



Wexford County Council

Killurin Landfill
W0016-02

Annual Environmental Report 2014

Quality Control Sheet

Publication title Annual Environmental Report for Killurin Landfill 2014
Date March 2015
Address: Wexford County Council
County Hall,
Wexford.

Sean Meyler, Facility Manager

Tel 053-9120872
Mob 087 7406265
Email sean.meyler@wexfordcoco.ie

Doc No.	Issue No.	Reason for Issue	Author	Approved
Kill16-02_EPA_2014 AER	1	Compliance with Waste Licence W0016-02	Fran Hobbs Facility Technician Billy Byrne Facility Supervisor	Sean Meyler, Executive Engineer, Facility Manager

Contents Page

Annual Environmental Report 2014	1
EXECUTIVE SUMMARY	5
1 INTRODUCTION	6
1.1 General Information	6
1.2 Site information	6
2 MANAGEMENT & STAFFING STRUCTURE	7
2.1 Management and staffing structure for Killurin Landfill on 31 st December 2014	7
2.2 Financial provisions	8
2.3 Environmental Management System	8
3 REPORTED INCIDENTS & COMPLAINTS SUMMARIES	12
3.1 Incidents	12
3.2 Complaints	12
4 DEVELOPMENT WORKS UNDERTAKEN DURING THE REPORTING PERIOD & THOSE PROPOSED FOR THE COMING YEAR	13
4.1 Landfill Engineering Works	13
4.2 Restoration and Aftercare	13
5 WASTE ACCEPTANCE & HANDLING	15
5.1 Waste Activities carried out at the Facility	15
5.2 Total Quantity of Waste Consigned Off Site	15
5.3 Remaining capacity of the site	15
6 ENVIRONMENTAL NUISANCES	18
6.1 Review of environmental nuisance control at the facility for the reporting period	18
7 RESOURCE & ENERGY CONSUMPTION	19
7.1 Electricity and Energy Usage	19
7.2 Water	19
7.3 Diesel	19
8 ENVIRONMENTAL MONITORING & EMISSIONS SUMMARY	20
8.1 Summary report on emissions	20
8.2 Environmental Monitoring	21
9 WATER BALANCE CALCULATIONS	29

APPENDICES

- A1 PRTR 2014
- A2 Topographical and Monitoring location drawings
- A3 Meteorological Data
- A4 Air emission report
- A5 Water Balance Calculation
- A6 Leachate Tank Integrity Test Report

EXECUTIVE SUMMARY

This *Annual Environmental Report* has been prepared for Killurin Landfill, Waste Licence 16-2, for the reporting period from **1 January 2014 to 31 December 2014 inclusive**. The report includes the information specified in Schedule G of the Waste Licence, Content of the Annual Environmental Report, in accordance with Waste Licensing - *Draft Guidance on Environmental Management Systems (EMS) and Reporting to the Agency, 1999*. The main topics discussed with this report are as follows:

- ◆ General Site Information
- ◆ Management and Staffing
- ◆ Reported Incidents and Complaints
- ◆ Development Works
- ◆ Waste Acceptance and Handling
- ◆ Emissions Management
- ◆ Environmental Nuisances
- ◆ Resource and Energy Consumption
- ◆ Environmental Monitoring and Emissions

Killurin Landfill was closed to accepting waste on the 07 June 2008. No waste was accepted to landfill in 2014.

Wexford County Council continued to carry out a comprehensive environmental monitoring programme during 2014, in compliance with the waste licence conditions (Schedule D), to assess the significance of emissions. The monitoring programme included Landfill Gas, Leachate Level & Quality, Surface Water Quality, Groundwater Level & Quality, Odour monitoring and Meteorological monitoring as well as Topographical.

Works to complete final capping of the landfill haul road and to install additional leachate abstraction boreholes was completed in March 2014.

1 INTRODUCTION

1.1 General Information

The Annual Environmental Report (AER) for Killurin Landfill includes the information specified in Schedule G of the Waste Licence 16-2, *Content of Annual Environmental Report* and has been prepared in accordance with the Environmental Protection Agency (EPA) publication *Waste Licensing – Draft Guidance on Environmental Management Systems (EMS) and Reporting to the Agency, 1999*.

The reporting period for this AER is **1st January 2014 to 31st December 2014 inclusive**.

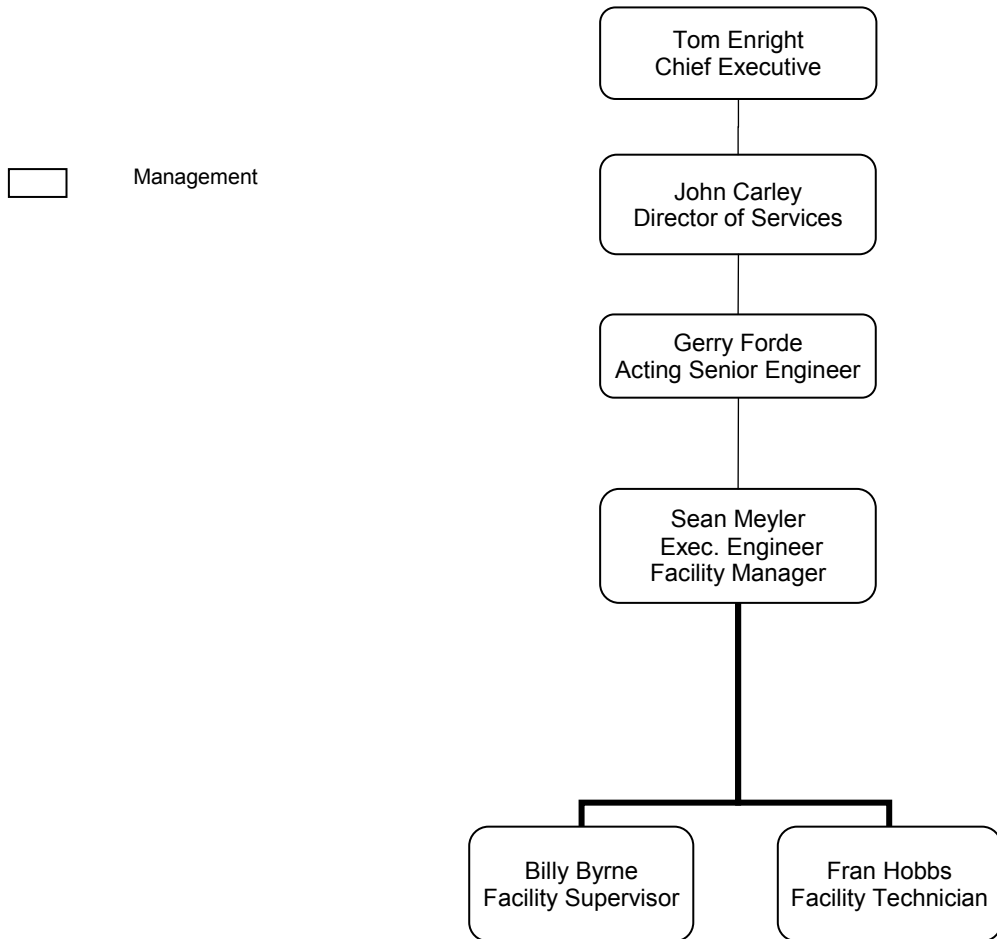
1.2 Site information

Table 1 Site information for Killurin Landfill

KILLURIN LANDFILL	
Waste licence register no:	W0016-2
Name and address of operator:	Wexford County Council County Hall Spawell Road County Wexford
Name and address of facility:	Killurin Landfill Killurin County Wexford
Site Description:	Killurin Landfill site is located in the town land of Newtown lower, Killurin, close to Deeps Bridge on a meander of the eastern bank of the River Slaney. The site is approximately 11km from Wexford town and covers an area of 10.7 hectares, of which 4.9 hectares are landfill and the remainder is CA site, buildings, car parking and buffer zones/screening. The facility is located in what once was a sand and gravel quarry. The area surrounding the site is rural with a mixed pattern of highly productive pasture and arable land use, with the River Slaney being the prominent landscape feature. Landfilling and CA site operations ceased in June 2008.

2 MANAGEMENT & STAFFING STRUCTURE

2.1 Management and staffing structure for Killurin Landfill on 31st December 2014



Killurin Landfill was operated by Wexford County Council during 2014 with consultancy support provided by sub consultants including Fehily Timoney & Company and Irish Biotech Services.

2.2 Financial provisions

In accordance with Condition 12.1 Wexford County Council paid a sum of €15,699 to the Environmental Protection Agency for the management and monitoring of the waste licence.

2.2.1 *Provision for the Closure, Restoration and Aftercare*

Wexford County Council (WCC), as a Local Authority, has made the necessary provisions, for the development, management, restoration and aftercare of Killurin Landfill. WCC has assigned engineering and technical staff to manage the facility. Wexford County Council is committed to the ongoing provision of funding for all site development works, environmental monitoring costs and restoration and aftercare works at Killurin Landfill for the duration of the Waste Licence.

2.3 Environmental Management System

2.3.1 *Environmental Management Programme*

The site has an operational environmental management system (EMS) in accordance with the Waste Licence condition 2.3.2.1. Implementation of the EMS continued during this reporting period (January 2014 - December 2014). The Objectives and Targets of the EMS were reviewed and revised for the reporting period 2014.

2.3.2 *Environmental objectives and targets.*

Table 2 below provides the Objectives and Targets for 2014 and details progress made regarding each objective. Table 3 provides the Objectives and Targets for 2015 and the methods by which they will be achieved.

An environmental management plan (EMP) was prepared as part of the EMS for the facility. The EMP comprises information on the following topics:

- Site description
- Site infrastructure
- Leachate Collection and treatment Leachate Management System
- Landfill Gas Abatement Methods
- Surface water Control Measures
- Environmental Monitoring
- Site Security and Site Offices
- Operational Matters
- Vermin control
- Fires
- Restoration and Aftercare

Table 2 **Achievements of Objectives and Targets for 2014**

Achievement of Objectives and Targets for 2014			
	Comments	Date	Responsibility
Objective No 1:			
1.1 Complete capping of the landfill perimeter haul road	Complete	March 2014	Facility Manager / Facility Technician
Objective No 2:			
2.1 Complete installation of additional leachate abstraction wells	Completed installation of 16 additional deep leachate abstraction wells	March 2014	Facility Manager / Facility Technician
Objective No 3:			
3.1 Undertake improvements to existing leachate management infrastructure	Completed replacement of existing leachate rising main to increase discharge rate; replaced compressor to improve air supply to pneumatic leachate abstraction pumps	June 2014	Facility Manager / Facility Technician
Objective No 4:			
4.1 Optimise landfill gas extraction from waste body	Connected new leachate abstraction wells to LFG extraction system and rebalanced gas field. No great impact.	May 2014	Facility Manager / Facility Technician
Objective No 5:			
5.1 Implement revised environmental monitoring regime in accordance with the Leachate management Plan	Commenced and ongoing	May 2014 and ongoing thereafter	Facility Manager / Facility Technician
Objective No 6:			
6.1 Evaluate effectiveness of the initial works carried out in accordance with the leachate management plan	Commenced Interrogation of environmental monitoring data and abstracted leachate data to evaluate effectiveness of the perimeter road capping works and enhanced leachate abstraction system	June 2014 and ongoing	Facility Manager / Facility Technician

Table 3 Objectives and Targets for 2015

Objectives and Targets for 2015			
	Comments	Target	Responsibility
Objective No 1:			
1.1 Resolve landfill gas flare issues	LFG is oversized now for the reducing gas yield. Undertake pumping trials to evaluate options.	September 2015	Facility Manager / Facility Technician
Objective No 2:			
2.1 Compile enhanced data set in accordance with the leachate management plan	Interrogate environmental monitoring data and abstracted leachate data to evaluate effectiveness of the perimeter road capping works and enhanced leachate abstraction system	December 2015	Facility Manager / Facility Technician
Objective No 3:			
3.1 Complete the Groundwater Technical Assessment and Implement any recommendations	GW Technical Assessment report will be issued under separate cover Timeline for implementation of recommendations to be assessed	April 2014 December 2015	Facility Manager / Facility Technician

2.3.3 Corrective action Procedure

Procedures are in place in accordance with Condition 2.3.2.3 of the licence to monitor, measure, audit and record the environmental performance of the environmental management system. These procedures establish how non-conformance within the system is dealt with and how any corrective and preventive action is carried out. A corrective action procedure was prepared in October 2008 (reviewed in 2010) and is included in the overall EMS report.

2.3.4 Awareness and Training Programme

In accordance with Condition 2.3.2.4 of the licence, an awareness and training programme has been developed to increase environmental awareness among staff and identify training needs of all personnel working at Killurin Landfill. The facility manager has overall responsibility for reviewing training needs on an annual basis to ensure that all staff have the necessary skills and level of awareness to carry out their duties to the highest environmental and safety standards. Training records are kept on file at Holmestown Waste Management Facility.

2.3.5 Full title of any procedures developed by the licensee in the year which relates to the facility operation

No additional procedures were developed or submitted during the reporting period.

2.3.6 **Report on communication programme**

The site's EMS includes a procedure for communication. In addition Wexford County Council provides the following documentation for public viewing at Holmestown Waste Management Facility:

Table 4 List of records available for public access in relation to the landfill

List of records available for public viewing
Waste Licence W0016-2
Waste Licence application
Correspondence with the EPA
Incident / complaints records
Audit records
Waste acceptance records
Material acceptance dockets
All monitoring records
Leachate removal records
Vermin control reports

3 REPORTED INCIDENTS & COMPLAINTS SUMMARIES

3.1 Incidents

No incidents were reported during this reporting period. However ongoing elevated levels of ammonia (which are decreasing over time) are still being recorded in downstream groundwater boreholes. Refer to quarterly monitoring reports and the Leachate Management plan for further details.

3.2 Complaints

No complaints were received during this reporting period.

4 DEVELOPMENT WORKS UNDERTAKEN DURING THE REPORTING PERIOD & THOSE PROPOSED FOR THE COMING YEAR

4.1 Landfill Engineering Works

4.1.1 *Completed Engineering Works 2014*

Engineering works for 2014 as detailed in the Leachate Management Plan were progressed as follows

- Completion of capping works to the perimeter landfill access road
- Installation of 16 additional dual purpose leachate extraction/monitoring and landfill gas extraction wells
- Install new leachate collection pipework system
- Surface Water Management Works
- Continue the leachate extraction infrastructure maintenance works programme

4.1.2 *Proposed Engineering Works 2015*

Proposed engineering works for 2015 as detailed in the Leachate Management Plan are summarized as follows

- Continue the leachate extraction infrastructure maintenance works programme

4.2 Restoration and Aftercare

A revised restoration and aftercare plan was submitted to the EPA for approval in July 2013.

Restoration and aftercare works carried out in 2014 include:

- Completion of capping works to the perimeter landfill access road

There are no restoration and aftercare development works planned for 2015.

5 WASTE ACCEPTANCE & HANDLING

5.1 Waste Activities carried out at the Facility

No waste disposal operations took place on site at Killurin Landfill during the reporting period 1st January 2014 to 31st December 2014.

5.2 Total Quantity of Waste Consigned Off Site

A summary of the total quantity of waste consigned off site at Killurin Landfill for the period 1st January 2014 to 31st December 2014 is presented below in Table 5.

The total volume of leachate transported off site for treatment at Wexford Wastewater Treatment Works was 5,322 Tonnes.

5.3 Remaining capacity of the site

Killurin Landfill closed at the end of June 2008. There is no remaining landfill capacity.

Table 5

Waste consigned off-site from Killurin Landfill from 1st January to 31st December 2014 (tonnes)

Waste Out	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly totals
LEACHATE	651	558	856	649	551	313	249	0	59	300	933	203	5,322
Total													5,322

6 ENVIRONMENTAL NUISANCES

6.1 Review of environmental nuisance control at the facility for the reporting period

Nuisances at Killurin Landfill are logged in a monthly tick-box report and action is taken immediately to address any identified issues. Table 7 below summarises the measures implemented on site to combat environmental nuisances during 2014.

Table 6 Environmental Nuisance Control during 2014

Nuisance	Mitigation Measures in Place
Vermin	Permanent bait points set up on site (internal and external). Inspections carried out on a monthly basis. If infection found then weekly inspections until rodent free. Monthly reports produced and kept at Holmestown site office.
Litter	Killurin landfill is litter free.
Flies	No flies present.
Odour	No odour emissions

7 RESOURCE & ENERGY CONSUMPTION

7.1 Electricity and Energy Usage

Electricity usage for the reporting period was estimated at 81,150 kWh.

7.2 Water

Domestic water usage data was not recorded.

7.3 Diesel

Total diesel fuel consumption (for operations) is estimated to be 0 litres from 1st January to 31st December 2014.

8 ENVIRONMENTAL MONITORING & EMISSIONS SUMMARY

8.1 Summary report on emissions

A summary of emissions monitoring at Killurin Landfill carried out during this reporting period (January 2014 – December 2014) is contained in Table 8 below. The E-PRTR Regulation (EC) No. 166/2006 concerning the establishment of a European Pollutant Release and Transfer Register came into force in February 2006 and was brought into Irish law through SI No 123 of 2007. As a result all industries have to annually report environmental emissions and waste transfer data through a web-based form as part of their AER. The PRTR 2014 document is included in Appendix A1.

Table 7 **A summary of Emissions monitoring as specified in Waste Licence W0016-2**

Emission Monitoring	Frequency
Landfill Gas	Continuously (Dwellings adjacent to Landfill, Flare) Weekly (Site Accommodation) Monthly (Landfill Gas & Leachate Wells) Annual (Flare emissions)
Leachate	Monthly (Level & Analysis Note 2) Quarterly (Analysis) Annually (Analysis)
Surface water	Weekly (Visual) Quarterly (Analysis) Annually (Analysis)
Groundwater Levels	Monthly (Borehole Level)
Groundwater	Quarterly (Analysis) (Note 2) Annually (Analysis)
Noise	As required (Note 1)
Dust	As required (Note 1)
River Water	Quarterly (Analysis)

Note 1: When specific engineering works are being carried out

Note 2: As detailed in the Leachate Management Plan additional monitoring of groundwater and leachate around and within the Landfill footprint took place during 2014

8.2 Environmental Monitoring

Wexford County Council carries out a comprehensive environmental monitoring programme, in compliance with the waste licence conditions, to assess the significance of emissions. The monitoring programme includes Landfill Gas, Leachate Level & Quality, Surface Water Quality, Groundwater Level & Quality, Noise and Dust monitoring (as required), Odour monitoring and Meteorological monitoring, as well as Flare emission and Topographical.

Monitoring during this reporting period was carried out according to Schedule D of Waste Licence W0016-2, Quarters 1, 2, 3 and 4 results for 2014 are summarised in this chapter. Additional monitoring was also carried out as detailed in the Leachate Management Plan. A monitoring point location plan is provided see Appendix A2.

8.2.1 Landfill gas

In accordance with Schedule D.1 of the Waste Licence W0016-2, the following monitoring has been carried out and reported to the Agency.

- Monitoring boreholes within waste LB2, LB3, LB4, LB5, LB6, LB7, LB8, and LB14 as specified in the licence. Monitoring points LB12 and LB14 were lost during construction works on site in 2013.
- Monitoring boreholes boundary locations GW1, GW9, GW10, GW11, GW17, GW18, GW19, GBH1 and GBH2
- Perimeter boreholes T1, T2, T3, T5, T6, T7, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18 and T19 were monitored on a monthly basis by Wexford County Council site staff.

The majority of boreholes have varying levels of gas quality over the reporting period and no particular trend could be identified. Gas monitoring details are provided in Table 8 below.

Table 8 **Gas Monitoring Points**

Off site and on site gas boreholes		
CO2 and CH4 levels (monthly)	34 points	In waste gas monitoring wells LB 2 - LB8,
		Boundary gas monitoring wells T1 –T3, T5- T7, T9- T19
		GW1, GW9- GW11, GW17-GW19.
		Resident gas boreholes: GB1 and GB2
Residential Dwelling gas alarms		
CO2 and CH4 levels (continuously)	2 points	Two closest residences
CO2 and CH4 levels (As required)	8 points	All site buildings

Perimeter boreholes

Methane and Carbon Dioxide levels are elevated in gas monitoring wells T14, T15, T16, GW17, GW18 and GW19. The elevated Methane and Carbon Dioxide levels result from the location of these boreholes which are either in or on the periphery of the waste body. WCC no longer use these locations as peripheral wells. T17, T18, T19, GBH1 and GBH2 are in a similar orientation but further removed from the waste body and are considered suitable for ongoing monitoring in this area. No exceedences of licence limits were recorded at T17, T18, T19, GBH1 or GBH2 which would indicate that no landfill gas migration off site has taken place.

Carbon Dioxide levels in T2, T3, T6, T9, T11, T12 and T13 are slightly elevated. The most likely cause of the slightly elevated readings is their location in a mature wooded area. The exceedences are low (max 10.1% in T6).

No exceedences of licence limits were recorded at any of the remaining peripheral gas monitoring wells. This indicates that landfill gas migration off site has not taken place.

Methane (CH₄)

Resident's boreholes

The following was recorded at resident's boreholes during this reporting period:

- ◆ **GB1 at Carley's:** Methane levels at this monitoring location were seen to be below the 1.0% volume per volume (v/v) trigger-level throughout the reporting period.
- ◆ **GB2 at Kelly's:** Methane levels at this monitoring location were seen to be below the 1.0% volume per volume (v/v) trigger-level throughout the reporting period.

The CH₄ trigger level at the gas monitoring wells is 1.0% volume by volume (v/v).

Carbon Dioxide (CO₂)

Resident's boreholes

The following was recorded at resident's boreholes during this reporting period:

- ◆ **GB1 at Carley's:** All results were below the 1.5% volume per volume (v/v) trigger-level.
- ◆ **GB2 at Kelly's:** All results were below the 1.5% volume per volume (v/v) trigger-level.

The CO₂ trigger level at the gas monitoring wells is 1.5% volume by volume (v/v).

Monitoring boreholes GBH1 and GBH2 are located on the resident's side of the gas migration cut off trench. The cut off trench consists of an excavated trench along the landfill boundary adjacent to Carley's and Kelly's residents. Installed in this trench is an impermeable geotextile membrane with a series of gas extraction wells installed on the landfill side. The results indicate that the gas migration cut off trench combined with the gas abstraction system is operating as designed. Continuous monitoring for the detection of landfill gas was carried out at Carley's and Kelly's residents. Landfill gas was not detected at either residence in 2014.

Methane and Carbon Dioxide levels (as expected) remain elevated in the dual leachate/Gas monitoring wells which are located in the waste body (LB 3 – LB8, LB 13). This gas is being continuously extracted and flared off.

8.2.2 Flare Emissions

An air emission test of the landfill flare was carried out by AXIS environmental services on the 26th June 2014. NO_x, HCL, HF were found to be in compliance with the emission limit values contained in Waste Licence W0016-2 – Schedule C5, the CO and VOC levels were not found to be compliant. The report is included in Appendix A4.

8.2.3 Leachate levels and monitoring

Leachate monitoring points

Leachate Monitoring			
Level	8 points	LB2-LB8, LB12-LB16	Monthly
Analysis	1 point	Leachate storage tanks	Annually

Leachate levels

Leachate levels were taken at 8 leachate boreholes during 2014 in compliance with Schedule D.5 of the waste licence. Samples for analysis were obtained from the leachate storage tanks in 2014 in compliance with Schedule D.5. The levels were recorded using a dip meter on a monthly basis by Wexford County Council staff at the landfill. The annual analysis results of the leachate removed from the tanks in 2014 is detailed in Table 10. The quantity exported off-site in 2014 was 5,322 tonnes compared to 3,518 tonnes in 2013.

Leachate is collected from 40 extraction wells located around the site within the waste boundary. This leachate is directed to the three holding tanks located in the northwest of the landfill. It is then removed by road tanker on a routine basis and transported to Wexford Wastewater Treatment Plant for treatment in accordance with Waste Licence Condition 6.6.

Leachate monitoring

Annual monitoring was undertaken on 15th May 2014. A leachate sample was collected from the leachate storage tanks. The sample was analysed for a range of parameters as defined in Table D.5.1 of the Waste Licence 16-2.

The typical characteristics of leachate generated on site are presented in Table 10. The results are similar to those obtained for the last reporting period and are in general indicative of a landfill in the methanogenic stage of decomposition of organic compounds i.e. conversion of organic compounds to landfill gas.

Table 9 Leachate analysis results 2014

Sampling Points		Tanks
Sampling Date		15/05/2014
Parameters	Units	Annual
Temperature	°C	14.4
Ammonia	mg/l N	610
Biochemical Oxygen Demand	mg/l O ₂	54
Chemical Oxygen Demand	mg/l O ₂	1170
Chloride	mg/l Cl	419
Conductivity	µS/cm	9410
Fluoride	mg/l F	<2.5
Mercury	µg/l	<0.5
Nitrite	mg/l N	Nm
Ortho-Phosphate	mg/l P	3.2
pH	pH	7.7
Sulphate	mg/l SO ₄	<25
Total Oxidised Nitrogen	mg/l N	2.4
Aluminum	µg/l	220
Antimony	µg/l	7.4
Arsenic	µg/l	49
Barium	µg/l	110
Beryllium	µg/l	<1.0
Boron	µg/l	2700
Cadmium	µg/l	0.18
Calcium	mg/l	100
Chromium	µg/l	94
Cobalt	µg/l	15
Copper	µg/l	16
Iron	µg/l	4800
Lead	µg/l	2.8
Magnesium	mg/l	66
Manganese	µg/l	590
Molybdenum	µg/l	5.6
Nickel	µg/l	77
Potassium	mg/l	470
Selenium	µg/l	3
Sodium	mg/l	800
Thallium	µg/l	<1.0
Uranium	µg/l	<1.0
Vanadium	µg/l	120
Zinc	µg/l	120

Additional leachate analysis was undertaken during 2014 from 45 number leachate wells located within the waste body, the results of this analysis is to be submitted as part of the Leachate Management Plan review reports.

Inspection and testing of leachate storage tanks

The leachate tanks were tested in October 2014 by Capital Surveys Ltd., the tanks passed the integrity test and were assessed as being fit for the storage of leachate. The full report is attached in appendix A4. The tanks are due to be re-tested in October 2017.

8.2.4 Surface Water

Under Schedule D.5 of the Waste Licence 16-2, surface water monitoring was required in the locations listed below. SW1 is located upstream of the site, SW2 is situated downstream of the site SW3 is located on the eastern side of the site adjacent to the landfill flare compound and SW4 is located at the southern tip of the facility (see monitoring point location drawing in Appendix A2). The site streams regularly run dry during the drier months of the year and consequently surface water samples cannot be obtained. These are discussed in subsequent sections.

Table 10 **Surface water monitoring locations and frequency**

Surface water monitoring locations and frequency			
Parameter	Location	Name	Frequency
Visual Inspection/ Odour	Off site (River Slaney)	S1, S2, S3	Quarterly
Chemical analysis	Off site (River Slaney)	S1, S2, S3	Quarterly
Visual inspection	On site	SW1, SW2, SW3 and SW4	Weekly
Chemical analysis	On site	SW1, SW2, SW3 and SW4,	Quarterly and Annual

Visual inspection of surface water

Surface water on site consists of a series of open and piped drains. Weekly visual inspections of surface water were conducted for monitoring points SW1, SW2, SW3 (SW 3 is a surface water manhole that collects surface water from the upper cap subsurface drainage layer and is adjacent to the flare compound, monitoring commenced in Q4, 2012) and SW4, and quarterly at off-site locations (River Slaney) S1, S2 and S3. All surface water details are included in previously submitted monitoring reports for the landfill. No visual abnormalities were recorded for any of the surface water inspection points during the reporting period.

Surface water quality analysis

Results for all surface water monitoring carried out in 2014 will be submitted to the Agency in the annual monitoring report. Due to dry periods it was not always possible to retrieve samples from all of the monitoring points. No sample was obtainable from SW1 & SW3 in Q2, SW1, SW2, SW3 & SW4 in Q3, SW3 in Q4.

All sampling and analysis was carried out in accordance with recognised quality assurance and control procedures. The detailed monitoring results are presented in the annual monitoring report. The range of analysis is as specified in Schedule D.5 of the Waste Licence 16-2 and includes parameters such as ammoniacal nitrogen, BOD, COD, dissolved oxygen, pH, electrical conductivity, suspended solids and temperature. No atypical results were recorded during the quarterly monitoring in 2014.

River water

The river water monitoring results for the river Slaney are presented in the annual monitoring report. Monitoring location S1 is located upstream of the landfill, monitoring location S2 in the river adjacent to the landfill and monitoring location S3 is located downstream of the landfill and all are located within the tidal zone of the river estuary.

Ammonia results were relatively low. There is no evidence from the upstream and downstream river results that the landfill is impacting negatively on the Slaney.

8.2.5 Groundwater

Table 11 **Groundwater monitoring locations**

Groundwater Monitoring Locations		
Downgradient	1 point	GW1
Downgradient (border of reed beds)	1 point	GW9
Downgradient (border of reed beds)	1 point	GW10
Upgradient	1 point	GW11
Upgradient	1 point	GBH1
Upgradient	1 point	GBH2

Groundwater levels

Groundwater levels were measured on a monthly basis using a dip meter. The groundwater dip levels are included in the annual monitoring report. Groundwater levels remained relatively constant throughout the monitoring period, with only minor variations in groundwater levels in accordance with prevailing weather conditions. During the drier months the groundwater levels were seen to gradually decrease while during wetter periods where prolonged rain was evident.

Groundwater quality boreholes

No significant variation from historical result trends was noted in 2014. The highest levels of contaminants have been recorded in the boreholes located along the south east side of the landfill. These BH's are on the maximum hydraulic groundwater gradient that falls from the landfill towards the river. Samples were taken from both soil and underlying rock layers. In both cases the distribution of contamination was not even, with certain boreholes recording higher results than others. This may be due to preferential flow paths caused by gravel/sand lenses in the soils and increased permeability due to higher levels of fracturing or faults in the underlying rock. The result trends show that leachate management on site has had a beneficial effect on these wells and Ammonal, Chloride and Conductivity levels have been decreasing since 2006. Boreholes with low contaminant readings have exhibited little change

since 2006. This may be due to the lower permeability and recharge in these zones. Further information on the above can be found in the annual monitoring report and the Leachate Management Plan review report.

Boreholes GW17-19 are included as groundwater (and peripheral gas) monitoring locations in Table D1.1 of the Licence. They have been reported as dry since 2006. The boreholes are too shallow and too close to the landfill. GBH1 and GBH2 are in a similar orientation and are considered suitable for ongoing monitoring in this area. This revision has been included in the updated Leachate Management Plan

Private Well water analysis

Table 12 Private well monitoring locations

Drinking water		
Private residence	UV treated	Kitchen tap

Quarterly and annually monitoring was carried out on drinking water samples from our neighbour's private well.

Additional private well / groundwater analysis was undertaken during 2014 from 3 number private wells located above the western bank of the river Slaney opposite the landfill, the results of this analysis is to be submitted as part of the Leachate Management Plan review report.

8.2.6 Noise

A noise survey was undertaken on 16th January 2014 by AXIS environmental services, while both capping and well drilling works were ongoing. Elevated LAeq 64 & 65 dB were recorded at two of the three monitoring locations resulting from construction traffic movements and well drilling operations.

No dust monitoring was undertaken during 2014. The construction works were carried out outside of the dust monitoring season and were therefore not subjected to dust monitoring.

8.2.7 Meteorological monitoring

All 2014 meteorological monitoring information was obtained from the Met Éireann weather station located at Johnstown Castle, Wexford; this station is within 10km of the Killurin Landfill site. The monitoring data is contained in Appendix A3.

8.2.8 Topographical Survey

A topographical survey of the site was carried out by Capital Surveys Ltd in November 2014. The topographical survey drawing is contained in Appendix A2.

Given that the landfill has not accepted waste since 2008, and that the site has been fully capped the enclosed topographical survey was carried out for the purpose of checking settlement in the waste body. There appears to have been very little settlement since the 2013 AER topographical survey was carried out. The maximum observed level for the 2013 AER survey was 30.2 mOD, as compared to a level of 30.5 mOD for the 2014 AER survey. The rise in level appears to be due to local temporary works associated with the recent leachate abstraction wells installation.

There has been some minor changes to levels along the route of the perimeter road due to capping works, but these are inconsequential in relation to settlement or stability.

8.2.9 *Slope Stability Assessment*

A walkover slope stability assessment was conducted in March 2015 to check for any visible signs of slippage or instability on the flanks of the waste body. None were noted. It was concluded that the waste body remained stable during 2014.

8.2.10 *Leachate storage tank integrity testing*

The on-site leachate storage tanks were subjected to integrity testing in October 2014 and were deemed to pass. The report is attached in Appendix A6.

9 Water Balance Calculations

The objective of the assessment of water balance calculations is to understand and predict the liquid inputs and outputs of the facility. Water balance calculations have been calculated for the period 1st January 2014 to 31st December 2014 to estimate the approximate volume of leachate generated on site. This volume can then be compared to the volume of leachate leaving site, by tanker over the weighbridge.

The water balance addressed the volume of leachate generated at the site including the estimated annual infiltration of rainfall. The water balance methodology is described below and the calculation is shown in Appendix A5.

The water balance calculations are based on the methodology specified in the EPA's Landfill Site Design Manual. The calculation used is as follows: -

$$Lo = [ER(A) + LW + IRCA + ER(I)] - [aw]$$

Lo = leachate produced (m³)

ER = effective rainfall (m) (Use actual rainfall (R) for active cells)

A = area of cell (m²)

LW = liquid waste (m³)

IRCA = infiltration through restored and capped areas (m)

I = surface area of lagoon (m²)

a = absorptive capacity of new waste (m³/t)

w = weight of waste deposited (t/a)

An absorptive capacity of 0.025 m³ per tonne was assumed.

The meteorological data used was obtained from the nearby Met Eireann meteorological station at Johnstown Castle. The total rainfall from 1st January 2014 to the 31st December 2014 was approximately 1155 mm. Meteorological data is presented in Appendix A3.

The water balance calculation considers the infiltration types influencing leachate generation:

- Infiltration directly through the permanently capped areas, estimated at 5%
- Infiltration due to direct precipitation through the uncapped perimeter access road (until March 2014)
- Infiltration due to run-off from the upper capped areas onto the uncapped perimeter access road (until March 2014)

The estimated volume of leachate generated for the period 1st January 2014 to the 31st December 2014 is 4,585 m³ (a calculation summary is included in Appendix A5). During the same period 5,322 m³ of leachate was removed from the site for treatment in the waste water treatment plant at Wexford. A monthly breakdown of leachate volumes removed is presented in Table 5 above. It is expected that the additional volume of leachate removed over that generated is due to the additional deeper leachate extraction boreholes installed during 2014. While the process of reducing the elevation of the leachate water table is ongoing, a surplus of leachate extracted each year (over that generated) can be expected.

The fact that more leachate was removed off-site than was estimated to be generated in 2014 is a positive development.

APPENDICES



[Guidance to completing the PRTR workbook](#)

AER Returns Workbook

Version 1.1.18

REFERENCE YEAR	2014
-----------------------	------

1. FACILITY IDENTIFICATION

Parent Company Name	Wexford County Council
Facility Name	Killurin Landfill Site
PRTR Identification Number	W0016
Licence Number	W0016-02

Classes of Activity

No.	class_name
-	Refer to PRTR class activities below

Address 1	Newtown Lower
Address 2	Killurin
Address 3	
Address 4	
Country	Wexford
Coordinates of Location	Ireland
River Basin District	-6.56116 52.3816
NACE Code	IESE
Main Economic Activity	3821
AER Returns Contact Name	Treatment and disposal of non-hazardous waste
AER Returns Contact Email Address	Sean Meyler
AER Returns Contact Position	sean.meyler@wexfordcoco.ie
AER Returns Contact Telephone Number	Facility Manager
AER Returns Contact Mobile Phone Number	053 9120922
AER Returns Contact Fax Number	087 6846089
Production Volume	
Production Volume Units	0.0
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	700
User Feedback/Comments	Closed landfill no permanent staff presence on site, Leachate collection and landfill gas infrastructure maintenance ongoing, leachate tankered off site ongoing, environmental monitoring ongoing, general site maintenance ongoing. Methane emissions increased as a result of poor performance of flare unit due to landfill gas quality issue.
Web Address	

2. PRTR CLASS ACTIVITIES

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

4. WASTE IMPORTED/ACCEPTED ONTO SITE

[Guidance on waste imported/accepted onto site](#)

Do you import/accept waste onto your site for on-site treatment (either recovery or disposal activities)?	
---	--

This question is only applicable if you are an IPPC or Quarry site

4.1 RELEASES TO AIR

[Link to previous years emissions data](#)

[PRTR# : W0016 | Facility Name : Killurin Landfill Site | Filename : Killurin PRTR_2014 (2).xls | Return Year : 2014]

01/05/2015 14:26

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASERS TO AIR		METHOD			Please enter all quantities in this section in KGs			
POLLUTANT		Method Used			QUANTITY			
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
01	Methane (CH4)	C	ALT	GasSim model	348331.72	348331.72	0.0	0.0
02	Carbon monoxide (CO)	M	EN 15058:2004		802.359936	802.359936	0.0	0.0
06	Nitrogen oxides (NOx/NO2)	M	EN 14792:2005		91.047936	91.047936	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

RELEASERS TO AIR		METHOD			Please enter all quantities in this section in KGs			
POLLUTANT		Method Used			QUANTITY			
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

* 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)

RELEASERS TO AIR		METHOD			Please enter all quantities in this section in KGs			
POLLUTANT		Method Used			QUANTITY			
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
351	Total Organic Carbon (as C)	M	ALT	EN12619:2012	283.305408	283.305408	0.0	0.0
319	Inorganic acids	M	ALT	EN15713:2006 and EN19111:2010	4.471104	4.471104	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:		Killurin Landfill Site			
Please enter summary data on the quantities of methane flared and / or utilised		Method Used			Facility Total Capacity m3 per hour
T (Total) kg/Year		M/C/E	Method Code	Designation or Description	
Total estimated methane generation (as per site model)	552927.0	C	EST	GasSim	N/A
Methane flared	204595.28	M	OTH	Continuous analyser	1250.0 (Total Flaring Capacity)
Methane utilised in engine/s	0.0	C	OTH	Not applicable	0.0 (Total Utilising Capacity)
Net methane emission (as reported in Section A above)	348331.72	C	EST	Total estimated methane	N/A

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

| PRTR#: W0016 | Facility Name : Killurín Landfill Site | Filename : Killurín PRTR_2014 (2).xls | Return Year : 2014 |

01/05/2015 14:26

Please enter all quantities on this sheet in Tonnes

3

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	02 02 02	No	0.0	animal-tissue waste landfill leachate other than those mentioned	D10	M	Weighed	Offsite in Ireland	Waterford Proteins Ltd., Dept of Agriculture R919 Wexford WWTP Wexford County Council, "	Ferrybank,,Waterford ..,Ireland Pumping Station,,Trinity Street ,Wexford,,Ireland Mulligan Dismantling and Salvage Ltd,Lower Inch,Gorey,County Wexford.,Ireland		
Within the Country	19 07 03	No	5322.8	in 19 07 02	D9	M	Volume Calculation	Offsite in Ireland				
Within the Country	20 01 40	No	0.0	metals	R4	M	Weighed	Offsite in Ireland	Mulligan Dismantling and Salvage Ltd,WP/05/20			

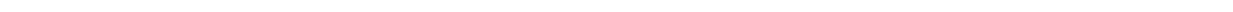
* Select a row by double-clicking the Description of Waste then click the delete button

[Link to previous years waste data](#)

[Link to previous years waste summary data & percentage change](#)

[Link to Waste Guidance](#)

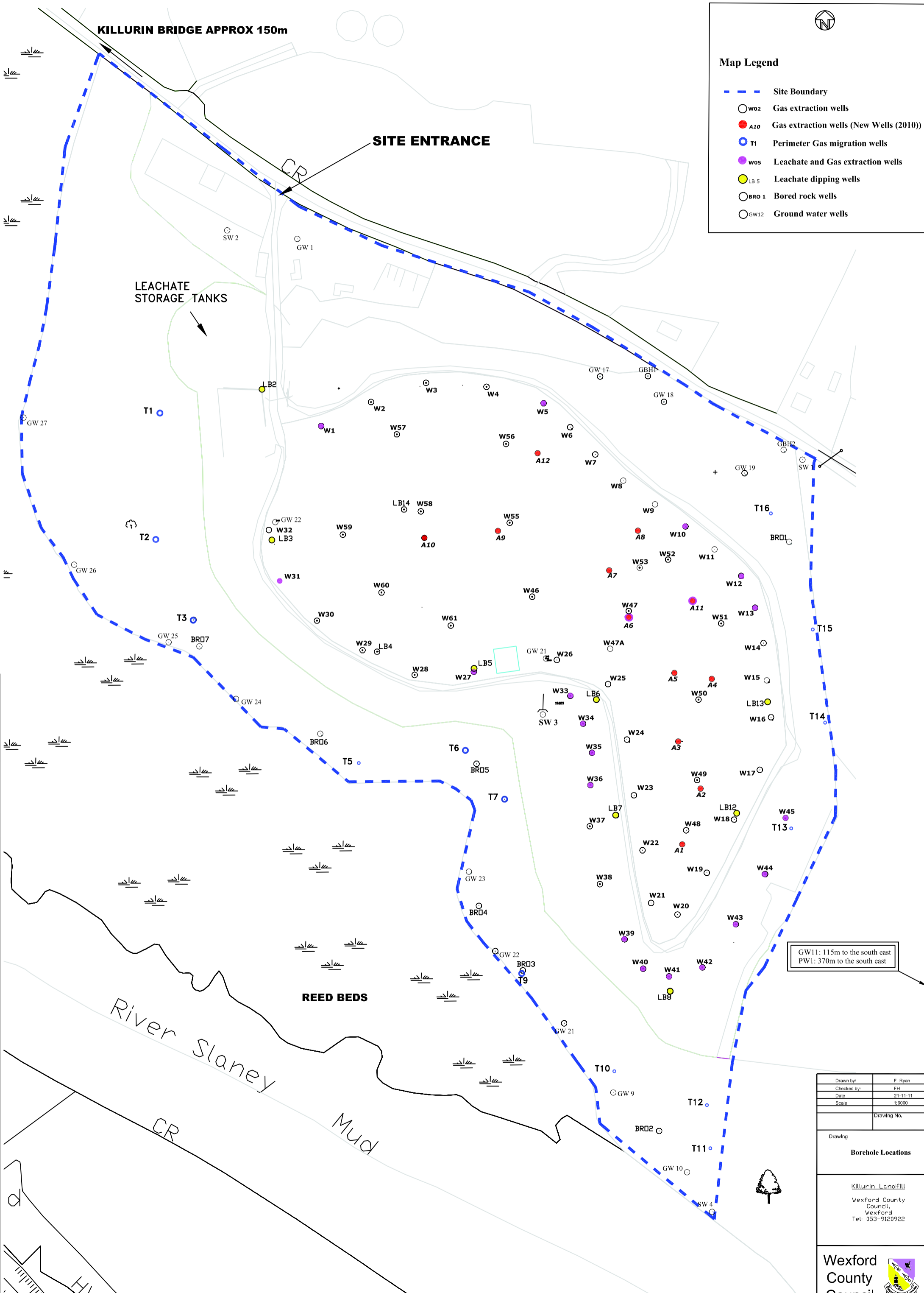
A2 Topographical and Monitoring location drawings





Rev:	Date:	Description	By:
A:			

 Capital Surveys Land Surveyors & Civil Engineers.		 CHARTERED SURVEYORS IRELAND	
Bridestown, Tappin, Co. Westford Phone: (053) 34218 or (087) 6857464		email: info@capitalsurveys.ie website: www.capitalsurveys.ie	
Project: Killarney Land Fill Topo Survey.		Client: Frab Hobbs, Westford Campy Council Homestown Land Fill Facility, Homestown, Co Westford	
Dwg Title: Site Plan			
Scale:	Date:	Job no.:	Dwg no.:
1 : 500	Nov 14	12-77	12-77/1
		Dr by:	Rev:
		J.K.	A



Map Legend

- Site Boundary
- W02 Gas extraction wells
- A10 Gas extraction wells (New Wells (2010))
- T1 Perimeter Gas migration wells
- W05 Leachate and Gas extraction wells
- LB 5 Leachate dipping wells
- BRD 1 Bored rock wells
- GW12 Ground water wells

GW11: 115m to the south east
 PW1: 370m to the south east

Drawn by:	F. Ryan
Checked by:	FH
Date:	21-11-11
Scale:	1:8000
Drawing No.	

Borehole Locations

Killurin Landfill
 Wexford County Council,
 Wexford
 Tel: 053-9120922

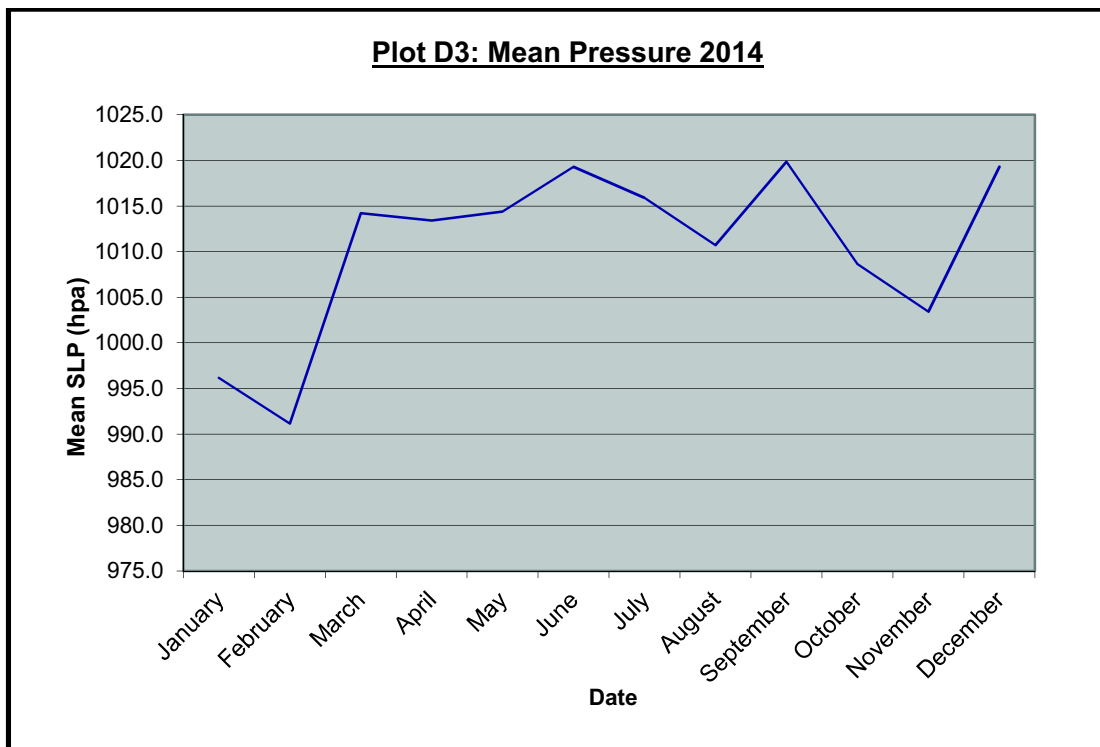
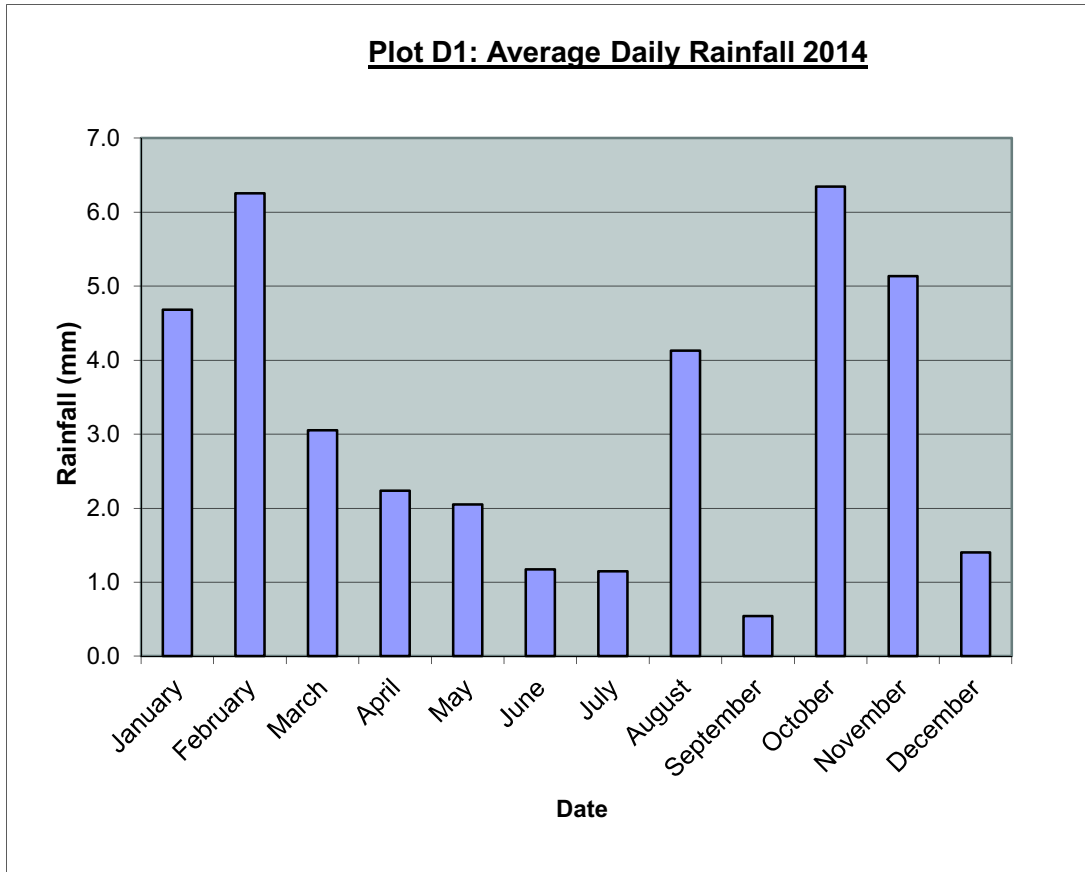
Wexford County Council



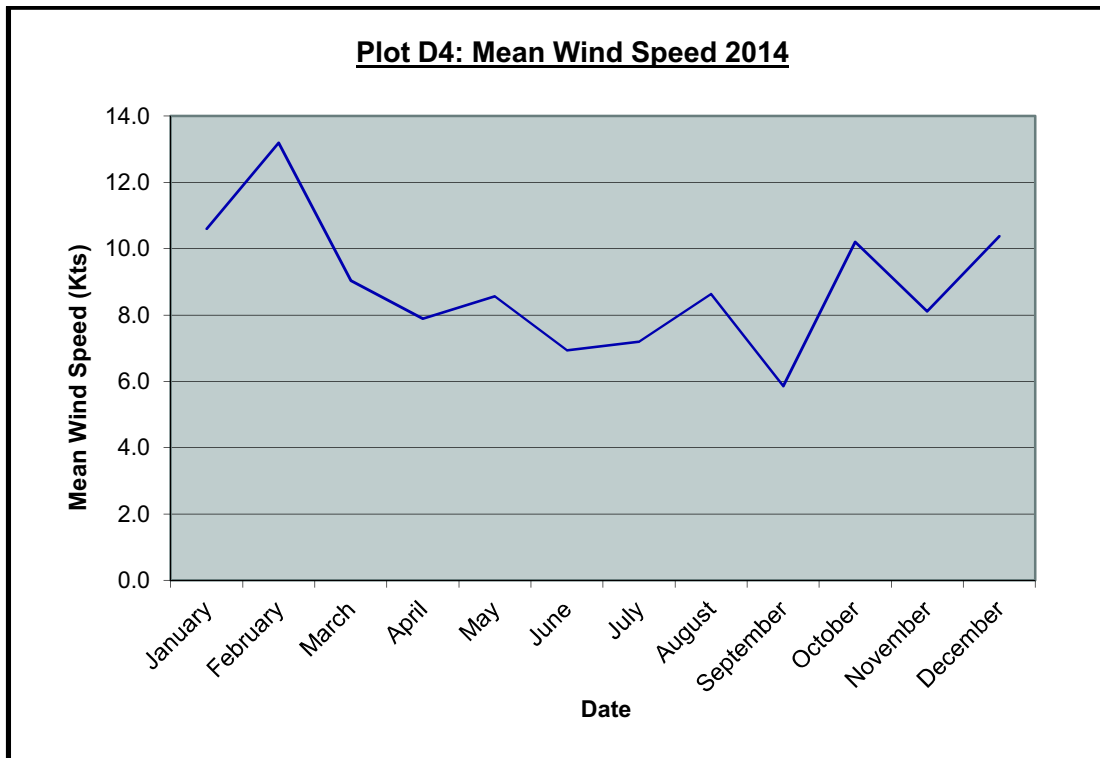
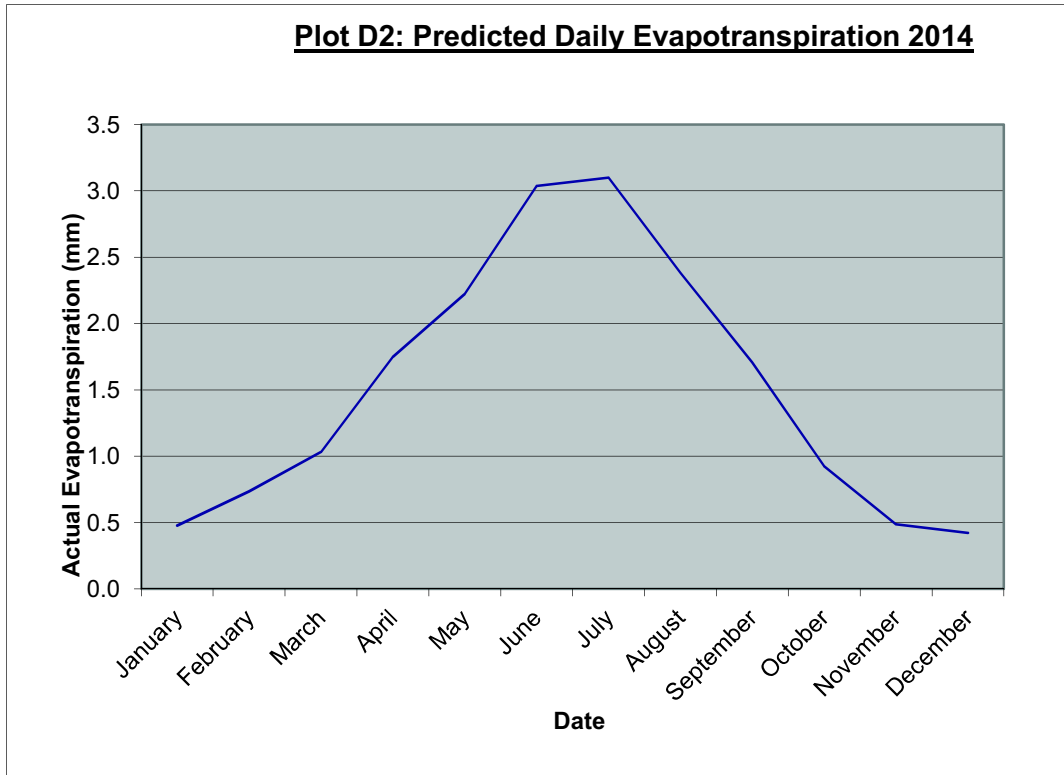
A2 Topographical and Monitoring location drawings

A3 Meteorological Data

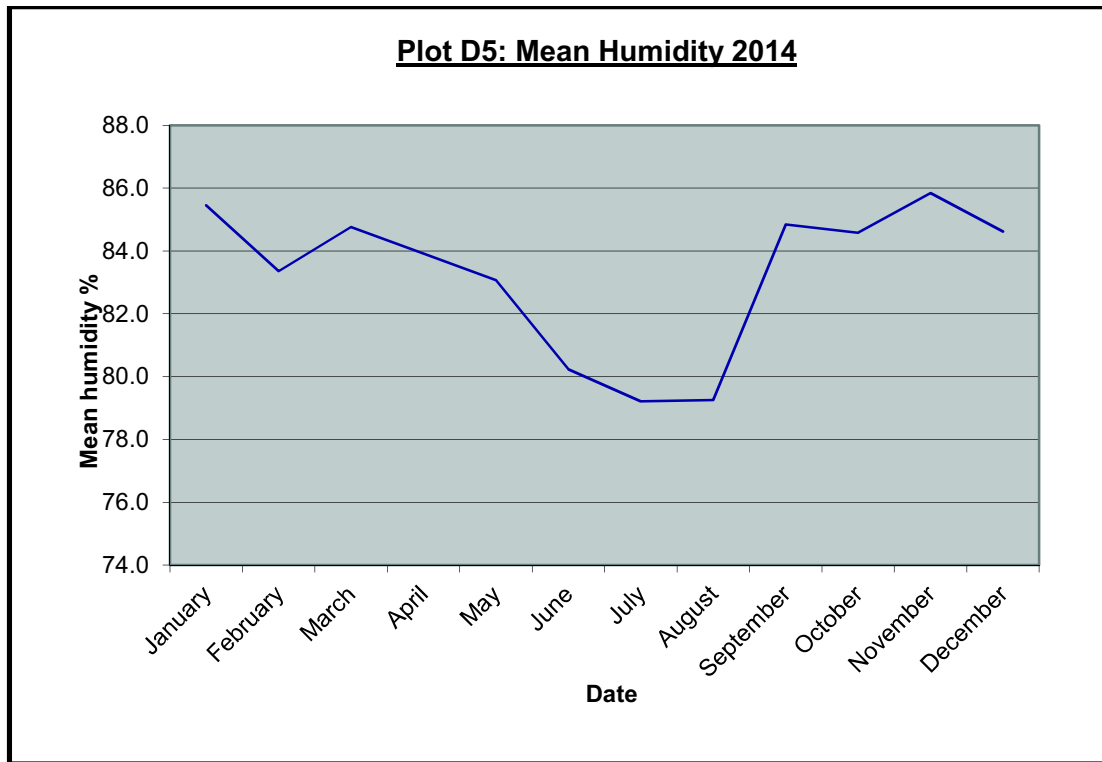
Appendix D – Meteorological Graphs



Appendix D – Meteorological Graphs




Appendix D – Meteorological Graphs



A4 Air emission report



Report Title	Air Emissions Compliance Monitoring Emissions Report
Company address	Air Scientific Ltd., 40 Coolraine Heights, Old Cratloe Road, Limerick
Stack Emissions Testing Report Commissioned by	Wexford County Council
Facility Name	Killurin Landfill, Wexford
Contact Person	Fran Hobbs
EPA Licence Number	W0016-02
Licence Holder	Wexford County Council
Stack Reference Number	Flare
Dates of the Monitoring Campaign	26-06-2014
Job Reference Number	KILATL3260614
Report Written By	Mr Dean Meagher
Report Approved by	Mr Mark McGarry
Stack Testing Team	Mark McGarry and Dean Meagher
Report Date	16-07-2014
Report Type	Test Report Compliance Monitoring
Version	2
Signature of Approver	 Operations Manager

*Opinions and interpretations expressed herein will be outside the scope of Air Scientific Limited INAB accreditation.
This test report shall not be reproduced, without the written approval of Air Scientific Limited.
All sampling and reporting is completed in accordance with Environmental Protection Agency Air Guidance Note 2 requirements.*



Executive Summary

Monitoring Objectives

Overall Aim of the monitoring Campaign

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values as specified in the site licence.

Special Requirements

There were no special requirements.

Target Parameters

Carbon Monoxide (CO)
Oxides of Nitrogen (NO _x) as NO ₂
Total Volatile Organic Carbon (TOC)
Hydrogen Chloride (HCL)
Hydrogen Fluoride (HF)
Total Chlorine
Total Fluorine
Total Sulphur

Emission Limit Values

Killurin Flare Outlet	mg.m ⁻³
CO	50
NO _x as NO ₂	150
TOC	10
HCL	50
HF	5
Volumetric Flow (m ³ .hr ⁻¹)	3,000

Reference Conditions

Reference Conditions	Value
Oxygen Reference %	3
Temperature K	273.15
Total Pressure kPa	101.3
Moisture Content	Dry

Executive Summary

Overall Results

Killurin Flare Outlet	Concentration				
Parameter	Units	Result	MU +/-	Limit	Compliant
Carbon Monoxide (CO)	mg.m ⁻³	197.4	28	50	No
Oxides of Nitrogen (NOx) as NO ₂	mg.m ⁻³	22.4	9.6	150	Yes
Total Volatile Organic Carbon (VOC)	mg.m ⁻³	69.7	0.82	10	No
Hydrogen Chloride (HCL)	mg.m ⁻³	0.8	0.05	50	Yes
Hydrogen Fluoride (HF)	mg.m ⁻³	0.3	0.005	5	Yes
Volumetric Flow	m ³ .hr ⁻¹	464	-	3,000	Yes

Note : Volumetric Flow was determined by calculation as outline in the landfill guidance notes.

Killurin Flare Inlet	Concentration				
Parameter	Units	Result	MU +/-	Limit	Compliant
Total Chlorine	mg.m ⁻³	2.7	0.16	-	-
Total Fluorine	mg.m ⁻³	0.2	0.0033	-	-
Total Sulphur	mg.m ⁻³	1.5	0.025	-	-

Accreditation details

Air Scientific Limited	INAB Number: 319T
External Analytical Laboratory	Accreditation number: UKAS 0605

Executive Summary

Process details

Flare	
Process status	Normal
Capacity (per/hour) (if applicable)	Very low gas concentrations
Continuous or Batch Process	Continuous
Feedstock	Landfill Gas
Abatement System	Yes
Abatement Systems Running Status	Normal
Fuel	Gas
Plume Appearance	None
Other information	None

Executive Summary
Monitoring, Equipment & Analytical Methods

Parameter	Standard	Technical Procedure	Accredited Testing	Analytical Technique	Equipment / Media	Equipment ID Used on Site
Carbon Monoxide (CO)	EN15058:2006	2004	Yes	NCIR By Horiba PG-250	Horiba	ASLLK12EQ525 ASLLK12EQ527 ASLLK14EQ513
Oxides of Nitrogen (NOx) as NO ₂	EN14792:2006	2002	Yes	Chemiluminescence	Horiba	
Total Volatile Organic Carbon (TOC)	EN12619:2012	2009	Yes	Flame Ionisation Detection	FID	ASLLK12EQ505 ASLLK12EQ507
Hydrogen Chloride (HCL)	EN1911:2010	2014	No	Ion Chromatography	Impingers	
Hydrogen Fluoride (HF)	EN15713:2006	2024	No	Ion Chromatography	Impingers	ASLLK14EQ502 ASLLK13EQ513 ASLLK12EQ537
Total Sulphur	EN 14791:2005	2012	No	Ion Chromatography	Impinger	

Sampling Deviations

Parameter	Deviation
Carbon Monoxide (CO)	-
Oxides of Nitrogen (NOx) as NO ₂	-
Total Volatile Organic Carbon (TOC)	-
Hydrogen Chloride (HCL)	-
Hydrogen Fluoride (HF)	-
Total Sulphur	-

Reference Documents

Risk Assessment (RA)	SOP 1011
Site Review (SR)	SOP 1015
Site Specific Protocol (SSP)	SOP 1015

Suitability of Sample Location

General Information	Flare
Permanent/Temporary	Permanent
Inside/ Outside	Outside

Platform Details		
Irish EPA Technical Guidance Note AG1 / BS EN 15259 Platform Requirements	Value	Comment
Sufficient Working area to manipulate probe and measuring instruments	Yes	-
Platform has 2 handrails (approx. 0.5m & 1.0 m high)	Yes	-
Platform has vertical base boards (approx. 0.25 m high)	Yes	-
Platform has chains / self-closing gates at top of ladders	Yes	-
There are no obstructions present which hamper insertion of sampling equipment	Yes	-
Safe Access Available	Yes	-
Easy Access Available	Yes	-

Sampling Location / Platform Improvement Recommendations
MEWP Required to reach port.

BSEN 15259 Homogeneity Test Requirements
No
Select Option : 1: There is no requirement to perform a BSEN15259 Homogeneity Test on this stack 2: Test results were obtained from previous Homogeneity test carried out by ASL 3: Test results were obtained from previous Homogeneity test carried out by Alternative contractor

Stack Diagram



1. APPENDICES

Appendix I Monitoring Personnel & Equipment

Stack Emissions Monitoring Personnel

Team Leader	Name	Mark McGarry
	System approval	ASL Team Leader Approved
Technician	Name	Dean Meagher
	System approval	ASL Technician Approved

Appendix II Stack Raw Data

Title: Determination of Total Organic Compounds
Method: EN 12619:2013
Client: Wexford Co Co
Stack Reference: Killurin Landfil Flare

Licence Limits

Emission Limit Value	10	mg.m ⁻³
Flow Rate Limit	3,000	m ³ .Hr ⁻¹

Results

TOC Concentration	15.4	mg.m ⁻³
Flow Rate	464	m ³ .Hr ⁻¹
Uncertainty of Measurement	0.82	mg.m ⁻³

Reference Conditions

Temperature (K)	273.13	⁰ K
Pressure (kPa)	101.3	kPa
Gas (Wet or Dry)	Dry	
Oxygen	3	%

Quality Data

Sampling Time	10:00	-
Sampling Date	26/06/2014	-
Instrument Range	100	ppm
Span Gas Value	75	ppm
Acceptable Gas Range	Yes	50 - 90% of Range
Oven Temperature	180	⁰ C
Average Temperature	180	⁰ C
Temperature Acceptable	Yes	Yes or No
Sample line temperature	180	C

Zero Drift

Zero Down Sampling Line (Pre)	0.1	ppm
Zero Down Sampling Line (Post)	-0.6	ppm
Zero drift	-0.7	ppm
Allowable Zero Drift	1.5	ppm
Zero Drift Acceptable	Yes	Yes or No

Span Drift

Span (Pre)	75	ppm
Span (Post)	74	ppm
Span Drift	-1	ppm
Allowable Span Drift	1.5	ppm
Span Drift Acceptable	Yes	Yes or No

Leak Check

Span Gas Conc.	75	ppm
Recorded Conc. down Line (Pre)	74	ppm
Leak Result	-1	ppm
Leak check acceptable (< 2%)	1.5	(Y/N)

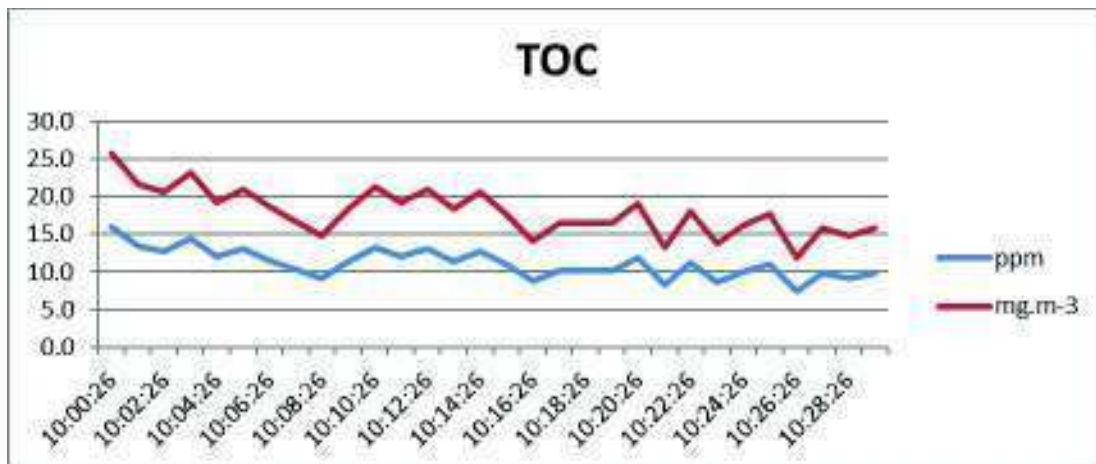
Parameter

Standard	EN 12619:2013	
Technical Procedure	2009	
Probe material	Stainless Steel	
Filtration Type	Ceramic	
Heated Head Filter Used	Stainless Steel	
Heated Line Temperature	180	Deg C
Span Gas Reference Number	ASLLK13ING531	
Span Gas Expiry Date	Oct-16	
Span Gas Start Pressure (bar)	60	bar
Gas Cylinder Concentration (ppm)	75	ppm
Span Gas Uncertainty (%)	0.3	%
Zero Gas Type	Ambient	
Number of Sampling Lines Used	1	

Number of Sampling Points Used	1	
Sample Point I.D's		
Certified Range of Analyser	10000	ppm
Operational Range of Analyser	100	ppm
Measured Reading	10	ppm
Non linearity	0.5	ppm
Temperature Dependent Zero drift	0.15	ppm Per Degree
Temperature Dependent Span drift	0.1	% Per Degree
Cross-sensitivity	0.1	ppm
Leak	-1	ppm
Calibration Gas uncertainty	0.3	ppm
Calibration Gas uncertainty	0.3	ppm

Title: Determination of Total Organic Compounds
Method: EN 12619:2013
Client: Wexford Co Co
Stack Reference: Killurin Landfil Flare

Run 1	Time	ppm	mg.m ⁻³
1	10:00:26	16.0	25.8
2	10:01:26	13.4	21.6
3	10:02:26	12.8	20.6
4	10:03:26	14.4	23.2
5	10:04:26	12.0	19.3
6	10:05:26	13.0	20.9
7	10:06:26	11.6	18.7
8	10:07:26	10.4	16.7
9	10:08:26	9.2	14.8
10	10:09:26	11.4	18.4
11	10:10:26	13.2	21.3
12	10:11:26	12.0	19.3
13	10:12:26	13.0	20.9
14	10:13:26	11.4	18.4
15	10:14:26	12.8	20.6
16	10:15:26	11.0	17.7
17	10:16:26	8.8	14.2
18	10:17:26	10.2	16.4
19	10:18:26	10.2	16.4
20	10:19:26	10.2	16.4
21	10:20:26	11.8	19.0
22	10:21:26	8.2	13.2
23	10:22:26	11.2	18.0
24	10:23:26	8.6	13.8
25	10:24:26	10.0	16.1
26	10:25:26	11.0	17.7
27	10:26:26	7.4	11.9
28	10:27:26	9.8	15.8
29	10:28:26	9.2	14.8
30	10:29:26	9.8	15.8
Average		11.1	17.9
Adjusted for O₂ and Moisture			69.7



Title: **Determination of Combustion Flue Gases**
Method: EN 14792 / EN 14789 / EN 12039 / TGN M21
Client: Wexford Co Co
Test Date: 26/06/2014
Stack Name: Killurin Landfill Flare

Reference Conditions

Measured Oxygen 16.0 %
 Reference Oxygen 3 %

Parameter		CO	NO	O ₂
Emission Limit Values	mg.m ⁻³ ref	50	150	
Instrument Range	ppm	500	500	25
Span Gas Value	ppm	211	350	20.9
Acceptable Gas Range	-	No	Yes	Yes
Calibration Gas Uncertainty	%	1.1	0.4	0.5

Quality Assurance	Units			
Conditioning Unit Temperature	C	2	2	2
Average Temperature	< C	2	2	2
Allowable Temperature	-	4	4	4
Temperature Acceptable	-	Yes	Yes	Yes
Pump flow rate	l/min.	0.4	0.4	0.4

Zero Drift	Units			
Zero (Pre)	ppm	-1	0.1	0
Zero (Post)	ppm	-1.6	0.3	0.14
Zero drift	ppm	-0.6	0.2	0.14
Allowable Zero Drift (Less than)	ppm	4.22	7	0.418
Adjustable Zero Drift (Less than)	ppm	10.55	17.5	1.045
Zero Drift Failure (Greater than)	ppm	10.55	17.5	1.045
Zero Drift Acceptable	-	Yes	Yes	Yes

Span Drift	Units			
Span Down (Pre)	ppm	211	350	20.9
Span Down (Post)	ppm	210	346	20.86
Span Drift	ppm	-1	-4	-0.04
Allowable Span Drift (less than)	ppm	4.22	7	0.418
Adjustable Span Drift (Less than)	ppm	10.55	17.5	1.045
Span Drift Failure (Greater than)	ppm	10.55	17.5	1.045
Span Drift Acceptable (Y/N)	-	Yes	Yes	Yes

Leak Check				
Span Gas Conc.	ppm	211	350	0
Recorded Conc. down Line	ppm	212	351	0.04
Leak Detected	ppm	1	1	0.04
Leak check acceptable (< 2%)	ppm	4.22	7	0.418
Pass	(Y/N)	Yes	Yes	Yes

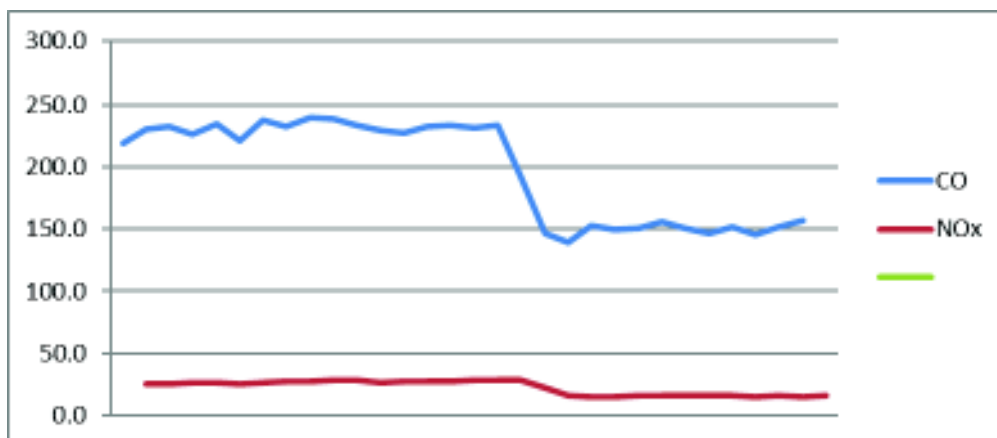
Test Conditions	Units			
Run Ambient Temperature Range	C	12	12	12

Raw Data

<i>Date/Time</i>	<i>Data source</i>	<i>CO</i> <i>ppm</i>	<i>NOx</i> <i>ppm</i>	<i>O₂</i> <i>vol%</i>
26/06/2014 10:08		37.392	2.642	17.087
26/06/2014 10:09		43.300	2.908	16.694
26/06/2014 10:10		43.117	2.950	16.745
26/06/2014 10:11		46.517	3.308	16.292
26/06/2014 10:12		52.158	3.400	15.930
26/06/2014 10:13		40.733	2.992	16.786
26/06/2014 10:14		45.508	3.250	16.620
26/06/2014 10:15		42.550	3.050	16.798
26/06/2014 10:16		45.600	3.275	16.643
26/06/2014 10:17		43.775	3.225	16.798
26/06/2014 10:18		47.408	3.292	16.367
26/06/2014 10:19		45.450	3.275	16.459
26/06/2014 10:20		42.117	3.108	16.747
26/06/2014 10:21		47.250	3.417	16.343
26/06/2014 10:22		41.242	3.117	16.947
26/06/2014 10:23		40.958	3.058	16.939
26/06/2014 10:24		37.292	2.725	17.332
26/06/2014 10:25		38.492	2.742	16.428
26/06/2014 10:26		37.908	2.533	15.107
26/06/2014 10:27		34.108	2.292	15.411
26/06/2014 10:28		40.833	2.525	14.918
26/06/2014 10:29		39.242	2.525	15.029
26/06/2014 10:30		39.983	2.542	14.980
26/06/2014 10:31		42.008	2.658	14.868
26/06/2014 10:32		38.767	2.483	15.133
26/06/2014 10:33		36.175	2.375	15.366
26/06/2014 10:34		40.242	2.500	14.980
26/06/2014 10:35		36.192	2.358	15.343
26/06/2014 10:36		40.050	2.450	14.989
26/06/2014 10:37		42.600	2.625	14.811
Average		41.632	2.853	16.030

Referenced Data

	CO	NOx
	mg/Nm³ Reference O₂	
26/06/2014 10:08	219.4	25.5
26/06/2014 10:09	230.4	25.4
26/06/2014 10:10	232.2	26.1
26/06/2014 10:11	225.9	26.4
26/06/2014 10:12	234.8	25.1
26/06/2014 10:13	221.5	26.7
26/06/2014 10:14	237.9	27.9
26/06/2014 10:15	232.1	27.3
26/06/2014 10:16	239.6	28.3
26/06/2014 10:17	238.7	28.9
26/06/2014 10:18	234.0	26.7
26/06/2014 10:19	229.0	27.1
26/06/2014 10:20	226.9	27.5
26/06/2014 10:21	232.0	27.6
26/06/2014 10:22	233.5	29.0
26/06/2014 10:23	231.4	28.4
26/06/2014 10:24	233.9	28.1
26/06/2014 10:25	192.6	22.5
26/06/2014 10:26	146.4	16.1
26/06/2014 10:27	139.0	15.3
26/06/2014 10:28	152.7	15.5
26/06/2014 10:29	149.6	15.8
26/06/2014 10:30	151.1	15.8
26/06/2014 10:31	155.8	16.2
26/06/2014 10:32	150.4	15.8
26/06/2014 10:33	146.3	15.8
26/06/2014 10:34	152.1	15.5
26/06/2014 10:35	145.7	15.6
26/06/2014 10:36	151.6	15.2
26/06/2014 10:37	156.5	15.8
Average	197.4	22.4
Uncertainty of Measurement	28.0	9.6
Uncertainty as % of ELV	55.91	6.38
Standard Requirement	<10%	<10%



Title: Determination of Inorganic Compounds
Method: EN 1911
Client: Wexford Co Co
Test Date: 26/06/2014
Laboratory Used: RPS
Certificate Numbers: WK14-4328
Stack Reference: Killurin Landfill Flare Inlet

Leak Check Results	Chlorine	Sulphur	Fluorine	
Prior to test:	0	0	0	l/min
Post Test:	0	0	0	l/min
Sample Volume Flow Rate:	2	2	2	l/min
Standard Requirement:	<2	<2	<2	%
Test Result:	0.0	0.0	0.0	%
Test Status	Pass	Pass	Pass	

Reference Details		
Reference Oxygen	3	%
Measured Oxygen	16.03	%

Calibration Details	Chlorine	Sulphur	Fluorine	
Pump Number:	ASLLK13EQ513	ASLLK13EQ513	ASLLK12EQ537	
Calibration Unit:	ASLLK14EQ502	ASLLK14EQ502	ASLLK14EQ502	
Calibration Rate Before Test:	2.1	2.1	2.4	litres per minute
Calibration Rate After Test:	2.050	2.050	2.350	litres per minute
Average sample Volume:	2.075	2.075	2.375	litres per minute
Sample Test Time:	30	30	30	minutes
Pump Gas Temperature:	12	12	12	°C
Pump Sample Pressure:	100.3	100.3	100.3	kPa
Actual Sample Volume:	0.06225	0.062	0.071	m ³
Normalised Gas Volume:	0.05904	0.059	0.068	Nm ³

Sample Details	Chlorine	Sulphur	Fluorine
Impinger Solution	DI Water	DI Water	0.1N NaOH
Solution ID Number:	Run 1	Run 1	Run1
Blank Identification Number:	Blank 1	Blank 1	Run1
Impinger Material	PTFE	PTFE	PE
Breakthrough Occurred	No	No	No
Transport Temp meets Standard	Yes	Yes	Yes
Analysed Within Specified Timeframe	Yes	Yes	Yes
Transport Container Airtight	Yes	Yes	Yes
Exposed to Sunlight	No	No	No
Field Blank <10% ELV	Yes	Yes	Yes

Calculations	Chlorine	Sulphur	Fluorine	
Laboratory Result Imp 1	1.06	0.36	0.05	ug/ml
Laboratory Result Imp 2	0.15	0.59	0.05	ug/ml
Impinger Final Volume Imp 1	34	34	45	ml
Impinger Final Volume Imp 2	40	40	27	ml
Combined Concentration	0.04204	0.03584	0.0036	mg
Factor	1.023	0.667	1.053	
Concentration	0.043	0.024	0.004	mg
Air Sample Volume	0.059	0.059	0.068	Nm ³
Emissions Concentration	0.728	0.4	0.1	mg.m ⁻³
Referenced Results	HCl	SO4	HF	
Emissions Concentration	2.7	1.5	0.2	mg.m ⁻³ Referenced O ₂
Licence Limits	50		5	mg.m ⁻³
Uncertainty	0.1642	0.0248	0.0033	mg.m ⁻³

Title:	Determination of Inorganic Compounds	
Method:	EN 1911	EN 14791
Client:	Wexford Co Co	
Test Date:	26/06/2014	
Laboratory Used:	RPS	
Certificate Numbers:	WK14-4328	
Stack Reference:	Killurin Landfill Flare Inet	

Leak Check Results	HCl	HF	
Prior to test:	0	0	l/min
Post Test:	0	0	l/min
Sample Volume Flow Rate:	2	2	l/min
Standard Requirement:	<2	<2	%
Test Result:	0.0	0.0	%
Test Status	Pass	Pass	

Reference Details		
Reference Oxygen	3	%
Measured Oxygen	16.03	%

Calibration Details	HCl	HF	
Pump Number:	ASLLK13EQ513	ASLLK12EQ537	
Calibration Unit:	ASLLK14EQ502	ASLLK14EQ502	
Calibration Rate Before Test:	2.12	2.42	litres per minute
Calibration Rate After Test:	2.140	2.430	litres per minute
Average sample Volume:	2.13	2.425	litres per minute
Sample Test Time:	30	30	minutes
Pump Gas Temperature:	15	15	°C
Pump Sample Pressure:	100.2	100.2	kPa
Actual Sample Volume:	0.06390	0.073	m ³
Normalised Gas Volume:	0.05991	0.068	Nm ³

Sample Details	HCl	HF
Impinger Solution	DI Water	0.1N NaOH
Solution ID Number:	Run 1	Run1
Blank Identification Number:	Blank 1	Run1
Impinger Material	PTFE	PE
Breakthrough Occurred	No	No
Transport Temp meets Standard	Yes	Yes
Analysed Within Specified Timeframe	Yes	Yes
Transport Container Airtight	Yes	Yes
Exposed to Sunlight	No	No
Field Blank <10% ELV	Yes	Yes

Calculations	HCl	HF	
Laboratory Result Imp 1	0.13	0.05	ug/ml
Laboratory Result Imp 2	0.1	0.05	ug/ml
Impinger Final Volume Imp 1	51	56	ml
Impinger Final Volume Imp 2	61	42	ml
Combined Concentration	0.01273	0.0049	mg
Factor	1.023	1.053	
Concentration	0.013	0.005	mg
Air Sample Volume	0.060	0.068	Nm ³
Emissions Concentration	0.217	0.1	mg.m ⁻³

Referenced Results	HCl	HF	
Emissions Concentration	0.8	0.3	mg.m ⁻³ Referenced O ₂
Licence Limits	50	5	mg.m ⁻³
Uncertainty	0.0488	0.0045	mg.m ⁻³

A5 Water Balance Calculation

Appendix A5

Water Balance Calculation for Killurin Landfill 2014

Month	Rainfall	Evaporation	Effective Rainfall	Capped Area (above road)	Capped Area (Below road)	Open Area (Haul Road)	Additional runoff to haul road (effective area)	Capped Infiltration	Infiltration through incident rain on haul road	Infiltration from runoff to haul road	Total Leachate Production	Cumulative Leachate Production	Leachate Tankered Offsite
	(mm)	(mm)	(mm)	(m ²)	(m ²)	(m ²)	(m ²)	(m ³)	(m ³)	(m ³)	(m ³)	(m ³)	(m ³)
Jan-14	145.1	14.8	130.3	39,282	15,340	6,600	39,282	355.9	322.5	575.8	1,254.2	1,254.2	650.7
Feb-14	175.1	20.6	154.5	39,282	15,340	6,600	39,282	422.0	382.4	682.8	1,487.1	2,741.3	558.4
Mar-14	94.6	32	62.6	39,282	15,340	6,600	39,282	171.0	154.9	276.6	602.5	3,343.8	855.8
Apr-14	67.1	52.4	14.7	39,282	15,340	6,600	39,282	45.0	-	-	45.0	3,388.8	648.8
May-14	63.6	68.9	0	39,282	15,340	6,600	39,282	-	-	-	-	3,388.8	551.3
Jun-14	35.2	91.1	0	39,282	15,340	6,600	39,282	-	-	-	-	3,388.8	313.0
Jul-14	35.5	96.1	0	39,282	15,340	6,600	39,282	-	-	-	-	3,388.8	249.3
Aug-14	128	73.8	54.2	39,282	15,340	6,600	39,282	165.9	-	-	165.9	3,554.7	-
Sep-14	16.3	51.2	0	39,282	15,340	6,600	39,282	-	-	-	-	3,554.7	59.2
Oct-14	196.7	28.7	168	39,282	15,340	6,600	39,282	514.3	-	-	514.3	4,069.0	300.5
Nov-14	154	14.6	139.4	39,282	15,340	6,600	39,282	426.7	-	-	426.7	4,495.7	933.3
Dec-14	43.5	13.1	30.4	39,282	15,340	3,960	39,282	89.0	-	-	89.0	4,584.8	202.5
Total	1,155	557	754					2,190	860	1,535	4,585		5,323

Notes:

The calculation was carried out using MS Excel following the method from the EPA Landfill Manual on Landfill Site Design, as shown:

$$Lo = [ER(A) + LW + IRCA + ER(I)] - a(W);$$

- where:
- Lo = leachate produced(m³)
 - ER = effective rainfall, [(ER) is defined as Total Rainfall (R) minus Actual Evapotranspiration (AE) i.e. ER=R-AE]
 - A = area of cell (m²)
 - LW = liquid waste (m³)
 - IRCA = infiltration through restored and capped areas (m²)
 - I = surface area of lagoons (m²)
 - a = absorptive capacity of waste (m³/t)
 - W = weight of waste deposited (t/a)

* Infiltration Rates (%) Look to Design Criteria for exact figures (Ranges from 5% to 100%)

A6 Leachate Tank Integrity Test Report

Capital Surveys Ltd

Bricketstown, Taghmon,
Co Wexford
053 9240825
087 6857464

Capital Surveys Ltd

www.capitalsurveys.ie

GPS Surveying Systems

Mapping

Land Surveying

Building and Elevation Surveys

Report on Inspection and testing of leachate Storage tanks at Killurin Land Fill site.

October 2014.

Client Address - Mr Fran Hobbs.

Wexford County Council, County Hall, Carriglawn, Wexford.

Prepared by - Justin Kelly BEng MIEI MCIQB, Capital Surveys Ltd

Castlehayestown, Taghmon, Co Wexford.

Tel 053 92 40825 - 087 6857464

info@capitalsurveys.ie

www.capitalsurveys.ie

File ref no - 2014 – 145 SS/T1

Content Page.

1. Introduction.
2. Summary of Inspection.
3. Summary of Integrity Tests.
 - 3.1 Test Protocol.
 - 3.2 Visual inspection
 - 3.3 Testing results.
4. Conclusion.

Plates.

Appendices.

1. Procedure for inspection and testing of banded areas and leachate storage tanks at Killurin Landfill.
2. Visual examination records of leachate storage tank interior (Photo file).

Introduction.

This report covers the inspection and testing of leachate storage tanks (LSTs) at Killurin Landfill, Newtown Lower, Killurin, Co Wexford.

The LSTs were inspected and tested in compliance with Condition 3.12.2 of the licence , which states

The licensee shall provide and maintain leachate storage tanks at the facility to facilitate the storage of leachate abstraction / collection from the waste. All leachate storage structures on the facility shall be inspected and certified fit for purpose every three years by an independent and appropriately qualified engineer

There are three LSTs connected in series on site.

The structures were inspected and tested in October 2011, following the procedure for inspection and testing of bunded area and leachate storage tanks contained in Appendix 1.

3.3 Testing results.

The LSTs are connected in series with leachate from the landfill discharging to LST 1. A gravity overflow arrangement ensures that water above a level of approximately 2.57 m in LST 1 will flow into LST 2. Water above 2.43m in LST 2 discharge to LST3. As the landfill leachate is pumped continuously in to LST 1, it was not practicable to test this tank. A 24 hr test was carried out to determine any possible leakage. By ensuring that LST 1 was emptied frequently the seven days tests were possible on LST 2 and LST 3.

LST 2 and LST 1 were filled with water on the 5th of October and were allowed to stabilise for 24 hours prior to the commencement of the test on the 7th October 2014. Measurements of the liquid were made each day for the 7 days. The external walls were also inspected during the test to check for signs of seepage from the tanks.

The results of the tests indicate that the water levels in LST 2 and LST 3 fell by 2-3 mm respectively. No seepage from the tanks was observed on the external tanks during the test. Both these tanks are deemed to have passed the integrity test and are deemed fit for storing leachate.

Operational restrictions precluded the testing procedures being applied to LST1. Therefore we cannot categorically certify that the condition of this tank is appropriate for the storage of leachate. However the tank was constructed similarly to LST2 and LST 3. Based on the results of the integrity test of LST2 and LST 3 and considering the similar physical conditions of LST1, we consider it is reasonable to assume that LST 1 is also fit for the storing leachate as the other tanks passed the test.

Table 2 Test records.

2. Summary of Inspection.

The LST s comprise three tanks connected in series (see Photograph 2). Each tank comprise two precast concrete box culvert sections laid on their side and stacked. The joints between the lower section and the reinforced concrete base, and the joints between the upper and lower section are sealed using a bitumen based seal. Each tanks is covered by four reinforced concrete slabs laid across the top of each tank.

Each tank measures 4.1 m long by 5.0 m wide externally. The walls are nominally 260mm thick. Internally each tank measures 3.58 m by 4.48 m by 2.9 m deep. The tanks were constructed in early 2003.

The summary details of construction and capacity of the tanks is given in Table 2.

Table 1. Summary of Inspection of leachate Storage Tanks.

TANK NO	VOLUME OF TANKS LITRES	EFFECTIVE CAPACITY OF TANK LITRES	TANKS CONSTRUCTION LITRES.
1	46,500	40,150	Precast Concrete
2	46,500	38,800	Precast Concrete
3	46,500	46,500	Precast Concrete

1. This is the gross volume of the tank using the internal dimension.
2. This is the volume of the tank up the level of the invert of the overflow from the tank

The tanks are partially buried and the eastern faces of all tanks, the southern face of LST 1 and the northern face of LST 3 are covered with soil. An inspection of the exposed external faces of each tank was made . The sealed joints between the precast sections are pointed with cement mortar on the external faces of LST 3, but are not pointed on LST 1 and LTS 2. The exposed bitumen seal are continuous and show no sign of cracking or weathering. The joints are approximately 1.32 m above the base of the tank.

The exposed concrete is in good condition and there are no cracks or corrosion in evidence.

There is some minor damage to the external north west corner of LTS 3, where a thin layer of concrete has

broken away. There are no cracks or deterioration of concrete around this damaged area.

Hoist anchors are located at the external corners of each precast section, where the thickness of concrete is significantly reduced. The anchors are exposed and are rusted on the surface.

There is no evidence of leakage or staining by leachate on the exposed external walls of the tanks.

The LSTs were pumped out and visually inspected using a visual aid and photo survey. Some residual sediment and leachate remained on the floor of each tank precluding a visual inspection of the floor and the floor to wall joints of each tank.

The internal joints between the upper and lower sections are pointed with cement mortar in LST 3 only, while LST1 and LST2 only some of the internal joints are pointed. The bitumen seal behind the cement pointing remains intact however. The concrete is in good condition throughout the internal surfaces of the tanks and no defects to the concrete, joints, water bar or reinforcement are in evidence.

3. Summary of Integrity tests.

3.1 Test protocol.

The procedure for integrity testing of bunded areas and LSTs was designed to comply with the requirements of section 9.2 of B.S 8007:1987, the British standards code of practice for design of concrete structure for retaining aqueous liquids. The relevant section of the procedure are summarised in the form contained in appendix 1.

BS 8007 calls for a minimum 7 day test for concrete structures designed and construed in accordance with the requirements of the standards. While the standard is not applicable to the structure to be tested on site, this testing period was used as a guide for the tests.

The LSTs were tested over 7 days. The records of hydrostatic test form, also contained in Appendix 1, was completed for each LST. Each structure would be deemed to have failed the test if the level of the water dropped more than 10mm over the duration of the test, as required by the standard.

As the LSTs are covered it was not necessary to measure and record the daily rainfall and evaporation for the duration of the test.

3.2 Visual Inspection.

In addition to integrity testing all three of the tanks were visually inspected and a photographic survey included in appendix 2.

The results of the test are discussed in the following sections.

I confirm that as the engineer the above test were carried out to my satisfaction and these tanks are certified fit for use.

A handwritten signature in black ink, appearing to read "Justin Kelly", is written over a horizontal line.

Conclusion.

The LSTs were drained and inspected. Some of the seals in LST 1 and LST 2 were not pointed with cement mortar, however the bitumen seals were found to be in tact. The pointing should be replaced to maintain the integrity of the seals.

The small area of damage concrete was noted on the upper north western corner of LST 3. The damages should be made good.

The steel anchors should be cleaned and covered to reduce corrosion of the concrete around these points and to provide uniform thickness of concrete at all points of the tanks.

LST2 and LST 3 were integrity tested in October 2014. Both tanks passed the integrity test and are deemed fit for storage of leachate.

LST 1 was not tested due to operational restrictions, but a 24 hrs test was carried out and visually inspected and is of the same age, construction and condition as LST2 and LST3. Therefore we consider it is reasonable to conclude that LST 1 is also fit for purpose.

Table 2 Test records

Tank 2.				
Date	Date	Time	Liquid level mm	Signed
Tuesday	7 th Oct	5.45	.659	J Kelly.
Wednesday	8 th Oct	5.45	.659	J Kelly.
Thursday	9 th Oct	5.20	.658	J Kelly.
Friday	10 th Oct	5.40	.658	J Kelly
Saturday	11 th Oct	5.45	.658	J Kelly
Sunday	12 th Oct	5.40	.657	J Kelly
Monday	13 th Oct	5.40	.657	J Kelly

Tank 3.				
Date	Date	Time	Liquid level mm	Signed
Tuesday	7th Oct	5.45	.663	J Kelly.
Wednesday	8th Oct	5.45	.663	J Kelly.
Thursday	9th Oct	5.20	.663	J Kelly.
Friday	10th Oct	5.40	.662	J Kelly
Saturday	11th Oct	5.45	.662	J Kelly
Sunday	12th Oct	5.40	.662	J Kelly
Monday	13th Oct	5.40	.662	J Kelly

Capital Surveys Ltd

Brickerslowe, Taghmon,
Co. Westford
0534 924025
0870 4857464
www.capitalsurveys.com

GPS Surveying Systems

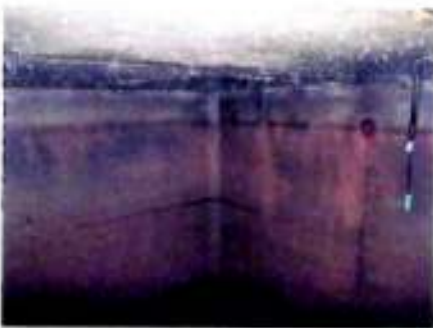
Mapping

Land Surveying

Drilling and Operational Surveys



External images of tanks at Killurin.



Internal images of LST 1



External images LST 2



Internal images of LST 2



External image of LST 3



Internal Images of LST 3.