Comhairle Chontae Chill Chainnigh
Halla an Chontae Sraid Eoin Cill Chainnigh

Kilkenny County Council
County Hall John Street Kilkenny

28th November, 2008.

Serving People - Preserving Heritage

Per Registered Post
Office of Climate, Licensing & Licence Use,
Environmental Protection Agency,
PO Box 3000,
Johnstown Castle Estate,
Co. Wexford.

Environmental Protection Agency
02 DEC 2008

Attn: Dr. Jonathan Derham

Re: Dunmore Landfill Waste Licence No. W0030-02, Condition 1.5.3
Request for Technical Amendment

Dear Dr. Derham,

I refer to the above and to previous Technical Amendment issued to Kilkenny County Council dated 20th June, 2008.

The Technical Amendment provides that, only waste that has been subject to adequate pre-treatment (including source separation) is permitted to be accepted at the facility after 1st January, 2009. Such pre-treatment has been identified to reflect, as a minimum, the commitments of the Joint Waste Management Plan for the South East Region 2006-2011, namely the introduction of a three-bin waste collection system from 1st January, 2009, thereby diverting Biodegradable Municipal Waste from landfill facilitating contributory compliance with the objectives of the EU Landfill Directive.

For inspection purposes only.
Consent of copyright owner required for any other use.

Throughout 2008 Kilkenny County Council, in partnership with the other local authorities, has sought to advance the introduction of the three bin system throughout the South East Region. Agreed draft Bye-Laws have been developed and, in the case of County Kilkenny, put on public display. Suitable conditions, pertaining to Waste Collection Permits, have been developed, marrying the collection bye-laws and waste collection provisions, to provide for the suitable diversion and pre-treatment of biodegradable waste arisings. However it is now clear that the target implementation date of 1st January 2009 will not be achieved and there are a number of reasons for this including the following:-

- Lack of available facilities to provide for the treatment of biodegradable waste arisings.
- Lack of agreed statutory definition of pre-treatment together with the identification of standards applicable to pre-treatment.
- Lack of clarity with respect to national waste management policy pending completion of international review.
- Private sector resistance to the introduction of the three bin system.

Recycled
EPA Export 26-07-2013:10:59:07

In line with the foregoing Kilkenny County Council requests a technical amendment to Waste Licence W0030-02, with specific reference to Condition 1.5.3, providing for the replacement of '1st January, 2009' with '31st December, 2009'. Such technical amendment will provide for the closure of the landfill by the end of 2009 noting that, at the current rate of filling, a closure date of September, 2009 is envisaged.

In addition to the waste management policy matters highlighted above in support of this technical amendment application, Kilkenny County Council reiterates it's commitment to adhere to the Waste Licence provisions for Dunmore Landfill and makes particular note of the ongoing implementation of the landfill engineering and operational measures specified in Fehily Timoney's proposals for odour management in Cell 14.

Odour Management proposals for Cell 14 include the following specific requirements:-

- combined system of vertical wells and horizontal slotted pipework to be installed progressively.
- slotted pipe connection to each of four vertical vent shafts (at low level).
- two additional stacks founded on waste (at 3m above floor level) to be installed.
- all six stacks to be eventually fitted with well heads and used for permanent gas extraction.
- any fugitive emissions at the active tipping face to be controlled by:-
  -application of organic filter materials such as wood chip or compost
  -other as approved by the Agency.
- proprietry gas monitoring/balancing software system.

For inspection purposes only.
Consent of copyright owner required for any other use.

Compliance with the above odour management measures is ongoing. Attached in Appendix 1 please find report prepared by Fehily Timoney & Company confirming ongoing compliance with the landfill engineering and operational measures specified in support of the previous technical amendment sought in this matter. Please also note that, further to the granting of the previous technical amendment in June 2008, placement of biodegradable waste in Cell 14 commenced shortly thereafter. In the four to five month period since Kilkenny County Council has not received a single complaint regarding odours emanating from the landfill. Furthermore, daily odour surveys, undertaken by the Landfill Manager, indicate an absence of discernable odours, at nearby sensitive receptors.

In the matter of the general management of landfill gas surface emissions Kilkenny County Council notes the contents of Odour Monitoring Ireland (OMI) Phase 2 Assessment in which OMI have reported 'positive improvements' towards the reduction of surface emissions. Furthermore Kilkenny County Council notes the OMI

EPA Export 26-07-2013:10:59:08

recommendation that 'the active cell area should be placed under improved abstraction and the flanked areas in the active cell should be engineered immediately to facilitate the reduction of surface emissions'. For ease of reference a copy of the OMI Phase 2 Report is attached in Appendix 2. In addition Appendix 3 contains a detailed, costed proposal from Fehily Timoney & Company regarding the provision of a Landfill Gas Field Balancing Management and Model for Dunmore Landfill consistent with commitments given as part of our previous Technical Amendment application for Cell 14.

Over and above waste management and environmental matters it is also appropriate to consider staffing arrangements at Dunmore Landfill Site. The closure of the landfill presents a material change to traditional staffing arrangements that have pertained at the facility for considerable years now. Detailed discussions have commenced with staff and Unions through the Partnership process in line with an anticipated closure date for the landfill of September 2009.

In conclusion taking particular account of;

- ongoing implementation of landfill engineering and operational measures to manage potential, previously identified odour problems.
- absence of adverse odour issues associated with the filling of Cell 14.
- closure of Dunmore Landfill in September 2009 at the current rate of filling.
- policy uncertainties mitigating against the introduction of a three bin collection regime from 1st January, 2009.
- lack of available facilities to provide for the treatment of biodegradable waste arisings.

Consent of copyright owner required for any other use.
For inspection purposes only.

Kilkenny County Council requests a Technical Amendment to Condition 1.5.3 of E.P.A. Waste Licence W0030-02 providing for the replacement of 1st January, 2009 by 31st December, 2009. Such Technical Amendment shall allow for the orderly completion of filling operations at Dunmore Landfill Site, the ongoing implementation of licence measures to mitigate potential adverse environmental impacts of such filling operations, the closure of the landfill site before the end of 2009 together with the commencement of the after-care phase.

Yours sincerely,

Simon Walton,
Senior Engineer,
Environment Section.

Encl.

EPA Export 26-07-2013:10:59:08

APPENDIX 1

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:08

Our Ref: Q/CE07/112/02/Let005/SM

Eimear Doyle
Facility Manager
Dunmore Landfill
Kilkenny County Council

28 November 2008

Re: Dunmore Landfill (W0030-02) – FTC Site Visit to Appraise Cell 14 Gas Management Measures

Dear Eimear,

We write with reference to the proposed technical amendment to Condition 1.5.3 of waste licence W0030-02.

A technical amendment to the original Condition 1.5.3 was granted on 20th June 2008. This withdrew the restriction on waste containing foodstuffs being placed in Cell 14. However it imposed a restriction that only waste that has been subjected to pre-treatment, in the form of introduction of a three-bin kerbside collection service, may be placed in Cell 14 from 1st January 2009. This suggests a necessity to comply with the Landfill Directive on biowaste diversion. We wish to point out that compliance with national biowaste diversion targets is not required until 1st January 2010. The original Condition 1.5.3 was imposed due to concerns regarding potential nuisance odours and was not imposed in order to achieve biowaste diversion targets. The revised Condition 1.5.3 in effect brings forward the implementation of the national biowaste diversion obligations by one year, a restriction which we are unaware of at any other landfill.

For inspection purposes only.
Consent of copyright owner required for any other use.

Kilkenny County Council (KCC) requested that Fehily Timoney and Company (FTC) visit Dunmore Landfill to carry out an appraisal of the landfill gas management measures being implemented in the active Cell 14. We write to advise of our findings following our site visit of 30 October.

We attach two drawings illustrating a) the conceptual gas management system as notified to the EPA in the technical amendment application of May 2008 and b) the actual gas management system construction drawing illustrating progress of installation to date. You will note that the location of the manifolds has changed, and that the horizontal pipes are now connected to two solid header pipes rather than one. These changes were made due to the filling regime to be employed by KCC and have no impact on the effectiveness of the system. The area subjected to negative pressure by the horizontal system is still the same.

Tadhg Murphy (TM) of FTC visited the site on 30 October 2008 at approximately 10:30am to assess the current conditions at the site. He carried out an inspection of the

EPA Export 26-07-2013:10:59:08

site and spoke with the facility caretaker, John Bolger (JB) to discuss the measures in place in Cell 14 with regard to active landfill gas management.

TM observed the following on site:

i. Horizontal pipework has been installed progressively in advance of the waste front.
ii. Approximately 40% of the horizontal pipework has been installed in Cell 14. This pipework has been connected to the permanent gas collection system via a control manifold. JB commented that there have been few operational difficulties in the extraction of gas from this area. Excessive air ingress to the gas system has not been a problem.
iii. Three of the four vertical vent stacks that are to be founded on the leachate blanket have been installed with the remaining vent stack to be installed prior to waste placement in this area. The remaining stack to be founded on the waste has yet to be installed as waste emplacement has not yet progressed to this area of the cell.
iv. A stockpile of woodchip cover material is being maintained on site, for immediate emplacement should fugitive odours become apparent.

In TM's opinion, the active gas management system in place in Cell 14 is performing very well with a very low level of odour emanating form the waste body. It should be noted that the site visit was carried out on a cold day with temperatures below 10˚C which may affect the odours observed on site.

Since commencement of mixed municipal waste emplacement in Cell 14 there have been no complaints from the surrounding residents regarding odours from the site.

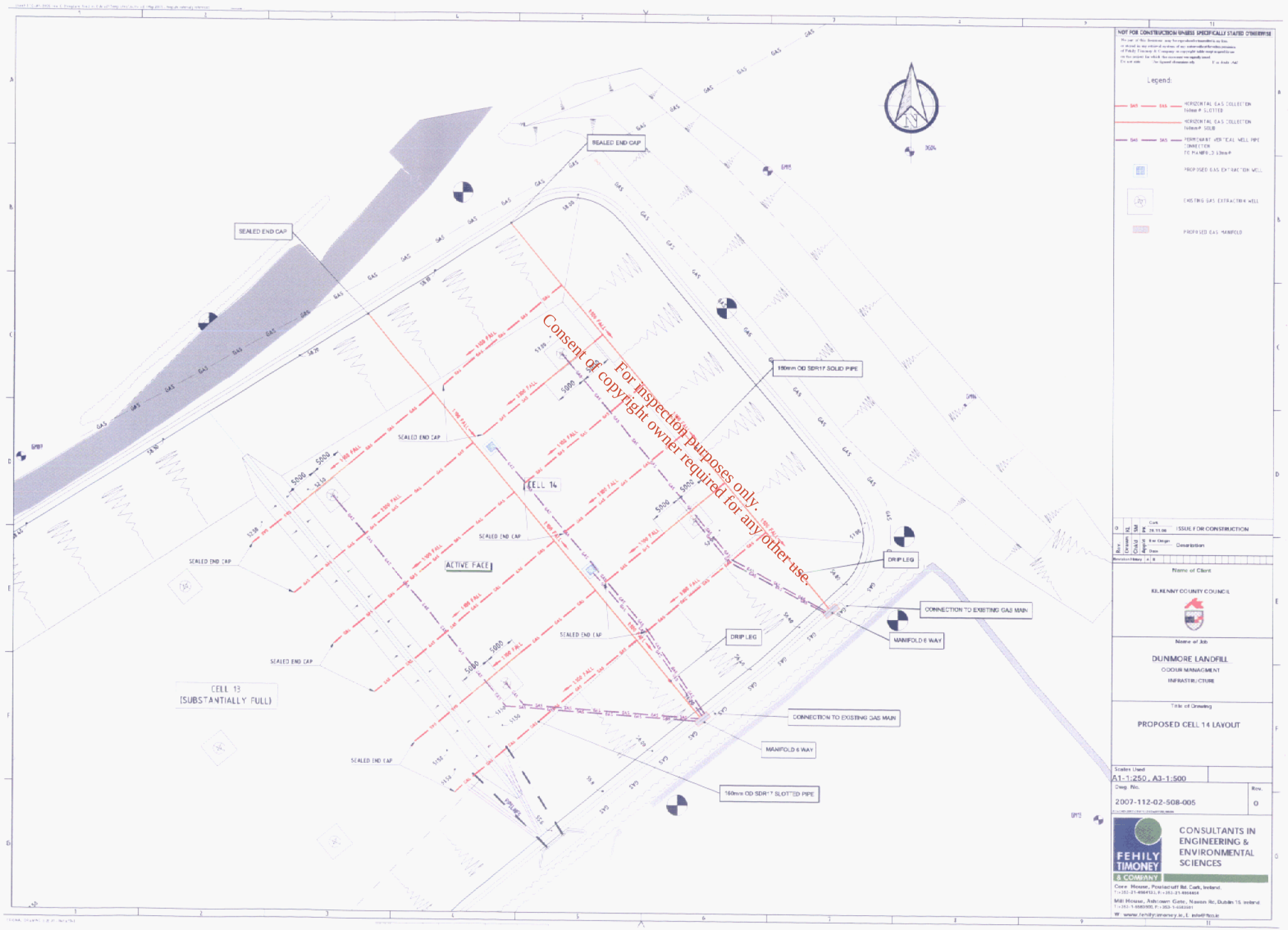
If you require any further assistance, please do not hesitate to contact the undersigned or Tadhg Murphy.

Yours Sincerely

For inspection purposes only.
Consent of copyright owner required for any other use.

Sean Meyler
for and on behalf of **Fehily Timoney and Company**

EPA Export 26-07-2013:10:59:08



Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 26-07-2013:10:59:08

APPENDIX 2

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:08

ODOUR & ENVIRONMENTAL ENGINEERING CONSULTANTS

Unit 32 De Granville Court, Dublin Rd, Trim, Co. Meath

Tel: +353 46 9437922
Mobile: +353 86 8550401
E-mail: info@odourireland.com
www.odourireland.com

PHASE 2 ASSESSMENT OF TOTAL VOLATILE ORGANIC COMPOUND SURFACE EMISSIONS FROM DUNMORE LANDFILL FACILITY, DUNMORE, CO. KILKENNY.

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF THE ENVIRONMENTAL PROTECTION AGENCY
(OFFICE OF ENVIRONMENTAL ENFORCEMENT)

For inspection purposes only.
Consent of copyright owner required for any other use.

PREPARED BY:	Dr. Brian Sheridan
ATTENTION:	Dr. Mick Henry & Mr. Kealan Reynolds
WASTE LICENCE NUMBER:	W00 30-2
DATE:	24th Oct 2008
REPORT NUMBER:	2008A94(18)-1
DOCUMENT VERSION:	Document Ver. 001
REVIEWERS:	

EPA Export 26-07-2013:10:59:09

TABLE OF CONTENTS

Section		Page number
TABLE OF CONTENTS		i
DOCUMENT AMENDMENT RECORD		ii
RECORD SHEET		iii
EXECUTIVE SUMMARY		iv
1.	**Introduction**	1
1.1.	Background to work	1
1.2.	Task completed during inspection	1
2.	**Techniques used**	2
2.1	"Odour hog" monitoring within the landfill	2
2.2	Meteorological conditions	2
3.	**Results**	3
3.1	Volatile organic compound surface emissions locations identified within Dunmore	3
3.2.	Close out meeting with landfill manager	5
4.	**Conclusions**	6
5.	**References**	6
6.	***Appendix I*-Volatile organic compound surface emissions contour map.**	7

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:09

DOCUMENT AMENDMENT RECORD

Client: ***Environmental Protection Agency (Office of Environmental Enforcement)***

Title: Phase 2 Assessment of Total volatile organic compound surface emissions from Dunmore Landfill Facility, Dunmore, Co. Kilkenny.

For inspection purposes only.
Consent of copyright owner required for any other use.

Project Number: 2008A94(18)-1			**Document Reference:** Phase 2 Assessment of Total volatile organic compound surface emissions from Dunmore Landfill Facility, Dunmore, Co. Kilkenny.		
2008A94(18)-1	Document for review	JWC	BAS	JWC	24/10/2008
Revision	**Purpose/Description**	**Originated**	**Checked**	**Authorised**	**Date**

EPA Export 26-07-2013:10:59:09

Record sheet

Site Inspection **Report by Odour Monitoring Ireland (OMI) on behalf of Office of Environmental Enforcement (OEE)**			
Report title: Phase 2 Assessment of Total volatile organic compound surface emissions from Dunmore Landfill Facility, Dunmore, Co. Kilkenny.			
Facility:	Dunmore Landfill	**Inspection Reference No:**	2008A94(18)-1
Register No:	W0030-2	**OMI Staff on-site:**	Dr. John Casey
Licensee staff met during inspection on-site	Ms. Emeir Doyle	**EPA Inspectors on-site during inspection**	--
Weather Conditions	Dry weather	**Announced visit**	Yes
Date of Inspection:	22nd May 2008	**Date of report issue Ver 1:**	24th Oct 2008
		Date of report issue Ver 2:	--

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:09

Executive Summary

The Office of Environmental Enforcement commissioned Odour Monitoring Ireland to perform a landfill gas surface emissions survey of the Dunmore Landfill, Dunmore, Co. Kilkenny in order to ascertain any likely sources of landfill gas surface emissions from the operating landfill. Landfill gas surface emissions are the predominant source of odour complaints from landfills in Ireland.

During the surface emissions survey, the following tasks were performed on site:

- Identification the key mechanisms that lead to the release of landfill gas surface emissions from the site.
- Identify geographically on a site map, the locations of landfill gas surface emissions in order to perform remediation of the identified surface emissions areas.
- Provide a close out meeting with the landfill manager and to notify verbally of the main conclusions of the survey.
- Compare Phase 1 surface emissions survey with Phase 2 surface emissions survey.

The following conclusions were drawn from the study of the Dunmore Landfill, Dunmore, Co. Kilkenny:

- Many of the sources identified were localised surface emissions. The flanked areas on active cell require immediate remediation.
- Surface emissions location D1B and D3B, appeared to be present due to vertical wells not been taped into the gas management system. These are localised surface emissions.
- Surface emissions location D2B appeared to be present as a result of landfill gas flux from leachate slope risers. All leachate slope risers should be adequately sealed and should be connected to the landfill gas abstraction system and –ive abstraction applied.
- Surface emissions location D4B, D5B and D6B are a result of landfill gas surface emissions from flanked areas within the landfill. Consideration will need to be given to the current methodology used to farm flanked areas within the landfill. Techniques such as GLC membrane, benching, etc. should be considered for future fill areas, as currently utilised techniques are not successfully containing landfill gas within the cell. In addition, the capacity of static pressure and volume flow of the flaring system should be audited to ensure adequate ability of the gas abstraction infrastructure to remove landfill gas from the operating landfill.
- Since the Phase 1 surface emissions survey, five surface emission zones namely identified locations D3, D4, D5, D8 and D9 have been remediated. Cover material has been applied and abstraction from those zones has been improved. These are positive improvements towards reducing surface emissions. Moving forward, the active cell area should be placed under improved abstraction and the flanked areas in the active cell should be engineered immediately to facilitate the reduction of surface emissions. All the vertical wells identified with surface emissions should be fully remediated and the leachate slope risers should be capped and placed under slight negative abstraction if engineering capacity allow for same.
- Five of the distinct identified surface emissions locations were localised while one surface emissions locations were diffuse. There has been a general improvement in the reduction of surface emissions from the facility. This progress should be maintained through frequent auditing of the landfill gas management system operation, capacity and design.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 26-07-2013:10:59:09

1. Introduction

1.1. Background to work

Odour Monitoring Ireland were commissioned by the Office of Environmental Enforcement (OEE) to perform a specified independent detailed assessment of landfill gas management systems at a number of EPA licensed landfills on behalf of the Office of Environmental Enforcement (OEE). The independent detailed assessment involves a Volatile organic compound (VOC) surface emissions survey and gas collection survey of licensed landfill facilities in order to ascertain the cause and location of significant VOC emission points located within each landfill facility. In addition, the study was used to identify novel techniques used on site to control landfill gas surface emissions and will be used to form the basis of a guidance report for landfills in general. This report presents a summary of the findings of the VOC surface emissions survey at Dunmore Landfill, Dunmore, Co. Kilkenny. The report is based on scientific measurements and observations made during re-visit to the site conducted on the 22nd May 2008.

1.2. Task completed during inspection

The following tasks were completed during the inspection:

- Capping source monitoring using continuous kinematic VOC/GPS system to detect areas of potential landfill gas release/flux;
- Geo-referencing of detected landfill gas flux areas and plotting upon basemap for visual interpretation and remediation;
- Discussion meeting with landfill manager once survey was complete in order to communicate main surface emissions areas for immediate remediation, where necessary.

This methodology has been used by Odour Monitoring Ireland as a means of continuous odour and landfill gas management surveying on a number of licensed Irish landfills.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:09

2. Techniques used

This section describes the techniques used throughout the study.

2.1. "Odour hog" monitoring within the landfill

The "Odour hog" VOC analyser is a portable, intrinsically safe, survey VOC dual monitor, which provides fast and accurate readings of organic and inorganic vapours. A Photo ionisation detector (PID) uses an Ultraviolet (UV) light source (*photo*) to ionise a gas sample and detect its concentration. Ionisation occurs when a molecule absorbs the high energy UV light, ejecting a negatively charged electron and forming of positively charged molecular ion. The gas becomes electrically charged. These charged particles produce a current that is easily measured at the sensor electrodes. Only a small fraction of the VOC molecules are ionised. A PID does not respond to methane. A FID is similar to a flame thermocouple detector, but measures the ions from the flame instead of the heat generated. The FID detects the methane fraction, which provides greater sensitivity in terms of methane leakage detection but not necessarily odour hence why the PID data is also interpreted. Both sensors were calibrated using NPL gravimetrically filled certified reference material isobutylene and methane.

Using the continuous kinematic "Odour hog" with integrated GPS, the capping of the landfill was surveyed for potential leakage areas. Those areas identified were geo-referenced and highlighted for remediation. This technique is useful for comparison in leakage area within the same landfill facility on different surveys but is not for cross comparison of VOC leakage between landfills due to a number of factors including, mass flow of VOC on the day of measurement, relative odourous nature of the detected compounds within individual facilities, etc. The leakage maps generated for the particular facility can be used to assess the effectiveness of implemented mitigation techniques and to semi qualitatively assess the nature of leakage from the facility.

Efforts should be made to attain surface emissions <100 ppm from open surfaces and <500 ppm around features such as vertical wells, leachate collection sumps, leachate slope risers and other protrusions into the waste body (Casey et al., 2008). These are minimum standards, which should lead to greater landfill collection efficiencies thus reducing the impact on the general environment.

For inspection purposes only. Consent of copyright owner required for any other use.

2.2. Meteorological conditions

Table 2.1 illustrates the predominant wind direction during the monitoring exercise. The meteorological conditions were characterised for the day of monitoring and were as follows:

Table 2.1. Meteorological conditions during Dunmore landfill facility TVOC survey

Day 1-22nd May 2008	
Average wind speed 3 m s^{-1}	Wind direction Southerly breeze
Cloud cover 3 to 4 octaves	1010 mbar
Temperature 14 to 16 C	Relative humidity 60 to 70%
Dry weather	Capping moisture content medium

During the TVOC and gas field survey, wind direction deviated from the South. During the survey it was noted that there was moisture retention in the landfill cover material. Water has the effect of increasing the gas retention in the cell because porosity is decreased and therefore the surface emissions of gas are restricted somewhat from the landfill cap.

EPA Export 26-07-2013:10:59:10

3. Results

3.1. Volatile organic compound surface emissions locations identified within Dunmore landfill facility

Figure 6.1 and Table 3.1 illustrates the results obtained for the capping surface emissions survey. A total of 6 individual surface emissions zones were identified. Each surface emissions zone is discussed separately in this manner in order to allow for the development of remediation strategies to mitigate the individual surface emissions areas.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:10

Table 3.1. Capping VOC surface emissions locations results with source identities correlating with *Figure 6.1 (see Appendix I)*.

Location	Easting (m)	Northing (m)	Average Range VOC conc. (ppm)	Identification and Mitigation
D1B	249630	160505	31 to 620	Localised source Unidentified Vertical Well not tapped into abstraction system. This vertical well should be tapped into landfill gas abstraction system in any event.
D2B	249523	160516	4000+	Localised source: Surface emissions localised around leachate slope riser. Applying approximately –ve 1 mbar to the leachate riser (if engineering allow for same) and further sealing around this riser should reduce landfill gas flux. No improvement from Phase 1 (see Location D1).
D3B	249648	160606	4000+	Localised source: Unidentified Vertical Well not tapped into abstraction system. This vertical well should be tapped into landfill gas abstraction system. No improvement from Phase 1 (see Location D3).
D4B	249743	160546	31 to 123	Localised source: Sloped flanked area. Insufficient cover material present. Areas affected by water damage should be recovered and tracked with low permeability cover material (10^{-9} minimum). In moving forward other techniques that minimise surface emissions from flanked areas should be considered. Careful consideration should be given to the influx of Oxygen into the temporary cap flanks in this area.
D5B	249799	160578	31 to 2586	Diffuse source: Sloped flanked area. Insufficient cover material present. Areas affected by water damage should be recovered and tracked with low permeability cover material (10^{-9} minimum). In moving forward other techniques that minimise surface emissions from flanked areas should be considered. Careful consideration should be given to the influx of Oxygen into the temporary cap flanks in this area. Improvement from Phase 1 (Location D5)
D6B	249797	160580	31 to 758	Localised source: Sloped flanked area. Insufficient cover material present. Areas affected by water damage should be recovered and tracked with low permeability cover material (10^{-9} minimum). In moving forward other techniques that minimise surface emissions from flanked areas should be considered. Careful consideration should be given to the influx of Oxygen into the temporary cap flanks in this area.

Consent of copyright owner required for any other use. For inspection purposes only.

EPA Export 26-07-2013:10:59:10

Six distinct source locations of landfill gas surface emissions were identified (*see Figures 6.1 and Table 3.1*) within the landfill. Many of the sources identified were localised surface emissions. The flanked areas on active cell require immediate remediation.

Surface emissions location D1B and D3B, appeared to be present as a result of vertical wells not been taped into the gas management system. These are localised surface emissions.

Surface emissions location D2B appeared to be present as a result of landfill gas flux from leachate slope risers. All leachate slope risers should be adequately sealed and be connected to the landfill gas abstraction system and slight –ive abstraction applied.

Surface emissions location D4B, D5B and D6B are a result of landfill gas surface emissions from flanked areas within the landfill. Consideration will need to be given to the current methodology used to form flanked areas within the landfill. Techniques such as GLC membrane, benching, etc. should be considered for future fill areas, as currently utilised techniques are not successfully containing landfill gas within the cell. This should be implemented immediately.

Five of the distinct identified surface emissions locations were localised while one surface emissions locations were diffuse. There has been a general improvement in the reduction of surface emissions from the facility. This progress should be maintained through frequent auditing of the landfill gas management system operation, capacity and design.

Since the Phase 1 surface emissions survey, five surface emission zones namely identified locations D2, D4, D5, D8 and D9 have been remediated. Cover material has been applied and abstraction from those zones has been improved. These are positive improvements towards reducing surface emissions. Moving forward, the active cell area should be placed under improved abstraction and the flanked areas in the active cell should be engineered immediately to facilitate the reduction of surface emissions. All the vertical wells identified with surface emissions should be fully remediated and the leachate slope risers should be capped and placed under slight negative abstraction if engineering capacity allow for same.

Consent of copyright owner required for any other use. For inspection purposes only.

3.2. Close out meeting with landfill manager

Following completion of the surface emissions survey, the surface emissions team and landfill management team discussed all aspects and general conclusions of the survey. The landfill manager was informed of the potential areas of surface emissions. In moving forward on a continuous basis, great emphasises is required on mitigating emissions from new flanked areas.

EPA Export 26-07-2013:10:59:10

4. Conclusions

The following conclusions were drawn from the study of Dunmore Landfill:

The surface emissions contour map generated from the kinematic Volatile organic compound (VOC) survey illustrated surface areas of landfill gas surface emissions within the operating facility. This was a result of the following:

- Surface emissions location D1B and D3B, appeared to be present as a result of vertical wells not been taped into the gas management system. These are localised surface emissions.
- Surface emissions location D2B appeared to be present as a result of landfill gas flux from leachate slope risers. All leachate slope risers should be adequately sealed and should be connected to the landfill gas abstraction system and –ive abstraction applied.
- Surface emissions location D4B, D5B and D6B are a result of landfill gas surface emissions from flanked areas within the landfill. Consideration will need to be given to the current methodology used to form flanked areas within the landfill. Techniques such as GLC membrane, benching, etc. should be considered for future fill areas, as currently utilised techniques are not successfully containing landfill gas within the cell. In addition, the capacity of static pressure and volume flow of the flaring system should be audited to ensure adequate ability of the gas abstraction infrastructure to remove landfill gas from the operating landfill.
- Since the Phase 1 surface emissions survey, five surface emission zones namely identified locations D2, D4, D5, D8 and D9 have been remediated. Cover material has been applied and abstraction from those zones has been improved. These are positive improvements towards reducing surface emissions. Moving forward, the active cell area should be placed under improved abstraction and the flanked areas in the active cell should be engineered immediately to facilitate the reduction of surface emissions. All the vertical wells identified with surface emissions should be fully remediated and the leachate slope risers should be capped and placed under slight negative abstraction if engineering capacity allow for same.
- Five of the distinct identified surface emissions locations were localised while one surface emissions locations were diffuse. There has been a general improvement in the reduction of surface emissions from the facility. This progress should be maintained through frequent auditing of the landfill gas management system operation, capacity and design.

For inspection purposes only.
Consent of copyright owner required for any other use.

5. References

1. Turner, D. B., (1996). Workbook of Atmospheric Dispersion Estimates, CRH Press, New York, U.S.A.
2. Casey, J.W., Sheridan, B.A., Henry, M., Reynolds, K., (2008). Effective tools for managing odours from landfill facilities. International Conference on Environmental Odour Monitoring and Control, Rome, Italy. July 6-8, 2008.

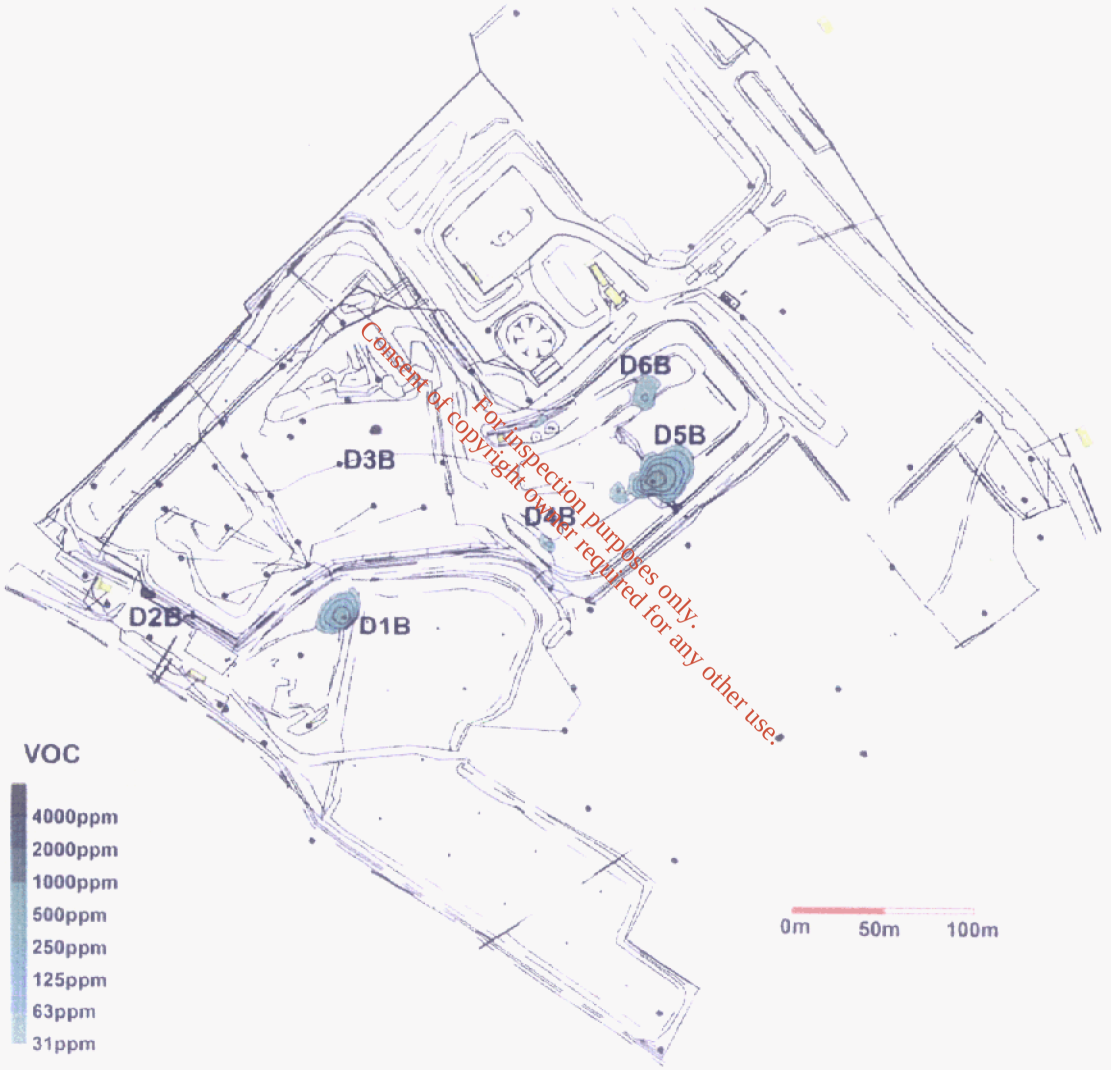
EPA Export 26-07-2013:10:59:10

6. *Appendix I*-Volatile organic compound surface emissions contour map.

Figure 6.1. Landfill gas surface emissions monitoring within the operating landfill facility (colour scale area indicating TVOC gas colour scale).

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:10



Consent of copyright owner required for any other use.
For inspection purposes only.

Drawing number:
2008.A94(18)-1

CLIENT EPA

PROJECT
DUNMORE LANDFILL FACILITY

TITLE
LEAKAGE SURVEY MONITORING MAP

REVISION NO 1 | DRAWN BY JC DATE Oct 2008

NOT TO SCALE IF IN DOUBT ASK | APPROVED BY BS Oct 2008

EPA Export 26-07-2013:10:59:10

APPENDIX 3

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:10

PROPOSAL FOR THE DEVELOPMENT OF A MANAGEMENT AND AUDITING MODEL FOR BALANCING THE LANDFILL GAS FIELD AT DUNMORE LANDFILL, CO. KILKENNY

For inspection purposes only.
Consent of copyright owner required for any other use.

Prepared For:
Kilkenny County Council
County Hall
John Street

Prepared By
Fehily Timoney & Company
Floor 2,
Mill House
Ashtowngate
Navan Rd
Dublin 15

November 2008

EPA Export 26-07-2013:10:59:11

PROPOSAL FOR THE DEVELOPMENT OF A MANAGEMENT AND AUDITING MODEL FOR BALANCING THE LANDFILL GAS FIELD AT DUNMORE LANDFILL, CO. KILKENNY

For inspection purposes only.
Consent of copyright owner required for any other use.

User is Responsible for Checking The Revision Status of This Document

Rev. Nr.	Description of Changes:	Prepared by:	Checked by:	Approved by:	Date:
0	Issue to Client	SO'B	TR	BG	25/11/08

Client Kilkenny County Council

Keywords Dunmore Landfill Site, gas collection system, gas flare, vertical extraction wells, landfill gas balancing, management and auditing model

Abstract This is a proposal for the development of a management and auditing model for balancing the landfill gas field at Dunmore Landfill, Co. Kilkenny

EPA Export 26-07-2013:10:59:11

TABLE OF CONTENTS

PAGE

1. INTRODUCTION 1

1.1 BACKGROUND TO THE MODEL 1
1.2 PROJECT TEAM 2

2. LANDFILL GAS FIELD BALANCING MODEL 3

2.1 SCOPE OF WORKS 3
2.2 PROFESSIONAL FEES 4
2.3 EXCLUSIONS 5
2.3.1 1.4.1 Requirements for Validation 5
2.4 START DATE AND TIMEFRAME 7

3. ADDITIONAL INFORMATION 8

3.1 FIELD BALANCING EQUIPMENT 8
3.2 OPTIONAL TRAINING 9

LIST OF TABLES

PAGE

TABLE 2.1: ACTIVITIES TASK LIST 3
TABLE 2.2: EXPENSES RATES 4
TABLE 2.3: EXPENSES COST ESTIMATE 4

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:11

1. INTRODUCTION

1.1 Background to the Model

Waste Licence No. W0030-02 was issued by the Environmental Protection Agency (EPA) to Kilkenny County Council (KCC) on 20th May 2002.

An amendment to the licence was sought by KCC in mid 2008 in relation to Condition 1.5.3 of the licence, which states:

'Only commercial and industrial wastes, not including foodstuffs, may be deposited in Cell 14.'

The amendment was sought to enable importation of municipal waste including foodstuffs to Cell 14. As part of the report prepared by FTC in support of the application, the environmental implications of filling the cell more quickly were addressed and proposals were set out for mitigation of the risk of odour nuisance in Cell 14. One tool proposed for management of odour at the facility was the implementation of proprietary gas management software, as described in Section 3.4 of the FTC report:

Section 3.4 Gas Collection System Auditing Software

KCC proposes to purchase proprietary software developed for the purpose of recording all gas monitoring and balancing data. This software will assist in the following functions:

- *Provision of clear and concise graphical portrayal of the gas collection system at the facility (superimposed on an aerial photograph)*
- *Setting of clearly defined target operating parameters for the gas extraction system*
- *Monitoring of actual gas system performance such as gas flows, gas concentrations and actual extraction in comparison to gas model predictions*
- *Storing of all entered data in database format making it easily retrievable at the touch of a button*
- *Automatic issue of audit reports in a standard format for each gas system audit carried out*
- *Trend analysis – the operator can observe historical trends for all monitored points*
- *Equipment log – gives details of balancing equipment used and recalibration due dates*
- *The effective implementation of this software will help KCC to ensure the facility gas extraction system operates at maximum efficiency, and will enable maintenance of clear and consistent records for all gas extraction system data.*

This proposal has been prepared in response to a request from Ms. Eimear Doyle, Landfill Manager, Dunmore Landfill to submit a fee proposal for the preparation of a Landfill Gas Field Balancing and Management Model for Dunmore Landfill. This document includes a fee proposal to develop the balancing model. In order to build the model, FTC will be required to validate the infrastructure on site so that the model once built will be fit for purpose.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 26-07-2013:10:59:11

An on-site assessment will determine whether the cost of validating the infrastructure is included in the overall fee or charged separately. This is explained in more detail in Section 2.

1.2 Project Team

Ms. Tanya Ruddy will act as the Project Manager. Tanya is a Senior Scientist and has specialist experience in landfill gas management. Tanya has been involved in the development of landfill gas balancing models at two other landfills and is currently working on a third. She has experience of landfill gas field validation, auditing and balancing and has trained staff both internally and externally in landfill gas balancing.

Ms. Siobhan Carroll and Mr. Shane O' Brien will carry out the validation and site auditing. Siobhan is a Project Engineer with experience in construction supervision of landfill capping contracts and the installation of landfill gas collection infrastructure. Shane will be responsible for building the database and writing the visual basic code for the model. Shane is a Graduate Engineer with experience in visual basic and landfill gas management.

Mr. Chris Cronin, Principal Engineer will provide expert advice and Mr. Sean Meyler, Senior Engineer will provide assistance based on his knowledge of the site.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:11

2. LANDFILL GAS FIELD BALANCING MODEL

2.1 Scope of Works

Landfill gas management in Ireland typically balances gas extraction from wells according to methane and oxygen concentrations. This can lead to gas migration and odour problems because the combined extraction capacity of generation plant and flares may be lower than the total landfill gas produced.

This model uses a flow based extraction philosophy to manage and balance landfill gas extraction. The model works by setting flow and pressure criteria to develop a negative pressure gradient within the waste body to mitigate risk of migration. An Excel spreadsheet is then used to design and manage landfill gas extraction.

The preparation of the model involves undertaking 8 activities as outlined in Table 1:

Table 2.1: Activities Task List

Activity	Description
1	Site walkover and validation*
2	Site schematic preparation
3	Database preparation
4	Audit sheet preparation
5	Development of the model
6	Preparation of help files
7	Model review and ground truthing
8	Preparation of characteristic curves for control valves
9	Demonstration of model to KCC
10	Supply of a 24" monitor to facilitate large site schematics

*validation works limited to 2 days desk study and 3 days on site, please refer to Section 1.4.1 'Requirements for Validation'

Consent of copyright owner required for any other use. For inspection purposes only.

The model will be developed to balance flows from respective wells regardless of methane content. The aim is to extract gas at a rate equal to its generation.

The model will enable staff to methodically balance the field using the following steps:

- Definition of operating criteria
- Field work to gather data
- Input of data into the model
- Analysis of results
- Adjustment of the field based on analysis

EPA Export 26-07-2013:10:59:11

2.2 Professional Fees

The estimated professional fee for the gas model development is **€20,000** excluding VAT and expenses. This fee is inclusive of the tasks listed in Table 1. Expenses are likely to include the following:

- hire of a helicopter and photographer to take a series of aerial photographs of the site (FTC has procured this service in the past for several landfills at an approx cost of €2,000. This can be halved if we have another site that needs to be photographed at the same time). If KCC decide to go ahead with this project, FTC will request a quote from the photographer we have used in the past. His quote will include the cost of the helicopter.

- travel expenses associated with site visits. It is estimated that approximately 2 weeks would be required on site to gather information, calculate characteristic curves of valves, and record preliminary data. Mileage to the site will be billed at €1.16/mile, hire of monitoring equipment at €50 per site visit, day rates 5-10 hours at €16.95 and >10 hours €41.45. Overnight allowance is €132.18. The total costs for travel and sustenance are estimated at €2,931.17 as shown in Tables 2 and 3:

Table 2.2: Expenses Rates

		Visit 1 (5 days)	Visit 2 (3 days)	Visit 3 (2 days)	Visit 4 (1 day)
day rate >10 hrs	€ 16.95	1	2 p x 1d	2 p x 1d	2 p x 1d
day rate <10 hrs	€ 41.54	0	0	0	0
overnight	€ 132.18	2 p x 4 n	2 p x 2 n	2 p x 1 n	0
equipment hire	€ 50.00	1 visit	1 visit	1 visit	0
mileage	€ 1.16	280 miles	140	140	140
staff		TR 2d SOB & SC 5d	SOB & SC 3d	SOB & SC 2d	TR &SOB 1d

p person, n night, d day

For inspection purposes only. Consent of copyright owner required for any other use.

Table 2.3: Expenses Cost Estimate

	Visit 1 (days)	Visit 2 (days)	Visit 3 (days)	Visit 4 (days)	Totals
day rate >10 hrs	€ 16.95	€ 33.90	€ 33.90	€ 33.90	
day rate <10 hrs	0	0	0	0	
overnight	€1,057.44	€ 528.72	€ 264.36	0	
equipment hire	€ 50.00	€ 50.00	€ 50.00	0	
mileage	€ 324.80	€ 162.40	€ 162.40	€ 162.40	
total	€1,449.19	€ 775.02	€ 510.66	€ 196.30	€ 2,931.17

EPA Export 26-07-2013:10:59:11

Summary of Task List for Site Visits

Visit 1	Validate drawings against infrastructure Make a list of any monitoring infrastructure that needs to be amended Sum flows across the site Take pressure and flow readings across site Take quality and pressure readings at manifolds and well heads Highlight any issues
Visit 2	Development of characteristic curves Re-measurement of pressure and flow readings Address issues highlighted site visit 1 Gather any outstanding information or to answer queries resulting from model
Visit 3	building
Visit 4	Presentation of model to site staff

Interim invoices will be issued on a monthly basis. Additional out-of-pocket expenses such as travel, printing, duplicating, and outside consultants if required will all be charged extra at cost. Any sub-consultants retained by FTC on behalf of the client will incur a 10% administration/insurance charge. Payment terms are strictly 28 days from the date of the invoice.

The proposed conditions of engagement are as per RA9101 for the Appointment of Consulting Engineers for Reporting and Advisory Work, Institution of Engineers of Ireland 2000.

For inspection purposes only.
Consent of copyright owner required for any other use.

2.3 Exclusions

The professional fee does not include work that may be required in respect of protracted validation issues. FTC will validate the site to confirm that all infrastructure shown on the drawings exists and that all infrastructure present on site is shown on drawings. FTC will carry out flow tests to ensure that the sum of all flows from each manifold on site equals the flow to the flare. Any significant difference in total flows could indicate ingress of air or blockage in a pipe due to debris or water/condensate/leachate.

Flow tests will also be carried out on all wells to identify poorly operating wells. Older wells are at risk of silting/clogging up and occasionally perched leachate or high leachate levels may prevent gas abstraction from wells. Connector pipework from the wellheads to the manifold can also become blocked or occasionally due to settlement can become partially disconnected at a join allowing ingress of air.

2.3.1 1.4.1 Requirements for Validation

In order to carry out the flow tests and validation the following is required:

- a set of fully labelled as-built drawings showing all landfill gas collection infrastructure for both the horizontal and vertical systems. All infrastructure on the ground should be labelled as per the drawings so that FTC site staff are able to locate well heads, manifolds, control valves etc. FTC will conduct a site walkover to confirm that all infrastructure on the ground matches that on drawings as all infrastructure will be represented in the model.

EPA Export 26-07-2013:10:59:11

- flow chambers[1] on each manifold and on each separate inlet pipeline to the flare (from the drawing it looks like there is only one pipeline going to the flare)
- taps on every wellhead and on the connector pipe to enable measurement of upstream and downstream pressure
- access to every wellhead
- dip facility on every wellhead
- access to flare
- all monitoring equipment at the flare should be fully calibrated and the flare should be in good working order
- all condensate pots should be emptied or topped up as required to ensure fit for purpose
- access to all control valves (for both vertical and horizontal systems)
- any long or overgrown vegetation should be cut back to allow easy location of the infrastructure and room to work at the wellhead (room to put down equipment, site notebooks etc.)

Should any or all of the above not be in place, this will have a consequent impact on the amount of time FTC will have to spend on site. This has occurred at a number of other sites and typical works required are:

- excavation of topsoil (in cap) to expose the main carrier pipeline from the manifold
- construction of a permanent chamber around the monitoring port (FTC can provide design detail as required)
- extensive searches for wellheads (particularly in old overgrown capped areas)
- identification through pressure tests of wellheads if they are not labelled
- alterations to wellheads if monitoring caps and dip ports are not present in some of the older phases
- excavation to locate pipework at inlet to flare if buried and if there is more than one pipe
- if a blockage or air ingress is suspected, some repeat tests are required to determine the location. The pipe then has to be cut open to remove debris or drained to remove water.
- installation of additional valves or replacement of broken valves
- use of metal detectors to locate wellheads hidden in undergrowth and partially obscured by soil
- other excavation works, welding works as required

In the event that any or more of these events occur it could add to time spent on site. In this case a record of additional works will be kept and charged as extra at site staff day rates. Naturally some additional works will be required on site for the audit and FTC is happy to carry these out as part of the agreed fee once the total hours spent on excluded items are carried out within the time allocated for Visit 1.

For inspection purposes only.
Consent of copyright owner required for any other use.

[1] A flow chamber is a permanent structure to provide access to the flow port. The flow port is to have an internal diameter of 35mm. It has to be located in a straight length of pipe with a distance of not less than 10 times the diameter of the pipe on either side of the port. In a 180 mm ∅ pipe for example, there should be a straight length of pipe of 1.8m on each side of the port. The straight length of pipe has to be free of any interruptions such as valves, bends, teed in pipes etc. The purpose of this is so that there is laminar flow in the pipe and an accurate measurement of velocity can be obtained.

EPA Export 26-07-2013:10:59:11

2.4 Start Date and Timeframe

In the event that the flare was not operational at the preliminary site visit, it would be very difficult to assess the performance of the infrastructure. FTC will coordinate this site visit with KCC to ensure regular flaring is in place for days prior to and during the visit. FTC will likely require the assistance of the landfill manager or an assistant familiar with all of the landfill gas infrastructure including the flare. Therefore it is proposed that a start date convenient to both parties be agreed. It is estimated that the model will take 3 months to complete, this includes all site work and development of the model. FTC has commenced the validation phase at another landfill and is expected to build the model in January-February 2009.

Due to the specialised expertise required, the modelling team would complete this model before commencing the Dunmore model. Therefore a start date of late February/March is proposed. FTC would review all drawings and conduct a preliminary site visit before that date to advise KCC whether any preliminary works are required on site.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:11

3. ADDITIONAL INFORMATION

Following completion of the model, it is recommended that the field be balanced and audited on a fortnightly basis until the field settles down. Thereafter audits should be carried out monthly. It is envisaged that KCC will carry out the field balancing. FTC will be pleased to offer assistance if required.

3.1 Field Balancing Equipment

The following kit is required for effective field balancing:

1. Monitoring Equipment

- Landfill gas analyser for measuring methane, carbon dioxide, oxygen, carbon monoxide, gas temperature and atmospheric pressure. There are two types of gas analyser on the market, one that is suited to monitoring perimeter wells and one for monitoring extraction wells. The model best suited to monitoring extraction wells is also suited to perimeter wells. FTC uses an LMSxi manufactured by Gas Data. Another popular model is the Geotechnical Instruments GA series, e.g. GA2000. Both can be set up for site to record data at each monitoring point. It can subsequently be downloaded in the office. Spare tubing and filters are recommended. This has to be calibrated in accordance with the manufacturer's recommendations. FTC uses our 2 analysers so frequently that they are calibrated every 6 months. Calibration cylinders can be used on site to double check the calibration of the instrument. The cylinder has gas with methane at 5%, carbon dioxide at 5% and oxygen at 5%.
- Anemometer (intrinsically safe) capable of measuring gas flow in a pipe. FTC uses a Mini Air Junior, spec 35 mm probe head, 0.5-40 m/s or 12 mm probe head 0.2-20 m/s manufactured by Schlitknecht. One spare vane anemometer head is recommended. This should be calibrated annually.
- Digital Differential Manometer, FTC uses a 480 series manufactured by Dwyer Instruments.

2. Ancillary Equipment

- Intrinsically safe hand held portable drill with drill bits suitable for drilling ports to fit either a 35 mm probe and for drilling holes to install gas/pressure monitoring taps.
- Spare gas/pressure monitoring taps
- 35 mm rubber bungs to seal flow ports (suppliers Lennox)
- Waterproof duct tape – several rolls should be stored on site. It is very useful for sealing up any points of air ingress on a temporary basis, if detected.

FTC can provide specs of this equipment and supplier details if required. We will use our own equipment on site including a drill for installing taps or ports as required. The use of this equipment will be charged on a site visit basis at €50 per visit. It is recommended that KCC purchase their own manometer and anemometer if you do not already have them on site. The anemometer is a specialised piece of kit and has to be ordered as it is not available to buy off the shelf. It typically takes 4-6 weeks for delivery through a UK based company. It is manufactured in Switzerland.

Consent of copyright owner required for any other use.
For inspection purposes only.

EPA Export 26-07-2013:10:59:11

3.2 Optional Training

Depending on the experience of the site staff in landfill gas management, KCC may wish to undergo some landfill gas balancing training. In this case, FTC would come to site and audit the site with the site staff. Ms. Tanya Ruddy, Senior Scientist, would be responsible for conducting the training. Tanya has carried out training at two landfills and has trained a number of internal FTC staff in landfill gas balancing. The training would be designed to give staff an understanding of landfill gas balancing and training in using equipment and interpreting findings on site. The training course duration would be dependant on the number of staff and prior knowledge of the staff. A fee to carry this out can be proposed at a later date if required.

For inspection purposes only.
Consent of copyright owner required for any other use.

EPA Export 26-07-2013:10:59:11