42.6
NSL04	55.1	56.3	30.1

Notes

1. Levels are the mean, (arithmetic average) for the specific period

2. LAeq is the total A weighted noise level, L_{10} is the highest 10%, while L_{90} is the background or lowest 10% of noise for the period.

4.0 Discussion

The survey was undertaken during a period, which is representative of the typical operational conditions of the landfill facility. The complete set of monitoring data is presented in appendix i.

Noise levels recorded at location NSL01 indicate a mean daytime L_{Aeq} (30 minute) of 51.6 dB(A); at location NSL02 the mean L_{Aeq} is 54.2 dB(A); at location NSL03 the mean L_{Aeq} is 53.8 and at location NSL04 the mean L_{Aeq} is 55.1 .

The high noise levels at location NSL03, a residence located EAST of the facility along the busy N5 national primary route, can be attributed to road traffic noise. Noise from the landfill operation is inaudible at this location.

At the residences South and North of the facility the noise from the facility itself is only just audible. Traffic movements to and from the site contribute to the noise environment, more noticeably at location NSL04.

The measured/recorded noise levels are within the licence limits.

Traffic movements on the local road and noise from the facility itself influence noise levels at the entrance to the site, location NSL01. The levels at this location are below the limit value.

1/3 octave band frequency analysis undertaken at each location indicated no tonal emissions from the landfill facility

5.0 Conclusion

The noise emissions from the facility are well within the levels specified in the waste licence for daytime. The facility does not operate during nighttime hours.

There are no tonal noise emissions audible at any of the monitoring locations.

Appendix i

Complete Noise Survey Data

Complete set of monitoring data									
Date	**Time**	**Location**	**LAeq**	**LAFmin**	**LAFmax**	**LAF5.00**	**LAF10.00**	**LAF50.00**	**LAF90.00**
06/12/2010	11:47:11	NSL1	40.2	39.4	40.4	40.3	40.2	39.9	39.5
06/12/2010	11:59:23	NSL2	60.3	42.6	69.1	66.5	66.0	52.9	45.3
06/12/2010	12:00:00	NSL2	61.0	37.4	76.7	68.4	64.9	46.7	40.3
06/12/2010	12:13:52	NSL3	39.5	38.8	39.9	39.9	39.9	39.6	39.5
06/12/2010		NSL3		48.0	34.8	72.8	51.4	50.3	46.2
06/12/2010	12:30:00	NSL3	50.2	38.7	70.2	51.8	49.0	46.2	42.6
06/12/2010	12:38:43	NSL4	58.1	25.5	77.1	59.8	52.6	32.8	27.9
06/12/2010	12:45:00	NSL4	58.6	24.6	79.4	63.1	56.3	42.2	30.1

Appendix ii

Acoustics Terminology

Sound is produced by a mechanical disturbance emanating as a wave motion in air at a speed of about 330 metres per second (the speed of sound in air). This is characterised by its amplitude, measured in decibels (dB) and its frequency, measured in Hertz (Hz). Noise is unwanted or undesirable sound, it does not accumulate in the environment and is usually localised.

The Decibel Scale

The difficulty in assigning a unit of measurement to sound is the sensitivity of the human ear. Audible sound pressures range from the threshold of hearing and the threshold of pain, which corresponds to a ratio of 1:1,000,000. In order to cover this vast range a logarithmic unit: the decibel (dB) is used. The decibel scale corresponding to the threshold of hearing and the threshold of pain ranges from 0 to 140dB. A decibel is defined as ten times the base-ten logarithm of a power ratio.

The decibel scale with indicative noise examples

Decibels	Pascals	Activity
140dB	200Pa	Threshold of Pain
120dB	20Pa	Jet taking off
100dB	2Pa	Pneumatic Drill
80dB	0.2Pa	Heavy Truck
60dB	0.02	Business Office
40dB	0.002	Library
20dB	0.0002	Wood
0dB	0.00002	Threshold of Hearing

Frequency

The size of the pressure fluctuation is measured using the Decibel, the rate of these fluctuations is measured by cycles per second or Hertz (Hz). Human ears are most sensitive to mid frequencies in the range between 500 Hz to 6kHz. Sounds with a frequency less that 20 Hz are generally not audible, this type of sound is said to be

infrasonic. Above 20kHz sounds are generally inaudible and the sounds are described as ultrasonic.

LArT:
The equivalent continuous A- weighted sound pressure level during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound.

'A' Weighting

Within that range the ear can tolerate low frequencies more than middle to high frequencies and one must ensure that any measurement device elicits a numerical value, which matches the ear's response. This is achieved by introducing an electronic filter (called an 'A' weighted filter) into the measuring system. This weighting characteristic provides good correlation with loudness and since its maximum lies in the frequency region where the ear is most sensitive, it takes into account the hearing damage potential of the noise. For this reason environmental noise levels are generally measured in terms of 'A' weighted decibels, dB(A).

Where noise levels vary in time, statistical analysis of the variation can be carried out. The results are usually stated in the form L_N (L for level), where N is the percentage of time a level is equalled or exceeded. Hence if L_{90} = 40 dB(A), the noise level exceeds 40 dB(A) for 90% of the time measured period (i.e. background noise level is 40 dB(A).)

In addition to the statistical units, the equivalent continuous level is also measured. The equivalent continuous level, L_{eq}, is measured in dB(A) and is a notional steady level that has the same sound energy as the real fluctuating sound over the same

measurement period. It is measured using an integrating sound level meter (SLM). L_{eq} is often described as the total noise level for a specified period.

Appendix K
Meteorological Data

12 Pages

Ballaghaderreen Landfill Meteorological Monitoring 2010

January

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N*)	(mbar)	(%)	(Penman)
1	0.0	-0.4	-3.2	1.5	88.8	1002.1	79.5	0.00
2	1.8	-0.1	-3.7	4.0	206.3	1008.8	78.5	0.19
3	0.0	-0.3	-4.0	2.5	85.2	1015.2	77.5	0.05
4	0.6	0.8	-4.5	1.0	185.5	1011.1	84.0	0.30
5	3.6	1.2	0.6	7.5	120.4	999.8	80.5	0.11
6	0.0	0.8	-5.8	7.5	39.7	1004.2	78.5	0.06
7	0.2	-2.6	-5.4	2.5	212.8	1007.0	83.0	0.11
8	0.2	-3.0	-8.5	1.0	90.0	1018.0	83.5	0.00
9	0.2	-4.2	-8.8	0.0	90.0	1021.6	82.5	0.18
10	0.4	1.2	-4.9	3.5	80.3	1016.3	84.5	0.23
11	3.2	1.1	0.6	9.5	111.1	1006.1	84.0	0.09
12	10.8	0.8	0.4	11.5	124.7	986.7	86.0	0.40
13	8.8	1.5	0.4	6.0	112.0	985.4	89.5	0.17
14	0.2	5.1	1.3	8.0	135.0	990.1	87.0	0.16
15	11.8	9.8	5.1	19.5	180.5	986.6	84.5	0.12
16	3.2	9.9	4.8	17.0	219.8	984.4	82.5	0.17
17	0.6	8.6	4.8	12.0	229.7	1000.9	81.5	0.11
18	0.6	8.5	2.3	6.5	222.2	1009.2	84.5	0.09
19	6.4	5.6	2.6	12.0	140.6	1000.6	85.5	0.26
20	3.0	5.6	2.9	12.0	151.3	998.3	86.5	0.07
21	9.2	6.7	2.7	7.0	177.2	993.6	87.0	0.16
22	0.4	6.1	-1.5	1.0	243.2	1004.9	86.5	0.08
23	0.2	-0.9	-2.5	0.0	337.5	1014.0	87.0	0.00
24	0.6	0.8	-2.5	0.0	295.8	1015.8	89.0	0.08
25	0.0	1.0	-2.6	0.5	100.1	1023.5	89.0	0.05
26	0.4	-0.2	-2.6	0.5	112.5	1030.4	87.5	0.11
27	0.2	6.4	-0.3	4.0	223.1	1023.0	83.5	0.21
28	1.6	8.2	6.2	10.0	289.2	1006.3	82.0	0.30
29	7.0	8.1	1.3	12.0	111.6	993.0	82.5	0.18
30	0.2	1.4	-0.4	2.0	264.4	996.0	84.0	0.15
31	5.4	1.0	-0.3	1.0	308.0	1000.2	85.0	0.18
Total:	**80.8**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

February

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	2.0	5.7	1.0	5.0	261.1	1003.6	85.5	0.26
2	2.0	5.8	3.9	4.5	209.8	995.6	83.5	0.11
3	11.4	4.0	3.7	5.0	168.8	993.2	85.5	0.36
4	14.6	6.7	3.3	4.0	154.7	982.7	87.0	0.23
5	0.2	6.7	2.9	2.0	119.5	984.1	86.5	0.25
6	0.2	3.3	2.3	2.5	122.0	1006.9	87.0	0.25
7	0.2	3.7	2.7	7.5	127.0	1011.1	84.5	0.21
8	0.0	3.7	2.6	5.5	95.6	1007.8	78.5	0.43
9	0.0	2.7	-2.0	2.5	52.8	1010.2	73.5	0.65
10	0.0	-1.2	-2.5	0.0	85.3	1013.9	76.0	0.57
11	0.0	-0.1	-1.4	0.5	61.4	1018.4	74.5	0.41
12	0.0	1.3	-1.3	1.5	27.3	1019.8	79.5	0.57
13	0.2	1.5	-3.1	1.0	22.5	1017.9	84.5	0.43
14	0.2	2.9	-3.3	1.0	198.3	1009.8	87.0	0.30
15	3.2	2.6	1.1	4.0	279.4	993.3	85.5	0.34
16	9.6	1.8	1.2	4.5	204.4	979.3	85.5	0.44
17	0.6	1.4	-1.7	1.5	76.9	981.0	87.0	0.37
18	0.8	1.1	-1.8	3.5	126.5	984.5	86.5	0.45
19	0.8	1.0	-2.4	2.5	303.8	986.3	87.0	0.36
20	0.4	0.1	-2.8	0.5	255.2	984.9	89.5	0.30
21	1.0	-0.2	-1.8	0.5	202.5	980.6	90.0	0.26
22	0.0	-0.4	-2.4	0.5	97.8	980.5	86.5	0.43
23	1.2	1.3	-0.6	7.0	88.6	980.2	85.0	0.54
24	2.4	1.2	0.6	6.0	30.9	978.4	86.0	0.41
25	0.2	2.3	0.4	2.0	217.5	976.6	85.5	0.53
26	5.0	2.7	1.8	4.5	303.8	978.3	88.0	0.43
27	0.6	2.7	1.1	4.0	152.3	980.2	88.0	0.56
28	6.6	1.3	-0.3	1.5	142.2	986.6	86.5	0.70
Total:	**63.4**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

March

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	0.2	-0.2	-1.3	1.5	302.1	1000.8	85.0	0.81
2	0.2	3.8	-1.3	5.0	180.9	1010.0	80.5	0.69
3	17.8	3.5	1.9	5.0	152.3	1008.0	82.5	0.44
4	0.2	2.0	-0.4	1.0	90.0	1017.6	86.0	0.82
5	0.2	1.1	-0.7	0.0	46.8	1023.0	87.5	1.00
6	0.0	2.1	-0.9	0.5	38.3	1019.6	86.0	0.80
7	0.2	1.5	-2.6	2.0	130.8	1020.4	81.5	1.05
8	0.0	-1.3	-2.5	1.0	121.9	1020.5	74.5	1.21
9	0.0	-0.8	-2.5	2.0	128.0	1022.8	77.5	1.22
10	0.0	-0.9	-2.1	0.5	124.6	1022.4	80.0	1.08
11	0.0	-1.2	-1.4	0.0	242.1	1018.8	82.0	1.12
12	0.2	8.1	4.3	4.9	4.5	1018.5	84.708	1.08
13	0.0	8.2	3.7	4.3	285.6	1023.5	85.458	1.00
14	0.0	9.1	3	3.5	322.0	1022.6	79.208	1.13
15	0.0	8.4	2.9	3.3	259.5	1017.3	78.083	1.14
16	0.0	8.6	1.1	1.3	295.1	1007.7	79.625	0.86
17	0.0	11.4	6.7	7.7	214.8	1001.1	88.208	1.19
18	0.0	11	7	8.1	222.5	989.7	90.833	1.08
19	0.0	9.6	4.4	5.1	202.3	994.9	73.125	1.24
20	0.0	10.2	3.6	4.1	13.5	996.0	73.333	1.46
21	0.0	10.9	3.6	4.1	225.0	999.2	80.042	1.32
22	0.2	8.9	2.1	2.4	263.0	996.6	85.417	0.82
23	0.0	8.9	3.2	3.7	186.4	995.2	88.75	0.90
24	0.0	10.2	4.9	5.6	255.9	987.2	80.792	1.56
25	0.0	11	4.9	5.6	155.6	983.3	85.292	1.18
26	0.0	12.1	5.3	6.1	135.0	983.6	89.625	1.55
27	1.2	9.1	4.1	4.7	298.8	995.8	79.583	1.56
28	0.0	7.9	3.3	3.8	272.5	996.2	79.75	1.32
29	0.0	3.7	1.1	1.3	278.3	984.7	90.917	0.59
30	0.0	3.1	1.5	1.7	249.3	978.2	91.792	0.89
31	3.6	4.7	-0.2	-0.2	234.8	990.7	77.333	1.46
Total:	**24.0**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

April

Day	Rainfall (mm)	Maximum Temp (Deg C)	Minimum Temp (Deg C)	Wind Speed (Mph)	Wind Direction (Deg From N)	Atmospheric Pressure (mbar)	Relative Humidity (%)	Potential Evapotranspiration (Penman)
1	0.0	7.1	-0.4	7.4	255.4	993.2	79.958	1.47
2	0.0	6.9	0.9	11.7	81.0	984.0	93.917	0.89
3	0.0	7.6	1.4	10.5	24.1	991.3	86.792	1.24
4	0.0	6.7	-0.1	12.9	35.3	1000.7	86.333	0.79
5	1.6	10.5	6.3	23.3	202.5	993.2	93.958	0.74
6	3.4	9.6	4.3	9.4	280.6	994.6	92.833	1.14
7	0.0	10.9	3.3	10.3	282.2	1011.5	76.875	1.99
8	0.0	11	5.3	7.4	252.2	1019.4	82.167	1.42
9	0.0	13.9	4.7	11.1	190.4	1020.2	73.333	2.31
10	0.0	16.7	3.4	9.4	172.8	1020.9	65.792	2.85
11	0.0	18.1	4.6	5.2	103.0	1020.8	68.125	2.77
12	0.0	16.6	5.9	6.7	59.7	1020.4	64.417	2.82
13	0.0	15.5	5.6	5.6	86.3	1018.7	74.833	2.43
14	0.0	12	5	7.4	72.7	1016.3	75.083	2.36
15	0.0	13.7	3	8.5	57.1	1017.7	74.708	2.34
16	0.0	14.4	3.4	6.7	169.2	1018.8	71.375	2.60
17	0.0	12.9	3.4	6.5	206.8	1011.5	76.333	2.67
18	0.0	10.1	4.5	6.0	170.0	1007.3	83.5	1.30
19	0.0	10.5	1.7	7.3	93.2	1009.8	67.125	2.40
20	0.0	8.7	2.7	8.3	66.7	1012.3	72.125	1.91
21	0.0	10.3	0.4	5.3	143.3	1013.4	60.667	2.21
22	0.0	11.4	3.2	5.4	181.7	1008.0	67.583	1.95
23	0.0	13.3	5.3	7.5	221.7	1002.7	72	1.94
24	0.2	13.9	4.3	10.9	167.9	1001.3	84.125	1.48
25	0.0	14.4	8.2	11.3	255.3	1004.0	87.5	2.17
26	0.0	15.2	8.1	8.5	239.2	1012.3	84.5	2.25
27	0.6	10.7	10.7	9.2	185.6	1009.3	97	1.05
28	4.8	11.2	10.3	12.5	216.1	1000.6	87.5	1.12
29	0.6	10.4	6.9	5.0	254.1	998.7	87.0	1.79
30	2.4	7.8	6.6	1.5	217.3	996.2	84.5	2.29
Total:	**13.6**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

May

Day	Rainfall (mm)	Maximum Temp (Deg C)	Minimum Temp (Deg C)	Wind Speed (Mph)	Wind Direction (Deg From N)	Atmospheric Pressure (mbar)	Relative Humidity (%)	Potential Evapotranspiration (Penman)
1	7.0	8.7	7.3	1.0	337.5	999.0	80.5	1.73
2	0.4	8.8	5.2	5.0	22.5	1005.5	80.0	2.19
3	0.0	6.3	4.9	0.0	0.0	1016.3	80.0	2.81
4	0.0	8.8	5.4	1.0	337.5	1023.2	76.5	1.74
5	0.0	11.1	8.8	3.0	315.0	1020.1	79.5	0.98
6	0.2	11.1	7.3	7.0	0.0	1009.9	82.5	1.73
7	0.0	7.7	6.4	2.0	22.5	1007.6	77.0	2.28
8	0.0	6.4	5.8	3.0	45.0	1010.0	71.5	3.71
9	0.0	6.7	5.8	2.0	0.0	1009.8	68.5	2.61
10	0.0	6.2	4.2	3.0	22.5	1006.9	69.5	2.64
11	0.2	4.3	3.8	4.0	0.0	1009.6	74.0	1.82
12	0.0	6.6	3.9	2.0	22.5	1007.9	70.5	2.72
13	0.4	7.9	5.8	0.0	45.0	1005.4	78.0	1.94
14	0.8	7.3	6.0	4.0	315.0	996.7	82.0	2.46
15	1.2	7.0	6.0	2.0	337.5	1006.4	81.0	2.10
16	0.4	6.4	5.8	7.0	292.5	1004.2	80.5	2.34
17	0.2	8.9	6.0	1.0	292.5	1011.9	84.0	2.16
18	4.4	11.6	7.8	2.0	180.0	1015.2	86.5	0.74
19	0.2	13.1	11.6	9.0	202.5	1012.6	88.0	1.68
20	0.0	15.1	13.0	7.0	225.0	1018.6	82.5	3.18
21	7.2	16.0	14.6	5.0	270.0	1021.5	83.0	1.91
22	0.0	17.0	15.3	2.0	225.0	1018.9	79.0	3.72
23	0.0	16.4	11.4	1.0	180.0	1015.7	81.5	4.72
24	0.0	11.6	9.9	6.0	22.5	1010.5	81.0	3.66
25	0.0	9.9	6.9	5.0	22.5	1007.7	72.5	3.59
26	0.0	6.9	6.3	5.0	45.0	1005.3	71.0	3.38
27	0.4	7.1	6.4	2.0	315.0	1004.1	80.0	2.83
28	0.0	10.6	5.7	2.0	315.0	1002.4	77.0	2.72
29	3.2	11.1	8.5	4.0	157.5	999.4	77.5	1.80
30	0.0	10.4	8.0	5.0	315.0	1001.6	79.0	3.09
31	4.8	11.1	9.9	0.0	45.0	1008.5	84.0	1.74
Total:	**31.0**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

June

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	0.2	11.1	10.2	6.0	285.0	1005.4	83.5	2.98
2	0	15.8	10.2	3.0	241.1	1010.8	72.5	3.44
3	0	15.7	13.8	5.5	160.8	1008.7	69.5	3.34
4	3.2	13.8	11.9	3.0	209.1	1006.2	75	3.26
5	2.2	12.2	11.1	1.5	207.9	1008.2	82	3.22
6	0	12.1	11.8	0.5	73.6	1005.2	79	3.13
7	2.8	12.1	11.7	3.5	89.5	996.5	82	2.41
8	0.4	13.1	11.6	6.5	47.8	992.2	84.5	1.77
9	3.4	12.8	11.7	5.5	42.2	998.5	78.5	1.32
10	0	11.7	10.1	4.0	32.3	1005.6	79.5	4.14
11	0	12.1	9.9	4.0	190.8	1005.3	73	2.26
12	0	12.1	11.1	4.5	241.4	1009.9	72	2.61
13	2.6	11.1	10.1	3.0	248.9	1006.1	81	2.51
14	0	11.2	10.4	5.5	97.5	1013.8	77.5	3.18
15	0	12.8	10.3	2.0	48.8	1020.3	76.5	3.98
16	0	12.5	11.9	0.0	102.4	1018.1	81.5	2.00
17	0	13.3	11.4	1.0	38.2	1015.7	83	2.54
18	0	13.2	11.6	4.5	18.2	1014.5	76.5	2.56
19	0	11.6	9.3	4.0	35.2	1013.3	73.5	3.98
20	0	11.7	8.9	2.5	108.3	1013.7	80	4.03
21	0	13.9	10.6	2.0	189.7	1011.8	78	4.53
22	0	15.4	12.8	4.0	228.3	1010.5	76.5	2.79
23	0.8	15.1	14.2	3.5	238.1	1008.3	80	1.82
24	0	14.2	12.2	1.0	271.5	1008.9	79.5	3.41
25	0	17.9	10.9	1.5	224.5	1005.9	74	2.76
26	1	17.4	14.0	6.5	215.6	1002.3	79.5	3.57
27	2.8	14.0	13.0	6.5	217.0	1003.5	83.5	2.99
28	4.6	13.0	11.6	2.5	157.5	1005.8	83	1.83
29	0.2	13.7	11.1	0.0	196.9	1009.1	78	3.37
30	4.2	14.8	13.6	9.0	215.6	1003.2	79.5	2.16
Total:	**28.4**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

July

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	10.8	15.0	13.2	12.0	212.8	991.2	80.5	2.43
2	3.0	13.5	12.6	8.5	222.2	994.2	77.0	2.82
3	1.6	14.0	12.8	10.0	235.3	1004.3	76.0	2.14
4	6.6	14.0	12.2	10.0	251.7	1000.9	77.5	2.11
5	0.4	12.2	11.2	4.0	285.9	1012.3	80.5	3.31
6	3.2	15.3	10.7	6.0	218.9	1008.2	83.0	0.96
7	0.4	15.0	12.1	7.0	239.1	1001.5	83.5	2.68
8	1.0	13.8	11.9	4.5	217.0	1003.0	84.5	1.92
9	12.8	13.6	12.0	3.0	199.7	1001.7	89.0	2.18
10	19.2	13.0	12.0	11.5	108.3	999.3	87.5	0.95
11	0.6	12.3	12.0	12.0	269.1	1001.9	85.5	2.64
12	0.2	13.7	11.8	0.0	136.0	1003.1	83.0	2.10
13	3.0	13.5	13.2	4.0	96.1	995.3	84.0	1.85
14	15.4	14.6	13.4	5.0	98.9	984.3	88.0	2.16
15	18.2	14.2	13.7	5.5	182.9	984.1	88.0	2.03
16	3.4	13.7	11.4	9.5	262.5	993.1	82.0	2.29
17	3.2	13.3	11.1	7.5	246.1	1004.6	84.5	2.44
18	0.0	15.2	13.3	6.5	231.1	1004.6	86.0	2.43
19	6.0	15.4	13.3	2.0	218.4	1002.2	86.0	1.95
20	0.8	13.8	13.3	4.0	174.4	997.9	86.5	2.51
21	19.0	13.8	12.4	9.5	40.3	995.3	85.0	1.19
22	0.6	12.4	11.4	8.0	9.4	1005.7	83.0	3.30
23	0.0	14.3	11.4	2.0	146.0	1011.0	80.0	1.88
24	1.2	14.2	14.1	3.0	240.9	1008.5	81.5	2.38
25	0.0	16.1	14.1	1.5	276.1	1009.1	86.5	1.37
26	1.2	16.0	15.0	6.0	265.3	1008.4	88.0	1.68
27	0.2	15.0	12.9	6.0	274.2	1007.4	85.5	2.71
28	0.8	13.8	12.6	6.5	292.0	1008.6	83.0	1.89
29	0.0	14.7	13.4	3.0	288.8	1008.7	82.0	1.47
30	6.0	14.8	12.8	2.5	270.0	1001.4	84.5	1.70
31	0.4	13.0	12.7	3.5	280.3	1000.4	86.0	1.99
Total:	**139.2**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

August

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	0.0	12.8	11.9	2.0	169.2	1004.7	85.0	2.01
2	0.8	13.6	11.6	4.0	158.5	1009.1	87.5	1.19
3	2.0	13.8	10.8	3.5	279.4	1004.7	89.5	1.19
4	7.6	12.4	10.8	0.5	296.3	1001.5	87.0	2.38
5	0.4	13.3	12.3	6.0	272.3	1002.5	87.0	2.25
6	2.2	14.2	13.3	7.5	248.9	996.6	88.0	1.52
7	0.2	14.1	12.1	1.5	179.5	1007.2	85.5	2.33
8	2.4	14.4	12.1	5.5	264.8	1009.4	86.5	1.75
9	1.4	14.5	12.3	8.0	268.1	1000.4	84.5	2.18
10	5.8	12.3	11.1	4.0	302.3	998.8	82.0	2.92
11	1.4	13.3	10.6	5.0	303.3	1006.1	82.5	1.85
12	1.2	12.8	12.3	5.5	192.2	1012.6	84.0	1.77
13	1.2	12.6	12.2	5.0	125.2	1015.3	83.0	2.10
14	4.8	13.3	12.3	1.0	194.3	1013.8	84.5	1.24
15	0.2	12.8	11.7	0.0	171.1	1014.9	86.5	3.52
16	5.8	15.4	10.6	0.5	266.0	1008.3	89.5	0.75
17	0.2	15.4	11.4	1.5	277.0	1002.1	87.5	2.19
18	2.0	12.3	11.4	2.5	254.5	995.1	85.0	2.39
19	0.0	14.9	11.9	4.5	178.1	993.4	88.5	1.91
20	0.8	15.4	14.1	7.5	223.6	993.2	85.5	2.42
21	2.2	14.2	10.7	6.0	248.0	1001.9	84.0	2.14
22	6.4	13.2	10.1	2.5	238.7	999.9	90.0	1.88
23	6.6	12.9	10.9	5.0	267.2	990.6	89.0	2.08
24	3.6	11.3	8.6	5.0	300.9	996.8	85.0	1.41
25	0.2	10.4	8.2	0.0	174.0	1002.0	86.0	2.28
26	0.0	12.3	9.5	1.5	37.3	1000.6	80.0	2.77
27	0.6	11.6	10.1	4.0	204.9	1006.3	78.0	1.86
28	0.2	12.7	10.1	5.0	298.1	1012.6	82.0	2.26
29	0.8	12.7	5.4	3.0	147.2	1012.7	79.5	1.89
30	0.0	10.1	5.4	0.5	88.9	1017.2	79.5	2.68
31	0.0	12.7	8.7	2.0	147.2	1013.4	77.5	2.17
Total:	**61.0**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

September

Day	Rainfall (mm)	Maximum Temp (Deg C)	Minimum Temp (Deg C)	Wind Speed (Mph)	Wind Direction (Deg From N)	Atmospheric Pressure (mbar)	Relative Humidity (%)	Potential Evapotranspiration (Penman)
1	0.0	12.3	11.4	2.0	160.8	1009.3	78.5	2.36
2	0.0	14.2	11.1	5.0	151.9	1008.5	77.0	3.13
3	0.0	14.0	13.3	8.0	152.3	1007.2	75.0	3.12
4	2.8	15.8	13.6	5.0	201.1	1004.4	82.0	2.05
5	6.8	16.7	15.7	11.0	160.3	999.0	84.5	1.32
6	25.8	16.9	13.2	11.0	151.4	987.8	85.5	0.88
7	10.0	13.2	12.6	6.0	189.4	983.6	83.5	0.86
8	2.6	13.2	12.3	7.0	224.5	989.6	81.5	1.46
9	6.8	14.7	12.7	6.5	233.9	1001.1	84.5	1.42
10	5.8	15.1	14.0	8.0	240.0	997.9	86.5	1.75
11	3.0	14.1	11.3	4.0	274.7	1001.4	85.0	1.56
12	1.6	14.2	11.2	9.0	258.3	1013.1	82.5	1.01
13	14.4	16.0	14.1	11.5	248.0	1006.2	84.0	0.69
14	3.0	15.9	10.1	8.5	280.8	1002.8	79.0	1.49
15	0.8	11.1	10.1	7.0	301.9	1002.7	77.5	1.31
16	0.4	10.9	8.7	4.5	217.5	1006.3	83.5	1.86
17	0.0	8.8	6.9	2.0	92.4	1011.1	84.0	1.55
18	7.0	14.2	6.7	4.0	193.8	1006.2	85.5	0.73
19	5.0	14.4	13.3	7.0	248.4	997.6	85.5	0.84
20	2.0	14.0	13.0	3.0	241.9	998.8	84.0	1.44
21	0.4	14.5	13.8	8.5	183.8	1001.5	81.0	0.86
22	1.8	14.4	13.2	7.0	220.8	997.4	82.0	1.07
23	0.8	13.3	11.7	5.0	115.3	996.9	79.5	0.85
24	0.0	11.7	8.2	6.5	20.2	1007.3	69.0	1.47
25	0.0	9.3	7.9	1.0	37.0	1012.8	65.0	1.02
26	0.0	9.1	8.6	0.5	136.9	1008.5	69.0	1.19
27	0.0	10.2	8.5	4.0	147.7	1004.0	73.0	1.22
28	3.8	9.7	5.9	3.5	225.0	1001.0	78.0	1.13
29	0.6	8.7	5.3	1.0	267.1	1002.3	83.5	1.29
30	0.4	11.9	8.0	7.5	181.9	996.1	81.5	0.92
Total:	**105.6**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

October

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	6.8	11.9	9.4	13.0	215.6	981.5	78.0	0.99
2	1.4	10.1	9.2	9.5	192.2	983.3	79.5	1.18
3	0.0	10.1	7.9	4.0	227.4	981.3	82.0	1.15
4	4.2	11.3	7.7	5.5	207.7	980.1	80.0	0.46
5	9.4	11.4	7.7	12.5	209.1	979.4	75.5	1.08
6	3.6	9.9	7.8	11.5	213.3	987.8	78.0	1.04
7	0.0	13.6	9.6	14.5	164.5	998.1	72.0	1.38
8	0.2	15.1	13.6	15.5	120.9	998.9	72.0	1.04
9	0.0	15.1	12.8	13.5	110.6	1003.0	73.5	0.83
10	0.0	12.8	9.2	6.0	95.6	1005.9	75.0	0.77
11	0.4	9.3	6.8	1.0	91.9	1011.5	78.5	1.45
12	0.4	6.9	4.9	0.0	90.0	1013.1	79.5	1.26
13	0.2	8.2	4.7	0.0	85.5	1013.9	69.0	0.63
14	0.0	10.2	8.1	0.5	57.2	1014.8	48.0	0.65
15	0.2	10.1	9.7	3.0	111.5	1014.1	43.5	0.71
16	0.2	10.1	3.5	2.0	193.2	1015.6	48.5	0.71
17	1.6	10.1	3.1	0.5	177.5	1014.4	49.5	0.56
18	0.4	10.1	8.2	4.5	279.4	1009.7	48.0	0.67
19	3.6	8.2	4.7	3.0	170.2	1007.3	52.0	0.69
20	0.2	6.7	4.2	3.0	179.5	1013.3	55.0	0.59
21	0.2	8.2	6.2	3.0	256.4	1010.9	58.0	0.51
22	9.6	8.2	4.9	3.0	232.5	1000.5	59.5	0.31
23	1.2	4.9	3.4	0.0	203.9	996.7	63.0	0.57
24	0.4	3.4	2.0	0.0	43.1	1010.7	65.0	0.60
25	4.0	9.9	1.0	8.0	131.3	1012.7	63.0	0.22
26	6.4	12.1	9.9	9.5	225.5	998.9	58.0	0.29
27	5.4	11.4	6.6	7.0	237.2	997.3	59.5	0.47
28	4.8	12.7	6.2	14.0	202.5	990.9	54.0	0.41
29	6.6	12.5	6.8	14.5	234.4	976.7	53.5	0.50
30	0.4	6.8	4.2	3.5	250.0	980.3	69.0	0.32
31	0.4	4.7	1.4	0.0	69.4	994.9	73.5	0.50
Total:	**72.2**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

November

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	4.0	10.6	1.6	6.5	188.4	996.7	67.5	0.24
2	14.6	10.6	8.6	10.5	259.7	989.9	63.0	0.39
3	7.6	14.3	8.7	13.0	245.2	995.9	61.5	0.39
4	14.8	14.2	10.6	11.0	255.0	998.7	60.0	0.38
5	6.2	10.9	6.4	3.5	264.7	1006.6	62.5	0.38
6	4.0	6.4	4.2	2.5	293.9	1007.4	71.5	0.30
7	13.4	6.9	4.7	4.0	247.5	991.6	76.0	0.36
8	7.4	6.6	5.6	8.5	164.5	956.4	80.5	0.29
9	0.0	5.9	1.0	6.5	42.5	979.9	88.0	0.59
10	3.2	7.6	0.7	12.5	137.7	987.2	90.5	0.24
11	7.8	9.2	7.6	21.5	263.0	965.8	91.0	0.57
12	3.2	9.4	3.3	12.5	266.3	977.9	90.5	0.65
13	0.6	4.5	1.2	4.0	228.1	978.1	92.0	0.20
14	0.2	1.7	0.4	0.5	194.3	985.7	92.0	0.00
15	0.4	3.7	0.2	2.5	219.5	1000.5	90.5	0.24
16	17.4	8.2	3.7	15.5	169.2	997.0	73.5	0.50
17	8.4	8.5	8.2	21.0	162.2	978.0	32.0	0.16
18	6.0	8.7	3.9	11.0	220.8	983.0	16.5	0.23
19	0.0	6.0	4.2	3.0	145.3	997.1	10.5	0.02
20	0.2	6.0	4.7	1.0	82.5	1005.8	7.0	0.21
21	0.0	4.7	0.9	0.0	53.7	1008.8	12.5	0.05
22	0.2	1.8	0.1	0.0	32.7	1006.1	18.5	0.23
23	1.2	4.2	0.6	0.5	182.7	1007.3	16.0	0.00
24	0.6	4.3	0.9	1.5	154.8	1005.6	9.5	0.07
25	3.6	4.8	1.5	4.0	108.3	1007.5	5.0	0.09
26	1.4	4.4	-0.6	2.0	174.4	1002.3	19.0	0.08
27	0.4	-0.6	-1.8	0.5	160.0	1000.7	20.5	0.03
28	2.4	-0.9	-2.5	2.0	7.5	998.1	19.5	0.00
29	0.4	-1.1	-2.9	3.0	90.0	1005.8	18.0	0.09
30	0.0	-2.0	-3.8	2.0	66.1	1010.4	16.0	0.20
Total:	**129.6**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

December

Day	Rainfall	Maximum Temp	Minimum Temp	Wind Speed	Wind Direction	Atmospheric Pressure	Relative Humidity	Potential Evapotranspiration
	(mm)	(Deg C)	(Deg C)	(Mph)	(Deg From N)	(mbar)	(%)	(Penman)
1	0.0	-2.8	-4.2	2.0	37.0	1008.6	17.5	0.00
2	0.0	-3.9	-4.7	3.0	128.4	1007.7	23.0	0.00
3	1.2	-1.3	-4.8	1.0	248.9	995.7	26.0	0.24
4	0.2	0.8	-1.3	2.0	282.9	993.8	19.5	0.00
5	0.4	0.8	-6.2	2.5	265.9	997.2	21.0	0.00
6	2.6	-2.3	-6.4	0.0	143.1	991.7	24.0	0.10
7	0.2	-2.1	-4.8	0.5	24.0	998.7	19.5	0.00
8	0.2	-1.1	-5.2	0.5	182.3	1011.6	18.0	0.00
9	0.2	5.1	-0.9	2.5	274.7	1022.5	7.0	0.15
10	0.2	5.5	4.5	5.0	263.4	1023.2	3.5	0.00
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
Total:	**5.2**							

Notes

*** Wind direction from North is as follows:**

N = 0
NNE = 22.5
NE = 45
ENE = 67.5
E = 90
ESE = 112.5
SE = 135
SSE = 157.5
S = 180
SSW = 202.5
SW = 225
WSW = 247.5
W = 270
WNW = 292.5
NW = 315
NNW = 337.5

Appendix L
AER/PRTR Spreadsheet

3 Pages

Environmental Protection Agency

Guidance to completing the PRTR workbook

AER Returns Workbook

Version 1.1.11

REFERENCE YEAR	2010

1. FACILITY IDENTIFICATION

Parent Company Name	Roscommon County Council
Facility Name	Ballaghaderreen Landfill
PRTR Identification Number	W0059
Licence Number	W0059-03

Waste or IPPC Classes of Activity

No.	class_name
3.5	Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment.
3.1	Deposit on, in or under land (including landfill).
3.13	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.
3.4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.
4.11	Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule.
4.13	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced.
4.2	Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes).
4.3	Recycling or reclamation of metals and metal compounds.
4.4	Recycling or reclamation of other inorganic materials.

Address 1	Aghalustia Townland
Address 2	Ballaghaderreen
Address 3	Co. Roscommon
Address 4	
Country	Ireland
Coordinates of Location	-8.5582 53.8838
River Basin District	IEGBNISH
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	Annie Keane (W0059)
AER Returns Contact Email Address	akeane@roscommoncoco.ie
AER Returns Contact Position	Deputy Landfill Manager
AER Returns Contact Telephone Number	00353949862767
AER Returns Contact Mobile Phone Number	00353876977555
AER Returns Contact Fax Number	00353949862768
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	0
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
5(d)	Landfills
5(c)	Installations for the disposal of non-hazardous waste
5(d)	Landfills
50.1	General

3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)

Is it applicable?	
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR								
POLLUTANT		METHOD				QUANTITY		
		Method Used						
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0
03	Carbon dioxide (CO2)	C	SSC	GasSim II	3601000.0	3601000.0	0.0	0.0
01	Methane (CH4)	C	SSC	GasSim II	123000.0	123000.0	0.0	0.0
02	Carbon monoxide (CO)	C	SSC	GasSim II	5810.0	5810.0	0.0	0.0
06	Particulate matter (PM10)	C	SSC	GasSim II	119.0	119.0	0.0	0.0
11	Sulphur oxides (SOx/SO2)	C	SSC	GasSim II	4780.0	4780.0	0.0	0.0
07	Non-methane volatile organic compounds (NMVOC)	C	SSC	GasSim II	101.0	101.0	0.0	0.0
08	Nitrogen oxides (NOx/NO2)	C	SSC	GasSim II	1530.0	1530.0	0.0	0.0
55	1,1,1-trichloroethane	C	SSC	GasSim II	6.57	6.57	0.0	0.0
64	Hydrofluorocarbons (HFCs)	C	SSC	GasSim II	0.0	0.0	0.0	0.0
47	PCDD + PCDF (dioxins + furans)(as Teq)	C	SSC	GasSim II	0.0	0.0	0.0	0.0
53	Tetrachloromethane (TCM)	C	SSC	GasSim II	0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR								
POLLUTANT		METHOD				QUANTITY		
		Method Used						
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0
62	Benzene	C	SSC	GasSim II	2.99	2.99	0.0	0.0
52	Tetrachloroethylene (PER)	C	SSC	GasSim II	0.757	0.757	0.0	0.0
73	Toluene	C	SSC	GasSim II	0.642	0.642	0.0	0.0
57	Trichloroethylene	C	SSC	GasSim II	0.74	0.74	0.0	0.0
60	Vinyl chloride	C	SSC	GasSim II	7.83	7.83	0.0	0.0
78	Xylenes	C	SSC	GasSim II	1.77	1.77	0.0	0.0
14	Hydrochlorofluorocarbons (HCFCs)	C	SSC	GasSim II	7.6	7.6	0.0	0.0
58	Trichloromethane	C	SSC	GasSim II	0.127	0.127	0.0	0.0
35	Dichloromethane (DCM)	C	SSC	GasSim II	0.266	0.266	0.0	0.0
56	1,1,2,2-tetrachloroethane	C	SSC	GasSim II	0.315	0.315	0.0	0.0
34	1,2-dichloroethane (EDC)	C	SSC	GasSim II	0.471	0.471	0.0	0.0
54	Trichlorobenzenes (TCBs)(all isomers)	C	SSC	GasSim II	0.00435	0.00435	0.0	0.0
15	Chlorofluorocarbons (CFCs)	C	SSC	GasSim II	8.89	8.89	0.0	0.0
09	Perfluorocarbons (PFCs)	C	SSC	GasSim II	0.0	0.0	0.0	0.0
71	Phenols (as total C)	C	SSC	GasSim II	0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

SECTION C : REMAINING POLLUTANT EMISSIONS (As required in your Licence)

RELEASES TO AIR								
POLLUTANT		METHOD				QUANTITY		
		Method Used						
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0
					0.0	0.0	0.0	0.0

* Select a row by double-clicking on the Pollutant Name (Column B) then click the delete button

Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill: Ballaghaderreen Landfill

Please enter summary data on the quantities of methane flared and / or utilised			Method Used			
	T (Total) kg/Year	**M/C/E**	**Method Code**	**Designation or Description**	**Facility Total Capacity m3 per hour**	
Total estimated methane generation (as per site model)	828591.0	C	SCC	GasSim II	N/A	
Methane flared	845250.0	M	PER	Measured at permanent flare	500.0	(Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	123000.0				N/A	

Please enter all quantities on this sheet in Tonnes

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	15 01 04	No	52.3	metallic packaging	R4	M	Weighed	Offsite in Ireland	Barna Waste,CW074	Carrowbrowne,Headford Road,Galway,,Ireland		
Within the Country	**16 06 04**	**No**	3.88	alkaline batteries (except 16 06 03)	R4	M	Weighed	Offsite in Ireland	Enva Portlaoise,W0184-01	Clonmillam Industrial Estate,,Co Laois,,,Ireland		
Within the Country	15 01 01	No	114.48	paper and cardboard packaging	R5	M	Weighed	Offsite in Ireland	Barna Waste,CW074	Carrowbrowne,Headford Road,Galway,,Ireland		
Within the Country	20 01 02	No	34.44	glass	R5	M	Weighed	Offsite in Ireland	Rehab Enterprises Glass,WOPR004	Beach Road,Sandymount,D4,,Ireland		
Within the Country	20 01 36	No	53.43	discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35	R5	M	Weighed	Offsite in Ireland	KMK Metals Recycling Ltd,W01113-03	Cappincur,Tullamor,Co Offaly,,,Ireland		
To Other Countries	20 01 23	Yes	53.43	discarded equipment containing chlorofluorocarbons	R5	M	Weighed	Abroad	KMK Metals Recycling Ltd,W01113-03	Cappincur,Tullamor,Co Offaly,,,Ireland	Dela-gmbh,Ell315322,Alte-landstr-4,Essen,,,,Germany	Alte-landstr-4,Essen,,,,Germany
To Other Countries	20 01 27	Yes	5.85	paint, inks, adhesives and resins containing dangerous substances	R6	M	Weighed	Abroad	Indaver Ireland,W36-02	4 Haddington Terrace,Dun Laoighre,Co Dublin,,,Ireland	Nelson,.,Louis-Krages Strasse,1028237,Bremen,,,Germany	Louis-Krages Strasse,1028237,Bremen,,,Germany
Within the Country	20 01 40	No	65.82	metals	R4	M	Weighed	Offsite in Ireland	Barna Waste,CW074	Carrowbrowne,Headford Road,Galway,,,Ireland		
Within the Country	20 01 26	Yes	2.28	oil and fat other than those mentioned in 20 01 25	R9	M	Weighed	Offsite in Ireland	Enva Portlaoise,W0184-01	Clonmillam Industrial Estate,,Co Laois,,,Ireland	Enva Portlaoise,W0184-01,Clonmillan Industrial Estate,Portlaoise ,Co Laois,,,Ireland	Clonmillan Industrial Estate,Portlaoise ,Co Laois,,,Ireland
Within the Country	20 01 39	No	2.12	plastics	R5	M	Weighed	Offsite in Ireland	Barna Waste,CW074	Carrowbrowne,Headford Road,Galway,,,Ireland		
Within the Country	20 01 11	No	8.88	textiles	R5	M	Weighed	Offsite in Ireland	Textile Recycling,CW014	Glen Abbey Complex,Belgarde Road,Tallaght,D24,Ireland		
Within the Country	20 01 38	No	60.28	wood other than that mentioned in 20 01 37	R3	M	Weighed	Offsite in Ireland	Barna Waste,CW074	Carrowbrowne,Headford Road,Galway,,,Ireland		
Within the Country	19 07 03	No	20297.0	landfill leachate other than those mentioned in 19 07 02	D8	M	Volume Calculation	Offsite in Ireland	Ballaghaderreen WWTW,D0123-01	,,Ballaghaderreen,Co Roscommon,,,Ireland		

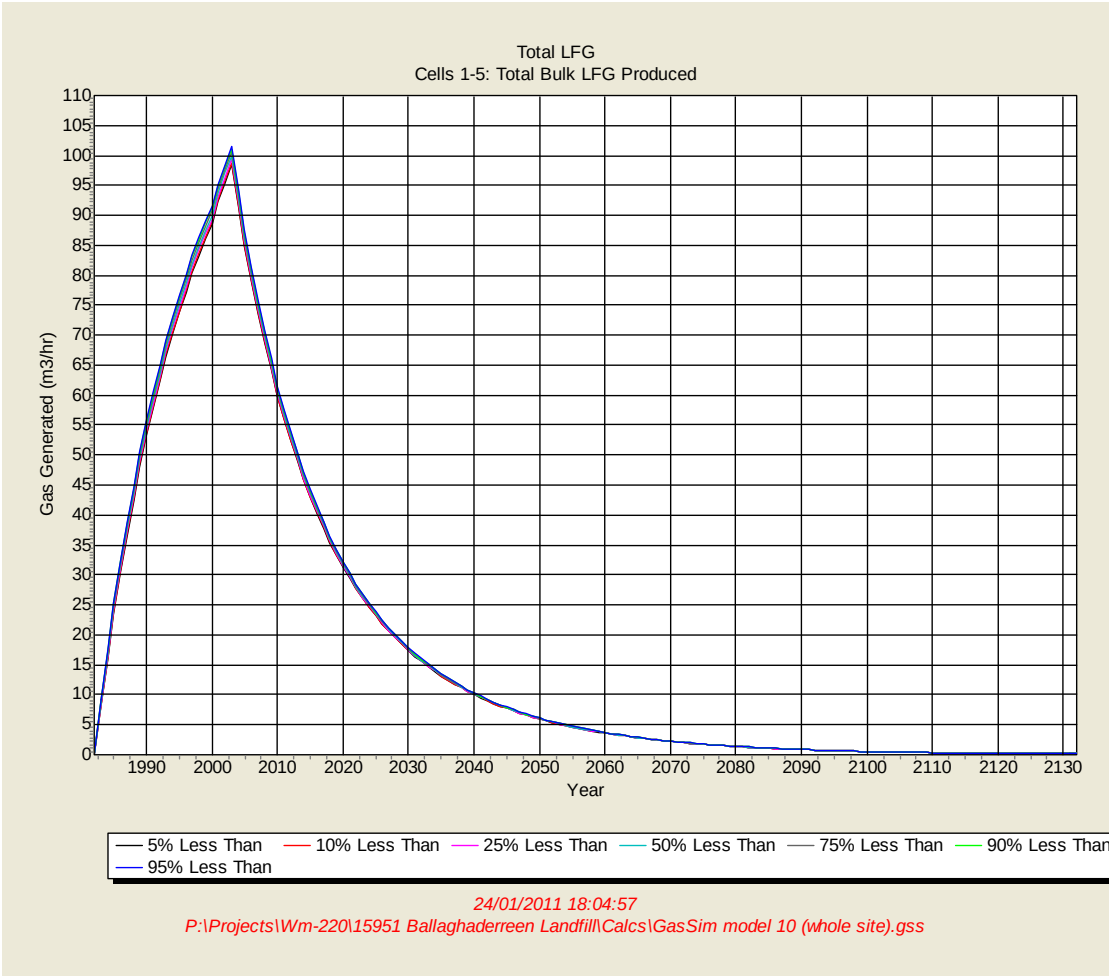
* Select a row by double-clicking the Description of Waste then click the delete button

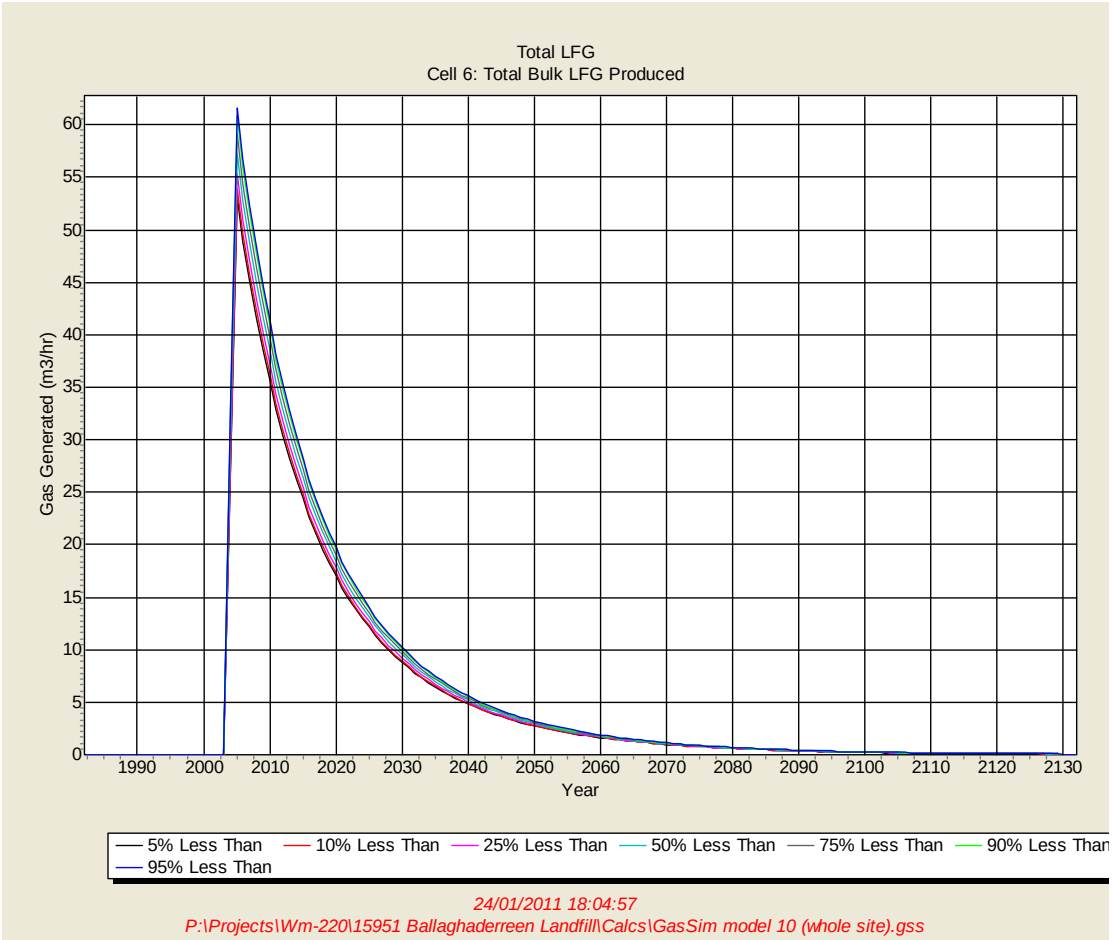
Link to previous years waste data
Link to previous years waste summary data & percentage change

Appendix M
GasSim Output Graphs

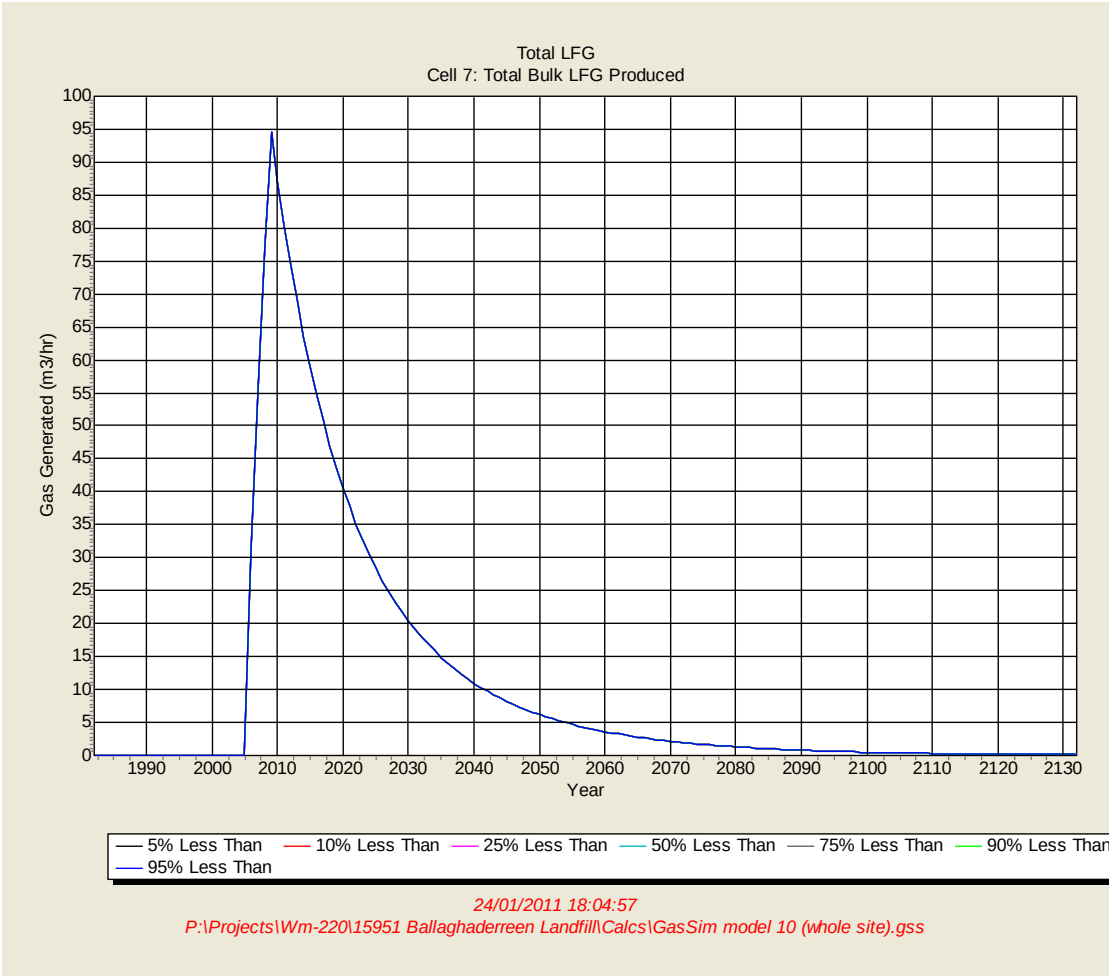
4 Pages

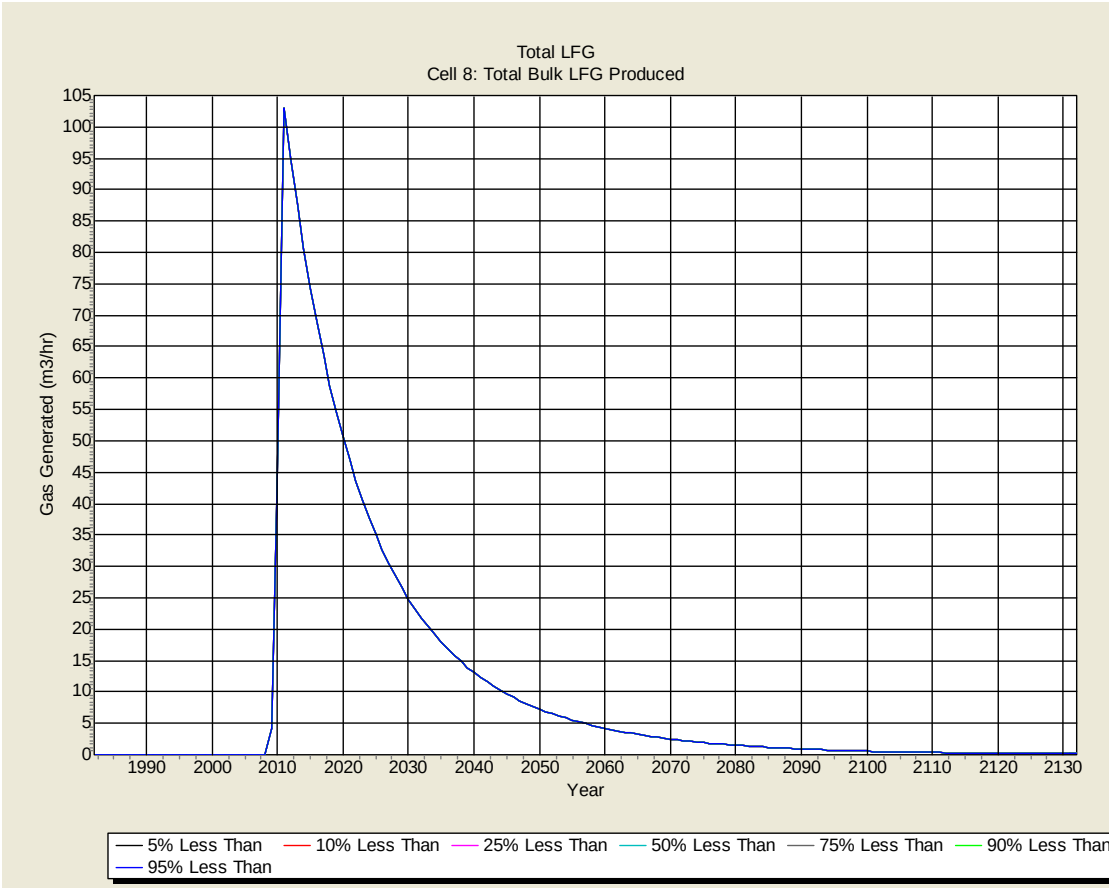
Entec
An AMEC company


Total LFG
Cells 1-5: Total Bulk LFG Produced
Gas Generated (m3/hr)
Year
5% Less Than
10% Less Than
25% Less Than
50% Less Than
75% Less Than
90% Less Than
95% Less Than
24/01/2011 18:04:57
P:\Projects\Wm-220\15951 Ballaghaderreen Landfill\Calcs\GasSim model 10 (whole site).gss



24/01/2011 18:04:57
P:\Projects\Wm-220\15951 Ballaghaderreen Landfill\Calcs\GasSim model 10 (whole site).gss


Total LFG
Cell 7: Total Bulk LFG Produced
Gas Generated (m3/hr)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
2110
2120
2130
Year
5% Less Than
10% Less Than
25% Less Than
50% Less Than
75% Less Than
90% Less Than
95% Less Than
24/01/2011 18:04:57
P:\Projects\Wm-220\15951 Ballaghaderreen Landfill\Calcs\GasSim model 10 (whole site).gss



24/01/2011 18:04:57
P:\Projects\Wm-220\15951 Ballaghaderreen Landfill\Calcs\GasSim model 10 (whole site).gss

Appendix N
EcoLab Monitoring Sheets

6 Pages

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/67887
Job/Cont No.: 6271/15196.2
Client Site Ref:
Visits in Year: 1 of 2
Call Type: Job
Service Date/Time: 22/02/2010 13:01:22

Conditions found and action taken:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Bait Stations inspected and serviced. Checked all baits/monitors and replaced bait as needed.

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found. Bait takes noted see report

STRUCTURAL COMMENTS:
Entire Site - No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
Entire Site - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Medium
Is a follow-up visit required?	No
Pests Encountered	Mice
Customer Attention Required?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Tim

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	17/EA	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/65776
Job/Cont No.: 6271/14833.7
Client Site Ref:
Visits in Year: 2 of 2
Call Type: Job
Service Date/Time: 26/01/2010 14:29:51

Conditions found and action taken:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Checked all baits/monitors and replaced bait as needed.

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found. Bait takes noted in externally Baits have been replenished.

STRUCTURAL COMMENTS:
Entire Site - No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
Entire Site - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Pests Encountered	Mice
Customer Attention Required ?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Tim

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	20/EA	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/73497
Job/Cont No.: JOB
Client Site Ref:
Visits in Year:
Call Type: Job
Service Date/Time: 30/04/2010 09:07:23

Conditions found and action taken:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. All accessible baits and monitors inspected and serviced.

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found. Bait takes noted see checklists
Evidence of rat activity found. Bait takes noted see checklists Baits have been replenished.

STRUCTURAL COMMENTS:
Entire Site - No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
Entire Site - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Pests Encountered	Mice
Customer Attention Required ?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Paraic

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	12/EA	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/69224
Job/Cont No.: JOB
Client Site Ref:
Visits in Year:
Call Type: Job
Service Date/Time: 24/03/2010 09:14:58

Conditions found and action taken:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Bait Stations inspected and serviced. Checked all baits/monitors and replaced bait as needed.

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found. Bait takes noted see checklists Baits have been replenished.

STRUCTURAL COMMENTS:
Entire Site - No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
Entire Site - No critical/obvious hygiene or housekeeping issues were found during today's visit.

GENERAL COMMENTS:
external no's 12 and 13 are missing and removed from service.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Pests Encountered	Mice
Customer Attention Required ?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Paraic

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	9/EA	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
roscommon county council
ballaghadreen landfill
ballaghadreen
co roscommon

Report Number: 178/67063
Job/Cont No.: 6271/16549/5
Client Site Ref:
Visits in Year:
Call Type: Job
Service Date/Time: 29/06/2010 14:50:25

Conditions found and action taken:

PURPOSE OF VISIT:
Carried out a Routine service of the premises.
Job work visit carried out. monthly inspection

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found. Bait takes noted landfill

STRUCTURAL COMMENTS:
External areas - No obvious proofing issues were found at time of inspection that would allow pest entry.

HYGIENE ISSUES:
External areas - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Pests Encountered	Mice
Customer Attention Required ?	Yes

Martin Gallagher

Service Specialist Signature
Signed By: mg

P Roche

Customer Signature
Signed By: p roche

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	3/EA	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/76969
Job/Cont No.: JOB
Client Site Ref:
Visits in Year:
Call Type: Job
Service Date/Time: 31/05/2010 13:19:30

Conditions found and action taken:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Bait Stations inspected and serviced.

EVIDENCE OF PESTS:
Entire Site - No pest activity reported by customer or found during today's visit.

STRUCTURAL COMMENTS:
Entire Site - No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
Entire Site - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	None
Pest Activity Level	None
Is a follow-up visit required?	No
Pests Encountered	None
Customer Attention Required ?	No

Enda Ward

Service Specialist Signature
Signed By: enda ward

P. Rocke

Customer Signature
Signed By: Paraic

Products Used	Quantity/UOM	Reference
No products used this visit	0/	

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/83656
Job/Cont No.: 6271/17492.3
Client Site Ref:
Visits in Year: 1 of 2
Call Type: Job
Service Date/Time: 27/08/2010 09:50:48

Observations and Recommendations:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Checked all baits/monitors and replaced bait as needed.

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found. Bait takes noted see checklists Baits have been replenished.

STRUCTURAL COMMENTS:
No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Pests Encountered	Mice
Customer Attention Required ?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: tim

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	5/Each	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/80447
Job/Cont No.: JOB
Client Site Ref:
Visits in Year:
Call Type: Job
Service Date/Time: 19/07/2010 13:38:54

Conditions found and action taken:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Bait Stations inspected and serviced.

EVIDENCE OF PESTS:
Entire Site - No pest activity reported by customer or found during today's visit.

STRUCTURAL COMMENTS:
Entire Site - No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
Entire Site - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	None
Pest Activity Level	None
Is a follow-up visit required?	No
Pests Encountered	None
Customer Attention Required ?	No

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Noel

Products Used	Quantity/UOM	Reference
No products used this visit	0/	

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax*o: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/88676
Job/Cont No.: 6271/18638/4
Client Site Ref:
Visits in Year:
Call Type: Job
Service Date/Time: 29/10/2010 10:52:36

Observations and Recommendations:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. All accessible baits and monitors inspected and serviced. The following monitoring points were missing: 7, 8, 9 and 11. These were on the cell which is being capped so won't be needed in these locations. The following monitoring points were damaged: no 4 at wood recycling needs to be replaced. Unpalatable baits have been replaced.

EVIDENCE OF PESTS:
External areas - No pest activity reported by customer or found during today's visit.

STRUCTURAL COMMENTS:
External areas - No obvious proofing issues were found at time of inspection that would allow pest entry.

HYGIENE ISSUES:
External areas - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	None
Pest Activity Level	None
Is a follow-up visit required?	No
Evidence of Pests	None
Customer Attention Required ?	No

Service Specialist Signature
Signed By: Enda Ward

Customer Signature
Signed By: Tim

Products Used*	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	5/Each	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/85349
Job/Cont No.: 6271/17492.3
Client Site Ref:
Visits in Year: 2 of 2
Call Type: Routine
Service Date/Time: 29/09/2010 15:37:50

Observations and Recommendations:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Checked all baits/monitors and replaced bait as needed.

EVIDENCE OF PESTS:
External areas - Evidence of rat activity found. Bait takes noted at flare Baits have been replenished.

STRUCTURAL COMMENTS:
No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Evidence of Pests	Rats
Customer Attention Required ?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Paraig

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	6/Each	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/88714
Job/Cont No.: 6271/19351/1
Client Site Ref:
Visits in Year:
Call Type: Routine
Service Date/Time: 10/12/2010 10:17:48

Observations and Recommendations:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Checked all baits/monitors and replaced bait as needed.

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found.
Evidence of rat activity found. Bait takes noted . Baits have been replenished.

STRUCTURAL COMMENTS:
External areas - No obvious proofing issues were found at time of today's visit.

HYGIENE ISSUES:
No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Evidence of Pests	Mice/Rats
Customer Attention Required ?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Tim

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	5/Each	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

CUSTOMER SERVICE REPORT

Site:
Roscommon County Council
Ballaghadereen Site 161.16
Roscommon Site 169.43

Report Number: 217/92667
Job/Cont No.: 6271/19221.7
Client Site Ref:
Visits in Year: 2 of 2
Call Type: Routine
Service Date/Time: 30/11/2010 09:30:20

Observations and Recommendations:

PURPOSE OF VISIT:
Carried out a Routine service of the premises. Checked all baits/monitors and replaced bait as needed.

EVIDENCE OF PESTS:
External areas - Evidence of mouse activity found. Bait takes noted . Baits have been replenished.

STRUCTURAL COMMENTS:
No obvious proofing issues were found at time of today's visit

HYGIENE ISSUES:
External areas - No critical/obvious hygiene or housekeeping issues were found during today's visit.

Summary:

Pest Activity Risk to Business	Low
Pest Activity Level	Low
Is a follow-up visit required?	No
Evidence of Pests	Mice
Customer Attention Required ?	Yes

Service Specialist Signature
Signed By: enda ward

Customer Signature
Signed By: Tim

Products Used	Quantity/UOM	Reference
Contrac All Weather (Bromadiolone - 0.005%)	10/Each	HSE no. 6718

THANK YOU FOR YOUR BUSINESS

Ecolab Pest Elimination, Bracetown Business Park, Clonee, Co. Meath

VAT No. IE9983111W Tel No: (01) 801 4007 Fax No: (01) 801 4031

Appendix O
Summary of Complaints

3 Pages

COMPLAINTS REGISTER 2010

COMPLAINT NO	DATE	NAME OF COMPLAINANT	COMPLAINT DETAILS
2010-01	01/01/2010	Nuala Frain	LFG Odour at residence
2010-02	01/01/2010	Mary Towey	LFG Odour at residence
2010-03	05/01/2010	Myles Sweeney	LFG Odour at residence
2010-04	06/01/2010	Myles Sweeney	LFG Odour at residence
2010-05	07/01/2010	Myles Sweeney	LFG Odour at residence
2010-06	07/01/2010	Nuala Frain	LFG Odour at residence
2010-07	11/01/2010	Myles Sweeney	LFG Odour at residence
2010-08	20/01/2010	Myles Sweeney	LFG Odour at residence at 9.06am
2010-09	20/01/2010	Myles Sweeney	LFG Odour at residence at 12.37pm
2010-10	23/01/2010	John Frain	LFG Odour at residence
2010-11	25/01/2010	Myles Sweeney	LFG Odour at residence
2010-12	26/01/2010	Myles Sweeney	LFG Odour at residence
2010-13	26/01/2010	Lorraine Carroll	LFG Odour at residence
2010-14	27/01/2010	Paul Higgins	LFG Odour at residence
2010-15	26/01/2010	Nuala Frain	LFG Odour at residence
2010-16	27/01/2010	Myles Sweeney	LFG Odour at residence
2010-17	31/01/2010	Myles Sweeney	LFG Odour at residence
2010-18	02/02/2010	Myles Sweeney	LFG Odour at residence
2010-19	04/02/2010	Myles Sweeney	LFG Odour at residence
2010-20	06/02/2010	Margaret Sweeney	LFG Odour at residence
2010-21	06/02/2010	Myles Sweeney	LFG Odour at residence
2010-22	08/02/2010	Paul Higgins	LFG Odour at residence
2010-23	11/02/2010	Loraine Carroll	LFG Odour at residence
2010-24	12/02/2010	Myles Sweeney	LFG Odour at residence
2010-25	12/02/2010	Noreen Flynn	LFG Odour at residence
2010-26	13/02/2010	Myles Sweeney	LFG Odour at residence
2010-27	14/02/2010	Mary Sweeney	LFG Odour at residence
2010-28	15/02/2010	Myles Sweeney	LFG Odour at residence at 09.23
2010-29	15/02/2010	Myles Sweeney	LFG odour at residence again at 09.23
2010-30	15/02/2010	Paul Higgins	LFG Odour at residence
2010-31	15/02/2010	Nuala Frain	LFG Odour at residence
2010-32	15/02/2010	Margaret Sweeney	LFG Odour at residence
2010-33	16/02/2010	Mary Sweeney	LFG Odour at residence
2010-34	16/02/2010	Christy McCann	LFG Odour at residence
2010-35	16/02/2010	Paul Higgins	LFG Odour at residence
2010-36	16/02/2010	John Towey	LFG Odour at residence
2010-37	16/02/2010	Rita Towey	LFG Odour at residence
2010-38	16/02/2010	Paul Higgins	LFG Odour at residence
2010-39	18/02/2010	Mary Gallagher	LFG Odour at residence
2010-40	18/02/2010	Paul Higgins	LFG Odour at residence
2010-41	19/02/2010	Myles Sweeney	LFG Odour at residence
2010-42	21/02/2010	Paul Higgins	LFG Odour at residence
2010-43	22/02/2010	John Towey	LFG Odour at residence
2010-44	25/02/2010	Paul Higgins	LFG Odour at residence
2010-45	25/02/2010	Christy McCann	LFG Odour at residence
2010-46	05/03/2010	Myles Sweeney	LFG Odour at residence
2010-47	04/03/2010	Paul Higgins	LFG Odour at residence
2010-48	05/03/2010	Mary Sweeney	LFG Odour at residence
2010-49	05/03/2010	Paul Higgins	LFG Odour at residence
2010-50	05/03/2010	Christy McCann	LFG Odour at residence
2010-51	05/03/2010	John Towey	LFG Odour at residence
2010-52	01/03/2010	Mary Towey	LFG Odour at residence

COMPLAINT NO	DATE	NAME OF COMPLAINANT	COMPLAINT DETAILS
2010-53	01/03/2010	John Towey	LFG Odour at residence
2010-54	01/03/2010	Rita Towey	LFG Odour at residence
2010-55	01/03/2010	John Frain	LFG Odour at residence
2010-56	01/03/2010	Paul Higgins	LFG Odour at residence
2010-57	01/03/2010	Margaret Sweeney	LFG Odour at residence
2010-58	01/03/2010	Myles Sweeney	LFG Odour at residence
2010-59	04/03/2010	Myles Sweeney	LFG Odour at residence
2010-60	11/03/2010	Anonymous	Lorries using road with weight restriction
2010-61	11/03/2010	Christy McCann	LFG Odour at residence
2010-62	12/03/2010	Rita Towey	LFG Odour at residence
2010-63	08/03/2010	Cyril O Connor	LFG Odour at residence
2010-64	06/03/2010	John Towey	LFG Odour at residence
2010-65	05/03/2010	Cyril O Connor	LFG Odour at residence
2010-66	14/03/2010	Myles Sweeney	LFG Odour at residence
2010-67	11/03/2010	John Towey	LFG Odour at residence
2010-68	13/03/2010	Mary Towey	LFG Odour at residence
2010-69	13/03/2010	Nuala Frain	LFG Odour at residence
2010-70	15/03/2010	Paul Higgins	LFG Odour at residence
2010-71	06/04/2010	Margaret Sweeney	LFG Odour at residence
2010-72	15/04/2010	Mary O'Hara	LFG Odour at residence
2010-73	15/04/2010	Seamus Sharkey	LFG Odour at residence
2010-74	16/04/2010	Margaret Sweeney	LFG Odour at residence
2010-75	16/04/2010	Tommy Towey	LFG Odour at residence
2010-76	16/04/2010	Nuala Frain	LFG Odour at residence
2010-77	22/06/2010	Mary Sweeney	LFG Odour at residence
2010-78	22/06/2010	Paul Higgins	LFG Odour at residence
2010-79	22/06/2010	Mary Sweeney	LFG Odour at residence
2010-80	22/06/2010	Margaret Sweeney	LFG Odour at residence
2010-81	23/06/2010	Myles Sweeney	LFG Odour at residence
2010-82	05/07/2010	John Towey	LFG Odour at residence
2010-83	07/07/2010	Margaret Sweeney	LFG Odour at residence
2010-84	07/07/2010	Rita Towey	LFG Odour at residence
2010-85	07/07/2010	John Towey	LFG Odour at residence
2010-86	16/07/2010	Paul Higgins	LFG Odour at residence
2010-87	18/07/2010	Paul Higgins	LFG Odour at residence
2010-88	19/07/2010	Paul Higgins	LFG Odour at residence
2010-89	19/07/2010	Christy McCann	LFG Odour at residence
2010-90	19/07/2010	Cyril O Connor	LFG Odour at residence
2010-91	27/07/2010	Nuala Frain	LFG Odour at residence & flies
2010-92	29/07/2010	Myles Sweeney	LFG Odour at residence
2010-93	30/07/2010	Mary Sweeney	LFG Odour at residence
2010-94	02/08/2010	Mary Sweeney	LFG Odour at residence & flies
2010-95	03/08/2010	Cyril O Connor	LFG Odour at residence & flies
2010-96	28/07/2010	Mary Sweeney	LFG Odour at residence
2010-97	16/08/2010	Paul Higgins	LFG Odour at residence
2010-98	17/08/2010	Cyril O Connor	LFG Odour at residence
2010-99	18/08/2010	Nuala Frain	LFG Odour at residence
2010-100	18/08/2010	Myles Sweeney	LFG Odour at residence
2010-101	18/08/2010	John Towey	LFG Odour at residence
2010-102	19/08/2010	Paul Higgins	LFG Odour at residence
2010-103	23/08/2010	Cyril O Connor	LFG Odour at residence
2010-104	24/08/2010	Mary Sweeney	LFG Odour at residence
2010-105	25/08/2010	Myles Sweeney	LFG Odour at residence

COMPLAINT NO	DATE	NAME OF COMPLAINANT	COMPLAINT DETAILS
2010-106	27/08/2010	Mary Sweeney	LFG Odour at residence
2010-107	28/08/2010	Mary Towey	LFG Odour at residence
2010-108	30/08/2010	Paul Higgins	LFG Odour at residence
2010-109	30/08/2010	Cyril O Connor	LFG Odour at residence
2010-110	30/08/2010	Margaret Sweeney	LFG Odour at residence
2010-111	30/08/2010	Nuala Frain	LFG Odour at residence
2010-112	22/09/2010	Mary Sweeney	LFG Odour at residence
2010-113	23/09/2010	Myles Sweeney	LFG Odour at residence
2010-114	20/09/2010	John Towey	LFG Odour at residence
2010-115	28/09/2010	Mary Sweeney	LFG Odour at residence
2010-116	30/09/2010	Mary Sweeney	LFG Odour at residence
2010-117	21/10/2010	Mary Sweeney	LFG Odour at residence

Appendix P
Correspondence with the EPA with regards to the Biological Assessment of the River Lung

1 Page

From: Kealan Reynolds [k.reynolds@epa.ie]
Sent: 11 August 2008 09:41
To: Tim Jessop
Subject: Biological Monitoring

Tim
With regard to the proposed biological monitoring I have spoken to Martin mcGarrigale about it and he is of the opinion that the river at the landfill is an unsuitable location for biologial monitoring due to depth, flows, etc. The lung has been monitored by the EPA this year and I would suggest that if you proposed not to do the biologial monitoring this year that would be ok, routine Physio-Chemcial analysis to be carried out.
regards
Kealan