ANNUAL ENVIRONMENTAL REPORT

FOR

ARTHURSTOWN LANDFILL
KILL, CO. KILDARE

FOR THE PERIOD

1ST JANUARY 2015 – 31ST DECEMBER 2015

WASTE LICENSE NO: W0004-04

Prepared by:

Facility Management,
Arthurstown Landfill,
Kill,
Co. Kildare.

12th April 2016

AER 17

TABLE OF CONTENTS

PAGE

TABLE OF FIGURES

PAGE

LIST OF APPENDICES

1. INTRODUCTION

1.1. Site Location

Arthurstown landfill, Kill, Co. Kildare is owned and operated by South Dublin County Council (SDCC). SDCC was granted a waste licence to operate the site by the Environmental Protection Agency. Land-filling commenced in October 1997.
The current waste licence register number is W004-004 and was issued December 2009. The facility is located approximately 25 km south-west of Dublin City and caters for the Greater Dublin Region.

The national grid coordinates for the facility are E 295691 N 220936. Figure 1.1 is a site location map.

The prevailing land use in the area is the bloodstock industry and agriculture. The site was a disused quarry when purchased by SDCC in 1992. It had been a sand and gravel quarry. Some unauthorised dumping took place in the 1970's. SDCC carried out remediation and restoration works on the unauthorised "dump" known locally as "Gavin's Dump".

Groundwater generally flows in a north-westerly direction. There are two rivers in the area, the Hartwell River and the Kill River. Surface water run-off from the site is first collected and stored in the on-site surface water storage lagoon before being discharged to the Hartwell River along with pumped groundwater. Groundwater levels beneath the landfill were artificially reduced during cell construction using a cut-off pipe system so that the water table is maintained below the landfill lining system base level.

The prevailing winds are south to south westerly. The annual rainfall for the area is approximately 900 mm.
The landfill is now closed and is now in the aftercare and restoration phases.

Final capping is now complete and this was achieved during the final quarter of 2013.

The landfill is now in the aftercare phase and is closed.

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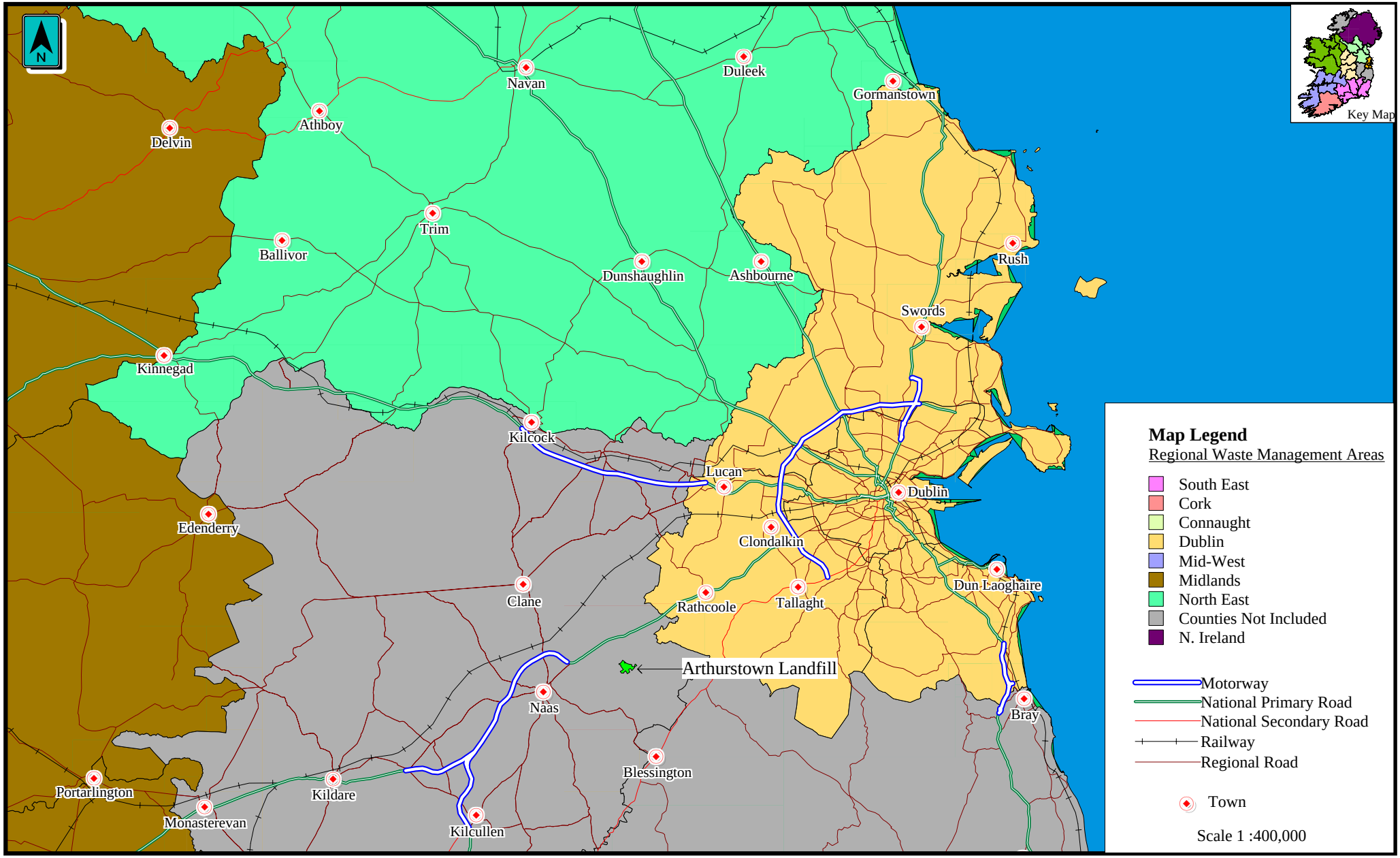
SDC-AP_Figure 2.1_ Site Location-Regional _Rev A



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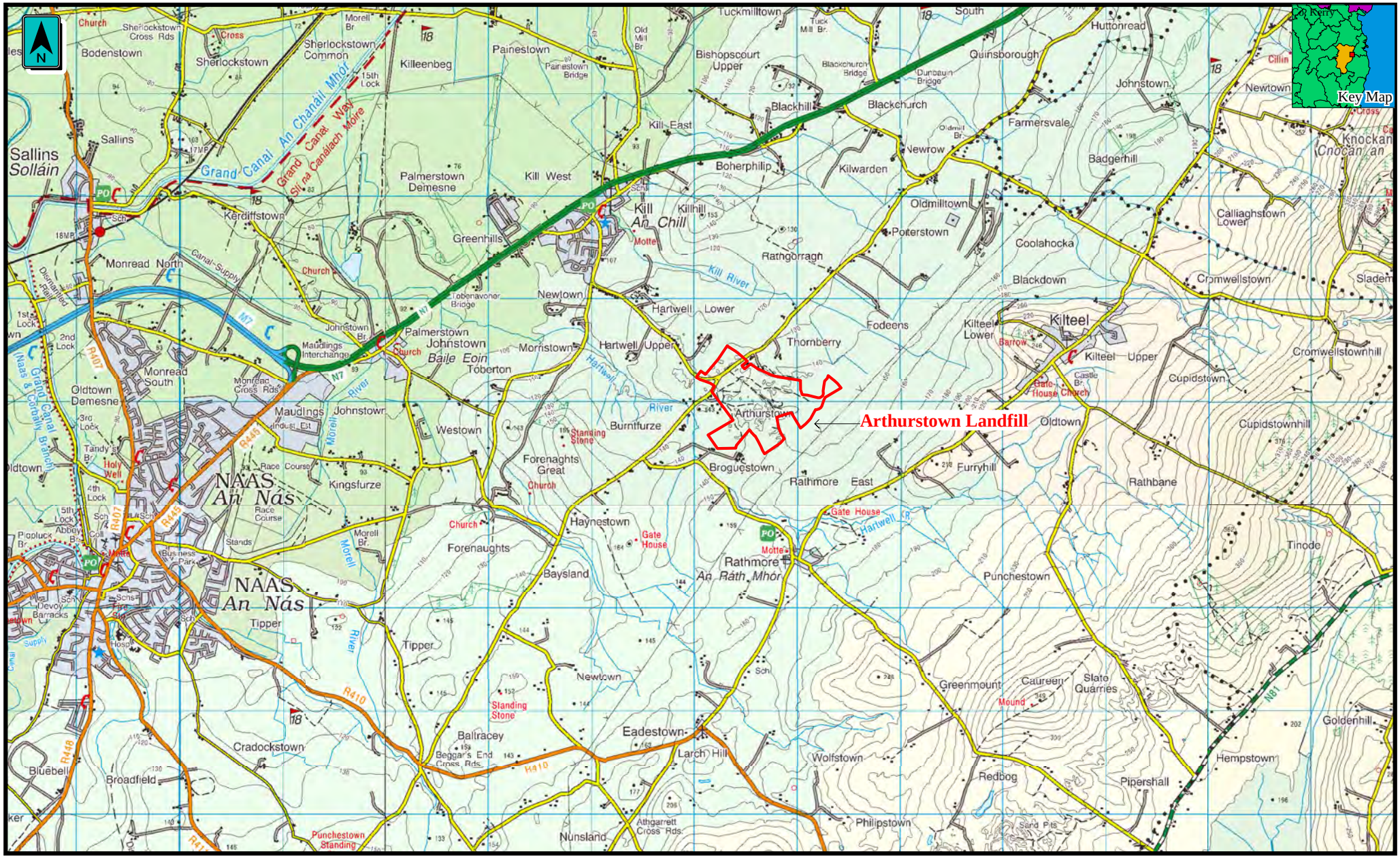
Site Location - Regional

Figure 2.1



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1: 50,000 Site Location Map

Figure 2.2

1.2. Purpose

This Annual Environmental Report (AER) has been prepared in compliance with Condition 11.5 of the waste licence. It is the 17th AER for the facility.

Condition 11.5.1 states that:

"Annual Environmental Report"

The licensee shall submit to the Agency for its agreement, by 31st March each year, an Annual Environmental Report (AER).

The AER shall include as a minimum the information specified in *Schedule F: Content of Annual Environmental Report*, of this licence and shall be reported in accordance with any relevant written guidance issued by the Agency".

The AER includes all of the items that are required by Schedule F of the current waste licence for the facility.

This AER covers the operational period of the landfill from 1st January 2015 to 31st December 2015.

This is the fifth AER to cover the period of closure for the facility as this facility is now closed for receiving waste since 21st December 2010.

2. SITE DESCRIPTION AND ACTIVITIES

2.1. Waste Activities

Waste activities are no longer carried out at Arthurstown as the facility is now closed.

Licensed Waste Disposal Activities,
in accordance with the Third Schedule of the Waste Management Acts 1996-2003

Class 1 **Deposit on, in or under land (including landfill):**

This activity is limited to the deposit of baled municipal waste at the facility.

Class 4 **Surface impoundment; including placement of liquid or sludge discards into pits, ponds or lagoons:**

This activity is limited to the storage of leachate in the storage and treatment tank and lagoons and the storage of surface water and groundwater at the facility.

Class 5 **Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment:**

This activity is limited to the deposit of baled municipal waste into lined cells at the facility.

Class 6 **Biological treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1. to 10. of this Schedule:**

This activity is limited to the biological treatment of leachate arising from the waste disposed of on-site.

Class 7 **Physico-chemical treatment not referred to elsewhere in this Schedule (including evaporation, drying and calcination) which results in final compounds or mixtures which are disposed of by means of any activity referred to in Paragraphs 1. to 10. of this Schedule:**

This activity is limited to the physico-chemical treatment of leachate arising from the waste disposed of on-site.

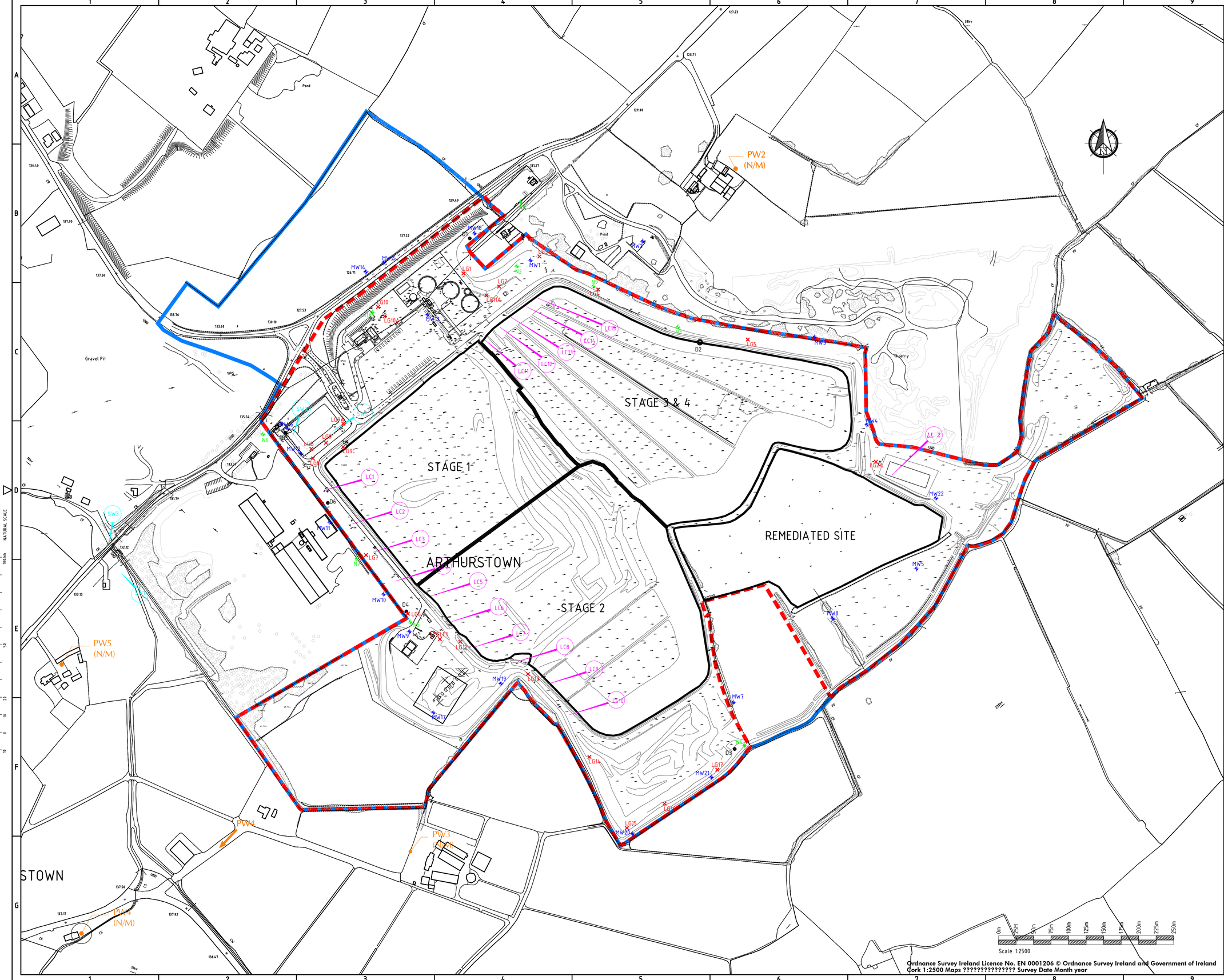
2.2. Waste quantities

Table 2.1 is a list of waste material received at the facility since operations commenced in 1997 until 21st December 2010 when land filling ceased.

Table 2.1 Waste Intake (Tonnes)

Year	Waste Materials (Tonnes)	
	Cumulative Waste Inputs	Annual Waste Inputs
2010	4,779,021.09	191,553
2009	4,587,468	214,560
2008	4,372,908	301,828
2007	4,071,077	480,529
2006	3,590,548	591,755
2005	2,998,793	497,400
2004	2,501,393	423,626
2003	2,077,767	483,582
2002	1,594,185	463,436
2001	1,130,749	334,333
2000	796,416	274,642
1999	521,774	271,079
1998	250,695	216,284
1997	34,411	34,411

The facility closed on the 21st December 2010 and is now in its aftercare phase.



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				Rev Origin Date	Description

Revision History: A

Name of Client

SOUTH DUBLIN COUNTY COUNCIL

Name of Job

ARTHURSTOWN LANDFILL
PLANNING AND EIS

Title of Drawing

ENVIRONMENTAL MONITORING LOCATIONS

Scales Used
1:2500

Dwg. No. 2006-054-03-FIG2.4 — **Rev.** A

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2.3. Resource and Energy Consumption

The principal resources consumed at the landfill facility are diesel oil and electricity. Site vehicles were fuelled by diesel oil.
There are no site vehicles presently on site due to the completion of the aftercare and restoration phase of closure programme.

Table 2.2 Resource Use and Energy Consumption

Resource/Energy	Units	Quantity Used in 2015
Diesel Oil	(Litres)	3,000 (Approx)
Electricity (As per SCADA)	(kWh)	280,330

2.4. Leachate Generation

In 2015 leachate was collected from the waste cells and pumped to the leachate treatment plant. Treated leachate only is discharged to the local sewer with the permission of Kildare County Council and the Agency. During periods of heavy rainfall, there was in the past the occasional requirement for leachate to be removed from site by road tanker for discharge to the agreed foul sewer location.
Table 2.3 lists the quantities of leachate tankered off site and treated leachate discharged to the sewer in 2015. These figures should reduce over the coming years due to the landfill area now being completely capped.

The total quantity of leachate tankered off-site and discharged to sewer for 2015 is 17,256.34 tonnes or m^3. (7,862.17 tonnes less than 2014)

Month	Tonnes leachate tankered off site 2015	Tonnes Leachate Discharged to Sewer 2015	Total Leachate
Total	**7,738.34**	**9,518**	**17,256.34**

Table 2.3 Leachate Removal Off-Site for 2015.

ENVIRONMENTAL MONITORING

This is a summary of results and interpretation of environmental monitoring carried out in the period 1st January 2015 to 31st December 2015.

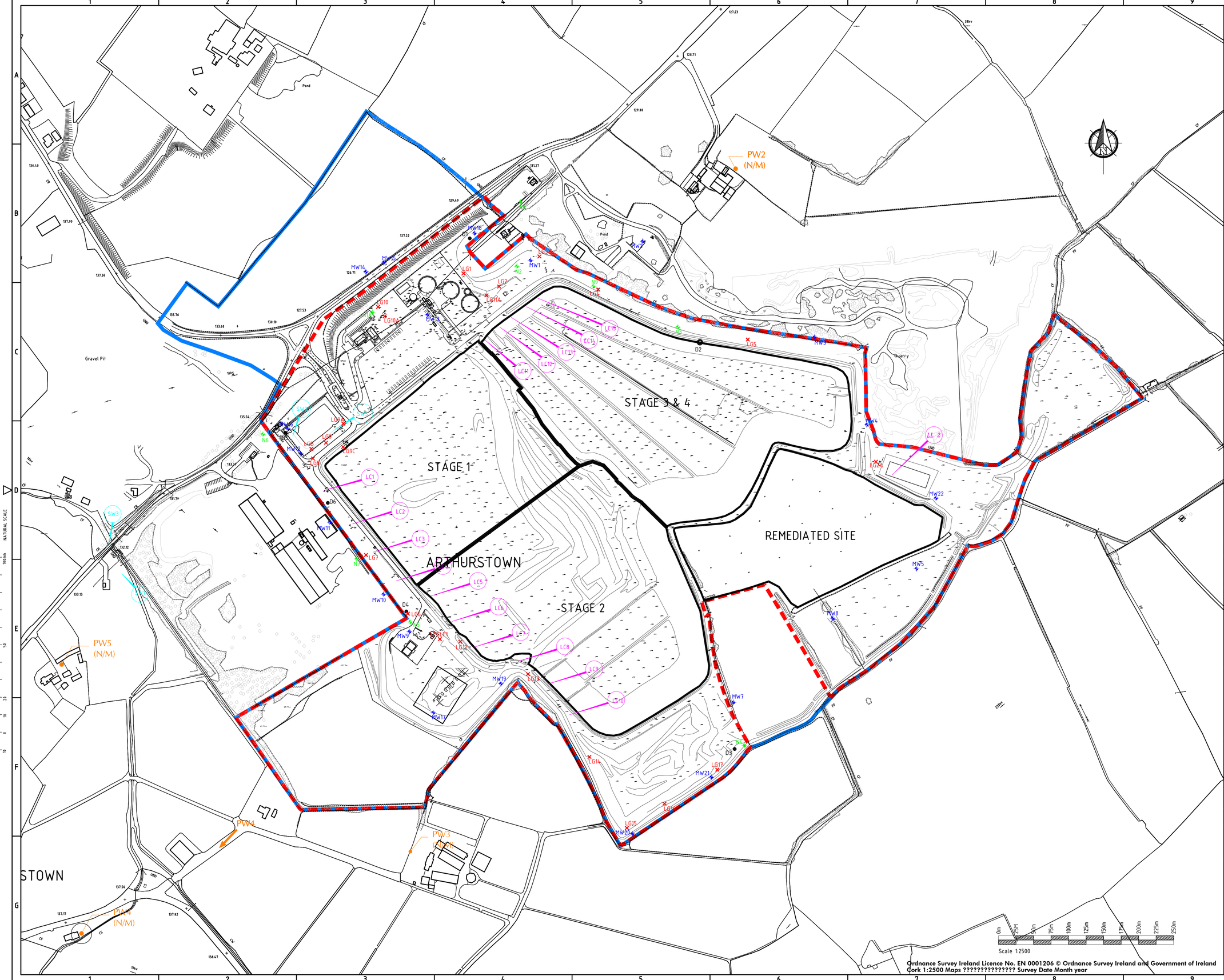
Environmental monitoring of the following is carried out in compliance with Condition 8 and Schedule D of the licence. (W0004-004)

- Landfill Gas
- Landfill Gas Utilisation Plant
- Dust Deposition
- Noise
- Surface Water including Biological Assessment
- Groundwater
- Private Wells (Groundwater)
- Leachate (including discharges to sewer)
- Nuisance
- Meteorological

Environmental monitoring is carried out on a monthly, quarterly, bi-annual and annual basis for various parameters of the various media. The AER presents the results of annual monitoring with interpretation.

2.5. Monitoring Locations

The environmental monitoring points are shown on Drawing Number AWL03 – 14. All samples were collected at the sampling points listed in Table D.1.1 of the licence unless specified otherwise in the following sections.



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2.6. Landfill Gas

Perimeter Monitoring Wells

There are 23 no. perimeter gas monitoring wells at the facility. In accordance with Schedule D.2.1 of the licence, monitoring of the wells is carried out on a monthly basis. An investigation was carried out in 2005 into elevated levels of carbon dioxide and methane at a number of perimeter wells. The investigation concluded that the elevated levels of CH_4 and $C0_2$ were due to incidences of rotting vegetation and proximity to old percolation areas. The methane was not due to landfill gas migration.

Appendix 2 shows methane and carbon dioxide levels measured in perimeter wells in 2015. The levels are comparable to levels recorded in 2013 & 2014. Methane levels in LG10 are at last showing a greater reduction during 2015.

Landfill Gas Extraction Wells

The final capped areas are connected to the gas extraction system. This system is controlled and monitored by landfill gas field balancing. A gas balancing model is used by the staff at Arthurstown.
There are no longer any temporary connections to the gas extraction system. There are a total of over 450 permanent gas wells within the landfill area.
All vents on site are now permanently connected to the gas extraction system for utilisation. Flares are only used as a back up to engine failure or during times of maintenance. There are 4 number 2,500 m^3 per hour enclosed flare units on standby on site at Arthurstown. Two are in SDCC ownership and two are owned by Bioverda.

Site Buildings

There are four permanent gas monitors, one in each building on site:

- Administration building
- Staff services building
- Leachate plant building
- Maintenance building

The following is the report of monitoring of these buildings for 2015.

- Quarter 1 – no exceedences
- Quarter 2 - no exceedences
- Quarter 3 - no exceedences
- Quarter 4 - no exceedences

2.6.1. Interpretation of Landfill Gas Results

Landfill gas results are typical for Arthurstown landfill.
Certain perimeter wells as indicated in the appendix tables are above the limit for CH_4 and CO^2. The Facility Management staff already engaged Odour Monitoring Ireland on 17th June 2005 to investigate these levels of methane in some of the perimeter wells.
The report concluded that due to the high sulphuric content of the gas in the perimeter wells that the gas was not migrating from the landfill and that this was occurring naturally due to decaying vegetation in certain areas and as a result of an old percolation area in another location. Before land-filling took place there was also background monitoring carried out. Levels of methane were also detected at that stage. Please refer to the consultant's report reference 090905A. This report was again submitted to the Agency during 2009.

Landfill Gas Utilisation Plant Emissions

In accordance with Schedule D.7.1of the licence, annual monitoring of the landfill gas utilisation plant was carried out.
The Landfill Gas Utilisation Plant commenced operations April 2004 with three no. Jensbaucher landfill gas engines extracting gas at a rate of approximately 3,000 m^3/hr. The Council requested that the enclosed flare operate in conjunction with the engines. This was carried out and the extraction rate increased to 4,900 m^3 per hour. During December 2004 a fourth engine was installed and the rate further increased to approximately 5,700 m^3 per hour. In 2005 an additional enclosed flare unit was installed.

The extraction rate in the utilisation plant for 2015 was 3,500 m^3/hour; this was generated by 4 no. engines. The 2 no. enclosed flares within the compound are on standby. A further 2 no 2,500 m^3 per hour enclosed flares operated by SDCC were not operational during 2015 and are on stand-by as all landfill gas is now being diverted to the utilisation plant for electricity production.

Annual monitoring of the landfill gas utilisation plant emissions is a requirement of the licence. Monitoring was carried out for the period 2015 and the report is included in the appendix.

2.6.2. Interpretation of Utilisation Emissions

All monitoring of flares and engine stacks showed all readings are in compliance with waste license W0004-004 for 2015.

2.7. Dust Deposition

Dust monitoring was carried out in accordance with the licence at 6 monitoring locations, three times in the year.

Dust monitoring was carried out over a 30 day period +/- 2 days. The periods were as follows:

- ___ 31st July 2015
- ___31st August 2015
- ___ 28th October 2015

2.7.1. Dust Deposition

Dust deposition results for 2015 are shown appendix 3.

2.7.2. Interpretation of Dust Deposition Results

The license limit for dust at the facility is 350 mg/m2/day. This was not exceeded during 2015. The maximum recorded during 2015 was only 91 mg/m2/day. All dust monitoring for 2015 was in compliance with waste license W0004-004.

2.8. Noise

In compliance with Schedule D (D.4) of the waste licence, noise monitoring was carried during 2015.

The noise monitoring event took place as follows:

Day time monitoring – 30th June 2015
Night time monitoring – 30th June 2015
As the landfill is now closed the Noise monitoring will be reduced to one round per year.

Noise Results

The report for noise monitoring is contained in Appendix 4.
Noise levels are consistent with previous years monitoring. Only two locations exceeded the 45dBA L_{aeq} for night-time limits at N1A and N5. This was due to the close proximity to the neighbouring timber processing facility, which also explains some of the tonal elements. Although there was elevated tonal noise at location N2, no penalties were applied as the location is not a Noise Sensitive Location. (NSL)
All other readings at all other locations were within the waste license limits.

2.9. Surface Water

The following is a summary of annual surface water quality findings in 2015. More detailed information has been submitted in each of the quarterly reports from ANUA. (formerly Bord Na Mona)

There are 5 no. surface water monitoring points. Chemical analyses are carried out at all 5 of the monitoring locations and a biological assessment was carried out at SW1, SW3 (Hartwell River) and at SW4 (Kill River). The 5 no. surface water monitoring points are located as follows:

- SW1 upstream of the outfall from the storm water lagoon in the Hartwell River
- SW2 outlet for the onsite storm water pond(storm and ground waters)
- SW3 downstream of the outfall from the storm water lagoon in the Hartwell River
- SW4 downstream of Arthurstown Road in the Kill River
- SW5 inlet to the storm water pond (storm and ground waters)

2.9.1. Surface Water Results

The annual surface water report is contained in Appendix 5.

2.9.2. Interpretation of Surface Water Results

During 2015 the biological quality rating for surface water has remained consistent with previous years for SW1 and SW3.
Quarterly monitoring is carried out by ANUA at all monitoring points for surface water.
Monitoring points SW2 and SW5 are within the on-site surface water retention pond. During 2015 there were slightly elevated levels of NH_4 Ammonia (<0.065mg/l) for "Good Quality Water" on six out of the thirteen weekly monitoring events. The exceedance levels varied between 0.07mg/l and 0.11mg/l. All remaining parameters were within their respective limits at SW2.
These locations are within the surface water retention pond.
On examining the results of the monitoring points in the Hartwell River (SW1 & SW3) there was no effect as a result of these levels and therefore no pollution caused throughout 2015. This proves that the surface water retention pond is working effectively.
During 2015 all SW reports were sent to the Environmental Protection Agency, Kildare County Council and the Department of Inland Fisheries Ireland.

Biological Sampling

During 2015 biological sampling was carried out in the Hartwell River. The Hartwell received a Q rating of 4. This is consistent with previous years for the Hartwell River.

Biological sampling is carried out annually in accordance with the licence. It was carried out during the third quarter of 2015. (10th August 2015) The Q rating system was used. This rating system recognises five macro-invertebrate communities/faunal groups ranging from A to E (i.e. most sensitive to most tolerant of pollution) and relates

to their relative abundance, from a standard 2 minute kick sample, to a quality rating – the Q Index. The area surveyed is then assigned a Q rating from 5 to 1, 5 being pristine unpolluted waters to 1 gross polluted. Results of biological sampling are shown below in Table 3.12.

Q Rating of Surface Waters for 2015.

Biological Q Rating for Surface Waters (within rivers)			
Location	SW-1	SW-3	
Q-Rating	4	4	

Table 3.12

Quality at point SW1 is consistent with last year's results. This point is upstream of the Arthurstown surface water discharge point. (note: discharge from ALCRETE Ltd is within 5m upstream of the discharge from Arthurstown Landfill)
Quality at point SW3 is consistent with previous years which indicate that discharges from the surface water retention pond from the landfill are having no impact on the surface water quality at point SW3 or the Hartwell River in general.

The overall bio-diversity noted for the Hartwell River was very good. The results of the biological survey indicate that the quality of water in the Hartwell River is good (using the Q-value system) / excellent (using the LQI interpretation of water quality) upstream and downstream of the landfill.
This demonstrates that the surface water retention pond outfall is not having any notable negative impact on the Hartwell River.

Groundwater

There are 22 no. groundwater monitoring wells and 5. no. private wells. Table 3.13 shows the locations of the wells in relation to the facility and in relation to groundwater flow in the area. Table 3.14 shows the depths of groundwater wells. Private Wells are discussed in Section 3.7.

Table 3.13 Location of groundwater monitoring boreholes relevant to the facility and the groundwater flow in the area

Well	**Direction with respect to the facility**	**Location with respect to groundwater flow***
MW3	260 M NE	**US**
MW4	400 m E	US
MW5	400 m E	US
MW6	100 m ESE	US
MW7	80 m SE	US
MW8	**240 m ESE**	**US**
MW20	**150 m S**	**US**
MW21	140 m SSE	US
MW22	**400 m E**	US
MW2	**260 m NE**	**CG**
MW17	100 m WSW	CG
MW19	20 m WSW	CG
MW1	140 m NE	DS
MW9	**50 m W**	**DS**
MW10	50 m W	DS
MW11	50 m W	DS
MW12	50 m NW	DS
MW13	100 m N	DS
MW14	**200 m NNE**	**DS**
MW15	200 m NNE	DS
MW16	**90 m NNW**	**DS**
MW18	170 m N	DS

*Note: US upstream
DS downstream
CS cross gradient
Wells highlighted in bold font are those that are required to be monitored by the waste licence.

The waste licence (W004-004), Schedule D.1 Table D.1.states that groundwater levels should be recorded for all wells on a monthly basis and that sampling for chemical parameters should be carried out in 7 no. wells. These 7 wells (as selected by the Agency) are highlighted in bold in Table 3.13.

Table 3.13 Depths of Groundwater Monitoring Wells

Wells	Base of wells m O.D (2006)*	Well height at ground level m O.D	Depth of Borehole (m)
MW1	130.04	138.67	8.63
MW2	130.22	137.00	6.78
MW3	131.67	140.20	8.53
MW4	141.72	143.40	1.68
MW5	146.12	148.00	1.88
MW6A	144.7	150.50	5.80
MW7	147	153.60	6.60
MW8	115.19	149.20	34.01
MW9	110.01	139.50	29.49
MW10	132.19	135.10	2.91
MW11	129.28	133.75	4.47
MW12	130.83	134.74	3.91
MW13	127.28	135.60	8.32
MW14	125.13	129.40	4.27
MW15	126.61	129.42	2.81
MW16	112.84	135.54	22.70
MW17	129.05	139.40	10.35
MW18	102.16	136.68	34.52
MW19	118.72	145.30	26.58
MW20	147.51	156.50	8.99
MW21	146.83	155.00	8.17
MW22	140.64	145.00	4.36

*Note: The total depths of wells are as per measurements in 2006. Wells can silt up gradually over time, diminishing their total depth.

Groundwater Results

Tables and charts showing groundwater results and trends are included in Appendix 6.

Interpretation of Groundwater Results

Annual Results

A total of twenty two groundwater monitoring boreholes are located at Arthurstown Landfill. During the annual sampling event for 2015 a total number of 7 boreholes were sampled.
Chemical analysis, Metals analysis, Organic analysis and Microbial Analysis were carried out as part of the annual analysis of the groundwater.

Appendix 3.6 Groundwater Annual outlines all elevated readings for the annual monitoring event and can be summarised as follows:

MW1A–Manganese 40 ug/l (IGV 50ug/l) and Ortho Phosphate 0.05 mg/l (IGV 0.03)
MW2- Ortho Phosphate 0.04 mg/l (IGV 0.03) Manganese 113 ug/l (IGV 50ug/l)
MW3 - Sulphate 309 mg/l (IGV 187.50 mg/l) Calcium 217 (IGV 200 mg/l)
MW8 – Manganese 174 ug/l (IGV 50ug/l)
MW14A - Calcium 204 (IGV 200 mg/l), Potassium 5.1mg/l (IGV 5 mg/l)
MW16 –Manganese 993 ug/l (IGV 50ug/l)
MW20 – Calcium 283 (IGV 200 mg/l) and Sulphate 301 mg/l (IGV 187.50 mg/l)

Levels of total coli-forms and E-coli were detected in locations MW1A, MW2, MW8, MW14A, MW16 and MW20. The highest reading for E-coli was taken at MW20. (15 cfu/100ml)

Locations MW2, MW3 and MW14 are not within the boundary of the landfill and are in an agricultural location (i.e. a farm adjacent with poor housekeeping).

The majority of monitoring at all other locations is consistent with previous years monitoring results.

2.10. Private Wells (Groundwater)

There are 5 no. private groundwater monitoring wells, referred to as Private Wells. Monitoring of the wells is carried out on a quarterly and annual basis.
PW1 is sampled on a quarterly basis and wells PW2 – PW5 are sampled on an annual basis.

The location of the wells is shown on Drawing Number AWL03 – 14 inserted as Figure 3.1.

2.10.1. Private Wells Results

Copies of the analysis for private wells for 2015 are included in the appendix 6.

2.10.2. Interpretation of Results

Annual
All private wells (PW1 – PW5) are sampled on an annual basis.
All chemical analysis for all private well locations (PW1 – PW5) was within the guidelines for drinking water.
During the microbiological analysis there were elevated coli-form readings at locations PW1 (540 MPN/100ml) 30 (cfu/100ml E.Coli) and PW4 (3900(MPN/100ml)
All well owners were notified.

The location of all wells are rural agricultural.

All other results for 2015 were below MAC limits.

Quarterly

PW 1 is the only private well that is sampled every quarter. See appendix for quarterly results for PW1 2015. All quarterly PW1 analysis was below the prescribed limits for drinking water for 2015.

2.11. Leachate

The waste licence (W0004-004), Schedule D.1 Table D.1.states that leachate levels should be recorded for all sumps and collection points on a continuous basis. This continued during 2015.

SDCC carries out quarterly and annual monitoring at 5 locations, LC1, LC8, LC11, LL (leachate lagoon) and LB (leachate balance tank).

2.11.1. Leachate Results

Annual reports showing leachate results are included in Appendix 6.

2.11.2. Interpretation of Leachate Results

Leachate results for 2015 are typical for leachate analysis for Arthurstown Landfill depending on age of the waste in the cell being tested.
At the end of 2007 all 15 cells contained leachate. Ammonia levels in the leachate at Arthurstown vary from 2,000mg/l to 3,300mg/l. BOD levels are currently at 100mg/l to 300mg/l which is typical for a leachate of this age. The COD currently ranges from 2,000mg.l to 6,000mg/l which is also typical for an ageing leachate as what remains is the recalcitrant element of the COD also known as “hard COD”.

Final capping was completed in 2013, which should reduce leachate volumes in the coming years.

During 2015 only treated leachate was discharged to the twin rising main connection to the local sewer in Kill.
The annual leachate results are enclosed in Appendix 6.

2.12. Meteorological Monitoring

Condition 8.10.1 and schedule D.6.1. of the current Waste Licence W0004-04 requires the daily monitoring of rainfall, temperature (min/max), wind speed and direction, evaporation, humidity and atmospheric pressure at the landfill site.
All weather data has been recorded by the on-site "VIASALA" Weather Station which was installed during March 2003.
The data indicates prevailing wind directions from a south to south-westerly direction.

Total annual rainfall during 2015 was 824.50 mm, which is 126.4 mm less than the previous year. Only November and December recorded rainfall levels higher than 100 mm. The highest amount of rainfall in one month period was 162.6 mm in December 2015.

It must be noted that December 2015 was the wettest and the mildest since records began.

The data indicates the dominant prevailing wind direction is from a south-westerly direction. Average wind speed recorded is 3.4 km/hr and the maximum wind speed recorded in 2015 was 49.9 km/hr.

Annual summary of meteorological conditions is included in Appendix 7 for 2015.

A new weather station (Precision Weather Station Vantage Vue by DAVIS) was installed at Arthurstown Landfill facility during December 2013.

2.13. Odour and Odour Control at Arthurstown

The facility management staff endeavour at all times to reduce odours and complaints at the facility.

The Facility is now closed since December 21st 2010. Odour control works are now greatly reduced due to the completion of the final capping works. The final phase 8 of the capping was completed during November 2013.
The integrity of the cap will continue to be checked every quarter by the surface VOC emissions monitoring carried out by Odour Monitoring Ireland. Gas balancing is the predominant feature of odour control now since closure.

Quarterly Odour Assessments:

Waste license W0004-004 states in condition 8.14.5 that an independent odour assessment is carried out every quarter. The quarterly odour audits are carried out by Odour Monitoring Ireland.

Quarterly surface VOC emissions monitoring audits are carried out on site by Odour Monitoring Ireland Ltd. They took place on:

- Q1 – No contractor appointed by Procurement Department
- Q2 – 30th June 2015 - Fully Compliant.
- Q3 – 10th Sept 2015 - 6 locations exceeding 500ppm
- Q4 – 18th November 2015 – 7 locations exceeding 500ppm

The methodologies employed include:

- Capping source monitoring using a continuous ppb PID and Jerome 631X analyser to detect areas of potential landfill gas release.
- Sniff odour assessments at pre-selected resident locations in the vicinity of the landfill
- Geo-referencing of detected leakage locations for remediation.

The new methodology used in the odour audit is very useful in identifying areas of potential leakage. It is concluded that this technique is very successful in the reduction of landfill odours in order to prevent odour impact downwind of the landfill operations.
Once the quarterly odour audit is carried out, the findings are brought to the attention of the Facility Manager, who carries out the remediation.

Surface VOC Emissions Results 2015

During 2015 elevated levels of VOC's were detected during quarter 3 and 4. This was as a result of inadequate extraction to these areas. Once the Facility management were consulted the corrective action of further extraction and gas balancing could be implemented. The results for Q2 2015 were fully compliant which indicates the success of the final capping installation, which is complete. The quarterly surface VOC emission surveys will continue to check the integrity of the final capping into the future.

2.14. Complaints for 2015.

The total number of complaints for 2015 was 7. This equals the lowest amount of complaints in one year at Arthurstown.
There was only one complaint due to traffic or road issues and the remaining six complaints were due to odour and may have been as a result of an alternative source as Arthurstown is now fully capped.

See complaint summary chart overleaf for 2015.

Q1 – 2015	Total Complaints	2
Q2 – 2015	Total Complaints	0
Q3 – 2015	Total Complaints	1
Q4 – 2015	Total Complaints	4

Total Complaints for 2015 was 7.

Q1 – 2014	Total Complaints	3
Q2 – 2014	Total Complaints	2
Q3 – 2014	Total Complaints	0
Q4 – 2014	Total Complaints	2

Total Complaints for 2014 was 7.

2.15. Landfill Gas Emissions

Approximately 30,066,000 m^3 of landfill gas was utilised by the gas extraction system in 2015. **(based on an average of 3,500 m^3 per hour)*
From July 2009 onwards all gas captured was sent to the utilisation plant.
During 2015 all gas was utilised. Flaring is only on standby mode should any of the engines fail.

Estimates vary as to the efficiency with which gas collection systems in landfills gather the methane formed in waste. Modern gas wells installed throughout a landfill site may collect between 70% – 90%. The efficiency for Arthurstown landfill is estimated here as 95% because the wells are relatively new, in good condition and most importantly capping is now complete. **Based on this efficiency it is estimated that the total landfill gas generated at Arthurstown Landfill in 2015 was 32,273,684 m^3.**

Gas extracted from the landfill can be managed in 3 different ways:

- Electricity production from landfill gas in 4 no. engines at the Bioverda compound (Approx. 4 MWh)
- Flaring in 2 no. enclosed flares at the Bioverda compound.
- Flaring in 2 no. 2,500m3 /hour enclosed flares owned by S.D.C.C.

All of the gas collected is directed to the Bioverda compound for electricity generation. The available generation capacity is 4,800 m^3 per hour and the capacity to flare gas is 10,000m^3. The maximum available extraction rate is approximately 14,800 m^3/hour.
Note: The current average extraction rate is 3,500 m^3 per hour.
All gas is now being extracted by the utilisation plant. The 4 no enclosed flares are currently on standby.

The table overleaf contains a summary of the results for the European PRTR in relation to the Utilisation plant and the enclosed flare units at Arthurstown Landfill for 2015.

European PRTR Table Arthurstown Landfill flares and gas utilisation engines only.

Table 1. Table for European-PRTR requirements for Landfill flare and Gas utilisation engines only 2015.

Location	Nitrogen Oxides (NO_x as NO_2) (kg/yr)	Carbon Monoxide (CO) (kg/yr)	Sulphur dioxide (SO_2) (kg/yr)	Total particulates (kg/yr)	TNMVOC's (kg/yr)	Methane (kg/yr)	Carbon dioxide (CO_2) (kg/yr)
Flare 1	964	20	1,222		84	40	2,035,371
Flare 2	812	1	1,180		101	29	1,131,258
AR01	5,068	20,410	4,807	53	9	15,090	4,173,352
AR02	7,102	17,380	4,432	36	3	13,817	4,524,515
AR05	4,667	20,704	4,937	44	6	14,932	4,282,806
AR06	4,508	21,659	4,950	44	3	13,810	4,559,721
AR07	4,265	20,349	4,897	48	1	12,938	4,366,295
Totals	**27,386**	**100,524**	**26,425**	**224**	**207**	**70,657**	**25,073,318**

Notes:

[1] denotes that the total values reported are based on 24 hr per day 365 days per year operation and for gas engines only. If the hours of operation are known through site records then the total actual amount can be calculated by calculating the yearly total to an hourly figure and then multiply by the number of hours operation (e.g. Emissions (kg/yr) / 8760 hrs = kg/hr × hours operation = Total emission in kg/yr).

2.16. Estimated Emissions from the Landfill Gas Generation Plant.

In summary, 70,657 kg / year of methane and 25,073,318 kg / year of CO_2 were produced at Arthurstown Landfill during 2015. (as per PRTR Table produced by Odour Monitoring Ireland Ltd above)

A GASSIM model for landfill gas production at Arthurstown was produced during 2008. The findings of the model did not reflect the actual gas production on site. This report on the capacity of the utilisation plant at Arthurstown and possible future capacity issues was submitted to the Agency on 03rd December 2008.

Estimated Electricity Production at Arthurstown Landfill from Landfill Gas.

During 2015 the amount of electricity produced at Arthurstown Landfill by converting the landfill gas via the 4 gas engines is outlined as follows:

Month 2015	MW per month
January	3000
February	3000
March	3000
April	3000
May	3000
June	3000
July	3000
August	3000
September	3000
October	3000
November	3000
December	3000
Total 2015 MW produced (approx)	**36,000 MW h (approx)**

2.17. Indirect Emissions to Groundwater

Estimated Annual and Cumulative Quantity of Indirect Emissions to Groundwater.

Monitoring results to date do not indicate the presence of indirect emissions to ground waters. Considering that groundwater flow is in a generally north-westerly (NW to NNW) direction, monitoring wells can be deemed to be upstream, downstream, or cross-gradient of the landfill area. Table 4.3 below presents a summary assessment of monitoring well locations relative to the existing waste body. Parameters selected for this assessment, because they are known to exhibit high concentrations in landfill leachate at Arthurstown, are Ammonia-N, Chloride and Electrical Conductivity.

Condition 6.4.1 states that there shall be no direct emissions to groundwater.

The waste license W0004-004 also required the completion of a groundwater trending analysis as per technical amendment B.
This report was completed and was submitted to the Agency via EDEN on the 9th March 2015.

Calculation of Direct and Indirect Emissions to Groundwater

Location	Direction	Relative Position	Summary of Results since March 1999 - Dec 2015				
			Ammonia (mg/l)		Chloride (mg/l)	Conductivity (uS/cm)	
			Max	Avg	Avg	Max	Avg
MW3	260 M NE	US	2.45 (April'04)	0.08	74	1614 (Aug 15)	1142
MW4 **	400 m E	US	1.2	<0.31	7.5	952 (Apr '02)	761
MW5 **	400 m E	US	<0.2	<0.2	10.6	686 (Oct '99)	481
MW6A	100 m ESE	US	5.8 (May'08)	0.18	14.6	838 (Nov'08)	694
MW7	80 m SE	US	5.7 (May'08)	1.20	16.4	987 (Nov'08)	881
MW8	240 m ESE	US	1.04 (April '05)	0.03	16	716 (Nov '10)	636
MW20	150 m S	US	1.7 (Feb '03)	0.03	21.1	2815 (Nov '09)	1320
MW21	140 m SSE	US	1.5 (May '01)	0.07	15.6	1568 (Apr '05)	1071
MW22	400 m E	US	0.33 (Feb ' 03)	0.07	12	805 (Apr '05)	514
MW2	260 m NE	CG	**7.6 (July '13)**	2.16	117	2363 (Nov'10)	1027
MW17	100 m WSW	CG	0.6 (May '01)	0.14	23.5	2097 (May'07)	1234
MW19	20 m WSW	CG	3.08 (July '07)	0.11	18.6	1204 (Jul'06)	911
MW1A	140 m NE	DS	<0.02	<0.02 (Q3_2014)	11.5	542	541
MW9	50 m W	DS	1.2 (July '01)	0.04	12.6	738 (Nov'08)	608
MW10 **	50 m W	DS	Dry	Dry	Dry	Dry	Dry
MW11	50 m W	DS	0.36 (April'04)	0.08	10.4	690 (Apr'04)	617
MW12 **	50 m NW	DS	Dry	Dry	Dry	Dry	Dry
MW13 **	100 m N	DS	0.2 (Nov '02)	<0.2	27.9	944 (Nov'02)	944
MW14A	200 m NNE	DS	<0.02	<0.02	21	1025 (Aug 15)	808
MW15 *	200 m NNE	DS	1.0 (May'01	<0.28	33	900 (Feb'03)	802
MW16	90 m NNW	DS	0.7 (July '01)	0.03	13.7	992 (Nov'08)	638
MW18	170 m N	DS	1.2 (May'01)	0.23	12.8	719 (Nov '10)	650

DS – downstream
US – upstream
CG – cross gradient

Locations upstream from the landfill are located in an agricultural area and are therefore sprayed several times a year with “slurry”.
There were two new maximum levels of conductivity reached in boreholes MW3 and MW14A of 1614(uS/cm) and 1025 (uS/cm) both of which are still within the GTV’s (Groundwater Threshold Values) for Groundwater Regulations 2010 (S.I. No.9 of 2010).

Due to the upstream and cross gradient locations of the boreholes and proximity to agricultural activities, it can be assumed that emissions to groundwater are satisfactory for the period 2015.

2.18. Water Balance

A number of assumptions were made in the calculation of the water balance.

Evaporation

Due to the nature of baled waste, rainfall tends to flow through the edges of each bale quickly and makes its way deep into the waste body or onto the cell floor quickly. Hence a nominal value of 10% of the recorded evaporation in the calculation.

Capped Areas

Total Complete Final Capped Area 290,000 m2

The volume of leachate tankered off-site and discharged to sewer in 2015 was 17,256 m^3.

The pumping of the leachate from each cell will continue during 2016. The leachate levels are seasonal at Arthurstown with levels normalising during the drier months of April, May, June & July.
Facility management staff is endeavouring at all times to maintain the levels to the 1m limit by constant pumping of leachate.

FACILITY DEVELOPMENT

Site Survey 2015.

A topographical survey of the landfill facility was carried out by the facility management team during October 2015.
The survey is attached as Appendix 5.1.

Developments Undertaken in 2015.

Bioverda Power Systems Utilisation Plant

The plant is now extracting on average 3,500 m^3 of gas per hour.
No further works were carried out during 2015 as the plant is now on a downward operating trend due to fall off in the gas production from the landfill.
There may be a requirement to relocate the 2 no SDCC enclosed flare units to the compound. This is still under consideration.

Staff reductions during 2015

There were no staff reductions during 2015.
The facility management would recognise that the current staff level of 3 would be the absolute minimum for a facility of this size.

Developments Proposed for 2016.

Leachate Treatment Trials.

Approval was received from the Agency for commencement of leachate treatment trials with Biocore Ireland. These trials are continuing and it is hoped that the facility management will be able to further progress the possibilities of other uses for Arthurstown during its period of closure.

Restoration Report

Restoration

The final phase (phase 8) of the capping works was completed during 2013.

Landscaping and fencing which was postponed during 2014 continued in 2015.

Some areas may still require topsoil, seeding and fencing.
This will be undertaken (subject to procurement approval) during 2016.

ENVIRONMENTAL OBJECTIVES AND TARGETS

Objectives and Targets

The list of objectives and targets for 2016 will be submitted as part of the EMP revision which will be submitted in the coming weeks.

FACILITY MANAGEMENT

Summary of New Written Procedures

The revision of the EMP in the coming weeks will include an updated EMS taking into account the closure and the need for a final EMP submission and a review of other annual monitoring requirements.

Tank, Pipeline and Bund Testing

Routine inspections of tank, pipeline and bund inspections are carried out once every three years.
The completed reports are kept on site for the Agency's Inspection.
The report currently held on site was carried out in November 2012.
A review will take place during 2016 of all tanks, pipelines and bunds

Reported Incidents

Reported Incidents

A summary of reported incidents during 2015 is shown as per table below.
Incidents are defined by Condition 1.6 of the current waste licence (W0004-004).

There were 19 incidences reported to the EPA in 2015.

	Incident Date	Cause	Mitigation Measure
Gas borehole trigger levels	310115	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 310115A (submitted to Agency)
	270215	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 060315B (submitted to Agency)
	300315	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 300315A (submitted to Agency)
	290415	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 290415A (submitted to Agency)
	280515	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 280515A (submitted to Agency)
	290615	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 290615A (submitted to Agency)
	300715	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 300715A (submitted to Agency)
	310815	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 310815A (submitted to Agency)
	300915	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 300915A (submitted to Agency)
	291015	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 291015A (submitted to Agency)
	271115	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 271115A (submitted to Agency)
	151215	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 151215A (submitted to Agency)
Leachate Sump Levels	120115	Breach of the 1m limit in the Leachate cells.	See Report dated 120115A (submitted to Agency)
	030215	Breach of the 1m limit in the Leachate cells.	See Report dated 030215A (submitted to Agency)
	060315	Breach of the 1m limit in the Leachate cells.	See Report dated 060315A (submitted to Agency)
	111115	Breach of the 1m limit in the Leachate cells.	See Report dated 111115A (submitted to Agency)
	161215	Breach of the 1m limit in the Leachate cells.	See Report dated 161215A (submitted to Agency)

Surface VOC Emissions	100915	Quarterly Surface VOC Emissions Monitoring: Breach in emission levels.	See Report dated 100915A (submitted to Agency)
Surface VOC Emissions	111115	Quarterly Surface VOC Emissions Monitoring: Breach in emission levels.	See Report dated 111115 (submitted to Agency)

Review of Nuisance Controls

The review of litter, birds and vermin no longer takes place since the facility is now final capped for over two years so there is no longer the requirement for this review.

Odour reviews may still be required under the waste license obligation to control the extraction of landfill gas at the facility.

Report on Staff Training

No training courses/seminars were attended by the staff at Arthurstown Landfill during 2015.

Staff Training Log 2015.

Training Course /Seminar	Staff Attendees

Non-Compliances at Arthurstown Landfill during 2015.

During 2015 Arthurstown landfill received a total of 1 non-compliance from the Environmental Protection Agency.

Reason for NC	Number	EPA Site Visit
Leachate Levels in Sumps	1	Yes

Non-Compliance Log for 2015.

All non compliances were responded to in writing by the facility management team and returned to the EPA.

The non compliance during 2015 was as a result of an incident of leachate levels in sumps on the day of an E.P.A. audit inspection carried out 27th March 2015 and report dated 26th May 2015.

Total number of non compliances for 2015 is 1.

Reports of Financial Provision

Report on Financial Provisions under Waste Licence W0004-004.

South Dublin County Council has taken out a bond in favour of Kildare County Council (the local authority in whose functional area the facility is located) in order to ensure satisfactory completion of Arthurstown Landfill. Significant contributions are made annually towards leachate treatment, environmental monitoring and landfill closure/aftercare.
Budgetary estimates for operational activities at Arthurstown during 2015 were in the region of € 700,000.
Under the Closure Restoration and Aftercare Management Plan (CRAMP) as part of the Environmental Liabilities and Risk Assessment (ELRA) conditions of the waste license, South Dublin County Council have contributed approximately €12 million Euro to the aftercare and restoration fund.

Report on Programme for Public Information

In accordance with Waste Licence W0004-04, information is made available on site and submitted to the EPA on a regular basis.
Information about the facility is available on the updated website which can be accessed at *www.arthurstown.ie*. Site contact numbers are posted at the facility entrance.

Report on Management Staff and Operation Structure

The site is owned and managed by South Dublin County Council, who also hold the Waste Licence and Planning Permission (now expired), for the facility. As the facility is now closed, the aftercare and restoration works, monitoring and reporting are supervised by the Facility Manager (J. Smith) and Deputy Facility Manager (M.Heffernan).

At the end of 2015 South Dublin County Council have 3 direct employees engaged in full time management and administrative functions at the site, namely the Facility Manager (J. Smith), Deputy Facility Manager (M. Heffernan) and E. Comerford (GO).
The Senior Engineer for South Dublin County Council Environmental Services is Mr. Leo Magee and the Director of Services for Environmental Services is now Ms.Teresa Walsh.

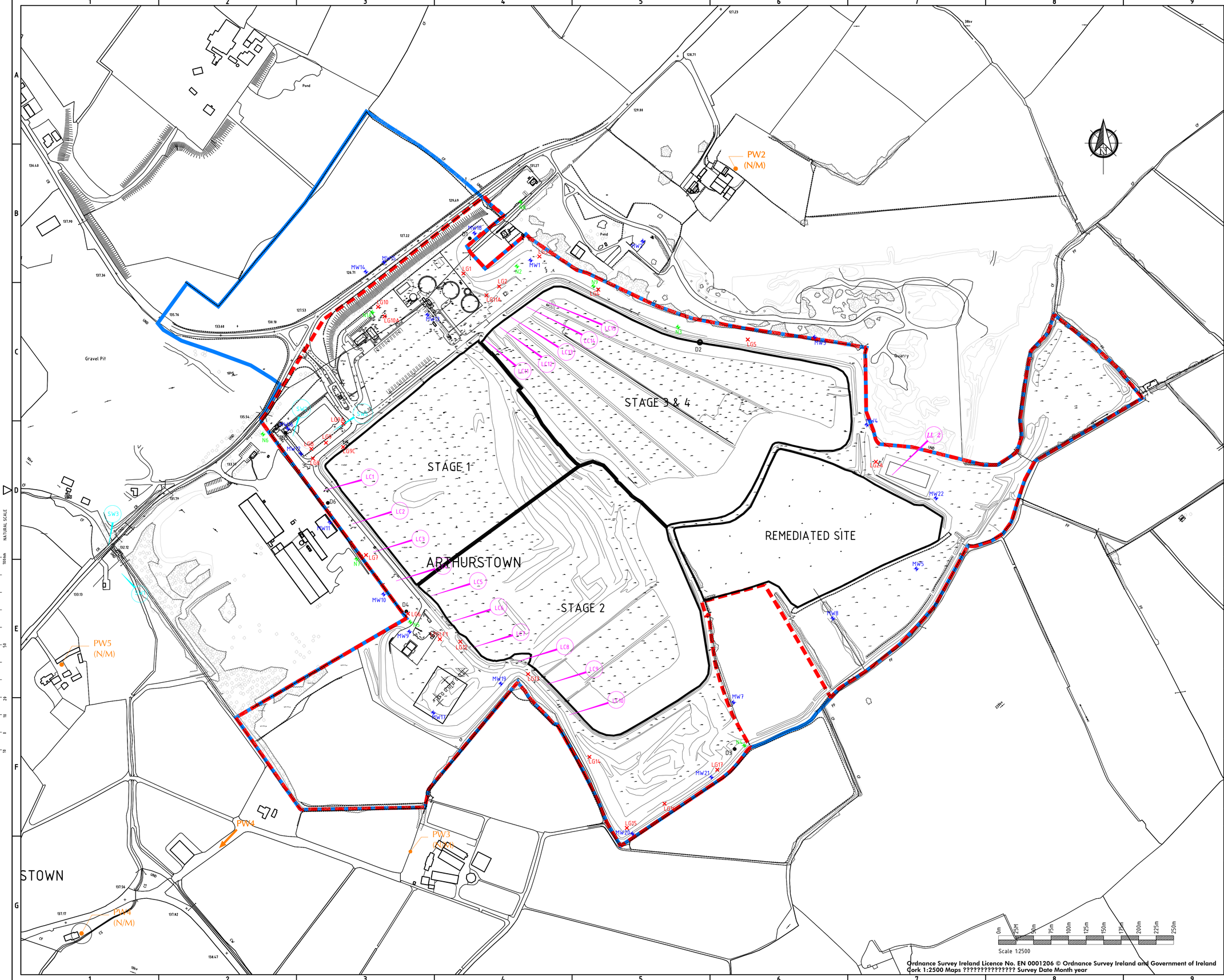
Local Environmental Project Funding

There was no local environmental funding during 2015.

This has now concluded and will no longer be reported on.

APPENDIX 1

Monitoring Locations Drawing



Rev.	Drawn	Chk'd	App'd		
A	KL	ME	CC	Cork 14.12.06	ISSUE FOR PLANNING
				Rev Origin Date	Description

Revision History: A

Name of Client

SOUTH DUBLIN COUNTY COUNCIL

Name of Job

ARTHURSTOWN LANDFILL
PLANNING AND EIS

Title of Drawing

ENVIRONMENTAL MONITORING LOCATIONS

Scales Used
1:2500

Dwg. No. 2006-054-03-FIG2.4 — **Rev.** A

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APPENDIX 2

Landfill Gas (Perimeter monitoring wells)

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**January 2015**
Address :	**Kill, Co. Kildare.**	Date :	**31st Jan 2015**
Licensee :	**South Dublin County Council**	Time :	**11:30hrs - 12:30hrs**
Licence Reg.:	**W0004-004**	Personnel :	**E.Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**996 mb**	Next Calibration :	**Mar-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.8	20.0	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	0.4	20.0	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.0	20.8	
LG5	BH	5.70	0.0	0	0.0	20.8	
LG6	BH	7.00	0.0	0	**2.1**	18.0	
LG7	BH	6.00	0.0	0	0.0	20.8	
LG8	BH	7.00	0.0	0	1.3	18.6	
LG9	BH	7.00	0.0	0	**1.7**	13.8	
LG9A	BH	7.40	0.0	0	0.7	12.3	
LG9B	BH	5.80	0.0	0	0.2	20.5	
LG9C	BH	7.00	0.0	0	0.0	18.5	
LG10	BH	5.60	**1.0**	**20**	0.6	18.8	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	0.7	19.5	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.8	
LG13	BH	13.05	0.0	0	**1.8**	18.5	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.1	19.2	
LG16	BH	9.32	0.0	0	0.0	20.8	
LG17	BH	8.15	0.0	0	0.0	20.8	
LG18	BH	4.42	0.0	0	1.2	18.5	

Note : Bold type denotes attainment or exceedence of Trigger Level

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :-

Example of Calc of LEL at LG10 1.0/ 5 x 100 = 20

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**February 2015**
Address :	**Kill, Co. Kildare.**	Date :	**06 March 2015**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 12:30hrs**
Licence Reg.:	**W0004-004**	Personnel :	**E.Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1010 mb**	Next Calibration :	**Mar-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	1.0	19.5	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	0.4	20.0	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.0	20.8	
LG5	BH	5.70	0.0	0	0.0	20.8	
LG6	BH	7.00	0.0	0	**1.8**	16.5	
LG7	BH	6.00	0.0	0	0.0	20.8	
LG8	BH	7.00	0.0	0	**2.4**	16.3	
LG9	BH	7.00	0.0	0	**6.2**	8.6	
LG9A	BH	7.40	0.0	0	0.5	13.9	
LG9B	BH	5.80	0.0	0	**7.0**	8.9	
LG9C	BH	7.00	0.0	0	0.0	20.2	
LG10	BH	5.60	**2.1**	**42**	**5.2**	6.1	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	0.7	19.2	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.8	
LG13	BH	13.05	0.0	0	**1.8**	18.5	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.4	19.0	
LG16	BH	9.32	0.0	0	0.0	20.2	
LG17	BH	8.15	0.0	0	0.0	20.8	
LG18	BH	4.42	0.0	0	1.4	18.0	

Note : Bold type denotes attainment or exceedence of Trigger Level

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Example of Calc of LEL at LG10 2.1/ 5 x 100 = 42

Signed :-

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**March 2015**
Address :	**Kill, Co. Kildare.**	Date :	**30 March 2015**
Licensee :	**South Dublin County Council**	Time :	**14:00 - 15:30hr**
Licence Reg.:	**W0004-004**	Personnel :	**E.Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GEM 5000**
Atmospheric Pressure :	**1000 mb**	Next Calibration :	**Oct-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.8	20.8	
LG2	BH	7.90	0.0	0	0.0	20.9	
LG2A	BH	4.40	0.0	0	0.0	20.2	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.0	20.9	
LG5	BH	5.70	0.0	0	0.0	20.9	
LG6	BH	7.00	0.0	0	**1.5**	15.0	
LG7	BH	6.00	0.0	0	0.0	20.9	
LG8	BH	7.00	0.0	0	**1.8**	12.5	
LG9	BH	7.00	0.0	0	**2.8**	10.2	
LG9A	BH	7.40	0.0	0	0.8	15.0	
LG9B	BH	5.80	0.0	0	**5.5**	12.8	
LG9C	BH	7.00	0.0	0	0.0	20.5	
LG10	BH	5.60	**3.0**	**60**	**2.8**	4.8	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	0.0	20.0	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.9	
LG13	BH	13.05	0.0	0	1.2	19.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.0	20.0	
LG16	BH	9.32	0.0	0	0.0	20.8	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	1.2	19.0	

Note : Bold type denotes attainment or exceedence of Trigger Level

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Example of Calc of LEL at LG10 3.0/ 5 x 100 = 60

Signed :- _____

Facility Manager

Date :- _____

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**April 2015**
Address :	**Kill, Co. Kildare.**	Date :	**29th April 2015**
Licensee :	**South Dublin County Council**	Time :	**14:00 - 15:30hr**
Licence Reg.:	**W0004-004**	Personnel :	**E.Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GEM 5000**
Atmospheric Pressure :	**1007 mb**	Next Calibration :	**Oct-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	1.0	20.8	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	0.0	20.0	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.0	20.9	
LG5	BH	5.70	0.0	0	0.0	20.9	
LG6	BH	7.00	0.0	0	1.3	16.0	
LG7	BH	6.00	0.0	0	0.0	20.9	
LG8	BH	7.00	0.0	0	**1.8**	13.0	
LG9	BH	7.00	0.0	0	**2.2**	12.0	
LG9A	BH	7.40	0.0	0	0.0	19.0	
LG9B	BH	5.80	0.0	0	**4.0**	13.5	
LG9C	BH	7.00	0.0	0	0.0	20.2	
LG10	BH	5.60	**3.2**	**64**	**2.2**	5.5	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	0.0	20.2	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.9	
LG13	BH	13.05	0.0	0	1.4	19.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	0.0	20.5	
LG16	BH	9.32	0.0	0	0.0	20.8	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	1.2	19.0	

Note : Bold type denotes attainment or exceedence of Trigger Level

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Example of Calc of LEL at LG10 3.2/ 5 x 100 = 64

Signed :- _____

Facility Manager

Date :- _____

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**May 2015**
Address :	**Kill, Co. Kildare.**	Date :	**28th May 2015**
Licensee :	**South Dublin County Council**	Time :	**14:00 - 15:30hr**
Licence Reg.:	**W0004-004**	Personnel :	**E. Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GEM 5000**
Atmospheric Pressure :	**1013 mb**	Next Calibration :	**Oct-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	1.2	20.8	
LG2	BH	7.90	0.0	0	0.0	20.9	
LG2A	BH	4.40	0.0	0	0.0	20.8	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.0	20.8	
LG5	BH	5.70	0.0	0	0.0	20.8	
LG6	BH	7.00	0.0	0	**1.8**	15.0	
LG7	BH	6.00	0.0	0	0.8	20.5	
LG8	BH	7.00	0.0	0	**2.2**	15.0	
LG9	BH	7.00	0.0	0	**1.6**	16.0	
LG9A	BH	7.40	0.0	0	0.0	20.2	
LG9B	BH	5.80	0.0	0	**2.8**	15.0	
LG9C	BH	7.00	0.0	0	0.0	20.6	
LG10	BH	5.60	**5.5**	**110**	**2.8**	3.0	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	0.0	20.6	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.8	
LG13	BH	13.05	0.0	0	**1.8**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	0.8	20.7	
LG16	BH	9.32	0.0	0	0.4	20.9	
LG17	BH	8.15	0.0	0	0.0	20.8	
LG18	BH	4.42	0.0	0	1.4	18.0	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :-

Example of Calc of LEL at LG10 5.5/ 5 x 100 = 110

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**June 2015**
Address :	**Kill, Co. Kildare.**	Date :	**29th June 2015**
Licensee :	**South Dublin County Council**	Time :	**12:00- 13:00 hr**
Licence Reg.:	**W0004-004**	Personnel :	**E. Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GEM 5000**
Atmospheric Pressure :	**1017 mb**	Next Calibration :	**Oct-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.8	20.1	
LG2	BH	7.90	0.0	0	0.0	20.1	
LG2A	BH	4.40	0.0	0	0.0	20.1	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.0	20.2	
LG5	BH	5.70	0.0	0	0.0	20.1	
LG6	BH	7.00	0.0	0	1.1	18.0	
LG7	BH	6.00	0.0	0	0.8	20.1	
LG8	BH	7.00	0.0	0	0.1	20.3	
LG9	BH	7.00	0.0	0	0.2	19.0	
LG9A	BH	7.40	0.0	0	0.2	19.4	
LG9B	BH	5.80	0.0	0	**1.6**	19.0	
LG9C	BH	7.00	0.0	0	0	17.3	
LG10	BH	5.60	0.4	8	0.1	20.7	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.4	8	0.9	19.9	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.2	
LG13	BH	13.05	0.0	0	**1.6**	19.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	0.8	20.2	
LG16	BH	9.32	0.0	0	0.0	20.2	
LG17	BH	8.15	0.0	0	0.0	20.1	
LG18	BH	4.42	0.0	0	0.8	19.0	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :-

Example of Calc of LEL at LG10 5.5/ 5 x 100 = 110

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**July 2015**
Address :	**Kill, Co. Kildare.**	Date :	**30th July 2015**
Licensee :	**South Dublin County Council**	Time :	**12:00- 13:00 hr**
Licence Reg.:	**W0004-004**	Personnel :	**E. Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1014.8 mb**	Next Calibration :	**Oct-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.8	20.8	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	0.0	20.8	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.0	20.4	
LG5	BH	5.70	0.0	0	0.0	20.5	
LG6	BH	7.00	0.0	0	**1.8**	18.0	
LG7	BH	6.00	0.0	0	1.2	19.8	
LG8	BH	7.00	0.0	0	0.5	20.0	
LG9	BH	7.00	0.0	0	0.0	20.0	
LG9A	BH	7.40	0.0	0	0.5	19.0	
LG9B	BH	5.80	0.0	0	**2.0**	18.0	
LG9C	BH	7.00	0.0	0	0	18.5	
LG10	BH	5.60	**12.5**	**250**	0.9	0.0	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	1.2	17.4	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.6	
LG13	BH	13.05	0.0	0	**2.0**	17.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	**2.1**	16.5	
LG16	BH	9.32	0.0	0	0.8	19.8	
LG17	BH	8.15	0.0	0	0.0	20.4	
LG18	BH	4.42	0.0	0	0.8	19.5	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :- _____

Example of Calc of LEL at LG10 12.5/ 5 x 100 = 250 Facility Manager

Date :- _____

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**August 2015**
Address :	**Kill, Co. Kildare.**	Date :	**31st August 2015**
Licensee :	**South Dublin County Council**	Time :	**11:30- 13:00 hr**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1017 mb**	Next Calibration :	**Oct-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	1.0	19.8	
LG2	BH	7.90	0.0	0	0.0	20.6	
LG2A	BH	4.40	0.0	0	0.0	20.8	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.2	20.2	
LG5	BH	5.70	0.0	0	0.0	20.2	
LG6	BH	7.00	0.0	0	**2.0**	17.0	
LG7	BH	6.00	0.0	0	1.0	19.0	
LG8	BH	7.00	0.0	0	0.5	20.0	
LG9	BH	7.00	0.0	0	0.2	19.5	
LG9A	BH	7.40	0.0	0	0.5	19.0	
LG9B	BH	5.80	0.0	0	**1.8**	18.5	
LG9C	BH	7.00	0.0	0	0	19.0	
LG10	BH	5.60	**19.7**	**394**	0.9	0.0	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	**1.6**	18.0	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.6	
LG13	BH	13.05	0.0	0	**1.8**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	**2.0**	17.0	
LG16	BH	9.32	0.0	0	0.2	19.8	
LG17	BH	8.15	0.0	0	0.0	20.2	
LG18	BH	4.42	0.0	0	1.0	19.0	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :-

Example of Calc of LEL at LG10 19.7/ 5 x 100 = 394

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**September 2015**
Address :	**Kill, Co. Kildare.**	Date :	**30th Sept 2015**
Licensee :	**South Dublin County Council**	Time :	**11:30- 13:00 hr**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1033 mb**	Next Calibration :	**Oct-15**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.8	20.1	
LG2	BH	7.90	0.0	0	0.0	20.2	
LG2A	BH	4.40	0.0	0	0.0	20.2	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.2	20.1	
LG5	BH	5.70	0.0	0	0.0	20.0	
LG6	BH	7.00	0.0	0	**1.8**	18.0	
LG7	BH	6.00	0.0	0	1.0	19.0	
LG8	BH	7.00	0.0	0	1.2	18.5	
LG9	BH	7.00	0.0	0	0.0	20.0	
LG9A	BH	7.40	0.0	0	1.1	16.0	
LG9B	BH	5.80	0.0	0	**3.1**	12.0	
LG9C	BH	7.00	0.0	0	0	18.0	
LG10	BH	5.60	**15.5**	**310**	1.4	0.0	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	**2.0**	16.2	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.1	
LG13	BH	13.05	0.0	0	**1.6**	18.5	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	**2.2**	16.8	
LG16	BH	9.32	0.0	0	0.8	20.0	
LG17	BH	8.15	0.0	0	1.1	20.1	
LG18	BH	4.42	0.0	0	**1.6**	18.5	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :- _____

Example of Calc of LEL at LG10 15.5/ 5 x 100 = 310 Facility Manager

Date :- _____

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**October 2015**
Address :	**Kill, Co. Kildare.**	Date :	**29th Oct 2015**
Licensee :	**South Dublin County Council**	Time :	**11:30- 13:00 hr**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1006 mb**	Next Calibration :	**April 2016**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.8	19.0	
LG2	BH	7.90	0.0	0	0.6	20.0	
LG2A	BH	4.40	0.0	0	0.2	20.1	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.4	19.8	
LG5	BH	5.70	0.0	0	0.2	20.0	
LG6	BH	7.00	0.0	0	**2.1**	18.5	
LG7	BH	6.00	0.0	0	1.0	19.8	
LG8	BH	7.00	0.0	0	1.1	19.0	
LG9	BH	7.00	0.0	0	0.0	20.2	
LG9A	BH	7.40	0.0	0	1.1	18.1	
LG9B	BH	5.80	0.0	0	**2.8**	14.8	
LG9C	BH	7.00	0.0	0	0	17.5	
LG10	BH	5.60	**17.5**	**350**	**2.2**	0.0	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	**2.0**	18.0	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.5	
LG13	BH	13.05	0.0	0	**1.8**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.2	4	**2.0**	18.0	
LG16	BH	9.32	0.0	0	0.6	20.2	
LG17	BH	8.15	0.0	0	1.4	20.0	
LG18	BH	4.42	0.0	0	**1.8**	19.0	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :-

Example of Calc of LEL at LG10 15.5/ 5 x 100 = 310

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**November 2015**
Address :	**Kill, Co. Kildare.**	Date :	**27th Nov 2015**
Licensee :	**South Dublin County Council**	Time :	**11:30- 13:00 hr**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1001 mb**	Next Calibration :	**April 2016**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.5	19.8	
LG2	BH	7.90	0.0	0	0.0	20.1	
LG2A	BH	4.40	0.0	0	0.6	19.2	
LG3	BH	9.30	0	0	**1.2**	19.0	
LG4	BH	6.50	0.0	0	0.4	19.8	
LG5	BH	5.70	0.0	0	0.2	19.5	
LG6	BH	7.00	0.0	0	0.8	19.0	
LG7	BH	6.00	0.0	0	0.5	19.8	
LG8	BH	7.00	0.0	0	0.2	19.4	
LG9	BH	7.00	0.0	0	**3.5**	10.2	
LG9A	BH	7.40	0.0	0	0.0	19.5	
LG9B	BH	5.80	0.0	0	**3.0**	15.0	
LG9C	BH	7.00	0.0	0	0	19.0	
LG10	BH	5.60	**9.8**	**196**	**2.5**	3.0	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	0.9	19.0	
LG11A	BH	7.10	0	0	0	20.1	UTM (Obstructed)
LG11B	BH	4.63	0	0	**1.0**	17.8	UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.4	
LG13	BH	13.05	0.0	0	0.2	20.3	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	0	20.1	
LG16	BH	9.32	0.0	0	0	20.1	
LG17	BH	8.15	0.0	0	0	19.9	
LG18	BH	4.42	0.0	0	0	20.4	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :- _____

Example of Calc of LEL at LG10 9.8/ 5 x 100 = 196 Facility Manager

Date :- _____

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**December 2015**
Address :	**Kill, Co. Kildare.**	Date :	**15th Dec 2015**
Licensee :	**South Dublin County Council**	Time :	**11:30- 13:00 hr**
Licence Reg.:	**W0004-004**	Personnel :	**E.Comerford**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1005 mb**	Next Calibration :	**April 2016**

Ref. No.	*BH VT SP*	*Survey Depth (m)*	*CH_4 % v/v*	*CH_4 % LEL*	*CO_2 % v/v*	*O_2 % v/v*	*Comments*
LG1	BH	9.90	0.0	0	0.5	20.0	
LG2	BH	7.90	0.0	0	0.0	20.3	
LG2A	BH	4.40	0.0	0	0.8	20.1	
LG3	BH	9.30	0	0	**1.4**	18.4	
LG4	BH	6.50	0.0	0	0.3	19.8	
LG5	BH	5.70	0.0	0	0.0	20.3	
LG6	BH	7.00	0.0	0	0.2	20.2	
LG7	BH	6.00	0.0	0	0.1	20.1	
LG8	BH	7.00	0.0	0	0.1	19.4	
LG9	BH	7.00	0.0	0	**4.6**	9.1	
LG9A	BH	7.40	0.0	0	0.0	19.7	
LG9B	BH	5.80	0.0	0	**3.8**	13.1	
LG9C	BH	7.00	0.0	0	0	19.7	
LG10	BH	5.60	**7.9**	**158**	**3.0**	2.4	Located in Old Percolation Area. Septic Tank now connected to treatment plant.
LG10A	BH	0.00	0.0	0	0.9	18.6	
LG11A	BH	7.10	0	0	0	20.5	UTM (Obstructed)
LG11B	BH	4.63	0	0	0.8	18.5	UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.1	
LG13	BH	13.05	0.0	0	0.4	20.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	0	20.3	
LG16	BH	9.32	0.0	0	0	20.1	
LG17	BH	8.15	0.0	0	0.2	20.1	
LG18	BH	4.42	0.0	0	0.4	19.8	

Note : Bold type denotes attainment or exceedence of TriggerLevel

(1.0 % v/v (20% LEL) CH_4 & 1.5% v/v CO_2) - Ref. Waste Licence 4-4 Condition 6.3.1.

Signed :- _____

Example of Calc of LEL at LG10 7.9/ 5 x 100 = 158 Facility Manager

Date :- _____

APPENDIX 3

Dust Monitoring 2015

Dust Template "For Reporting"

Sampler	**Odour Monitoring Ireland**
Sampling Purpose	**Dust**
Period	3rd event
Sample Type	**For Reporting**

Note: Dust samples should be taken over a 30 day period. Please enter the date the sample was collected from site, i.e. the 30th day.

Station	Sam	Comment	Dust Deposition
	Note: Dust samples should be taken over a 30 day period. Please enter the date the sample was collected from site, i.e. the 30th		
Units			**mg/m2/day**
D1	28/10/15		87
D2	28/10/15		73
D3	28/10/15		41
D4	28/10/15		91
D5	28/10/15		85
D6	28/10/15		88

Options

Do not change information in grey boxes

Select options from drop down lists or fill in own data

Fill in own data

Instructions

1. Fill in the Period (Cell B5) - without this the data cannot be transferred into the database.
2. Fill in data where applicable to all yellow and blue boxes.
3. The yellow boxes will only accept numerical data.
4. If there is no data for a parameter, please leave the box blank.
5. Any explanations for no data etc should be entered in the Comment box for that sample.
6. The user is obliged to insert the results in the units listed below each parameter. This is for graphing purposes within the database.
7. This template is only designed for use for the standard round of sampling as per the licence. If additional samples are carried out due to elevated levels within the same sampling period, these results should be entered in a separate template, labelled as Additional Templates.

Questions for Sign-Off

1. Have you filled in the mandatory boxes?
2. Does the sample date match the sample period?
3. Are all of the sampling results entered according to the mandatory units?

Name: Amanda Sheridan 10/12/2014

When you have completed the form, please email to arthurstownenvironmentaldata@gmail.com

Dust Template "For Reporting"

Sampler	**Odour Monitoring Ireland**
Sampling Purpose	**Dust**
Period	2nd event
Sample Type	**For Reporting**

Note: Dust samples should be taken over a 30 day period. Please enter the date the sample was collected from site, i.e. the 30th day.

Station	Sam	Comment	Dust Deposition
	Note: Dust samples should be taken over a 30 day period. Please enter the date the sample was collected from site, i.e. the 30th		
Units			**mg/m2/day**
D1	31/08/15		84
D2	31/08/15		70
D3	31/08/15		38
D4	31/08/15		88
D5	31/08/15		82
D6	31/08/15		86

Options

Do not change information in grey boxes

Select options from drop down lists or fill in own data

Fill in own data

Instructions

1. Fill in the Period (Cell B5) - without this the data cannot be transferred into the database.
2. Fill in data where applicable to all yellow and blue boxes.
3. The yellow boxes will only accept numerical data.
4. If there is no data for a parameter, please leave the box blank.
5. Any explanations for no data etc should be entered in the Comment box for that sample.
6. The user is obliged to insert the results in the units listed below each parameter. This is for graphing purposes within the database.
7. This template is only designed for use for the standard round of sampling as per the licence. If additional samples are carried out due to elevated levels within the same sampling period, these results should be entered in a separate template, labelled as Additional Templates.

Questions for Sign-Off

1. Have you filled in the mandatory boxes?
2. Does the sample date match the sample period?
3. Are all of the sampling results entered according to the mandatory units?

Name: Amanda Sheridan 10/12/2014

When you have completed the form, please email to arthurstownenvironmentaldata@gmail.com

Dust Template "For Reporting"

Sampler	**Odour Monitoring Ireland**
Sampling Purpose	**Dust**
Period	1st event
Sample Type	**For Reporting**

Note: Dust samples should be taken over a 30 day period. Please enter the date the sample was collected from site, i.e. the 30th day.

Station	Sam	Comment	Dust Deposition
	Note: Dust samples should be taken over a 30 day period. Please enter the date the sample was collected from site, i.e. the 30th		
Units			**mg/m2/day**
D1	31/07/15		88
D2	31/07/15		71
D3	31/07/15		37
D4	31/07/15		91
D5	31/07/15		80
D6	31/07/15		89

Options

Do not change information in grey boxes

Select options from drop down lists or fill in own data

Fill in own data

Instructions

1. Fill in the Period (Cell B5) - without this the data cannot be transferred into the database.
2. Fill in data where applicable to all yellow and blue boxes.
3. The yellow boxes will only accept numerical data.
4. If there is no data for a parameter, please leave the box blank.
5. Any explanations for no data etc should be entered in the Comment box for that sample.
6. The user is obliged to insert the results in the units listed below each parameter. This is for graphing purposes within the database.
7. This template is only designed for use for the standard round of sampling as per the licence. If additional samples are carried out due to elevated levels within the same sampling period, these results should be entered in a separate template, labelled as Additional Templates.

Questions for Sign-Off

1. Have you filled in the mandatory boxes?
2. Does the sample date match the sample period?
3. Are all of the sampling results entered according to the mandatory units?

Name: Amanda Sheridan 10/12/2014

When you have completed the form, please email to arthurstownenvironmentaldata@gmail.com

APPENDIX 4

Noise Monitoring 2015

Air I Noise I Water I Soil I Environmental Consultancy
www.axisenv.ie

Unit 5 Caherdavin Business Centre,
Ennis Road,
Limerick

South Dublin Arthurstown Landfill

Kill, Co. Kildare

Bi-Annual Environmental Noise Report
Noise Survey October 2015

Waste Licence Number: W0004-04

Report Reference Number:	**4130-15-02**
Version:	**2**
Date of Issue:	**16th December 2015**
Report Compiled by:	**Daniel Mullins**

Report Content

Report Date	16/12/2015	**Site Contact:**	John Smith (Facility Manager)
Report Issued By	Mark Mc Garry	**Version No:**	1
Signed:		**Client:**	South Dublin Arthurstown Landfill
Notes:			

1. Executive Summary

South Dublin Arthurstown Landfill is required as part of its Waste License W0004-04, Condition C.1 to carry out a bi-annual noise survey on its site. AXIS environmental services were commissioned to complete the survey after proposal acknowledgment and acceptance by the landfill operators. This survey was completed on the 14-10-2015.

The purpose of the survey was to monitor noise at predetermined locations and assess the sites compliance against limits set out in their waste licence.

All operations at Arthurstown Landfill were running as normal throughout the survey. The timber processing plant had the greatest impact on the noise survey at several of the monitoring locations. This site is located next to Arthurstown Landfill and so noise from here can be heard clearly at several monitoring locations. There was also some noise from a quarry which was located on the opposite boundary of the landfill. No significant noise interference was noted from the Arthurstown Landfill site. More detailed noise data recorded at each individual location are summarised in the report.

The survey was carried out in strict accordance with the standard ISO 1996 Parts 1 − 3, Acoustics − description, measurement and assessment of environmental noise. Reference was also made to the EPA guidelines NG4 *"Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities"* April 2012, in conjunction with the frequently asked questions issued by the Agency in August 2012.

As outlined in the Standard ISO 1996 and the associated noise guidance document issued by the Agency in 2012, where intermittent noise (traffic for example) is interfering with noise measurements, it is acceptable to assess noise compliance against the L_{A90} for the monitoring period. This is a statistical measurement of the noise level exceeded for 90% of the time which would largely be associated with the facility under assessment. N5 and N6 (both night) were all over the designated limit for night time noise even with the application of the L_{A90}. Noise recorded at these locations can be directly attributed to the timber processing plant. Where any other points were over the noise limits, the LA90 brought these levels down under the limits outlined.

There was no impulsive noise recorded during the survey. Several locations had minor tonal noise but this can also be attributed to noise from the wood processing plant.

2. Introduction

As part of compliance monitoring at South Dublin Arthurstown Landfill a bi-annual noise survey is to be carried out the site. The Agency and Arthurstown Landfill have agreed the monitoring points chosen to meet the requirements of the licence.

The license W0004-04 outlines Arthurstown Landfill's requirements under Condition C.1, which have been documented as follows:

2.1. Condition C.1:

Noise from the installation shall not give rise to sound pressure levels (Leq, T) measured at the noise sensitive locations of the installation which exceed the limit value(s)

2.2 Condition B4:

Day dB(A) L_{Aeq}(30minutes)	Night dB(A) L_{Aeq}(30 minutes)
55	45

Table 1: Condition 8: Noise Monitoring

Location	*Measurement*	*Frequency*
N1A	30 minute Day & Night survey to include 1/3rd octave measurements	Bi-Annually
N2	30 minute Day & Night survey to include 1/3rd octave measurements	Bi-Annually
N3	30 minute Day & Night survey to include 1/3rd octave measurements	Bi-Annually
N4	30 minute Day & Night survey to include 1/3rd octave measurements	Bi-Annually
N5	30 minute Day & Night survey to include 1/3rd octave measurements	Bi-Annually
N6	30 minute Day & Night survey to include 1/3rd octave measurements	Bi-Annually
N9	30 minute Day & Night survey to include 1/3rd octave measurements	Bi-Annually

3. Methods

Monitoring was carried out in strict accordance with ISO 1996 Parts 1 – 3, Description and Measurement of Environmental Noise. Reference was also made to the EPA guidelines NG4 *"Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities"* April 2012, in conjunction with the frequently asked questions issued by the Agency in August 2012.

Table 3: Equipment Details

	Meter No 2	**Meter No 3**
Manufacturer	Cirrus Optimus Green	Cirrus Optimus Green
Model	CR:171B	CR:172B
Serial Number	G061082	G061817
Firmware	V2.3.1156	V2.4.1529
Calibrator	CR:515 Acoustic Calibrator	CR:515 Acoustic Calibrator
Microphone	B&K4180 - 1893453	B&K4180 - 1893453
Windshield Type	UA:237 90mm Foam Windshield	UA:237 90mm Foam Windshield
Calibration Date		
Noise Meter	07th April 2015 – 2016	09th October 2015 - 2016
Certificate Number	227467	232526
Calibrator	07th April 2015 – 2016	09th October 2015 - 2016
Certificate Number	227465	102905

4.0 Monitoring Locations

4.1 N1A Day Time Survey

This monitoring point is located next to the site office. Noise recorded at this location was mainly due to traffic both on and off site, although traffic on the L2019 accounted for the majority of noise. There was occasional noise as people came and left from the office although this did not significantly impact upon the noise survey.

4.1.1 N1A Night Time Survey

There was no noise from the offices as there were no people coming or going from here. Noise onsite was confined to a van parking close to the meter which drove away again after several minutes. The most common source of noise was from traffic on the L2019, although this was infrequent.

4.2 N2 Day Time Survey

N2 is another onsite location, located approximately half way between N1A and N9. N2 is the most centrally located of all noise monitoring points. Traffic was heard in the distance and birds were also heard in the surrounding area. There was no noteworthy noise interferences from the landfill.

4.2.1 N2 Night Time Survey

As with several other points, there was no noise recorded at this location that could be attributed to activities underway at Arthurstown Landfill. A van was briefly heard nearby on one occasion during the survey. A light breeze blew through the site during the survey however it was below the required EPA limit (5m/sec).

4.3 N3 Day Time Survey

N3 is located along the western boundary of the site, close to a nearby quarry. There was some noise from activities in the quarry although this had very little impact on the noise survey. Birds were also heard in the surrounding area as well as sheep in the distance.

4.3.1 N3 Night Time Survey

This was a very quiet monitoring location during the night time nose survey. There was a slight breeze rustling nearby trees and shrubs during the noise survey however wind speed was well below the 5m/sec limit. No noise was attributed to the landfill.

4.4 N4 Day Time Survey

N4 is located at the very back of the site, next to an onsite road on the South-western boundary of the site. A van and jeep passed close to the noise monitor towards the beginning of the noise survey – both of which led to some noise. Apart from this, birds chirping and cattle mooing in nearby fields were the only sources of noise heard throughout the survey.

Faint sounds of traffic could also be heard in the distance.

4.4.1 N4 Night Time Survey

As with the day time survey, no noise was attributed to Arthurstown Landfill during the night-time noise survey. A van passed close to the monitor on several occasions which was the leading cause of noise. Traffic could also be heard further away although this was very faint. A light breeze blew throughout the survey.

4.5 N5 Day Time Survey

N5 is located next to the Timber Processing Plant – a site which is located directly beside Arthurstown Landfill, on the Western boundary. The majority of noise recorded at this monitoring point came from the timber processing plant. Other source of noise included traffic on the L2019 and birds chirping in the surrounding trees.

4.5.1 N5 Night Time Survey

The timber plant was once again the predominant source of noise at this monitoring location. There was also a slight breeze rustling trees onsite. No noise was heard from the Arthurstown site.

4.6 N6 Day Time Survey

N6 is located near the front of the site between the Tiber Processing Plant and the Arthurstown landfill lagoon. The Timber Processing Plant was the main source of noise at this location. Secondary sources of noise included water flowing into the lagoon and traffic on the L2019 which is located very close to this point.

4.6.1 N6 Night Time Survey

N6 experienced the same noise sources during the night time as during the day time survey. Noise from the timber processing plant was greatest throughout the survey. Secondary sources of noise included flowing water near the lagoon and offsite traffic.

4.7 N9 Day Time Survey

N9 is located along the same road as N3, on the western boundary. N9 is slightly further from the quarry and so while activities were audible, quarry noise was lower than that recorded at N3. Sheep were also heard in a distant field as well as birds in the surrounding trees. No noise was observed as having come from Arthurstown Landfill.

4.7.1 N9 Night Time Survey

As with N3, there was no noise attributed to the landfill at this location. A slight breeze rustled surrounding vegetation and a van was briefly heard as it drove past the meter.

5.0 Summary of Daytime Noise Measurements

Noise Monitoring Location: N1A (Internal Boundary Monitoring Point) 14-10-2015					
Period:	**Time**	**Measured Noise Levels (dB re. 2 x 10^{-5} Pa)**			**Comments**
		L_{Aeq}	**L_{AFMAX}**	**L_{A90}**	
Daytime:	**10:55**	48.5	75.5	40.1	Noise recorded at this location was mainly due to traffic both on and off site, although traffic on the L2019 accounted for the majority of noise. There was occasional noise as people came and left from the office although this did not significantly impact upon the noise survey.
	-	-	-	-	
	-	-	-	-	
Arithmetic Average (dB):		48.5	75.5	40.1	
Daytime Criterion, dB $L_{Ar,T}$:		55	-	-	
Evening:	**-**	-	-	-	This site is not required to monitor noise emissions during the evening period. The site is not defined as a new or revised licence since the guidelines were issued in 2012.
Arithmetic Average (dB):		-	-	-	
Evening Criterion, dB $L_{Ar,T}$:		-	-	-	
Night Time:	**23:45**	54.3	91.3	44.7	Noise onsite was confined to a van parking close to the meter which drove away again after several minutes. The most common source of noise was from traffic on the L2019, although this was infrequent.
	-	-	-	-	
Arithmetic Average (dB):		54.3	91.3	44.7	
Night time Criterion, dB $L_{Ar,T}$:		-	-	45	
Weather Conditions:					
	Daytime:		**Evening:**		**Night Time:**
Temperature (^{o}C)	7		-		3
Wind Speed (m/s)	0 – 0.5		-		1.2 – 2.1
Wind Direction:	Westerly		-		Westerly
Precipitation (mm):	0		-		0
Tonal Noise Assessment					
Daytime:	None		-		-
Night Time:	None		-		-
Compliance Status – this site would be considered a site boundary location and so is not bound the limits set out for NSLs. Due to interference from external noise sources it is appropriate to use the LA90 to assess Arthurstown landfill against its licence limits.					

Noise Monitoring Location: N2 (Internal Boundary Monitoring Point) 14-10-2015					
Period:	**Time**	**Measured Noise Levels (dB re. 2 x 10^{-5} Pa)**			**Comments**
		L_{Aeq}	**L_{AFMAX}**	**L_{A90}**	
Daytime:	**11:23**	48.3	77.1	38.4	N2 is the most centrally located of all noise monitoring points. Traffic was heard in the distance and birds were also heard in the surrounding area. There was no noteworthy noise interferences from the landfill.
	-	-	-	-	
	-	-	-	-	
Arithmetic Average (dB):		48.3	77.1	38.4	
Daytime Criterion, dB $L_{Ar,T}$:		55	-	-	
Evening:	**-**	-	-	-	This site is not required to monitor noise emissions during the evening period. The site is not defined as a new or revised licence since the guidelines were issued in 2012.
Arithmetic Average (dB):		-	-	-	
Evening Criterion, dB $L_{Ar,T}$:		-	-	-	
Night Time:	**23:13**	44.2	77.8	37.5	As with several other points, there was no noise recorded at this location that could be attributed to activities underway at Arthurstown Landfill. A van was briefly heard nearby on one occasion during the survey. A light breeze blew through the site during the survey.
	-	-	-	-	
Arithmetic Average (dB):		44.2	77.8	37.5	
Night time Criterion, dB $L_{Ar,T}$:		45	-	-	
Weather Conditions:					
	Daytime:		**Evening:**		**Night Time:**
Temperature (^{o}C)	7		-		3
Wind Speed (m/s)	0 – 0.5		-		1.2 – 2.1
Wind Direction:	Westerly		-		Westerly
Precipitation (mm):	0		-		0
Tonal Noise Assessment					
Daytime:	None		-		-
Night Time:	None		-		-
Compliance Status – this site would be considered a site boundary location and so is not bound the limits set out for NSLs. Due to interference from external noise sources it is appropriate to use the LA90 to assess Arthurstown landfill against its licence limits. The site complies with both day and night time criteria.					

Noise Monitoring Location: N3 (Internal Boundary Monitoring Point) 14-10-2015					
Period:	**Time**	**Measured Noise Levels (dB re. 2 x 10^{-5} Pa)**			**Comments**
		L_{Aeq}	**L_{AFMAX}**	**L_{A90}**	
Daytime:	**10:15**	40.9	74.8	28.9	There was some noise from activities in the quarry although this had very little impact on the noise survey. Birds were heard in the surrounding area. Sheep were also heard in the distance.
	-	-	-	-	
	-	-	-	-	
Arithmetic Average (dB):		40.9	74.8	28.9	
Daytime Criterion, dB $L_{Ar,T}$:		55	-	**-**	
Evening:	**-**	-	-	-	This site is not required to monitor noise emissions during the evening period. The site is not defined as a new or revised licence since the guidelines were issued in 2012.
Arithmetic Average (dB):		-	-	-	
Evening Criterion, dB $L_{Ar,T}$:		-	-	-	
Night Time:	**22:38**	38.3	76.2	25.4	This was a very quiet monitoring location during the night time nose survey. There was a slight breeze rustling nearby trees and shrubs during the noise survey however wind speed was well below the 5m/sec limit.
	-	-	-	-	
Arithmetic Average (dB):		38.3	76.2	25.4	
Night time Criterion, dB $L_{Ar,T}$:		45	-	**-**	

Weather Conditions:			
	Daytime:	**Evening:**	**Night Time:**
Temperature (^{o}C)	7	-	3
Wind Speed (m/s)	0 – 0.5	-	1.2 – 2.1
Wind Direction:	Westerly	-	Westerly
Precipitation (mm):	0	-	0

Tonal Noise Assessment			
Daytime:	None	-	-
Night Time:	None	-	-

Compliance Status – this site would be considered a site boundary location and so is not bound the limits set out for NSLs. The site complies with both day and night time criteria.

Noise Monitoring Location: N4 (Internal Boundary Monitoring Point) 14-10-2015					
Period:	**Time**	**Measured Noise Levels (dB re. 2 x 10^{-5} Pa)**			**Comments**
		L_{Aeq}	**L_{AFMAX}**	**L_{A90}**	
Daytime:	**09:42**	49.0	81.9	31.9	A van and jeep passed close to the noise monitor towards the beginning of the noise survey – both of which led to some noise. Apart from this, birds chirping and cattle mooing in nearby fields were the only sources of noise hear. Traffic could also be heard in the distance.
	-	-	-	-	
	-	-	-	-	
Arithmetic Average (dB):		49.0	81.9	31.9	
Daytime Criterion, dB $L_{Ar,T}$:		55	-	**-**	
Evening:	**-**	-	-	-	This site is not required to monitor noise emissions during the evening period. The site is not defined as a new or revised licence since the guidelines were issued in 2012.
Arithmetic Average (dB):		-	-	-	
Evening Criterion, dB $L_{Ar,T}$:		-	-	-	
Night Time:	**22:02**	49.9	87.1	28.7	A van passed close to the monitor on several occasions which was the leading cause of noise. Traffic could also be heard further away although this was very faint. A light breeze blew throughout the survey.
	-	-	-	-	
Arithmetic Average (dB):		49.9	87.1	28.7	
Night time Criterion, dB $L_{Ar,T}$:		-	-	45	

Weather Conditions:			
	Daytime:	**Evening:**	**Night Time:**
Temperature (^{O}C)	7	-	3
Wind Speed (m/s)	0 – 0.5	-	1.2 – 2.1
Wind Direction:	Westerly	-	Westerly
Precipitation (mm):	0	-	0

Tonal Noise Assessment			
Daytime:	None	-	-
Night Time:	None	-	-

Compliance Status – this site would be considered a site boundary location and so is not bound the limits set out for NSLs. The site complies with both day and night time criteria.

Noise Monitoring Location: N5 (Internal Boundary Monitoring Point) 14-10-2015					
Period:	**Time**	**Measured Noise Levels (dB re. 2 x 10^{-5} Pa)**			**Comments**
		L_{Aeq}	**L_{AFMAX}**	**L_{A90}**	
Daytime:	**09:47**	51.6	68.1	50.2	The majority of noise recorded at this monitoring point came from the timber processing plant. Other source of noise included traffic on the L2019 and birds chirping in the surrounding tree.
	-	-	-	-	
	-	-	-	-	
Arithmetic Average (dB):		51.6	68.1	50.2	
Daytime Criterion, dB $L_{Ar,T}$:		55	-	**-**	
Evening:	**-**	-	-	-	This site is not required to monitor noise emissions during the evening period. The site is not defined as a new or revised licence since the guidelines were issued in 2012.
Arithmetic Average (dB):		-	-	-	
Evening Criterion, dB $L_{Ar,T}$:		-	-	-	
Night Time:	**22:05**	56.1	92.1	49.9	The timber plant was once again the predominant source of noise at this monitoring location. There was also a slight breeze rustling trees onsite. No noise was heard from the Arthurstown site.
	-	-	-	-	
Arithmetic Average (dB):		-	-	49.9	
Night time Criterion, dB $L_{Ar,T}$:		-	-	45	

Weather Conditions:			
	Daytime:	**Evening:**	**Night Time:**
Temperature (^{O}C)	7	-	3
Wind Speed (m/s)	0 – 0.5	-	1.2 – 2.1
Wind Direction:	Westerly	-	Westerly
Precipitation (mm):	0	-	0

Tonal Noise Assessment			
Daytime:	None	-	-
Night Time:	None	-	-

Compliance Status – this site would be considered a site boundary location and is not bound the limits set out for NSLs. Due to interference from external noise sources the site does not comply with night time criteria.

Noise Monitoring Location: N6 (Internal Boundary Monitoring Point) 14-10-2015					
Period:	**Time**	**Measured Noise Levels (dB re. 2 x 10^{-5} Pa)**			**Comments**
		L_{Aeq}	**L_{AFMAX}**	**L_{A90}**	
Daytime:	**10:21**	46.8	67.0	43.9	The Timber Processing Plant was the main source of noise at this location. Secondary sources of noise included water flowing into the lagoon and traffic on the L2019 which is located very close to this point.
	-	-	-	-	
	-	-	-	-	
Arithmetic Average (dB):		46.8	67.0	43.9	
Daytime Criterion, dB $L_{Ar,T}$:		55	-	**-**	
Evening:	**-**	-	-	-	This site is not required to monitor noise emissions during the evening period. The site is not defined as a new or revised licence since the guidelines were issued in 2012.
Arithmetic Average (dB):		-	-	-	
Evening Criterion, dB $L_{Ar,T}$:		-	-	-	
Night Time:	**23:14**	56.2	81.5	53.6	N6 experienced the same noise sources during the night time as during the day time survey. Noise from the timber processing plant was greatest throughout the survey. Secondary sources of noise included flowing water in the lagoon and offsite traffic.
	-	-	-	-	
Arithmetic Average (dB):		56.2	81.5	53.6	
Night time Criterion, dB $L_{Ar,T}$:		**-**	-	45	

Weather Conditions:			
	Daytime:	**Evening:**	**Night Time:**
Temperature (^{O}C)	7	-	3
Wind Speed (m/s)	0 – 0.5	-	1.2 – 2.1
Wind Direction:	Westerly	-	Westerly
Precipitation (mm):	0	-	0

Tonal Noise Assessment			
Daytime:	None	-	-
Night Time:	None	-	-

Compliance Status – this site would be considered a site boundary location and is not bound the limits set out for NSLs. Due to interference from external noise sources the site does not comply with night time criteria.

Noise Monitoring Location: N9 (Internal Boundary Monitoring Point) 14-10-2015					
Period:	**Time**	**Measured Noise Levels (dB re. 2 x 10^{-5} Pa)**			**Comments**
		L_{Aeq}	**L_{AFMAX}**	**L_{A90}**	
Daytime:	**10:47**	41.7	71.1	28.8	N9 is slightly further from the quarry compared to N3 and so while activities were audible, quarry noise was lower than at N3. Sheep were also heard in a distant field as well as birds in the surrounding trees. No noise was observed from Arthurstown Landfill.
	-	-	-	-	
	-	-	-	-	
Arithmetic Average (dB):		41.7	71.1	28.8	
Daytime Criterion, dB $L_{Ar,T}$:		55	-	**-**	
Evening:	**-**	-	-	-	This site is not required to monitor noise emissions during the evening period. The site is not defined as a new or revised licence since the guidelines were issued in 2012.
Arithmetic Average (dB):		-	-	-	
Evening Criterion, dB $L_{Ar,T}$:		-	-	-	
Night Time:	**22:39**	48.4	82.9	28.4	As with N3, there was no noise attributed to the landfill at this location. A slight breeze rustled surrounding vegetation and a van was briefly heard as it drove past the meter.
	-	-	-	-	
Arithmetic Average (dB):		48.4	82.9	28.4	
Night time Criterion, dB $L_{Ar,T}$:		**-**	-	45	

Weather Conditions:			
	Daytime:	**Evening:**	**Night Time:**
Temperature (^{O}C)	7	-	3
Wind Speed (m/s)	0 – 0.5	-	1.2 – 2.1
Wind Direction:	Westerly	-	Westerly
Precipitation (mm):	0	-	0

Tonal Noise Assessment			
Daytime:	None	-	-
Night Time:	None	-	-

Compliance Status – this site would be considered a site boundary location and so is not bound the limits set out for NSLs. Due to interference from external noise sources it is appropriate to use the LA90 to assess Arthurstown landfill against its licence limits. The site complies with both day and night time criteria.

6.0 Conclusions

Seven internal boundary points were monitored for broadband and 1/3rd Octave frequency as part of this bi-annual environmental noise survey at Arthurstown South Dublin landfill at Kill, Co. Kildare. Each point was monitored for 30 minute periods during the day and night time.

The findings of the survey would indicate that there is no significant noise originating from the landfill during the day or night and therefore penalties need not be applied. Several points had slightly elevated LAeq's. Despite the application of the LA90, 2 points (N5 and N6) remained above the noise limit for night time noise monitoring (45dB). Penalties do not need to be applied however as noise at both locations is entirely attributed to the neighbouring wood processing plant.

There was no tonal or impulsive noise attributed to any of the locations monitored. Where tonal noise was observed, it was below the threshold and is also attributed to noise from the wood processing plant.

Appendix I Graphical Display of Raw Data

Tonal Noise:

The appropriate level differences vary with frequency. They should be greater than or equal to the following values in both adjacent one third octave bands:

· 15dB in low frequency one third octave bands (25Hz to 125Hz);
· 8dB in middle frequency bands (160Hz to 400Hz), and;
· 5dB in high frequency bands (500Hz to 10,000Hz)

This is the definition outlined by the EPA in the guidance note issued in 2012: NG4.

16/10/2015

Cirrus Research plc

Measurement Summary Report

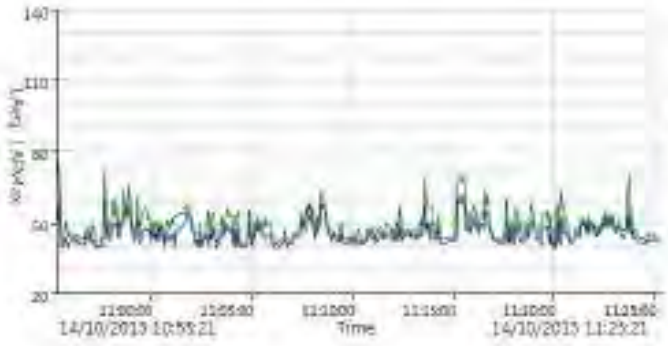
Name	Arthurstown Landfill, Day, N1A, Run 2			
Time	14/10/2015 10:55:21	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061082, CR:1719			

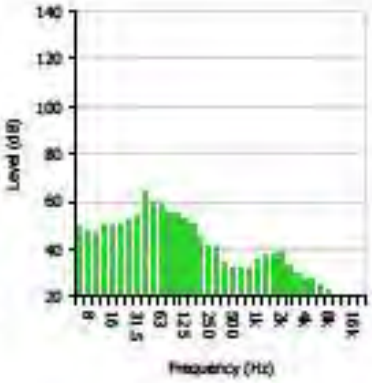
Calibration

Before 14/10/2015 09:42 Offset -2.85 dB **After** 14/10/2015 20:00 Offset -2.16 dB

Basic Values	
LAeq	48.5 dB
LAE	81.0 dB
LAFMax	75.5 dB

Statistical Levels (Ln)	
LAF1	59.0 dB
LAF5	53.2 dB
LAF10	50.4 dB
LAF50	42.9 dB
LAF90	40.1 dB
LAF95	39.5 dB
LAF99	38.8 dB





Report ID

MC1970100000125 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

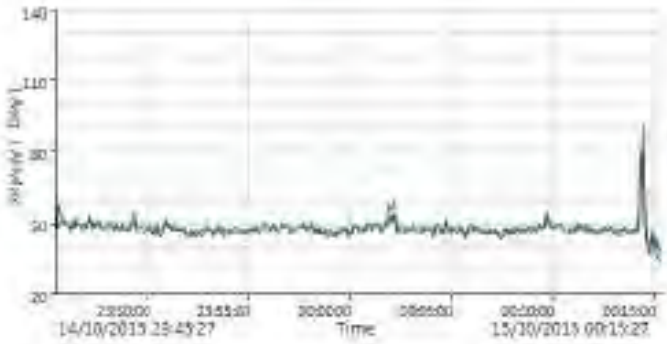
Name	Arthurstown Landfill, Night, N1A, Run 2			
Time	14/10/2015 23:45:27	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061082, CR:1718			

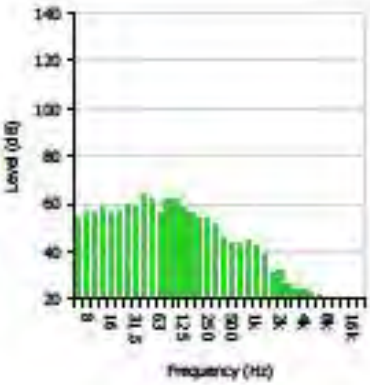
Calibration

Before 14/10/2015 22:02 Offset -2.82 dB **After** 15/10/2015 12:43 Offset -2.54 dB

Basic Values	
LAeq	54.3 dB
LAE	86.9 dB
LAFMax	91.3 dB

Statistical Levels (Ln)	
LAF1	54.0 dB
LAF5	49.8 dB
LAF10	48.9 dB
LAF50	46.5 dB
LAF90	44.7 dB
LAF95	44.0 dB
LAF99	36.3 dB





Report ID

MC197010000012A Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

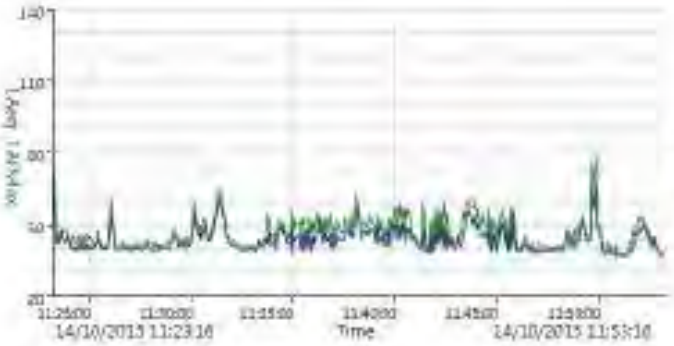
Name	Arthurstown Landfill, Day, N2, Run 2			
Time	14/10/2015 11:23:16	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061817, CR:1728			

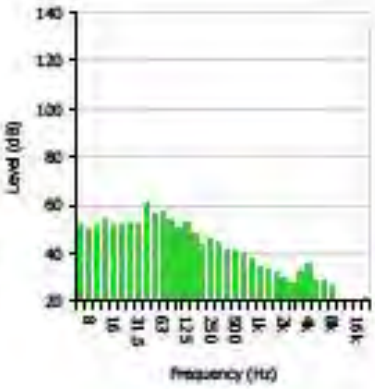
Calibration

Before	14/10/2015 09:41	Offset	-0.03 dB	**After**	14/10/2015 22:05	Offset	-0.05 dB

Basic Values	
LAeq	48.3 dB
LAE	80.8 dB
LAFMax	77.1 dB

Statistical Levels (Ln)	
LAF1	58.2 dB
LAF5	52.5 dB
LAF10	49.5 dB
LAF50	41.1 dB
LAF90	38.4 dB
LAF95	37.7 dB
LAF99	36.3 dB





Report ID

MCI97010000011E Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

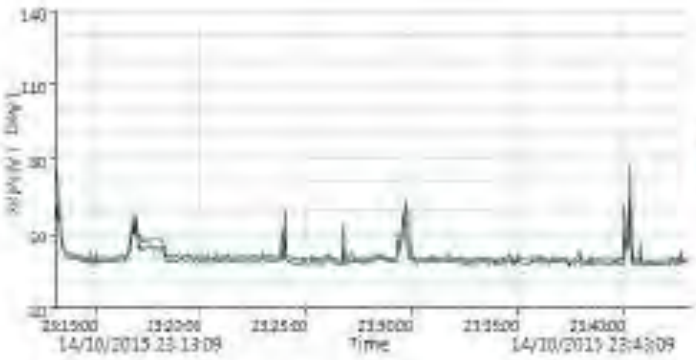
Name	Arthurstown Landfill, Night, N2, Run 2			
Time	14/10/2015 23:13:09	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061082, CR:1718			

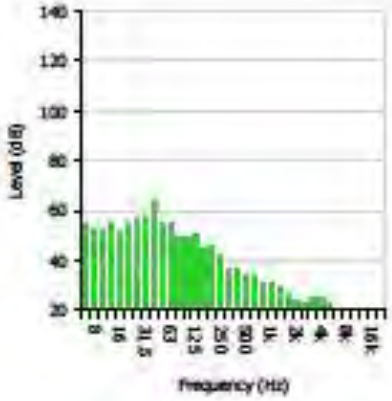
Calibration

Before 14/10/2015 22:02 Offset -2.82 dB **After** 15/10/2015 12:43 Offset -2.54 dB

Basic Values	
LAeq	41.2 dB
LAE	76.8 dB
LAFMax	77.8 dB

Statistical Levels (Ln)	
LAF1	54.1 dB
LAF5	44.4 dB
LAF10	41.2 dB
LAF50	38.7 dB
LAF90	37.5 dB
LAF95	37.2 dB
LAF99	36.7 dB





Report ID

MC1970100000129 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

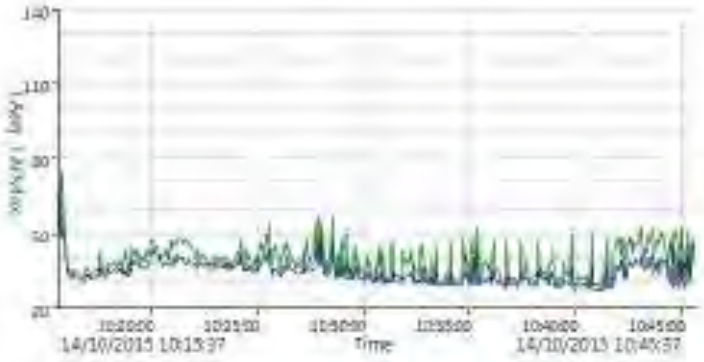
Name	Arthurstown Landfill, Day, N3, Run 2			
Time	14/10/2015 10:15:37	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061817, CR:172B			

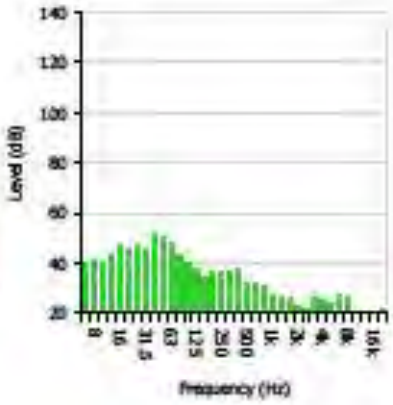
Calibration

Before 14/10/2015 09:41 Offset -0.03 dB **After** 14/10/2015 22:05 Offset -0.05 dB

Basic Values	
LAeq	40.9 dB
LAE	73.4 dB
LAFMax	74.8 dB

Statistical Levels (Ln)	
LAF1	49.1 dB
LAF5	42.1 dB
LAF10	39.0 dB
LAF50	32.6 dB
LAF90	28.9 dB
LAF95	28.1 dB
LAF99	27.1 dB





Report ID

MC197010000011C Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

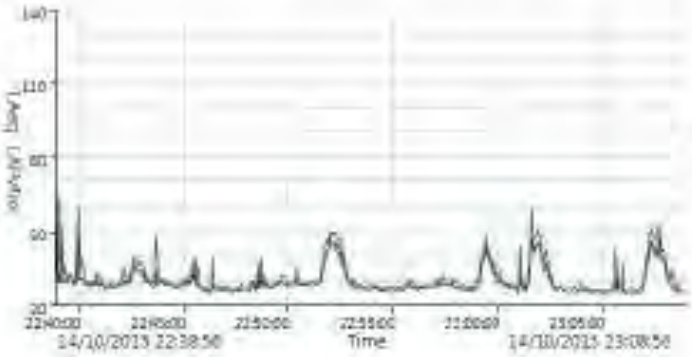
Name	Arthurstown Landfill, Night, N3, Run 2			
Time	14/10/2015 22:38:56	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	GO61082, CR:171B			

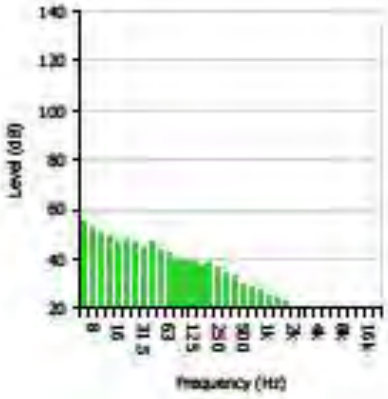
Calibration

Before 14/10/2015 22:02 Offset -2.82 dB **After** 15/10/2015 12:43 Offset -2.54 dB

Basic Values	
LAeq	38.3 dB
LAE	70.8 dB
LAFMax	76.2 dB

Statistical Levels (Ln)	
LAF1	46.4 dB
LAF5	40.6 dB
LAF10	35.9 dB
LAF50	27.7 dB
LAF90	25.4 dB
LAF95	24.9 dB
LAF99	24.4 dB





Report ID

MC1970100000128 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

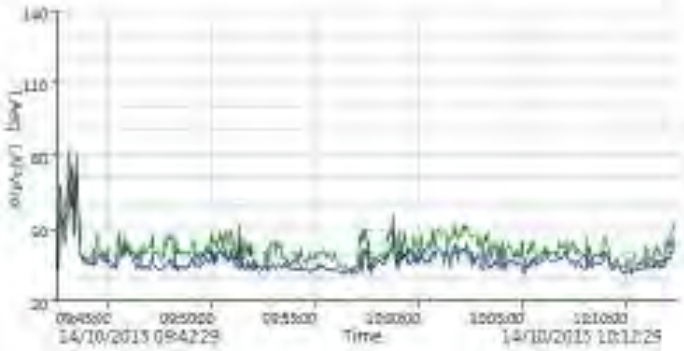
Name	Arthurstown Landfill, Day, N4, Run 2			
Time	14/10/2015 09:42:29	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061817, CR:172B			

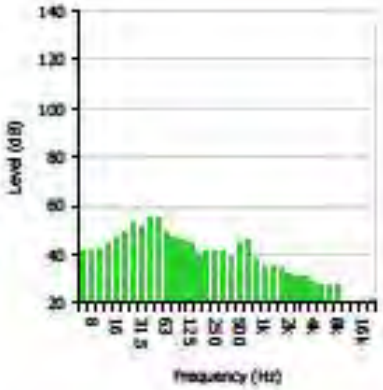
Calibration

Before 14/10/2015 09:41 Offset -0.03 dB **After** 14/10/2015 22:05 Offset -0.05 dB

Basic Values	
LAeq	49.0 dB
LAE	81.5 dB
LAFMax	81.9 dB

Statistical Levels (Ln)	
LAF1	54.4 dB
LAF5	43.4 dB
LAF10	40.3 dB
LAF50	34.3 dB
LAF90	31.9 dB
LAF95	31.5 dB
LAF99	30.8 dB





Report ID

MC1970100000118 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

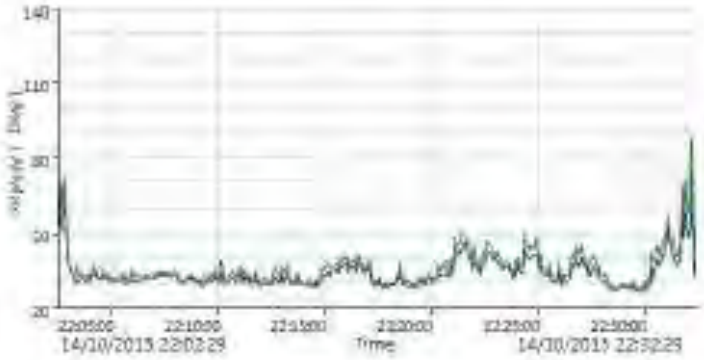
Name	Arthurstown Landfill, Night, N4, Run 2			
Time	14/10/2015 22:02:29	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061082, CR:1718			

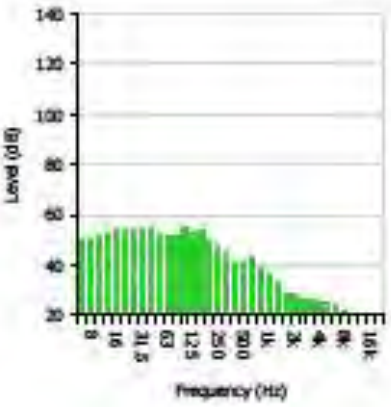
Calibration

Before	14/10/2015 22:02	Offset	-2.82 dB	**After**	15/10/2015 12:43	Offset	-2.54 dB

Basic Values	
LAeq	49.9 dB
LAE	82.5 dB
LAFMax	87.1 dB

Statistical Levels (Ln)	
LAF1	54.9 dB
LAF5	43.4 dB
LAF10	39.8 dB
LAF50	31.8 dB
LAF90	28.7 dB
LAF95	28.0 dB
LAF99	27.1 dB





Report ID

MCL9701000000127 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

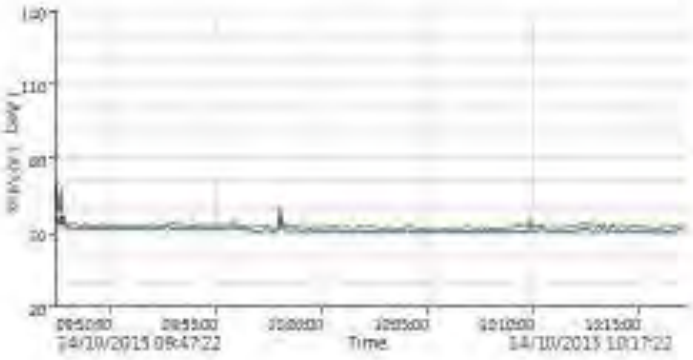
Name	Arthurstown Landfill, Day, N5, Run 2			
Time	14/10/2015 09:47:22	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061082, CR:171B			

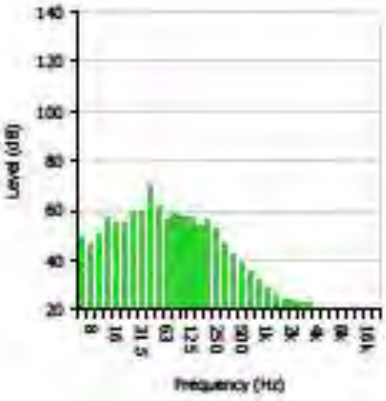
Calibration

Before 14/10/2015 09:42 Offset -2.85 dB **After** 14/10/2015 20:00 Offset -2.16 dB

Basic Values	
LAeq	51.6 dB
LAE	84.1 dB
LAFMax	68.1 dB

Statistical Levels (Ln)	
LAF1	53.8 dB
LAF5	52.8 dB
LAF10	52.5 dB
LAF50	51.3 dB
LAF90	50.2 dB
LAF95	50.0 dB
LAF99	49.5 dB





Report ID

MC1970100000123 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

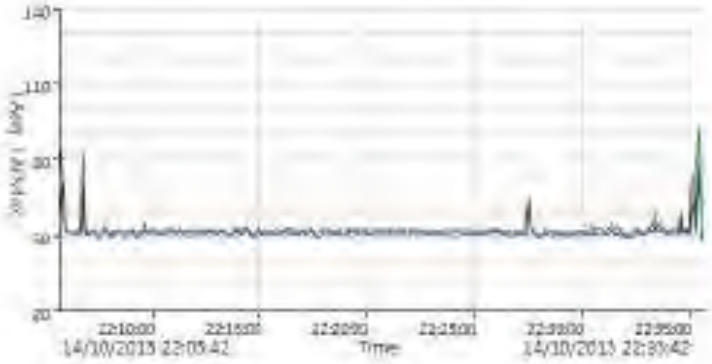
Name	Arthurstown Landfill, Night, NS, Run 2			
Time	14/10/2015 22:05:42	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061817, CR:172B			

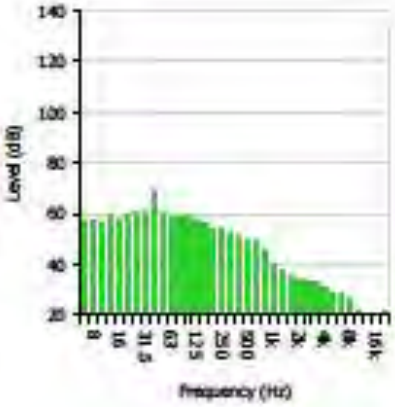
Calibration

Before 14/10/2015 22:05 Offset -0.05 dB **After** 15/10/2015 12:48 Offset -1.44 dB

Basic Values	
LAeq	56.1 dB
LAE	88.6 dB
LAFMax	92.1 dB

Statistical Levels (Ln)	
LAF1	60.1 dB
LAF5	52.5 dB
LAF10	52.1 dB
LAF50	51.0 dB
LAF90	49.3 dB
LAF95	49.6 dB
LAF99	48.9 dB





Report ID

MC197010000011F Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

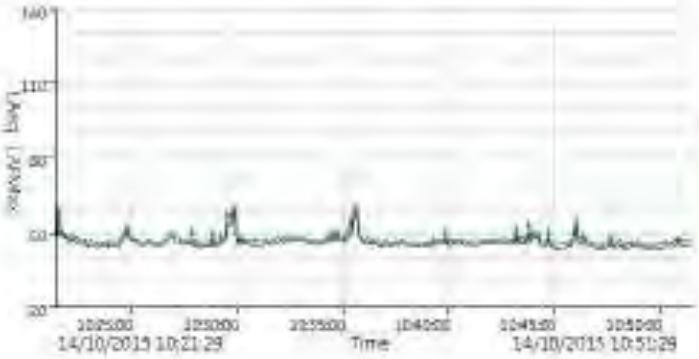
Name	Arthurstown Landfill, Day, N6, Run 2			
Time	14/10/2015 10:21:29	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061082, CR:1718			

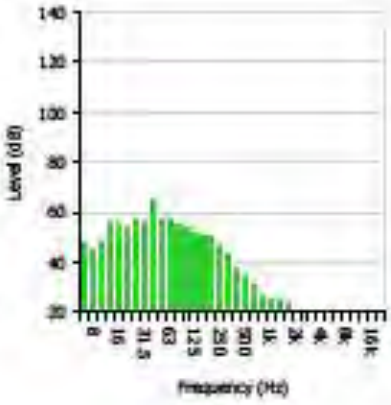
Calibration

Before 14/10/2015 09:42 Offset -2.85 dB **After** 14/10/2015 20:00 Offset -2.16 dB

Basic Values	
LAeq	46.8 dB
LAE	79.4 dB
LAFMax	67.0 dB

Statistical Levels (Ln)	
LAF1	56.2 dB
LAF5	49.4 dB
LAF10	47.6 dB
LAF50	45.2 dB
LAF90	43.9 dB
LAF95	43.5 dB
LAF99	43.0 dB





Report ID

MCL970100000124 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

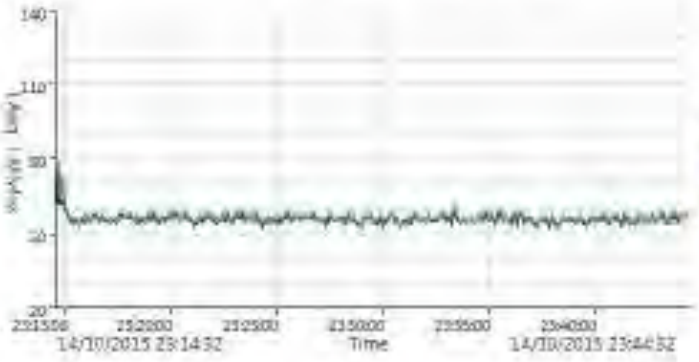
Name	Arthurstown Landfill, Night, N6, Run 2			
Time	14/10/2015 23:14:32	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061817, CR:1728			

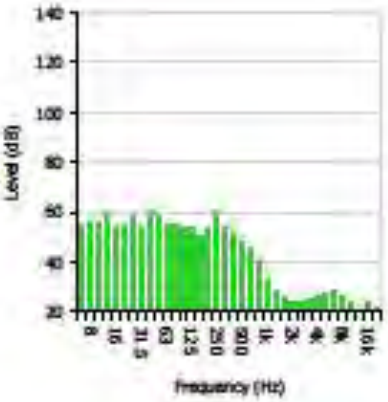
Calibration

Before 14/10/2015 22:05 Offset -0.05 dB **After** 15/10/2015 12:48 Offset -1.44 dB

Basic Values	
LAeq	56.2 dB
LAE	88.8 dB
LAFMax	81.5 dB

Statistical Levels (Ln)	
LAF1	61.1 dB
LAF5	58.0 dB
LAF10	57.3 dB
LAF50	55.5 dB
LAF90	53.6 dB
LAF95	53.1 dB
LAF99	52.2 dB





Report ID

MC1970100000121 Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

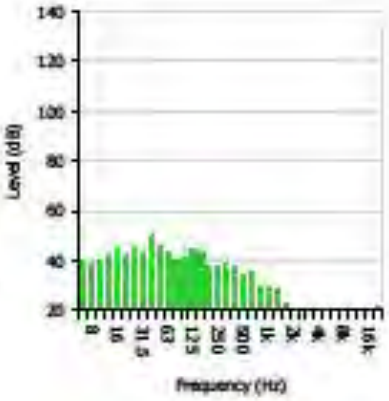
Name	Arthurstown Landfill, Day, N9, Run 2			
Time	14/10/2015 10:47:07	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061817, CR:172B			

Calibration

Before 14/10/2015 09:41 Offset -0.03 dB **After** 14/10/2015 22:05 Offset -0.05 dB

Basic Values	
LAeq	41.7 dB
LAE	74.3 dB
LAFMax	71.1 dB

Statistical Levels (Ln)	
LAF1	54.6 dB
LAF5	45.4 dB
LAF10	39.8 dB
LAF50	31.3 dB
LAF90	29.8 dB
LAF95	28.4 dB
LAF99	27.8 dB



Report ID:

MC197010000011D Cirrus Research NoiseTools Page 1 of 1

16/10/2015

Cirrus Research plc

Measurement Summary Report

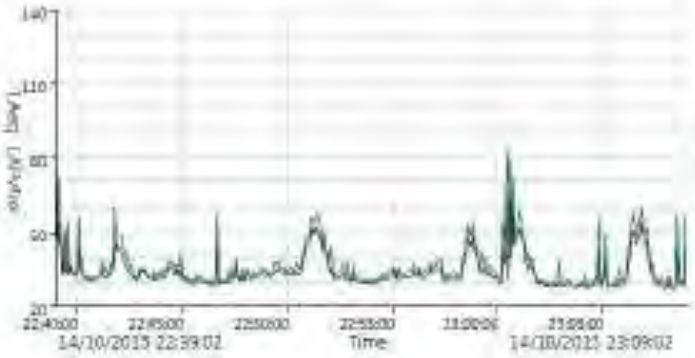
Name	Arthurstown Landfill, Night, N9, Run 2			
Time	14/10/2015 22:39:02	**Person**	**Place**	**Project**
Duration	00:30:00	Dan Mullins	Arthurstown Landfill	Environmental Noise
Instrument	G061817, CR:172B			

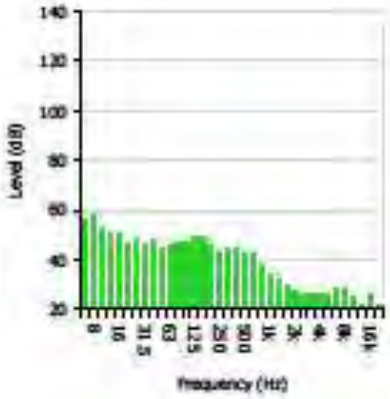
Calibration

Before 14/10/2015 22:05 Offset -0.05 dB **After** 15/10/2015 12:48 Offset -1.44 dB

Basic Values	
LAeq	48.4 dB
LAE	81.0 dB
LAFMax	82.9 dB

Statistical Levels (Ln)	
LAF1	53.5 dB
LAF5	46.7 dB
LAF10	41.8 dB
LAF50	31.7 dB
LAF90	28.4 dB
LAF95	27.9 dB
LAF99	27.4 dB





Report ID

MC1970100000120 Cirrus Research NoiseTools Page 1 of 1

Appendix II Site Map

Appendix III Calibration Certificates

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	CR:172B
Description	Sound Level Meter
Serial Number	G061817

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001,IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards (A.0.6). The standards are:

Microphone Type	B&K 4192	Serial Number	1920791	Calibration Ref.	S6450
Pistonphone Type	B&K 4220	Serial Number	613843	Calibration Ref.	S6388

Calibrated by	T. A. Goodhill
Calibration Date	09 October 2015
Calibration Certificate Number	232526

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Certificate Number: **102905**
Date of Issue: **09 October 2015**

Acoustic Calibrator

Manufacturer: **Cirrus Research plc** Serial Number: **59318**
Model Number: **CR:515**

Calibration Procedure

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer s data.

Date of Calibration: **09 October 2015**

Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	94.02	1000.0	0.39
2	94.00	1000.0	0.38
3	94.00	1000.0	0.39

Average	**94.01**	**1000.0**	**0.39**
Uncertainty	± 0.13	± 0.1	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level.

Cirrus Research plc, Acoustic House, Bellington Road, Harrowby, North Yorkshire, YO34 8PH, United Kingdom
Telephone: 0845 230 2434 **Int.** +44 1723 891655
Email: sales@cirrusresearch.co.uk
Web: www.cirrusresearch.co.uk
UK Registration No. 487607

Page 1 of 2

bsi. ISO 9001 Quality Management FM 531001 ISO 14001 Environmental Management EMS 552104

Environmental Conditions

Pressure:	101.49 kPa
Temperature:	21.8 °C
Humidity	48.1 %

Evidence of Pattern Approval

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC 60942:2003 Annex A to Class 1. This has been confirmed with the PhysikalischTechnische Bundesanstalt (PTB).

Statement of Calibration

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 1 requirements of IEC 60942:2003.

Calibration Laboratory

Laboratory:	Cirrus Research plc Acoustic House, Bridlington Road, Hunmanby North Yorkshire, YO14 0PH, United Kingdom
Test Engineer:	Mark Berry

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Certificate Number: **102903**

Date of Issue: **09 October 2015**

Microphone Capsule

Manufacturer: **Cirrus Research plc** Serial Number: **203029A**

Model Number: **MK224**

Calibration Procedure

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to the National Physical Laboratory, Middlesex, UK.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Date of Calibration: **08 October 2015**

Open Circuit Sensitivity at 1 kHz: **43.2 mV/Pa** **-27.3 dB rel 1 V/Pa**

Environmental Conditions

Pressure: **101.10 kPa**

Temperature: **21.0 °C**

Humidity: **38.0 %**

Calibration Laboratory

Laboratory: Cirrus Research plc
Acoustic House, Bridlington Road, Hunmanby
North Yorkshire, YO14 0PH, United Kingdom

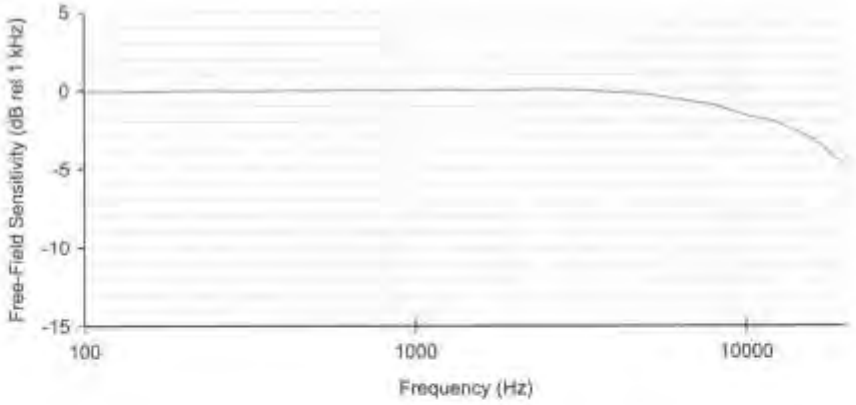
Test Engineer: Debra Swalwell

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH, United Kingdom
Telephone: 0845 230 2434 **Int**: +44 1723 891655
Email: sales@cirrusresearch.co.uk
Web: www.cirrusresearch.co.uk
UK Registered No. 962161

bsi. ISO 9001 Quality Management FM 53100 ISO 14001 Environmental Management EMS 552104

Free-Field Frequency Response

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator to Free-Field Correction (dB)
100	-0.12	-2.10
125	-0.13	-1.41
160	-0.10	-0.88
200	-0.04	-0.52
250	-0.04	-0.33
315	-0.06	-0.25
400	-0.03	-0.12
500	-0.04	-0.08
630	0.02	0.01
800	-0.03	-0.05
1 000	0.00	-0.01
1 250	0.04	-0.04
1 600	-0.02	-0.21
2 000	0.03	-0.28
2 500	0.06	-0.45
3 150	0.00	-0.76
4 000	-0.14	-1.31
5 000	-0.26	-2.02
6 300	-0.61	-3.11
8 000	-0.94	-4.62
10 000	-1.62	-6.78
12 500	-2.07	-8.77
16 000	-3.16	-11.25
20 000	-4.75	-14.96



Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type:	CR:171B
Description:	Sound Level Meter
Serial Number:	G061082

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001,IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meter:- All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards (A.0.6). The standards are:-

Microphone Type:	B&K 4192	Serial Number:	1920792	Calibration Ref:	56450
Preamplifier Type:	B&K 4220	Serial Number:	613843	Calibration Ref:	56386

Calibrated by: T. A. Goodall

Calibration Date: 07 April 2015

Calibration Certificate Number: 227467

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer:	Cirrus Research plc
Instrument Type:	CR:514
Description:	Acoustic Calibrator
Serial Number:	41373

Calibration Procedure

The acoustic calibrator detailed above has been calibrated to the published data as described in the operating manual. The procedures and techniques used to follow the recommendations of the IEC standard Electroacoustics – Sound Calibrators IEC 60942: 2003, IEC 60942: 1997, BS EN 60942: 1998 and BS EN 60942:2003 where applicable. The calibrator's main output is 94.00 dB (1 Pa) and this was set within the 0.01 dB resolution of the test system, i.e. one hundredth of a decibel. Numbers in {parentheses} refer to the paragraph in IEC 60942.

Calibration Traceability

The calibrator above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards { A 6.6 }. The standards are:

Microphone Type:	B&K 4192	Serial Number:	1930923	Calibration Ref:	56450
Preamplifier Type:	B&K 4220	Serial Number:	613643	Calibration Ref:	56398

Calibration Climate Conditions

The climatic test conditions were all maintained within the permitted limits of IEC 60942: 1997.

Temperature:	{ B.3.2 }	Permitted band 15°C to 25°C
Humidity:	{ B.3.2 }	Permitted band 30% to 90% RH
Static Pressure:	{ B.3.2 }	Permitted band 85 kPa to 105 kPa
Ambient Noise Level:	{ B.3.3.6 }	Max permitted level 65 dB(Z)

Measurement Results

The figures below are the Calibration Laboratory test limits for this model calibrator and have a smaller tolerance than those permitted by IEC 60942.

94 dB Output:	94.00 dB	Permitted band:	93.95 to 94.05dB
104 dB Output:	103.98 dB	Permitted band:	103.80 to 104.30dB
Frequency:	998.79 Hz	Permitted band:	990 to 1010Hz

Uncertainty

With an uncertainty coefficient of k=2, i.e. a 95% confidence level, the uncertainty of each measure is:

94 dB Output:	± 0.13 dB	104 dB Output:	± 0.13 dB
Frequency:	± 0.2 Hz	Level Stability:	± 0.04 dB

Calibrated by: T A Goodall

Calibration Date: 07 April 2015

Calibration Certificate Number: 223465

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH.
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 893342
Email: sales@cirrusresearch.co.uk

Cirrus Research plc

Calibration Chart for Electret Microphone

Type: MK:224 **Serial No.:** 2032204

Open Circuit Sensitivity at 1kHz

-26.1 dB rel. 1V/Pa

49.7 mV/Pa

Conditions of Tests:

Barometric Pressure 978 mBar

Relative Humidity 29 %

Temperature 16 °C

Signature: **Date:** 23/02/2015

Cirrus Research plc
Acoustic House, Hunmanby YO14 0PH UK
www.cirrusresearch.co.uk

Specifications:

Outside Diameter:

13.2mm with protecting grid

12.7mm without protecting grid

Mounting Thread:

11.7mm 60 UNS 2

Ambient Pressure Coefficient:

-0.02 to +0.02 dB/kPa for

±10% pressure change at 250Hz

Temperature Coefficient:

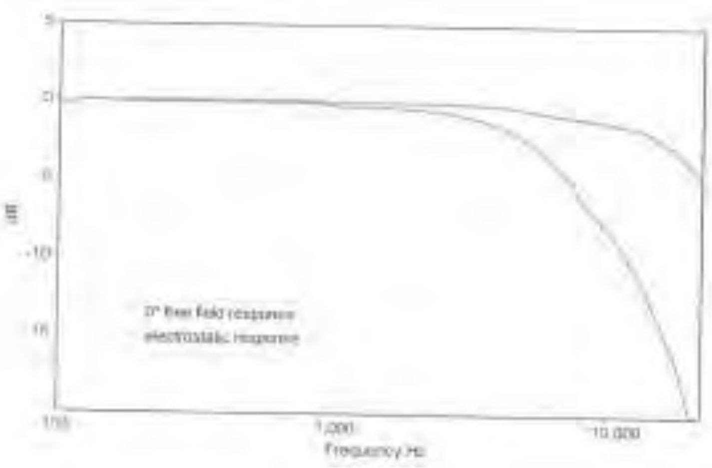
-10°C to +50°C

Approx. +/- 015dB/K at 250Hz

Dynamic Range:

SPL below which total harmonic

distortion is <1%: 130dB



Glossary of Terms

Note: Not all terms were used in the description of noise for this noise survey.

Ambient noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.
Acoustic shadow	An acoustic shadow is an area through which sound waves fail to propagate, due to topographical obstructions or disruption of the waves via phenomena such as wind currents.
Background noise	The steady existing noise level present without contribution from any intermittent sources. The A weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T (LAF90,T).
Broadband	Sounds that contain energy distributed across a wide range of frequencies.
Competent person	Individual possessing a combination of technical knowledge, experience and skills as outlined in Section 2.0 and who can demonstrate both practical and theoretical competence.
Criterion noise level	The long term mean value of the noise level that must not be exceeded. This is generally stipulated in the IPPC/Waste licence and it may be applied to a noise source, a boundary of the activity or to an NSL in the vicinity of the site.
dB	Decibel. The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro pascals (20 uPa).
Facade level	The noise level at a location 1m from the facade of a building is described by the term facade level, and is subject to a higher noise level than one in an open area (free-field conditions) due to reflection effects.
Free field	These are conditions in which the radiation from sound sources is unaffected by the presence of any reflecting boundaries or the source itself. In practice, it is a field in which the effects of the boundaries are negligible over the frequency range of interest. In environmental noise, true free-field measurement conditions are seldom achieved and generally the microphone will be positioned at a height between 1.2 and 1.5 metres above ground level. To minimise the influence of reflections, measurements are generally made at least 3.5 metres from any reflecting surface other than the ground.
Hertz (Hz)	The unit of sound frequency in cycles per second.
Impulsive	A noise that is of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.
LAeq,T	This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).The closer the LAeq value is to either the LAF10 or LAF90 value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources, such as traffic, on the background.
LAFN	The A-weighted noise level exceeded for N% of the sampling internal. Measured using the "Fast" time weighting.
LAr,T	The Rated Noise Level, equal to the LAeq during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.
LAF10	Refers to those A-weighted noise levels in the top 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period. It is

used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of road traffic. Measured using the "Fast" time weighting.

LAF90 Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to describe a background level. Measured using the "Fast" time weighting.

LAFmax The maximum **RMS** A-weighted sound pressure level occurring within a specified time period. Measured using the "Fast" time weighting.

LAFmin The minimum **RMS** A-weighted sound pressure level occurring within a specified time period. Measured using the "Fast" time weighting.

Lden Is the 24 hour noise rating level determined by the averaging of the Lday with the Levening plus a 5 dB penalty and the Lnight plus a 10 dB penalty.

Low background noise An area of low background noise is one where the existing background noise levels measured during an environmental noise survey are as follows:

- Average Daytime Background Noise Level ≤40dB LAF90, and;
- Average Evening Background Noise Level ≤35dB LAF90, and;
- Average Night-time Background Noise Level ≤30dB LAF90.

Low frequency noise LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum; see Appendix VI for a more detailed discussion.

LpA (dB) An 'A-weighted decibel' K a measure of the overall level of soundacross the audible frequency range (20Hz – 20kHz) with A-frequency weighting (i.e. 'A–weighting') to compensate for the varying sensitivity of the human ear to sound at different frequencies.

Noise Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.

Noise sensitive location NSL – any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

Octave band A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

Rating level See LAr,T.

RMS The RMS (Root Mean Square) value of a set of numbers is the square root of the average of their squares.

SEL (LAX or LAE) Sound exposure level **–** a measure of the A-weighted sound energy used to describe noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level if occurring over a period of 1 second, would contain the same amount of A-weighted sound energy as the event.

Sound pressure level Sound pressure refers to the fluctuations in air pressure caused by the passage of a sound wave. It may be expressed in terms of sound pressure level at a point.

Specific noise level A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval (LAeq, T)'.

Time weighting One of the averaging times (Fast, Slow or Impulse) used for the measurement of RMS sound pressure level in sound level meters.

Tonal Sounds which cover a range of only a few Hz which contains a clearly audible tone, i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.

1/3 octave analysis Frequency analysis of sound such that the frequency spectrum issubdivided into bands of one−third of an octave each.

APPENDIX 5

Annual Surface Water Report

Bord na Móna FOCUS 2030 LOOKING TO THE FUTURE

Main Street Newbridge
Co. Kildare
Ireland

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Environmental Assessment of the Quality of Surface Waters at the Arthurstown Landfill Site at Kill, Co. Kildare in Accordance with Waste License Register No.W0004-04

For the Attention of: Mr. John Smith / Mr. Mark Heffernan
Facility Manager / Deputy Facility Manager
South Dublin County Council
Arthurstown Landfill
Kill
Co Kildare

Prepared by: Ms. Kate Tynan
Environmental Scientist

Reviewed by: Mr. Peter Coogan
Environmental Team Leader

Report No: ECS5132-SW

Monitoring Date: 10th August 2015 (Annual)

Report Date: 06th November 2015

Executive Summary

In accordance with Waste License Register W0004-04, South Dublin County Council is required to monitor the quality of the surface waters within the vicinity of the Arthurstown Landfill site on a quarterly basis. In addition, an extensive bio-assessment of the Hartwell and Kill Rivers is required on an annual basis. The site was subsequently visited by an Environmental Scientists from Bord na Mona (BnM) Environmental on the 10th of August to carry out the monitoring event. Results obtained were compared with the *European Communities "Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)"* and the EQS for Aquatic Environment, EPA Discussion Document.

Retention Pond Inlet/Outlet (SW-5/2)

The Ammonia concentration at the Retention Pond Inlet (SW-5) was >0.02mg/l, while the Outlet (SW-2) was 0.05mg/l. This would suggest the water is of '*'high status"* at the inlet but deteriorates to "Good Status" at the outlet, in accordance with the *European Communities "Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)".*

All remaining parameters analysed were found to be within their respective limits and similar to the previous monitoring event.

Hartwell River - Upstream / Downstream (SW-1/SW-3)

The levels of BOD and Ammonia in both the upstream and downstream of the Hartwell River is of 'High Status' waters in accordance with Statutory Instrument No.293; Quality of Salmonid Waters Regulations, 1988.

The results of this biological survey indicate that the quality of water in the Hartwell River is good upstream and downstream of the landfill, the biological testing resulted in a Q-rating of 4.

Kill River (SW-4)

The Ammonia level displays a decrease (0.14→0.04mg/l) compared to the previous quarterly monitoring event and is now within its respective limit (≤0.04mg/l) for '*High Quality*' water.

The Orthophosphate level displays an increase (0.04→0.06mg/l) compared to the previous annual monitoring event and now exceeds its respective limit (≤0.035mg/l) for '*Good Quality*' water.

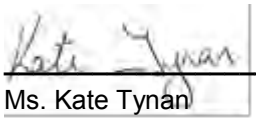
Weekly SW2 Analysis

The ammonia levels exceeded the respective limit (≤0.065mg/l) for 'Good Quality Water' on six out of the thirteen monitoring events. The exceedance levels recorded varied between 0.07mg/l and 0.11mg/l.

All remaining parameters were within their respective limits.

This report is certified as accurate and representative of the sampling and associated analysis carried out.

Respectively Submitted,



Ms. Kate Tynan
Environmental Scientist

Mr. Peter Coogan
Environmental Team Leader

CONTENTS

1.0 INTRODUCTION

In accordance with Waste Licence Register W0004-04, South Dublin County Council is required to carry out an assessment of the surface water quality within the vicinity of the Arthurstown Landfill site on a quarterly basis. In addition, an extensive bioassessment of the Hartwell River is required on an annual basis. BnM Environmental was commissioned to perform the quarterly and annual assessments.

An Environmental Scientist from BnM Environmental visited the five surface water monitoring locations on the 10th of August 2015 to conduct the third quarterly / annual sampling event of 2015. Sampling was carried out in accordance with the requirements of Waste Licence Register W0004-04.

This report details the sampling methodologies, procedures followed and results obtained.

2.0 METHODOLOGY

2.1 Sampling Locations

The surface water sampling locations as outlined in waste license W0004-04 are described in Table 2.1.

TABLE 2.1: LOCATION OF SURFACE WATER SAMPLING STATIONS

Sample Point	Location
SW-1	Hartwell river upstream of outfall from retention pond
SW-2	Outlet from groundwater / surface water retention Pond within Arthurstown Landfill
SW-3	Hartwell river downstream of outfall from retention pond
SW-4	Kill River, downstream of Arthurstown Road
SW-5	Inlet to groundwater / surface water retention pond within Arthurstown Landfill

2.2 Sampling

2.2.1 Surface Water

Grab samples of surface water were extracted in accordance with the following standards;

TABLE 2.2: SAMPLING PROCEDURE STANDARDS	
ISO STANDARD	**DESCRIPTION**
ISO 5667-1-2006	*Guidance on the design of sampling programmes and sampling techniques*
ISO 5667-3-2012	*Guidance on sample preservation and handling*
ISO 5667-14-1998	*Guidance on quality assurance of environmental sampling & handling*
ISO 5667-6-2005	*Guidance on sampling rivers & streams*

Sampling was conducted in strict accordance with BnM Environmental recognised Standard Operations Procedures (SOP) TS-W-02. All samples were returned to the laboratory, and stored between 1-8°C.

2.2.2 Biological Sampling

Two minute kick samples from a 900 cm^2 quadrant Serber sampler were collected at SW-1 and SW-3 surface water monitoring locations in accordance with USEPA 'Revision to Rapid Bio-assessment Protocols for Use in Streams and Rivers (1997)' in addition to procedures detailed in S.I. No. 258 of 1998, an amendment to the Local Government (Water Pollution) Act, 1977. A kick sample is a stationary sampling procedure accomplished by positioning a D frame dip net in the watercourse and disturbing one square meter upstream of the net. Using the toe or heel of the boot the upper layer of cobble or gravel was dislodged and the underlying bed was scraped. Larger substrate particles were picked up and rubbed by hand to remove attached organisms. In addition, individual stones and rocks were picked from the river bottom and inspected. Attached organisms were collected into the sample and noted.

2.3 Chemical Analysis

All samples returned to the laboratory were stored at 1-8°C. Subsequent analysis of all samples was carried out in strict accordance with recognised standard methods as detailed in Table 2.3.

3.0 MACROINVERTEBRATE I.D. & REVIEW OF BIOASSESSMENT INDICES

3.1 Identification of Macroinverterbrates

Macroinvertebrate samples were obtained upstream and downstream of the Arthurstown Landfill Site. Sorting and identification was carried out in-situ.
Individual sample containers were thoroughly rinsed in a 500mm-mesh sieve to remove fine sediment. Large organic material (whole leaves, twigs, algal or macrophyte mats, etc.) was removed, rinsed, visually inspected, and discarded. Identification was conducted in accordance with FBA procedures with sampling and sorting protocols carried out in accordance with the USEPA 'Revision to Rapid Bioassessment Protocols for Use in Streams and Rivers (1997)'. Identification was conducted to the lowest but, if necessary, consistent taxonomic level. Two levels of identification were followed. Genus/species provides more accurate information on ecological/environmental relationships and sensitivity to impairment. Family level provides a higher degree of precision among samples. Each taxon found in a sample was recorded and enumerated in a laboratory bench notebook for transcribing to the final report.

3.2 Biological Quality Rating (Q-Rating)

This is a Pollution Rating Index, which has been developed to measure the response of certain key macroinvertebrate species or groups to pollution. The Q Rating system has been implemented by the Environmental Protection Agency in Ireland as the standard means to assess the quality of any part of a river based principally on the composition of macroinvertebrate communities/faunal groups present and their general sensitivity to organic pollution. The Biological Quality Rating forms part of S.I No. 258 of 1998, an amendment to the Local Government (Water Pollution) Act, 1977. The rating system recognises five macroinvertebrate groups ranging from A to E (i.e. most sensitive to most tolerant) and relates to their relative abundance, from a standard 2 minute sample, to a quality rating known as a Q Index. The part of the stream or river surveyed may subsequently assigned a Q rating from 5 to 1 (i.e. pristine, unpolluted to gross polluted). *Table 3.1* overleaf presents Part I of the First Schedule of S.I No. 258 of 1998 which groups the macroinvertebrate indicator groups. *Table 3.2* presents Part II of the First Schedule of S.I No. 258 of 1998, which relates the Biological Q Rating and the five faunal groups. *Table 3.3* quantifies the various abundance categories.

Table 3.1 Biological Q Rating System for Rivers - Part 1 - Indicator Groups: Key Taxa				
Macroinvertebrate Communities/Faunal Groups & their General Sensitivity to Organic Pollution				
Group A *Sensitive*	**Group B** *Less Sensitive*	**Group C** *Tolerant*	**Group D** *Very Tolerant*	**Group E** *Most Tolerant*
Perlidae	Leuctridae	Tricladida	Hirudinea	Tubificidae
Chloroperlidae Capniidae	Nemouridae Taeniopterygidae Baetidae Leptophlebiidae	Ancylidae Neritidae Unionidae Astacidae	Mollusca (excl. Ancylidae, Margaritiferidae, Neritidae & Unionidae)	*Chironomus*
	Ephemerellidae			
Perlodidae	Ephemeridae	*Gammarus*	*Asellus*	
	Potamanthidae	Caenidae	Chironomidae	
Heptageniidae Siphlonuridae Margaritiferidae	Cased Trichoptera (excl. Limnephilidae Hydroptilidae & Glossosomatidae)	Limnephilidae Hydroptilidae Glossosmatidae UncasedTricoptera	(excl. Chironomus & Rheotanytarsus)	
	Odonata (excl. Coenagriidae)	Coleoptera Coenagriidae		
		Salidae		
		Tipulidae		
	Aphelocheirus	Simulidae		
	Rheotanytarsus	Hemiptera (excl. *Aphelocheirus*)		
		Hydracarina		

Table 3.2: Relationship between Biological Quality Rating/Index (Q) and the Five Faunal Groups						
	Q Index	Faunal Group				
Eroding Substrata (i.e the shallower, fast-flowing areas)	Q5 Q4 Q3 Q2 Q1	**A** **#** **++** **-** **-** **-**	**B** **#** **#** **+/-*** **-** **-**	**C** **++** **<** **#** **+/-** **-**	**D** **+/-** **++** **<** **#** **+/-**	**E** **+/-** **+/-** **++** **<** **#**
		(excl. *B rhodani* which may be dominant)				
Depositing Substrata (i.e. the deeper, slower-flowing areas)	Q5 Q4 Q3 Q2 Q1	++ +/- - - -	# < - - -	< # ++ - -	++ ++ < < -	++ ++ < < #

= Numerous or dominant < = Common ++ = Present in small numbers
+ = Scarce +/- = Scarce or absent - = Absent

Table 3.3 - Quantification of Macroinvertebrate Abundance Categories		
Abundance	**Approximate Frequency of Occurrence**	
Category	**Number***	**Percentage**
One	1	-
Scarce/few	2 - 5	<1%
Present in small numbers	6 - p0	<5%
Present in fair numbers	11 – 20	5 -10%
Common	21 – 50	10 – 20%
Numerous	51 - 100	25 – 50%
Abundant/Dominant	100 - 200	50 – 75%
Superabundant/Excessive	200+	>75%

4.0 RESULTS

The results of the investigation carried out by BnM Environmental are presented as follows:

Table 4.1: Results of Weather data taken from the nearest Met Éireann station, i.e. Casement.

Table 4.2: Results of Field Measurements taken at each Surface Water Sampling Station

Table 4.3: Results of Chemical Analysis of Surface Water Samples.

Table 4.4: Results of Metal Scan of Surface Water Samples.

Table 4.5: Results of Chemical Analysis of Weekly SW-2 Samples

Table 4.6: Calculated Biological Quality Rating (Q-Rating) For Surface Waters

Table 4.7: Macroinvertebrate Families Present Within the Water Body

TABLE 4.1: WEATHER DATA FROM MET EIREANN – CASEMENT

Date	Rainfall (mm)	Max Temp. (^{0}C)	Min Temp. (^{0}C)
09/08/15	0	20.2	14.2
10/08/15	0.1	20.2	11.6
11/08/15	0.2	18	5.9
	Total = 0.3	***Avg. = 19.4***	***Avg. = 10.57***

TABLE 4.2: RESULTS OF FIELD MEASUREMENTS AT EACH LOCATION

Parameter	SW-1	SW-2	SW-3	SW-4	SW-5
Temperature (^{o}C)	17.8	15.3	17.3	17.8	17.3
Dissolved Oxygen (mg/l)	10.29	6.60	10.26	9.15	7.20
Dissolved Oxygen (%)	108.9	67	108.3	97.9	76.2
Odour / Visual	Clear, no s.s., no odour	Clear, no s.s., no odour	Very pale yellow, no s.s., no odour	Light yellow, no s.s., no odour	Light yellow, no Very few s.s., no odour

TABLE 4.3: RESULTS OF CHEMICAL ANALYSIS OF SURFACE WATER SAMPLES						
Parameter	**Surface Water Quality Standard**	**SW-1**	**SW-3**	**SW-5**	**SW-2**	**SW-4**
		Up-stream	**Down-stream**	**Pond Inlet**	**Pond Outlet**	**Kill River**
pH (pH units)	***6.5 – 9.5*** *Note 1*	8.0	8.0	7.5	7.3	8.1
Conductivity (µS/cm @ 25^0C)	***1000*** *Note 1*	532	546	688	951	539
BOD (TCMP) (mg/l)	***High Status: ≤ 2.2 Good Status: ≤2.6*** *Note 2*	<2	<2	<2	<2	<2
COD (mg/l)	-	<10	<10	<10	<10	<10
Ammonia as N (mg/l) (Konelab)	***High Status: ≤ 0.04 Good Status ≤0.065*** *Note 2*	<0.02	<0.02	<0.02	0.05	0.04
Suspended Solids (mg/)l	***25*** *Note1*	<5	<5	<5	<5	8
Total Alkalinity ($CaC0_3$) (mg/l)	-	253	262	249	354	264
Chloride (mg/l)	***250*** *Note 1*	14	15	26	35	15
Sulphate (mg/l)	***200*** *Note1*	14	18	99	115	14
Total Phosphorous (mg/l)	-	<0.05	<0.05	<0.05	<0.05	0.09
Ortho-phosphate as P (mg/l)	***High Status:≤0.025 Good Status:≤0.035*** *Note 2*	<0.01	<0.01	<0.01	0.02	**0.06**
TON as N (mg/l)	-	1.5	1.4	0.25	2.0	0.8

Notes:

Note 1: EQS *for Aquatic Environment, EPA Discussion Document*

Note 2*: European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).*

Results highlighted in red bold text represent exceedences of respective surface water limits.

TABLE 4.4: RESULTS OF METAL ANALYSIS OF SURFACE WATER SAMPLES						
Parameter	**Surface Water Quality Standard**	**SW-1**	**SW-3**	**SW-5**	**SW-2**	**SW-4**
		Up-stream	**Down-stream**	**Pond Inlet**	**Pond Outlet**	**Kill River**
Boron (total) (µg/l)	***2,000*** *note 1*	9	13	46	70	11
Calcium (total) (mg/l)	**-**	86	86	84	151	84
Chromium (total) (µg/l)	***30*** *note 1*	<2	<2	<2	<2	<2
Cadmium (total) (µg/l)	***5*** *note 1*	<2	<2	<2	<2	<2
Copper (total) (µg/l)	***30*** *note 1*	<2	<2	<2	<2	<2
Iron (total) (mg/l)	***1.00*** *note 1*	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium (total) (mg/l)	**-**	1.3	1.3	0.7	2.5	2.0
Magnesium (total) (mg/l)	**-**	6.4	6.4	12	14	5.7
Manganese (total) (µg/l)	***30*** *note 1*	6	7	<2	31	11
Sodium (total) (mg/l)	**-**	8.2	8.6	23	39	9.3
Nickel (total) (µg/l)	***50*** *note 1*	<2	<2	<2	<2	<2
Lead (total) (µg/l)	***10*** *note 1*	<2	<2	<2	<2	<2
Zinc (total) (µg/l)	***100*** *note 1*	2	<2	<2	<2	3
Mercury (total) (µg/l)	***1*** *note 1*	<1	<1	<1	<1	<1

Notes:

Note 1: EQS *for Aquatic Environment, EPA Discussion Document*

Note 2*: European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).*

Results highlighted in red bold text represent exceedences of respective surface water limits.

TABLE 4.5: RESULTS OF CHEMICAL ANALYSIS OF WEEKLY SW-2 SAMPLES														
Parameters	***Surface Water Quality Standard***	**Wk 28 8/7/15**	**Wk 29 14/7/15**	**Wk 30 21/7/15**	**Wk 31 28/7/15**	**Wk 32 4/8/15**	**Wk 33 10/8/15**	**Wk34 18/8/15**	**Wk 35 25/8/15**	**Wk 36 31/8/15**	**Wk 37 8/9/15**	**Wk 38 15/9/15**	**Wk 39 22/9/15**	**Wk 40 29/9/15**
Temp	-	14.5	14.3	16.3	14.2	14.5	15.3	17.1	15.2	14.1	15.4	13.7	13.6	14.7
DO mg/l	-	5.20	5.95	6.58	4.70	5.02	6.60	6.06	7.70	7.23	-	3.68	5.58	6.26
Do %	-	51.7	58.7	68.4	66.8	50.9	67	63.6	79.0	70.0	-	36.5	54.7	61.2
Visual	-	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	V. Pale Yellow	Clear
Odour	-	None	None	None	None	None	None	None	None	None	None	None	None	None
Suspended Solids	-	None	None	None	None	None	None	None	None	None	None	None	None	None
Oily Surface	-	None	None	None	None	None	None	None	None	None	None	None	None	None
Ammonia as N (mg/l) (Konelab)	****High Status ≤ 0.04 Good Status ≤ 0.065***	**0.11**	**0.07**	0.06	**0.1**	**0.08**	0.05	0.05	**0.07**	0.04	0.05	0.06	**0.11**	<0.02
Conductivity (µS/cm)	**1000** *Note 1*	929	912	838	975	952	951	960	862	900.5	962	940	761	909
pH	**6.0 – 9.0** *Note 2*	7.3	7.3	7.4	7.1	7.4	7.3	7.3	7.2	7.3	7.2	7.4	7.4	7.3
Suspended Solids	***25*** *Note 2*	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	18	<5

Note 1: EQS for Aquatic Environment, EPA Discussion Document

Note 2*: European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).*

Results highlighted in red bold text represent exceedences of respective surface water limits.

* Converted GTV for Ammonia as N mg/l.

TABLE 4.6: CALCULATED BIOLOGICAL QUALITY RATING (Q RATING) FOR SURFACE WATERS Note 1		
Location	**SW-1**	**SW-3**
Q-Rating	4	4

Note 1: All sampling stations classified as Eroding Substrata

TABLE 4.7: MACROINVERTEBRATE FAMILIES PRESENT WITHIN THE WATER BODY		
Species	**SW-1**	**SW-3**
Gammarus spp	<50	<50
Baetidae	<50	<25
Ephemeridae	<50	<25
Caenis	3	2
Leuctridae	2	7
Odontoceridae	5	-
Oligochaeta	4	1
Rhyacophilaidae	-	2
Number Of Taxa	**5**	**5**

5.0 DISCUSSION

For discussion purposes, all parameters analysed will be compared to the most current surface-water standards i.e.(A)*EQS for Aquatic Environment, EPA Discussion Document and (B) European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).*Results of chemical analysis for Surface waters are also compared to the previous annual monitoring event, conducted in July 2014 (Ref: ANUA ENV. ECS4972-SW**).**

Annual Surface Water Monitoring

Retention Pond Inlet/Outlet (SW-5/2)

The Ammonia concentration at the Retention Pond Inlet (SW-5) was >0.02mg/l, while the Outlet (SW-2) was 0.05mg/l. This would suggest the water is of ''high status'' at the inlet but deteriorates to "Good Status" at the outlet, in accordance with the '' European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009).''

The levels of Suspended Solids were below the laboratory limit of detection (<5mg/l) at the Retention Pond Inlet and Outlet.

The results of all remaining parameters analysed at the Retention Pond Inlet/Outlet were broadly in-line with previous monitoring events and within respective surface water standard limit values. This demonstrates that the retention pond outfall, is not having any notable negative impact upon the Hartwell River

Hartwell River - Upstream / Downstream (SW-1/SW-3)

The levels of BOD and Ammonia in both the upstream and downstream of the Hartwell River is of 'High Status' waters in accordance with the European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)..

All parameters analysed in the Up/Down-stream samples displayed similar results and were below their respective water quality standard limits. This would suggest that the discharge from the Arthurstown Landfill facility is not having any discernible negative impact upon the Hartwell River.

The results of this biological survey indicate that the quality of water in the Hartwell River is good (using the Q-value system) upstream and downstream of the landfill. It is worth noting that the water quality has remained unchanged since the previous monitoring event, recording Q-values of 4 at each location.

Kill River - Downstream of Arthurstown Road (SW-4)

The Ammonia level displays an decrease (0.14→0.04mg/l) compared to the previous quarterly monitoring event and now is within its respective limit (≤0.04mg/l) for '*High Quality*' water.

The Orthophosphate level displays an increase (0.04→0.06mg/l) compared to the previous annual monitoring event and now exceeds its respective limit (≤0.035mg/l) for '*Good Quality*' water.

Metals

All parameters analysed were found to be within their respective limits and similar to the previous monitoring event.

Weekly SW2 Monitoring

The ammonia levels exceeded the respective limit (≤0.065mg/l) for 'Good Quality Water' on six out of the thirteen monitoring events. The exceedance levels recorded varied between 0.07mg/l and 0.11mg/l.

All remaining parameters were within their respective limits.

APPENDIX 1

Analytical Methods

Lab Accreditation

Chain of Custody

TABLE 4.8: CHEMICAL AND MICROBIOLOGICAL ANALYSIS OF SAMPLES			
Parameter	**Limit of Detection**	**Method**	
Visual Inspection	-	On-Site Visual Determination	-
Odour	-	On-Site Sensory Determination	-
pH (pH units)	0.1 – 14	G/05	✓ (INAB)
Ammonia-N (mg/l)	0.02 – 25	G/67	✓ (INAB)
BOD_5 – TCMP (mg/l)	2 – 5000	G/04	✓ (INAB)
COD (mg/l)	10 – 1500	G/03	✓ (INAB)
Conductivity (µS/cm)	0.1 - 1999	G/06	✓ (INAB)
Calcium (mg/l)	<0.1	G112 Based on EPA Method 200.8	X
Chloride (mg/l)	<0.5		
Chromium (µg/l)	<2		
Cadmium (µg/l)	<2		
Copper (µg/l)	<2		
Iron (mg/l)	<0.1		
Potassium (mg/l)	<0.1		
Magnesium (mg/l)	<0.1		
Manganese (µg/l)	<2		
Sodium (mg/l)	<0.1		
Nickel (µg/l)	<2		
Lead (µg/l)	<2		
Zinc (µg/l)	<2		
Mercury (µg/l)	<1		
Nitrate-N (mg/l)	<0.2	G/67: Based on APHA, 2012, 22nd Ed, 4500-NO2B colourmetric method.	✓ (INAB)
Nitrite-N (mg/l)	<0.02		
TON (mg/l)	<0.2		
Total Phosphorus (mg/l)	<0.05	G/67: Based on APHA, 2012, 22nd	✓ (INAB)
Orthophosphate (mg/l)	<0.01	G/67: Based on APHA, 2012, 22nd	✓ (INAB)
Fluoride	<0.5	G/39:Ion Chromatography	✓ (INAB)
Sulphate (mg/l)	<0.5	G/39:Ion Chromatography	✓ (INAB)
Total Alkalinity ($CaCO_3$)	0 – 500	APHA 2320b	✓ (INAB
Volatile Organic	<0.5 mg/l / <10 µg/l	GC-FID, GC-MS (USEPA 524.2)	X
Total Suspended Solids (mg/l)	<5	G/19: Based on APHA, 2012, 22nd Ed, Method 2540D.	✓ (INAB)

Notes:

APHA - American Public Health Association, Standard Methods for the Examination of Waters and Waste Waters, 22nd Edition, 2012.

G/ - INAB Accredited Method, BnM Environmental Analytical Services Standard Operating Procedures Manual

✓ - INAB Accredited Test Method – INAB Registration Reference No. 083T.

X – None Accredited Test Method

4.0 COMMITMENT TO QUALITY

4.1 INAB Accreditation

BnM Environmental analytical laboratory is accredited to ISO 17025 by the National Accreditation Board (INAB). ISO 17025 accreditation ensures that the laboratory operates a quality system with technically competent staff. The laboratory has accreditation since 1997 and it is the policy of the laboratory to achieve and maintain a high standard of quality consistent with client's requirements in all aspects of the work carried out within the laboratory.

4.2 Interlaboratory Proficiency Schemes

To ensure the accuracy of the analytical testing the laboratory participates in several external proficiency schemes. The ongoing competence of the laboratory and its staff is assessed by participation in various inter–laboratory proficiency testing schemes, such as LGC Aquacheck scheme and the EPA Intercalibration programme organised for environmental laboratories throughout Ireland. BnM Environmental Analytical Laboratory Services is listed on the EPA's register of Quality Controlled Laboratories

4.3 Control Chain of Custody

As part of the Quality System in place in BnM Environmental, measures are taken to ensure controlled chain of custody. An outline of the chain of custody is given below.

Bord na Mona Environmental

CONTROLLED CHAIN OF CUSTODY

SITE		TRANSPORT		LABORATORY
Sampling and packaging of all samples were carried out by BnM Environmental Technical Team:	Transport Document Form	Transport to laboratory by BnM Environmental Technical Team.	Sample Reception Form	Receiving of samples at BnM Environmental Laboratory complex by: Laboratory Manager (Secure laboratory complex access to authorised personnel only)
Ms. Kate Tynan	→		→	↓
				Storage of all samples for 1 month period after report issue.
				↓
				Supervised Disposal

APPENDIX 6

Annual Groundwater Report including Private Wells, Leachates and Discharge to Sewer

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An Environmental Assessment of the Quality of Groundwaters and Leachate at the Arthurstown Landfill Site at Kill, Co. Kildare in Accordance with Waste Licence Register No.W0004-4.

For the Attention of:
Mr. John Smith / Mr. Mark Heffernan
Facility Manager / Deputy Facility Manager
South Dublin County Council,
Arthurstown Landfill,
Kill,
Co Kildare.

Prepared by:
Ms. Kate Tynan
Environmental Scientist

Reviewed by:
Mr. Peter Coogan
Environmental Team Leader

Report No: ECS5132-GW

Monitoring Date: 30th July 2015 (Annual/Qtr3)

Report Date: 6th November 2015

Executive Summary

In accordance with Waste Licence Register No W0004-04, issued on the 21st of December 2009, South Dublin County Council is required to carry out monitoring of the underlying groundwater at the Arthurstown Landfill site, and in addition, monitoring of leachate and private wells in the environs of the site. Bord na Mona (BnM) Environmental was commissioned to perform the required sampling and analysis. The site was subsequently visited by a BnM Environmental Scientist on the 30th of July and the 13th of August to conduct the annual sampling event of 2015. Groundwater, leachate and private well samples were returned to the laboratory for subsequent analysis.

Groundwater

Samples were taken from seven (MW-1A, MW-2, MW-3, MW-8, MW-14A, MW-16 and MW-20) of the twenty-three boreholes at Arthurstown Landfill, in accordance with Schedule D of Waste Licence W0004-4. Samples were not required from the remaining wells; however they were checked for total and surface-water depth using a dip meter in accordance with EPA Waste License W0004-04.

Results are compared to the *"European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No.9 of 2010)"* and the EPA Guideline Values for the Protection of Groundwater in Ireland, as set out in the Interim Report *"Towards Setting Guideline Values for the Protection of Groundwater in Ireland, 2004."*

Exceedences of their respective GTV's and IGV's have occurred for the following parameters:

MW-1A - Orthophosphate
MW-2 – Orthophosphate & Manganese
MW-3 – Sulphate & Calcium
MW-8 – Manganese
MW-14 Potassium, & Calcium
MW-16 - Manganese
MW-20 - Sulphate & Calcium

Total Coliforms were detected in six of the boreholes sampled. Faecal Coliforms were present in three boreholes. The highest levels of Faecal Coliforms were detected at groundwater monitoring location MW-20 (15cfu/100ml).

All remaining parameters analysed for each monitoring location were within their respective GTV/IGV limits.

Private Well

Results for the private well show that the water is of similar quality to those levels recorded in previous monitoring events. All chemical parameters are within their respective Maximum Admissible Concentration values as outlined in Water Quality Standards set in S.I No. 278 of 2007 *"European Communities (Drinking Water) (No.2) Regulations".*

E.Coli was detected at one of the private wells monitored; PW-1.

Leachate

Three Leachate Cells; LC-1, LC-10 and LC-11 along with two treatment stages, LLAG, LT2 and LBAL were sampled during this monitoring event. Samples taken from the leachate cells display typical fluctuations in respective parameter concentrations compared to the previous monitoring event and remain broadly in-line with historical trends.

Samples taken from the Leachate Lagoon (LL) and Balance Tank (LBAL) indicated that key indicator parameters such as; COD and Ammonia, show considerable decrease in concentration levels as leachate moves through the treatment system.

The results gathered for monthly analysis show similar results to the previous monitoring carried out in Qtr 2 of 2015 (ECS5132).

This report is certified as accurate and representative of the sampling and associated analysis carried out.

Respectively Submitted,

Ms. Kate Tynan
Environmental Scientist

Mr. Peter Coogan
Environmental Team Leader

1.0 INTRODUCTION

In accordance with Waste Licence Register No W0004-04, South Dublin County Council is required to monitor the underlying groundwater at the Arthurstown Landfill site, private wells close to the site and leachate. BnM Environmental was commissioned to perform the sampling and analysis. The site was subsequently visited by a BnM Environmental Scientist on the 30th of July and the 13th of August to conduct the annual monitoring event of 2015. Groundwaters, leachates and private well samples were returned to the laboratory for subsequent analysis.

This report details the groundwater and leachate sampling that was carried out, including the sampling and analytical methods used. In addition, a commentary on the results obtained is included.

2.0 METHODOLOGY

2.1 Sampling Locations

2.1.1 Borehole Locations

The locations of the groundwater monitoring boreholes are described in Table 2.1. The borehole locations are illustrated on Drawing AWL02-14C. The private well, PW-1, was also sampled on this occasion. The private well locations are shown in Drawing AWL02-15B. All drawings are located within the Environmental Management Programme (EMP) for the site.

TABLE 2.1. LOCATION OF GROUNDWATER MONITORING BOREHOLES

Borehole ID	Location
MW-1	Approx. 140 meters N.E of landfill cells
MW-2	Approx. 260 meters N.E of landfill cells
MW-3	Approx. 260 meters N.E of landfill cells
MW-4	Approx. 400 meters East of landfill cells
MW-5	Approx. 400 meters E of landfill cells
MW-6	Approx. 100 meters E.S.E of landfill cells
MW-7	Approx. 80 meters S.E of landfill cells
MW-8	Approx. 240 meters E of landfill cells
MW-9	Approx. 50 meters W of landfill cells
MW-10	Approx. 50 meters W of landfill cells
MW-11	Approx. 50 meters W of landfill cells
MW-12	Approx. 50 meters N.W. of landfill cells
MW-13	Approx. 100 meters N of landfill cells
MW-14	Approx. 200 meters N.N.E. of landfill cells (across public road)
MW-15	Approx. 200 meter N.N.E of landfill cells (across public road)
MW-16	Approx. 90 meter s N.N.W of landfill cells
MW-17	Approx. 100 meters W.S.W. of landfill cells
MW-18	Approx. 170 meters N of landfill cells
MW-19	Approx. 20 meters W.S.W. of landfill cells
MW-20	Approx. 150 meters S of landfill cells
MW-21	Approx. 140 meters S.S.E. of landfill cells
MW-22	Approx. 400 meters East of landfill cells.
PW-1	Private well (Approx. 700 meters N.N.W from the landfill cells).

2.1.2 *Leachate Sampling Locations*

A number of representative samples of leachate were taken from selected sampling stations. The sampling stations are illustrated on Drawing AWL02-14C within the EMP. Raw Leachate from cells LC1-LC15 is normally discharged to the Storage Tank (LST) prior to treatment in the Aeration tanks LT1 and LT2.

- **Cell Nos.1 – 15 (LC1 – LC15):** Sumps wherein raw leachate from Cell No.1 to 15 inclusive is collected.
- **Storage Tank (LST)**: Tank used for temporary storage of leachate prior to treatment in the Aeration Tank (LT1).
- **Aeration Tank (LT1)**: Sequential Batch Reactor for biological treatment of leachate.
- **Aeration Tank (LT2)**: Sequential Batch Reactor for biological treatment of leachate.
- **Balance Tank (LBAL)**: Tank where treated effluent discharged from the Aeration Tanks (LT1 and LT2) is stored. The leachate is temporarily stored within the Balance Tank from which there are two disposal routes:
  - Transferred to the Leachate Lagoon
  - Tankered off-site.
- **Leachate Lagoon (LL)**: Leachate lagoon located to the east of the landfill where leachate is temporarily stored.

2.2 Sampling

2.2.1 Groundwater Monitoring

Groundwaters were extracted in accordance with the following recognised standards;

TABLE 2.2: STANDARDS	
ISO Standard	**Description**
ISO 5667-1-2006	*Guidance on the design of sampling programmes and sampling techniques*
ISO 5667-3-2012	*Guidance on sample preservation and handling*
ISO 5667-14-1998	*Guidance on quality assurance of environmental sampling & handling*
ISO 5667-11-2009	*Guidance on sampling groundwater's*

Groundwater in the well casing and in close proximity to the well is not considered representative of the general groundwater at a given location. In order to ensure that the groundwater samples extracted from the monitoring bores were representative of the water held in the subsurface strata and not water held stagnant in the borehole casing, it was necessary to evacuate the monitoring bores prior to sampling. A common procedure is to pump a well until between 3 and 6 bore volumes have been removed as cited in BnM Environmental Standard of Field Protocols (SOP TS-W-01) and as recommended in numerous technical publications (e.g. Marsh and Lloyd 1980 and Boateng 1987). The purged volumes were calculated on-site from the measured static water levels (measured using an electronic well dipper) and the total depth of the bores.

All samples were returned to the laboratory, and stored between 1-8°C.

2.2.2 Private Well

A grab sample was extracted from the private well supply located on a farm close to the landfill site and the sample was extracted directly to 1 litre polypropylene bottles. The private well sample was returned to the laboratory and stored at 1-8^{o}C according to standard sampling techniques.

2.2.3 Leachate Sampling

Grab samples of leachate were extracted in accordance with standard procedures. Chemical analysis samples were extracted directly to 1 litre polypropylene bottles. All samples were returned to the laboratory and stored at 1-8°C.

3.0 RESULTS

The results of the investigations carried out by BnM Environmental are presented as follows:

3.1 Groundwater Results

Table 3.1: Weather data taken from nearest Met Éireann station (Casement).

Table 3.2: Results of Field Measurements Taken at Each Groundwater Borehole

Table 3.3: Results of Chemical Analysis of Groundwater Samples

Table 3.4: Results of Metal Screening of Groundwater Samples

Table 3.5: Results of Annual Pesticide, SVOCs and VOCs for Groundwater Monitoring Boreholes

Table 3.6: Results of Microbiological Analysis of Groundwater Samples

3.2 Private Well Results

Table 3.7: Results of Chemical Analysis of Private Well Samples

Table 3.8: Results of Annual Pesticide, SVOCs and VOCs for Private Wells

Table 3.9: Results of Microbiological Analysis of Private Well Samples

3.3 Leachate Results

Table 3.10: Results of Chemical Analysis of Leachate Samples.

Table 3.11: Results of Annual Chemical Analysis of Leachate Balancing Tank (LBAL)

Table 3.12: Results of Monthly Chemical Analysis of Leachate Balancing Tank (LBAL)

TABLE 3.1: WEATHER DATA FROM MET ÉIREANN - CASEMENT

Date	Rainfall (mm)	Max Temp. (^{0}C)	Min Temp. (^{0}C)
29/07/15	0	15.9	6.7
30/07/15	0	16	5.3
12/08/15	0	19.7	5.4
13/08/15	0	20.8	9.9
	Total = 0	***Avg. = 18.1***	***Avg. = 6.8***

3.1 Groundwater Results

TABLE 3.2: RESULTS OF FIELD MEASUREMENTS TAKEN AT EACH GROUNDWATER MONITORING BOREHOLE

Borehole ID	Depth (m)	Static Water Level (m)	Volume Evacuated (l)	Temperature (°C)
MW-1A*NEW	36.84	9.61	180	11.1
MW-2	Well			
MW-3 [b]	16.15	4.40	100	11.4
MW-4[a]	Well removed / Sampling not required -			
MW-5	2.44	Sampling not required		
MW-6A	6.18	Sampling not required		
MW-7	6.52	Sampling not required		
MW-8	30.51	7.59	150	10.8
MW-9	28.44	Sampling not required		
MW-10	2.86	Well Dry		
MW-11	4.68	Sampling not required		
MW-12	4.36	Well Dry		
MW-13	8.30	Insufficient Volume / Sampling not required		
MW-14A*NEW	17.03	3.97	100	10.8
MW-15	2.86	Sampling not required		
MW-16	22.64	6.65	100	11.4
MW-17	10.50	Sampling not required		
MW-18	27.18	Sampling not required		
MW-19	26.36	Sampling not required		
MW-20[b]	9.18	6.50	12	11.1
MW-21	7.17	Sampling not required		
MW-22	4.80	Sampling not required		
LGW [a]	-			

Notes:

[a]: Due to site works MW-4 and LGW have been removed.

[b.] Due to on-going site works MW3 was inaccessible.

[c] Well Damaged.

TABLE 3.3(A): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE				
Parameter	**MW-1A**	**MW-2**	**MW-3**	***GTV*** [Note1] ***IGV*** [Note2]
pH (pH units)	7.7	7.6	7.3	*≥ 6.5 -≤9.5*[1]
Temperature (°C)	11	13.9	10.6	*25*[2]
Odour	No odour	No odour	No odour	-
Visual	Light yellow, No silt	Clear, No silt	Brown, High silt	-
Conductivity (µS/cm)	537	593	1614	*800 – 1875*[1]
Ammonia as N (mg/l)	<0.02	<0.02	<0.02	*0.05 – 0.136*[1**]
Chloride (mg/l)	12	14	128	*24 – 187.5*[1]
TON (mg/l)	<0.2	<0.2	7.2	-
Cyanide (mg/)	<0.01	<0.01	<0.01	*0.03751*
Fluoride (mg/l)	<0.1	<0.1	<0.1	*1.02*
Sulphate (mg/l)	26	38	**309**	*187.5*
Total Alkalinity (mg/l)	245	274	407	-
Ortho. P (mg/l)	**0.05**	**0.04**	<0.01	0.03[2]
Total Dissolved Solids (mg/l)	514	380	1084	-
TOC (mg/l)	<5.0	<5.0	<5.0	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010*)". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the Guideline Limits

< Indicates less than the laboratory detection limit

TABLE 3.3(B): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE					
Parameter	**MW-8**	**MW-14A**	**MW-16**	**MW-20**	***GTV*** [Note1] ***IGV*** [Note2]
pH (pH units)	7.6	7.5	7.6	7.3	*≥ 6.5 -≤9.5*
Temperature (°C)	11.9	11.1	12.3	11.6	*25*[2]
Odour	No odour	No odour	No odour	No odour	-
Visual	Light Brown, Some silt	Brown , High silt	Clear, No silt	Light brown, Some silt	-
Conductivity (µS/cm)	635	1025	618	1219	*800 – 1875*[1]
Ammonia as N (mg/l)	<0.02	<0.02	<0.02	<0.02	*0.05 – 0.136*[1*]
Chloride (mg/l)	18	26	14	20	*24 – 187.5*[1]
TON (mg/l)	<0.2	2.3	<2.0	1.9	-
Cyanide (mg/)	<0.01	<0.01	<0.01	<0.01	*0.03751*
Fluoride (mg/l)	<0.1	<0.1	<0.1	<0.1	*1.02*
Sulphate (mg/l)	14	170	15	**301**	*187.5*
Total Alkalinity (mg/l)	305	371	299	384	-
Ortho. P (mg/l)	<0.01	<0.01	<0.01	<0.01	0.03[2]
Total Dissolved Solids (mg/l)	386	758	404	924	-
TOC (mg/l)	<5.0	<5.0	<5.0	<5.0	-

Note 1: GTV = Groundwater Threshold Values refers to "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)*". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

* Converted GTV for Ammonia as N mg/l, Nitrate as N mg/l and Nitrite as N mg/l.

Bold font indicates exceedances above the Guideline Limits

TABLE 3.4(A): RESULTS OF METAL SCREENING OF GROUNDWATER SAMPLES				
Parameter	**MW-1A**	**MW-2**	**MW-3**	***GTV Note1 IGV Note2***
Sodium mg/l	9.8	13	44	*150[2]*
Potassium mg/l	0.8	0.8	5.0	*5[2]*
Magnesium mg/l	12	12	19	*50[2]*
Calcium mg/l	55	69	**217**	*200[2]*
Boron µg/l	19	18	65	*750[1]*
Cadmium µg/l	<2	<2	<2	*3.75[1]*
Chromium µg/l	<2	<2	<2	*37.5[1]*
Copper µg/l	<2	15	<2	*1500[1]*
Iron mg/l	<0.1	<0.1	<0.1	*0.2[2]*
Lead µg/l	<2	<2	<2	*18.75[1]*
Manganese µg/l	**40**	**113**	4	*50[2]*
Nickel µg/l	<2	<2	<2	*15[1]*
Zinc µg/l	5	72	4	*100[2]*
Mercury µg/l	<1	<1	<1	*0.75[1]*

TABLE 3.4(B): RESULTS OF METAL SCREENING OF GROUNDWATER SAMPLES					
Parameter	**MW-8**	**MW-14A**	**MW-16**	**MW-20**	***GTV Note1 IGV Note2***
Sodium mg/l	6.6	20	9.5	15	*150[2]*
Potassium mg/l	0.6	**5.1**	0.8	1.3	*5[2]*
Magnesium mg/l	8.6	17	14	14	*50[2]*
Calcium mg/l	63	**204**	80	**283**	*200[2]*
Boron µg/l	11	48	14	27	*750[1]*
Cadmium µg/l	<2	<2	<2	<2	*3.75[1]*
Chromium µg/l	<2	<2	<2	<2	*37.5[1]*
Copper µg/l	<2	<2	<2	3	*1500[1]*
Iron mg/l	<0.1	<0.1	<0.1	<0.1	*0.2[2]*
Lead µg/l	<2	<2	<2	<2	*18.75[1]*
Manganese µg/l	**174**	<2	**983**	3	*50[2]*
Nickel µg/l	<2	<2	<2	<2	*15[1]*
Zinc µg/l	3	<2	3	11	*100[2]*
Mercury µg/l	<1	<1	<1	<1	*0.75[1]*

Note 1:GTV = Groundwater Threshold Values refers to "European Communities Environmental Objectives (Groundwater) Regulations, 2010". "Threshold Values" have been established for pollutants that are causing a risk to groundwater bodies. Exceedance of a relevant threshold value at a representative monitoring point triggers further investigation to confirm whether the criteria for poor groundwater chemical status are being met.

Note 2: Guide Values refers to EPA Guideline Values for the Protection of Groundwater in Ireland, IGV = Interim Guideline Value. Note these standards are presented for guideline purposes only, therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained

Bold font indicates exceedances above the Guideline Limits

TABLE 3.5 RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR GROUNDWATER MONITORING BOREHOLES									
	Parameter	**Units**	**MW1A**	**MW2**	**MW3**	**MW8**	**MW14A**	**MW16**	**MW20**
Comb Pesticide Suite	Dichlorvos**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Mevinphos**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	alpha-HCH/Lindane**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Diazinon**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	gamma-HCH/Lindane**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Heptachlor**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Aldrin**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	beta-HCH/Lindane**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Methyl Parathion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Malathion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Fenitrothion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Heptachlor Epoxide**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Parathion**	µg/l	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-DDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Endosulfan I**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.1	<0.01	<0.01
	p,p-DDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Dieldrin**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-TDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Endrin**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-DDT**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	p,p-TDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Ethion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Endosulfan II**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	p,p-DDT**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-Methoxychlor**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	p,p-Methoxychlor**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

TABLE 3.5 RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR GROUNDWATER MONITORING BOREHOLES									
Comb Pesticide Suite	**Parameter**	**Units**	**MW1A**	**MW2**	**MW3**	**MW8**	**MW14A**	**MW16**	**MW20**
	Endosulfan Sulphate**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Azinphos Methyl**	µg/l	0.02	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
SVOCS	1,2,4-Trichlorobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2-Dichlorobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,3-Dichlorobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,4-Dichlorobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2,4-Trichlorobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2,4,5-Trichlorophenol**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2,4,6-Trichlorophenol**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2,4-Dichlorophenol**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2,4-Dimethylphenol**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2,4-Dinitrotoluene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2,6-Dinitrotoluene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2-Chloronaphthalene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2-Chlorophenol**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2-Methylnaphthalene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2-Methylphenol**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2-Nitroaniline**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2-Nitrophenol**	µg/l	<1	<1	<1	<1	<1	<1	<1
	3-Nitroaniline**	µg/l	<1	<1	<1	<1	<1	<1	<1
	4-Bromophenylphenylether**	µg/l	<1	<1	<1	<1	<1	<1	<1
	4-Chloro-3-methylphenol**	µg/l	<1	<1	<1	<1	<1	<1	<1

TABLE 3.5 RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR GROUNDWATER MONITORING BOREHOLES									
	Parameter	**Units**	**MW1A**	**MW2**	**MW3**	**MW8**	**MW14A**	**MW16**	**MW20**
SVOCs	4-Chloroaniline**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	4-Chlorophenylphenylether**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	4-Methylphenol**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	4-Nitrophenol**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	4-Nitroaniline**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Azobenzene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Acenaphthylene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Acenaphthene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Anthracene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Bis(2-Chloroethyl)ether**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Bis(2-chloroethoxy)methane**	*µg/l*	<1	<1	<1	<1	<1	<1	1
	Bis(2-ethylhexyl)phthalate**	*µg/l*	<2	<2	<2	<2	<2	<2	<2
	Benzo(a)anthracene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Benzo(a)pyrene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Benzo(ghi)perylene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Carbazole**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Chrysene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Dibenzofuran**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	n-Di-butylphthalate**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Diethyl phthalate**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Dibenzo(a,h)anthracene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Dimethyl phthalate**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	n-Di octyl phthalate**	*µg/l*	<5	<5	<5	<5	<5	<5	<5
	Fluoranthene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Flourene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Hexachlorobenzene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	hexachlorobutadiene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1

TABLE 3.5 RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR GROUNDWATER MONITORING BOREHOLES									
	Parameter	**Units**	**MW1A**	**MW2**	**MW3**	**MW8**	**MW14A**	**MW16**	**MW20**
SVOCS	Pentachlorophenol**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Phenol**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	N-nitrosodi-n-propylamine**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Hexachloroethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Nitrobenzene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Naphthalene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Isophorone**	*µg/l*	<3	<2	<3	<2	<2	<2	<2
	Hexachlorocyclopentadiene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Phenanthrene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Indenol(1,2,3-cd)pyrene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Pyrene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
VOCs	Dichlorodifluoromethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Chloromethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Vinyl chloride**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Bromomethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Chloroethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Trichlorofluoromethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	1,1-Dichloroethene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Dichloromethane**	*µg/l*	<3	<3	<1	<1	<1	<3	<3
	trans-1,2-Dichloroethene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	1,1-Dichloroethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	2,2-Dichloropropane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	cis-1,2-Dichloroethene**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Bromochloromethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Chloroform**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	1,1,1-Trichloroethane**	*µg/l*	<1	<1	<1	<1	<1	<1	<1
	Carbon Tetrachloride**	*µg/l*	<1	<1	<1	<1	<1	<1	<1

TABLE 3.5 RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR GROUNDWATER MONITORING BOREHOLES									
	Parameter	**Units**	**MW1A**	**MW2**	**MW3**	**MW8**	**MW14A**	**MW16**	**MW20**
VOCs	1,1-Dichloropropene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Benzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2-Dichloroethane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Trichloroethene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2-Dichloropropane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Dibromomethane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Bromodichloromethane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Toluene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,1,2-Trichloroethane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2-Dibromoethane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,1,1,2-Tetrachloroethane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	m,p-Xylene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Styrene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Isopropylbenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	2-Chlorotoluene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	4-Chlorotoluene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2,4-Trimethylbenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	4-Isopropyltoluene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,3-Dichloropropane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	cis-1,3-Dichloropropene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	trans-1,3-Dichloropropene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Dibromochloromethane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Chlorobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Ethyl Benzene**	µg/l	<1	<1	<1	<1	<1	<1	<1

TABLE 3.5 RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR GROUNDWATER MONITORING BOREHOLES									
	Parameter	**Units**	**MW1A**	**MW2**	**MW3**	**MW8**	**MW14A**	**MW16**	**MW20**
VOCs	o-Xylene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Bromoform**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2,3-Trichloropropane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Bromobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Tert-Butylbenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Sec-Butylbenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,3,5-Trimethylbenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2- Dibromo-3-chloropropane**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Hexachlorobutadiene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2,3-Trichlorobenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	Tetrachloroethene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	n-butylbenzene**	µg/l	<1	<1	<1	<1	<1	<1	<1
	1,2,4--Trichloroenzene	µg/l	<1	<1	<1	<1	<1	<1	<1
	MTBE**	µg/l	<1	<1	<1	<1	<1	<1	<1

** subcontracted test

TABLE 3.6: RESULTS OF MICROBIOLOGICAL ANALYSIS OF GROUNDWATER SAMPLES		
Borehole I.D	**Total Coliforms (cfu/100 ml)**	**E.Coli (cfu/100 ml)**
MW-1A	60	0
MW-2	1	0
MW-3	0	0
MW-8	25	10
MW-14A	2	0
MW-16	4	2
MW-20	77	15

Note: Micro-analysis was conducted by Advanced Laboratory Testing (ALT) in Newbridge.

TABLE 3.7: RESULTS OF CHEMICAL ANALYSIS OF PRIVATE WELL SAMPLES						
Parameter	*Water Quality Standard MAC*	**PW-1**	**PW-2**	**PW-3**	**PW-4**	**PW-5**
pH (pH units)	***6.5-9.5***	7.7	7.5	7	7.3	77.2
Odour	**-**	None	None	None	None	None
Visual	**-**	Clear	Clear	Clear	Clear	Clear
Conductivity µS/cm	***1500***	635	558	718	688	796
Ammonia as N mg/l	***0.23***	<0.02	<0.02	<0.02	<0.02	<0.02
Ortho P mg/l	**-**	0.03	0.05	<0.01	<0.01	<0.01
Total Alkalinity $CaCO_3$ mg/l	**-**	321	285	355	301	296
TOC mg/l	**-**	<5.0	<5.0	<5.0	<5.0	<5
Cyanide mg/l	***0.05***	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride mg/l	***1.0***	<0.1	<0.1	<0.1	<0.1	<0.1
Chloride mg/l	***250***	14	15	15	22	45
Sulphate mg/l	***250***	15	15	16	29	24
Total Oxidised Nitrogen mg/l	**-**	0.45	<0.2	1.4	3.7	2.4
Total Dissolved Solids mg/l	***1000***	394	342	434	440	506
Calcium mg/l	***200***	69	87	126	104	161
Sodium mg/l	***150***	14	11	3.8	6.1	24
Magnesium mg/l	***50***	24	14	6.1	12	31
Potassium mg/l	***12***	1.0	0.8	0.5	0.6	1.6
Chromium µg/l	***50***	<2	<2	<2	<2	<2
Manganese µg/l	***50***	<2	8	<2	<2	<2
Nickel µg/l	***20***	<2	<2	<2	<2	<2
Copper µg/l	***2,000***	<2	<2	<2	18	9
Zinc µg/l	***5,000***	4	13	5	16	79
Cadmium µg/l	***5***	<2	<2	<2	<2	<2
Lead µg/l	***10***	<2	<2	<2	<2	<2
Iron mg/l	***0.2***	<0.1	<0.1	<0.1	<0.1	<0.1
Boron µg/l	***1,000***	13	13	15	13	18
Mercury µg/l	***1***	<1	<1	<1	<1	<1

3.2 Private Well Results

TABLE 3.8: RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR PRIVATE WELLS							
	Parameter	**Units**	**PW1**	**PW2**	**PW3**	**PW4**	**PW5**
Comb Pesticide Suite	Dichlorvos**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Mevinphos**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	alpha-HCH/Lindane**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Diazinon**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	gamma-HCH/Lindane**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Heptachlor**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Aldrin**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	beta-HCH/Lindane**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Methyl Parathion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Malathion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Fenitrothion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Heptachlor Epoxide**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Parathion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-DDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Endosulfan I**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.1
	p,p-DDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Dieldrin**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-TDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Endrin**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-DDT**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	p,p-TDE**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Ethion**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Endosulfan II**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	p,p-DDT**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p-Methoxychlor**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	p,p-Methoxychlor**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01

** subcontracted test

TABLE 3.8: RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR PRIVATE WELLS							
Comb Pesticide Suite	**Parameter**	**Units**	**PW1**	**PW2**	**PW3**	**PW4**	**PW5**
	Endosulfan Sulphate**	µg/l	<0.01	<0.01	<0.01	<0.01	<0.01
	Azinphos Methyl**	µg/l	<0.01	<0.01	0.02	<0.01	<0.01
SVOCS	1,2,4-Trichlorobenzene**	µg/l	<1	<1	<1	<1	<1
	1,2-Dichlorobenzene**	µg/l	<1	<1	<1	<1	<1
	1,3-Dichlorobenzene**	µg/l	<1	<1	<1	<1	<1
	1,4-Dichlorobenzene**	µg/l	<1	<1	<1	<1	<1
	1,2,4-Trichlorobenzene**	µg/l	<1	<1	<1	<1	<1
	2,4,5-Trichlorophenol**	µg/l	<1	<1	<1	<1	<1
	2,4,6-Trichlorophenol**	µg/l	<1	<1	<1	<1	<1
	2,4-Dichlorophenol**	µg/l	<1	<1	<1	<1	<1
	2,4-Dimethylphenol**	µg/l	<1	<1	<1	<1	<1
	2,4-Dinitrotoluene**	µg/l	<1	<1	<1	<1	<1
	2,6-Dinitrotoluene**	µg/l	<1	<1	<1	<1	<1
	2-Chloronaphthalene**	µg/l	<1	<1	<1	<1	<1
	2-Chlorophenol**	µg/l	<1	<1	<1	<1	<1
	2-Methylnaphthalene**	µg/l	<1	<1	<1	<1	<1
	2-Methylphenol**	µg/l	<1	<1	<1	<1	<1
	2-Nitroaniline**	µg/l	<1	<1	<1	<1	<1
	2-Nitrophenol**	µg/l	<1	<1	<1	<1	<1
	3-Nitroaniline**	µg/l	<1	<1	<1	<1	<1
	4-Bromophenylphenylether**	µg/l	<1	<1	<1	<1	<1
	4-Chloro-3-methylphenol**	µg/l	<1	<1	<1	<1	<1

**** subcontracted test**

TABLE 3.8: RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR PRIVATE WELLS							
	Parameter	**Units**	**PW1**	**PW2**	**PW3**	**PW4**	**PW5**
SVOCs	4-Chloroaniline**	µg/l	<1	<1	<1	<1	<1
	4-Chlorophenylphenylether**	µg/l	<1	<1	<1	<1	<1
	4-Methylphenol**	µg/l	<1	<1	<1	<1	<1
	4-Nitrophenol**	µg/l	<1	<1	<1	<1	<1
	4-Nitroaniline**	µg/l	<1	<1	<1	<1	<1
	Azobenzene**	µg/l	<1	<1	<1	<1	<1
	Acenaphthylene**	µg/l	<1	<1	<1	<1	<1
	Acenaphthene**	µg/l	<1	<1	<1	<1	<1
	Anthracene**	µg/l	<1	<1	<1	<1	<1
	Bis(2-Chloroethyl)ether**	µg/l	<1	<1	<1	<1	<1
	Bis(2-chloroethoxy)methane**	µg/l	<1	<1	<1	<1	<1
	Bis(2-ethylhexyl)phthalate**	µg/l	<2	<2	<2	<2	<2
	Benzo(a)anthracene**	µg/l	<1	<1	<1	<1	<1
	Benzo(a)pyrene**	µg/l	<1	<1	<1	<1	<1
	Benzo(ghi)perylene**	µg/l	<1	<1	<1	<1	<1
	Carbazole**	µg/l	<1	<1	<1	<1	<1
	Chrysene**	µg/l	<1	<1	<1	<1	<1
	Dibenzofuran**	µg/l	<1	<1	<1	<1	<1
	n-Di-butylphthalate**	µg/l	<1	<1	<1	<1	<1
	Diethyl phthalate**	µg/l	<1	<1	<1	<1	<1
	Dibenzo(a,h)anthracene**	µg/l	<1	<1	<1	<1	<1
	Dimethyl phthalate**	µg/l	<1	<1	<1	<1	<1
	n-Di octyl phthalate**	µg/l	<5	<5	<5	<5	<5
	Fluoranthene**	µg/l	<1	<1	<1	<1	<1
	Flourene**	µg/l	<1	<1	<1	<1	<1
	Hexachlorobenzene**	µg/l	<1	<1	<1	<1	<1
	hexachlorobutadiene**	µg/l	<1	<1	<1	<1	<1

**** subcontracted test**

TABLE 3.8: RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR PRIVATE WELLS							
	Parameter	**Units**	**PW1**	**PW2**	**PW3**	**PW4**	**PW5**
SVOCS	Pentachlorophenol**	*µg/l*	<1	<1	<1	<1	<1
	Phenol**	*µg/l*	<1	<1	<1	<1	<1
	N-nitrosodi-n-propylamine**	*µg/l*	<1	<1	<1	<1	<1
	Hexachloroethane**	*µg/l*	<1	<1	<1	<1	<1
	Nitrobenzene**	*µg/l*	<1	<1	<1	<1	<1
	Naphthalene**	*µg/l*	<1	<1	<1	<1	<1
	Isophorone**	*µg/l*	<2	<2	<2	<2	<1
	Hexachlorocyclopentadiene**	*µg/l*	<1	<1	<1	<1	<1
	Phenanthrene**	*µg/l*	<1	<1	<1	<1	<1
	Indenol(1,2,3-cd)pyrene**	*µg/l*	<1	<1	<1	<1	<1
	Pyrene**	*µg/l*	<1	<1	<1	<1	<1
VOCs	Dichlorodifluoromethane**	*µg/l*	<1	<1	<1	<1	<1
	Chloromethane**	*µg/l*	<1	<1	<1	<1	<1
	Vinyl chloride**	*µg/l*	<1	<1	<1	<1	<1
	Bromomethane**	*µg/l*	<1	<1	<1	<1	<1
	Chloroethane**	*µg/l*	<1	<1	<1	<1	<1
	Trichlorofluoromethane**	*µg/l*	<1	<1	<1	<1	<1
	1,1-Dichloroethene**	*µg/l*	<1	<1	<1	<1	<1
	Dichloromethane**	*µg/l*	<3	<3	<3	<1	<3
	trans-1,2-Dichloroethene**	*µg/l*	<1	<1	<1	<1	<1
	1,1-Dichloroethane**	*µg/l*	<1	<1	<1	<1	<1
	2,2-Dichloropropane**	*µg/l*	<1	<1	<1	<1	<1
	cis-1,2-Dichloroethene**	*µg/l*	<1	<1	<1	<1	<1
	Bromochloromethane**	*µg/l*	<1	<1	<1	<1	<1
	Chloroform**	*µg/l*	<1	<1	<1	<1	<1
	1,1,1-Trichloroethane**	*µg/l*	<1	<1	<1	<1	<1
	Carbon Tetrachloride**	*µg/l*	<1	<1	<1	<1	<1

**** subcontracted test**

TABLE 3.8: RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR PRIVATE WELLS							
	Parameter	**Units**	**PW1**	**PW2**	**PW3**	**PW4**	**PW5**
VOCs	1,1-Dichloropropene**	*µg/l*	<1	<1	<1	<1	<1
	Benzene**	*µg/l*	<1	<1	<1	<1	<1
	1,2-Dichloroethane**	*µg/l*	<1	<1	<1	<1	<1
	Trichloroethene**	*µg/l*	<1	<1	<1	<1	<1
	1,2-Dichloropropane**	*µg/l*	<1	<1	<1	<1	<1
	Dibromomethane**	*µg/l*	<1	<1	<1	<1	<1
	Bromodichloromethane**	*µg/l*	<1	<1	<1	<1	<1
	Toluene**	*µg/l*	<1	<1	<1	<1	<1
	1,1,2-Trichloroethane**	*µg/l*	<1	<1	<1	<1	<1
	1,2-Dibromoethane**	*µg/l*	<1	<1	<1	<1	<1
	1,1,1,2-Tetrachloroethane**	*µg/l*	<1	<1	<1	<1	<1
	m,p-Xylene**	*µg/l*	<1	<1	<1	<1	<1
	Styrene**	*µg/l*	<1	<1	<1	<1	<1
	Isopropylbenzene**	*µg/l*	<1	<1	<1	<1	<1
	2-Chlorotoluene**	*µg/l*	<1	<1	<1	<1	<1
	4-Chlorotoluene**	*µg/l*	<1	<1	<1	<1	<1
	1,2,4-Trimethylbenzene**	*µg/l*	<1	<1	<1	<1	<1
	4-Isopropyltoluene**	*µg/l*	<1	<1	<1	<1	<1
	1,3-Dichloropropane**	*µg/l*	<1	<1	<1	<1	<1
	cis-1,3-Dichloropropene**	*µg/l*	<1	<1	<1	<1	<1
	trans-1,3-Dichloropropene**	*µg/l*	<1	<1	<1	<1	<1
	Dibromochloromethane**	*µg/l*	<1	<1	<1	<1	<1
	Chlorobenzene**	*µg/l*	<1	<1	<1	<1	<1
	Ethyl Benzene**	*µg/l*	<1	<1	<1	<1	<1

**** subcontracted test**

TABLE 3.8: RESULTS OF ANNUAL PESTICIDE, SVOCs AND VOCS FOR PRIVATE WELLS							
		Units	**PW1**	**PW2**	**PW3**	**PW4**	**PW5**
VOCs	o-Xylene**	µg/l	<1	<1	<1	<1	<1
	Bromoform**	µg/l	<1	<1	<1	<1	<1
	1,2,3-Trichloropropane**	µg/l	<1	<1	<1	<1	<1
	Bromobenzene**	µg/l	<1	<1	<1	<1	<1
	Tert-Butylbenzene**	µg/l	<1	<1	<1	<1	<1
	Sec-Butylbenzene**	µg/l	<1	<1	<1	<1	<1
	1,3,5-Trimethylbenzene**	µg/l	<1	<1	<1	<1	<1
	1,2- Dibromo-3-chloropropane**	µg/l	<1	<1	<1	<1	<1
	Hexachlorobutadiene**	µg/l	<1	<1	<1	<1	<1
	1,2,3-Trichlorobenzene**	µg/l	<1	<1	<1	<1	<1
	Tetrachloroethene**	µg/l	<1	<1	<1	<1	<1
	n-butylbenzene**	µg/l	<1	<1	<1	<1	<1
	1,2,4--Trichloroenzene	µg/l	<1	<1	<1	<1	<1
	MTBE**	µg/l	<1	<1	<1	<1	<1

**** subcontracted test**

TABLE 3.9: RESULTS OF MICROBIOLOGICAL ANALYSIS OF PRIVATE WELL SAMPLES			
Borehole I.D	***Water Quality Standard MAC*** *Note 1*	**Total Coliforms (MPN/100 ml)**	**E.Coli (cfu/100 ml)**
PW-1	***0***	540	30
PW-2	***0***	0	0
PW-3	***0***	0	0
PW-4	***0***	3900	0
PW-5	***0***	0	0

MAC Maximum Admissible Concentration. Note these standards are presented for guideline purposes only and do not relate specifically to groundwater quality standards. Therefore, due care should be exercised in cross-referencing these standards with the groundwater results obtained. Figures in bold indicate values over their MAC values.

Note 1: Water Quality Standard = Water Quality Standards set in S.I No. 278 of 2007. European Communities (Drinking Water) (No.2) Regulations, 2007

Note 2: Samples subcontracted to ALT laboratories

3.3 Leachate Results

TABLE 3.10: RESULTS OF LABORATORY ANALYSIS OF LEACHATE SAMPLES						
Parameter	**LC-1**	**LC-10**	**LC-11**	**LLAG**	**LT2**	**LST**
pH (pH units)	7.5	7.6	7.7	7.7	7.1	7.9
Conductivity (µS/cm)	23510	26720	3290	27250	19530	26480
Temperature (ºC)	21.4	27.4	28.7	23.7	24.4	21.8
Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour
Visual Inspection	Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown
BOD – TCMP (mg/l)	130	140	200	180	1100	140
COD (mg/l)	2960	3750	5950	4670	4130	4390
Ammonia-N (mg/l)	2014	2319	3264	2552	71.4	2457
Chloride (mg/l)	2075	2407	2876	2346	1814	2315
Fluoride (mg/l)	1.4	0.40	0.27	0.43	1.8	0.73
Total P (mg/l)	27.57	29.18	43.63	43.60	47.16	37.01
Sulphate (mg/l)	81	773	19	28	94	61
TON (mg/l)	0.36	3.6	0.21	0.33	1699	0.27
Calcium (mg/l)	30	38	66	16	42	49
Iron (mg/l)	<1	1.7	2.5	1.2	2.9	1.5
Potassium (mg/l)	572	833	848	694	672	998
Sodium (mg/l)	874	1375	1738	1540	2310	1348
Magnesium (mg/l)	24	29	38	25	20	31
Total Chromium(µg/l)	262	235	586	343	261	388
Manganese (µg/l)	142	112	190	129	250	182
Nickel (µg/l)	303	292	453	257	221	340
Copper (µg/l)	<20	33	604	<20	33	<20
Zinc (µg/l)	84	169	360	47	211	108
Cadmium (µg/l)	<20	<20	<20	<20	<20	<20
Lead (µg/l)	<20	<20	<20	<20	20	<20
Boron (µg/l)	1142	1010	2067	1449	1424	1621
Mercury (µg/l)	<10	<10	<10	<10	<10	<10

Note: < = Less Than Laboratory Limit of Detection.

TABLE 3.11: RESULTS OF ANNUAL CHEMICAL ANALYSIS OF LEACHATE BALANCING TANK (LBAL)		
Parameter	**Units**	**LBAL**
Alkalinity	mg/l	390
Ammonia	mg/l	1.5
BOD	mg/l	2575
Chloride	mg/l	1860
COD	mg/l	2375
Conductivity	µS/cm	19480
Cyanide	mg/l	<0.01
Fluoride	mg/l	0.26
Nitrate	mg/l	1978
Sulphate	mg/l	96
Orthophosphate	mg/l	27
Phenols	mg/l	<0.002
pH	pH units	6.1
Suspended Solids	mg/l	78
TOC	mg/l	678
TON	mg/l	1800***
Total N	mg/l	1871
Total P	mg/l	33.63
Aluminium	µg/l	1830
Antimony	µg/l	10.6
Barium	µg/l	544
Berylium	µg/l	<1
Cadmium	µg/l	0.844
Calcium	mg/l	128
Chromium	µg/l	395
Cobalt	µg/l	64.9
Copper	µg/l	63.3
Iron	mg/l	7.1
Lead	µg/l	7.14
Magnesium	mg/l	53.5
Manganese	µg/l	541
Nickel	µg/l	458
Mercury	µg/l	<0.02
Arsenic	µg/l	126
Boron	µg/l	2520
Potassium	mg/l	1240
Selenium	µg/l	22.2
Silver	µg/l	<2
Sodium	mg/l	3840
Tin	µg/l	123
Zinc	µg/l	543
Bismuth	µg/l	<2
Titanium	µg/l	369

Note: < = Less Than Laboratory Limit of Detection. *** = Outside accredited range

TABLE 3.12: RESULTS OF MONTHLY CHEMICAL ANALYSIS OF LEACHATE BALANCING TANK (LBAL)			
Parameter	**Units**	**21/07/15**	**15/09/15**
Chemical Oxygen Demand	mg/l	2715	3060
Biological Oxygen Demand	mg/l	32	37
Suspended Solids	mg/l	152	2260
Ammonia (as N)	mg/l	17	50
TOC	mg/l	757	86

4.0 Discussion

4.1 Groundwater

Samples were taken from seven (MW-1A, MW2, MW3, MW-8, MW-14A, MW-16 and MW-20) of the twenty-three boreholes at Arthurstown Landfill, in accordance with Schedule D of Waste Licence W0004-4. It is worth noting that the newly instated wells MW1A and MW14A replace MW1 and MW14 respectively. Remaining boreholes were checked for total and surface-water depth using a dip meter in accordance with EPA Waste License W0004-04.

Reference is made throughout a number of sections in the discussion of this report to the "*European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010*)" and the results of the analysis are compared to the limits contained in this report. For discussion purposes, results are also compared to the previous quarterly monitoring event, carried out during May 2015 (*See ANUA Report ECS5132*). All annual parameters are compared to the previous annual monitoring event carried out in July 2014 (*See ANUA Report ECS4972).*

Chemical Analysis

The results of chemical analysis carried out on each of the groundwater samples are presented in Tables 3.3A, 3.3B and 3.6.

Monitoring wells; MW8, MW-14A and MW16 were within the relevant EPA groundwater limits for all chemical parameters analysed (see Tables 3.3A/B). The results of parameters tested at these locations remain broadly in-line with previous results, with only slight variations observed.
The Orthophosphate level at MW1A (0.05mg/l) and MW2 (0.04mg/l) slightly exceeded its respective IGV limit (0.03mg/l).
The Sulphate concentration at MW-3 (309mg/l) and MW-20 (301mg/l) exceeded its respective IGV limit of 187.5mg/l.
SVOCs, VOCs and pesticides were below the limits of detection at all monitoring locations as seen in Table 3.5.

Metals Analysis

Results of metals analysis carried out on 7 boreholes are presented in Tables 3.4(a) and 3.4(b). Cadmium, Chromium, Nickel and Mercury were not detected at any of the groundwater monitoring locations, while trace amounts of Sodium, Potassium, Boron, Lead, and Zinc were present at a number of boreholes.

Levels of Manganese at; MW-2 (113µg/l), M8-8 (174mg/l) and MW-16 (983µg/l) have displayed typical fluctuations over previous monitoring events but remain above the respective Groundwater Threshold Value 50µg/l.

Levels of Calcium at MW20, MW-14a and MW3 exceeded the respective limits of 200mg/l. The level of Iron remains below the laboratory limit of detection (0.1mg/l) at all monitoring locations.

Minor fluctuations of levels occurred in the remaining parameters and each was in keeping with previous trends.

Microbial Analysis

Groundwater samples were analysed for Total and Faecal Coliforms and the results of the analysis are shown in Table 3.6. Total Coliforms were detected in 6 of the boreholes sampled. Faecal Coliforms were detected in 3 of the boreholes sampled. The highest levels of Faecal Coliforms were detected at groundwater monitoring locations: MW-20 (15cfu/100ml). It is worth noting that the number of locations were E-coli was present has reduced sine the previous annual monitoring event. The highest concentration of E-coli was detected at MW-16 (31cfu/100ml) in the 2014 annual monitoring event.

4.2 Private Well

Five private wells were sampled during this monitoring event. Results for the private wells show that the water is of similar quality to those levels recorded in previous monitoring events. All the chemical parameters were within their respective Maximum Admissible Concentration values as outlined in Water Quality Standards set in S.I No. 278 of 2007 European Communities (Drinking Water) (No.2) Regulations. It should be noted that these standards are presented for guideline purposes only and do not relate specifically to groundwater quality standards.
E.Coli was detected at one monitoring well; PW-1 (1600→30cfu/l00ml), this has decreased significantly since the previous annual monitoring event. The number of wells containing E-coli has also reduced from 3 to 1 in 2015. E.Coli was not detected above the laboratory limit of detection at PW-2, PW-3, PW-4 and PW-5. SVOCs, VOCs and pesticides were below the limits of detection at all monitoring locations as seen in Table 3.8. Total coliforms were detected at the highest concentration of 3900cfu/100ml at PW-4.

4.3 Leachate

Five leachate samples were taken during the monitoring event;

- Sample LC1 was taken from Cell 1 of 'Phase 1' of the landfill which has been final capped.
- Sample LC10 was taken from Cell 10 which is part of the Landfill which was capped with clay more recently. LC8 was originally selected for sampling, however the cell was dry on the day of sampling.
- Sample LC11 was taken from Cell 11 which is part of the Landfill which was capped with clay more recently.

In addition samples were taken from the different phases associated with the onsite leachate treatment system: LL (Leachate Lagoon) LT" (Leachate Tank 2) LST (Leachate Storage Tank) and LBAL (Leachate Balancing Tank).
The results of this monitoring event are compared to the previous annual monitoring event which was conducted in July 2014 (*see ANUA Report Ref ECS4972*).

Leachate samples display typical fluctuations in respective parameter concentrations compared to the previous annual monitoring event and remain broadly in-line with historical trends.

The results gathered for monthly analysis show similar results to the previous monitoring carried out in Qtr 2 of 2015 (ECS5132).

Leachate Cells

The majority of parameters at leachate cells; LC-1, LC-10 and LC-11 displayed a slight increase compared to the previous monitoring event, but remain broadly in line with historical trended results for these locations.

COMMENT

The leachate treatment system operates from the Leachate Lagoon (LL) → Storage tank (LST) → Aeration tanks (LT1 and LT2)→ Balance Tank (LBAL).

Samples taken from the Leachate Lagoon (LL) and Balance Tank (LBT) indicated that key indicator parameters such as; COD and Ammonia, show considerable decrease in concentration levels as leachate moves through the treatment system.

APPENDIX 1

Analytical Methods

Lab Accreditation

Chain of Custody

5.0 Analysis

All samples returned to the laboratory were stored at 1-8°C. Subsequent analysis of all samples was carried out in strict accordance with recognised standard methods as detailed in Table 2.3 below.

TABLE 2.3: CHEMICAL ANALYSIS OF SAMPLES			
Parameter	**LOD (limit of detection)**	**Method**	**Accredited**
Visual Inspection	-	On-Site Visual Determination	-
Odour	-	On-Site Sensory Determination	-
pH (pH units)	-	G/05: Based on APHA 2012, 22nd Edition, 4500-H+B	✓ (INAB)
Temperature (°C)	-	*In-Situ* Calibrated Temp. electrode	-
TOC (mg/l)	<5 mg/l	G/94: TOC analyser. Based on APHA, 2012, 22nd Ed, 5310-B	x
Conductivity (µS/cm)	1000 µS/cm	G/06: Based on APHA 2012, 22nd Edition, Method 2510B	✓ (INAB)
Anions	<0.5 mg/l SO_4	G/39: Based on APHA, 2012, 22nd Edition, Method 4110B.	✓ (INAB)
	<0.10 mg/l F		✓ (INAB)
	<0.2mg/l NO_3-N	G/67: Based on APHA, 2012, 22nd Edition, 4500-NH_3 & bluebook Ammonia in waters, 1981.	✓ (INAB)
	<0.01 mg/l PO4-P		✓ (INAB)
	<0.02 mg/l NO_2		X
			✓ (INAB)
Ammonia-N (mg/l) (Konelab)	<0.02 NH_3-N	G/67: Konelab Based on APHA, 2012, 22nd Edition, 4500-$N0_2$B/NH_3 & bluebook Ammonia in waters, 1981	✓ (INAB)
Nitrate	<0.2mg/l NO_3-N		✓ (INAB)
Nitrite	<0.02 mg/l NO_2		✓ (INAB)
TON as N	<0.2 mg/l	G/67: Based on APHA 2012, 22nd Edition, IC	
Chloride	<0.5 mg/l Cl		✓ (INAB)
VOC's (µg/l)	<1 mg/l	G/61: Based on USEPA 524,2 method	X
Cyanide (mg/l)	<1 mg/l	G/63 based on APHA 2012, 22nd Edition, Method 4500-CN-E	X
Total Phosphorus	<0.05mg/l TP	G/74: Based on APHA – 2012, 22nd Edition, Method 4500 – PB & Hach Method 8190	✓ (INAB)
Calcium, Sodium, Magnesium, Potassium	<0.1 mg/l	. G/57: Based on EPA Method 200.8.	X
Total Heavy Metals	Fe: <0.1 mg/l Others: < 2 µg/l		
	Hg: <10 µg/l Boron: <20 µg/l	ICP-MS	X

Notes:
APHA - American Public Health Association, Standard Methods for the Examination of Waters and Waste Waters, 22nd Edition, 2012.
G/ - INAB Accredited Method, BnM Environmental Standard Operating Procedures Manual
✓ - INAB Accredited Test Method – INAB Registration Reference No. 083T.
X – None Accredited Test Method

6.0 COMMITMENT TO QUALITY

6.1 INAB Accreditation

BnM Environmental analytical laboratory is accredited to ISO 17025 by the National Accreditation Board (INAB). ISO 17025 accreditation ensures that the laboratory operates a quality system with technically competent staff. The laboratory has accreditation since 1997 and it is the policy of the laboratory to achieve and maintain a high standard of quality consistent with client's requirements in all aspects of the work carried out within the laboratory.

6.2 Interlaboratory Proficiency Schemes

To ensure the accuracy of the analytical testing the laboratory participates in several external proficiency schemes. The ongoing competence of the laboratory and its staff is assessed by participation in various inter–laboratory proficiency testing schemes, such as LGC Aquacheck scheme and the EPA Intercalibration programme organised for environmental laboratories throughout Ireland. BnM Environmental Analytical Laboratory Services is listed on the EPA's register of Quality Controlled Laboratories

6.3 Control Chain of Custody

As part of the Quality System in place in BnM Environmental, measures are taken to ensure controlled chain of custody. An outline of the chain of custody is given below.

BORD NA MÓNA

CONTROLLED CHAIN OF CUSTODY

SITE		TRANSPORT		LABORATORY
Sampling and packaging of all samples were carried out by BnM Environmental Technical Team:	Transport Document Form	Transport to laboratory by BnM Environmental Technical Team.	Sample Reception Form	Receiving of samples at BnM Environmental Laboratory complex by: Laboratory Manager (Secure laboratory complex access to authorised personnel only)
Ms. Kate Tynan	→		→	↓
				Storage of all samples for 1 month period after report issue.
				↓
				Supervised Disposal

APPENDIX 7

Meteorological Monitoring

ANNUAL CLIMATOLOGICAL SUMMARY

NAME: Arthurstown CITY: Arthurstown STATE: SDCC
ELEV: 133 m LAT: 0 LONG: 0

TEMPERATURE (°C), HEAT BASE 18.3, COOL BASE 18.3

YR	MO	MEAN MAX	MEAN MIN	MEAN	DEP. FROM NORM	HEAT DEG DAYS	COOL DEG DAYS	HI	DATE	LOW	DATE	MAX >=32	MAX <=0	MIN <=0	MIN <=-18
15	1	7.6	1.8	4.6	0.0	426	0	14.9	9	-4.1	19	0	0	9	0
15	2	6.7	0.8	3.8	0.0	405	0	11.3	26	-5.6	4	0	0	8	0
15	3	9.7	2.2	6.0	0.0	378	0	13.1	9	-1.9	18	0	0	6	0
15	4	13.3	4.2	8.8	0.0	256	0	18.7	7	0.3	28	0	0	0	0
15	5	13.8	6.4	9.9	0.0	259	0	18.5	23	3.1	13	0	0	0	0
15	6	17.8	9.0	13.5	0.0	147	4	24.7	30	3.3	9	0	0	0	0
15	7	17.9	10.8	14.3	0.0	126	3	23.5	1	6.8	30	0	0	0	0
15	8	18.4	10.3	14.3	0.0	126	3	22.7	18	7.5	15	0	0	0	0
15	9	16.0	8.4	12.2	0.0	182	0	19.4	8	4.5	6	0	0	0	0
15	10	13.8	6.8	10.6	0.0	238	0	17.3	1	0.4	13	0	0	0	0
15	11	11.9	5.5	8.9	0.0	283	0	16.7	2	-0.6	22	0	0	2	0
15	12	11.6	5.5	8.6	0.0	300	0	14.4	19	1.5	31	0	0	0	0
		13.2	6.0	9.7	0.0	3129	11	24.7	JUN	-5.6	FEB	0	0	25	0

PRECIPITATION (mm)

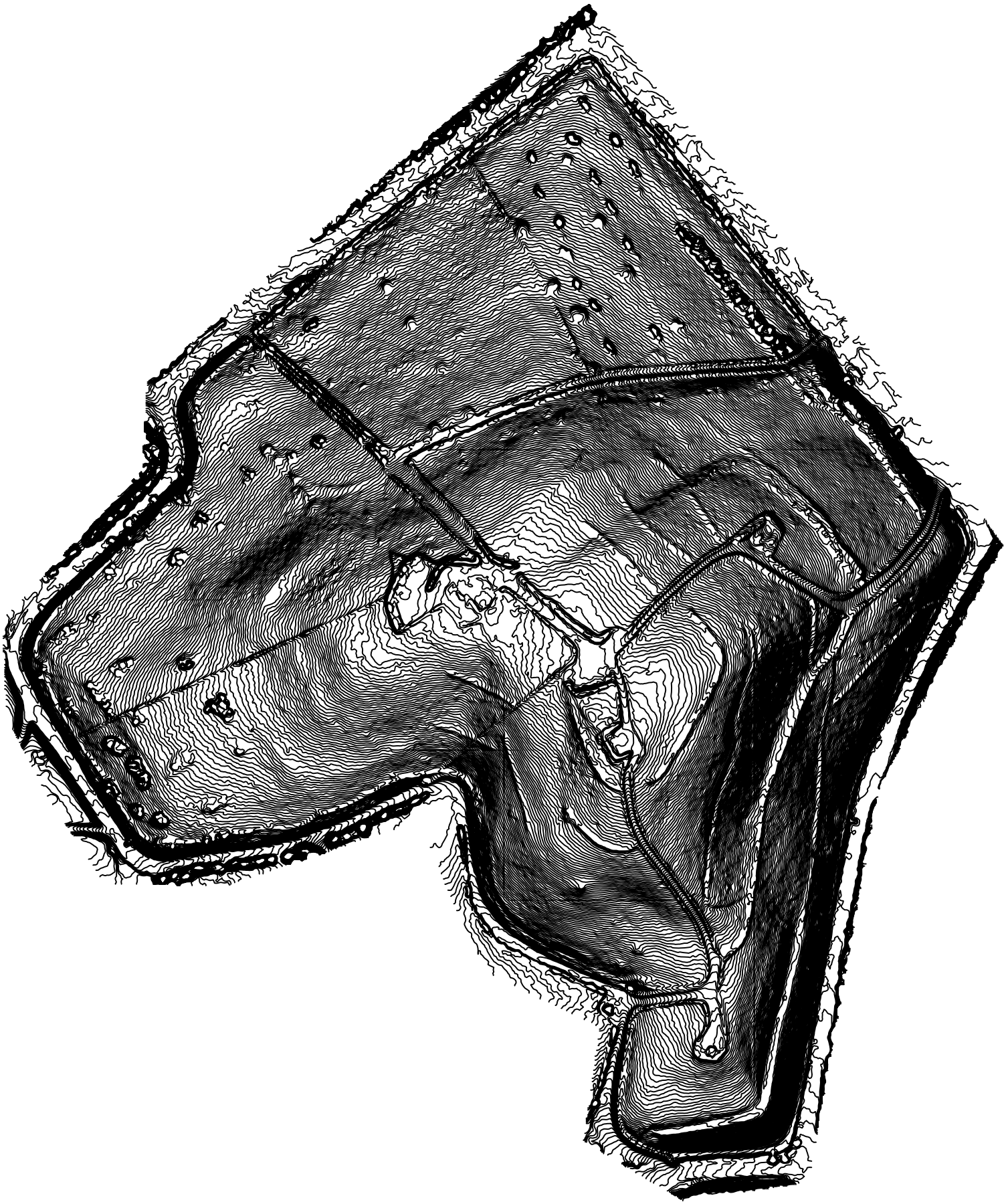
YR	MO	TOTAL	DEP. FROM NORM	MAX OBS. DAY	DATE	DAYS OF RAIN OVER .2	OVER 2	OVER 20
15	1	50.6	0.0	8.8	3	21	10	0
15	2	39.2	0.0	8.6	15	19	6	0
15	3	56.5	0.0	10.8	12	18	8	0
15	4	36.2	0.0	7.4	12	10	7	0
15	5	96.1	0.0	19.0	3	23	13	0
15	6	16.8	0.0	3.8	5	12	4	0
15	7	67.2	0.0	11.4	18	19	10	0
15	8	79.2	0.0	28.0	23	16	8	1
15	9	46.2	0.0	23.4	21	13	4	1
15	10	44.2	0.0	10.0	27	19	6	0
15	11	129.5	0.0	20.4	14	26	15	1
15	12	162.6	0.0	32.8	3	30	16	2
		824.4	0.0	32.8	DEC	226	107	5

WIND SPEED (m/s)

YR	MO	AVG.	HI	DATE	DOM DIR
15	1	1.2	13.0	14	SW
15	2	0.8	10.3	18	SW
15	3	1.0	11.6	9	SW
15	4	0.7	8.5	12	SW
15	5	0.9	9.4	10	WSW
15	6	0.8	8.5	2	WSW
15	7	0.8	8.0	6	WSW
15	8	0.8	8.9	3	SW
15	9	0.5	7.2	11	SW
15	10	0.7	9.4	26	SSW
15	11	1.2	12.5	12	SW
15	12	2.1	15.6	30	SW
		1.0	15.6	DEC	SW

APPENDIX 8

Topographical Survey



APPENDIX 9

PRTR Returns

Environmental Protection Agency

e to completing the PRTR workbook

ΓR Returns Workbook

Version 1.1.19

	blin County Council
	wn Landfill
Licence Number	W0004-04

Classes of Activity

No.	class_name
-	Refer to PRTR class activities below

Address 1	Arthurstown
Address 2	Kill
Address 3	
Address 4	
	Kildare
Country	Ireland
Coordinates of Location	-8.10013 54.5569
River Basin District	IEEA
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	John Smith
AER Returns Contact Email Address	arthurstownlandfill@eircom.net
AER Returns Contact Position	Facility Manager
AER Returns Contact Telephone Number	045877674
AER Returns Contact Mobile Phone Number	0868371729
AER Returns Contact Fax Number	
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	7
User Feedback/Comments	Air tab (Section A to C) Differences of +-50% in stack emissions - pls note eng 1 sampled '15 and not in '14 and eng 8 sampled in '14 and not in '15. Differences in mass flow emissions are mainly derived from differences in run time. All results were compliant both years. Different
Web Address	www.arthurstown.ie

2. PRTR CLASS ACTIVITIES

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

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

Is it applicable?	No
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

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs									
POLLUTANT		METHOD										QUANTITY		
			Method Used		flare 1	flare 2	engine 1	engine 2	engine 5	engine 6	engine 7			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	Emission Point 4	Emission Point 5	Emission Point 6	Emission Point 7	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
02	Carbon monoxide (CO)	M	EN 15058:2004	HICR by Horiba PG-250	0.27	0.01	19655.11	16737.18	17414.05	19807.11	3556.43	77170.16	0.0	0.0
08	Nitrogen oxides (NOx/NO2)	M	EN 14792:2005	Chemiluminesence	13.21	11.12	4880.55	6839.32	3925.39	4122.56	745.4	20537.55	0.0	0.0
11	Sulphur oxides (SOx/SO2)	M	EN 14791:2005	NDIR Adsorption	16.74	16.16	4629.21	4268.08	4152.49	4526.76	855.86	18465.3	0.0	0.0
01	Methane (CH4)	E	ESTIMATE	Calculation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	375848.0	0.0	375848.0
07	Non-methane volatile organic compounds (NMVOC)	M	ALT	FID	1.15	1.38	8.67	2.89	5.05	2.74	0.17	22.05	0.0	0.0
03	Carbon dioxide (CO2)	M	OTH		27882.0	15497.0	4018995.0	4358133.0	3602251.0	4169854.0	757862.0	16950474.0	0.0	0.0

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

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

RELEASES TO AIR					Please enter all quantities in this section in KGs								
POLLUTANT		METHOD								QUANTITY			
			Method Used		engine 1	engine 2	engine 5	engine 6	engine 7				
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	Emission Point 4	Emission Point 5	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year	
244	Total Particulates	M	ALT	Gravimetric	51.04	34.67	37.01	40.24	8.39	171.35	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: Arthurstown Landfill

Please enter summary data on the quantities of methane flared and / or utilised	**T (Total) kg/Year**	**M/C/E**	**Method Used**		**Facility Total Capacity m3 per hour**	
			Method Code	**Designation or Description**		
Total estimated methane generation (as per site model)	7,956,205	C	OTH	Gassim 2.5	N/A	
Methane flared	100,356	M	OTH	Measured at flares	4500.0	(Total Flaring Capacity)
Methane utilised in engine/s	7,480,001	M	OTH	Measured at engines	2400.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	375,848	C	OTH	calculated	N/A	

4.2 RELEASES TO WATERS

Link to previous years emissions data

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should NOT be submitted under AER / PRTR Reporting as this only concerns Releases from your facility

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT					QUANTITY			
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT					QUANTITY			
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

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

RELEASES TO WATERS					Please enter all quantities in this section in KGs			
POLLUTANT					QUANTITY			
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

4.3 RELEASES TO WASTEWATER OR SEWER

Link to previous years emissions data

SECTION A : PRTR POLLUTANTS

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

4.4 RELEASES TO LAND

Link to previous years emissions data

SECTION A : PRTR POLLUTANTS

RELEASES TO LAND					Please enter all quantities in this section in KGs		
POLLUTANT		METHOD			QUANTITY		
			Method Used				
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year
					0.0	0.0	0.0

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

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

RELEASES TO LAND					Please enter all quantities in this section in KGs		
POLLUTANT		METHOD			QUANTITY		
			Method Used				
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year
					0.0	0.0	0.0

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

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

Please enter all quantities on this sheet in Tonnes

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	19 07 03	No	9518.0	landfill leachate other than those mentioned in 19 07 02	D9	M	Weighed	Offsite in Ireland	Osberstown Wastewater Treatment Plan,.	Osberstown Wastewater Treatment Plan,Naas,Kildare,.,ireland		
Within the Country	19 07 03	No	7,738.34	landfill leachate other than those mentioned in 19 07 02	D9	M	Weighed	Offsite in Ireland	Ringsend Waste Water Treatmetment Plant,D0034-01	Pigeon House Road,NA,NA,Dub 4,Ireland		

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

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