ANNUAL ENVIRONMENTAL REPORT

FOR

ARTHURSTOWN LANDFILL
KILL, CO. KILDARE

FOR THE PERIOD

1ST JANUARY 2014 – 31ST DECEMBER 2014

WASTE LICENSE NO: W0004-04

Prepared by:

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

31st March 2015

AER 16

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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.

There were some small minor landscaping works which were completed during 2014.

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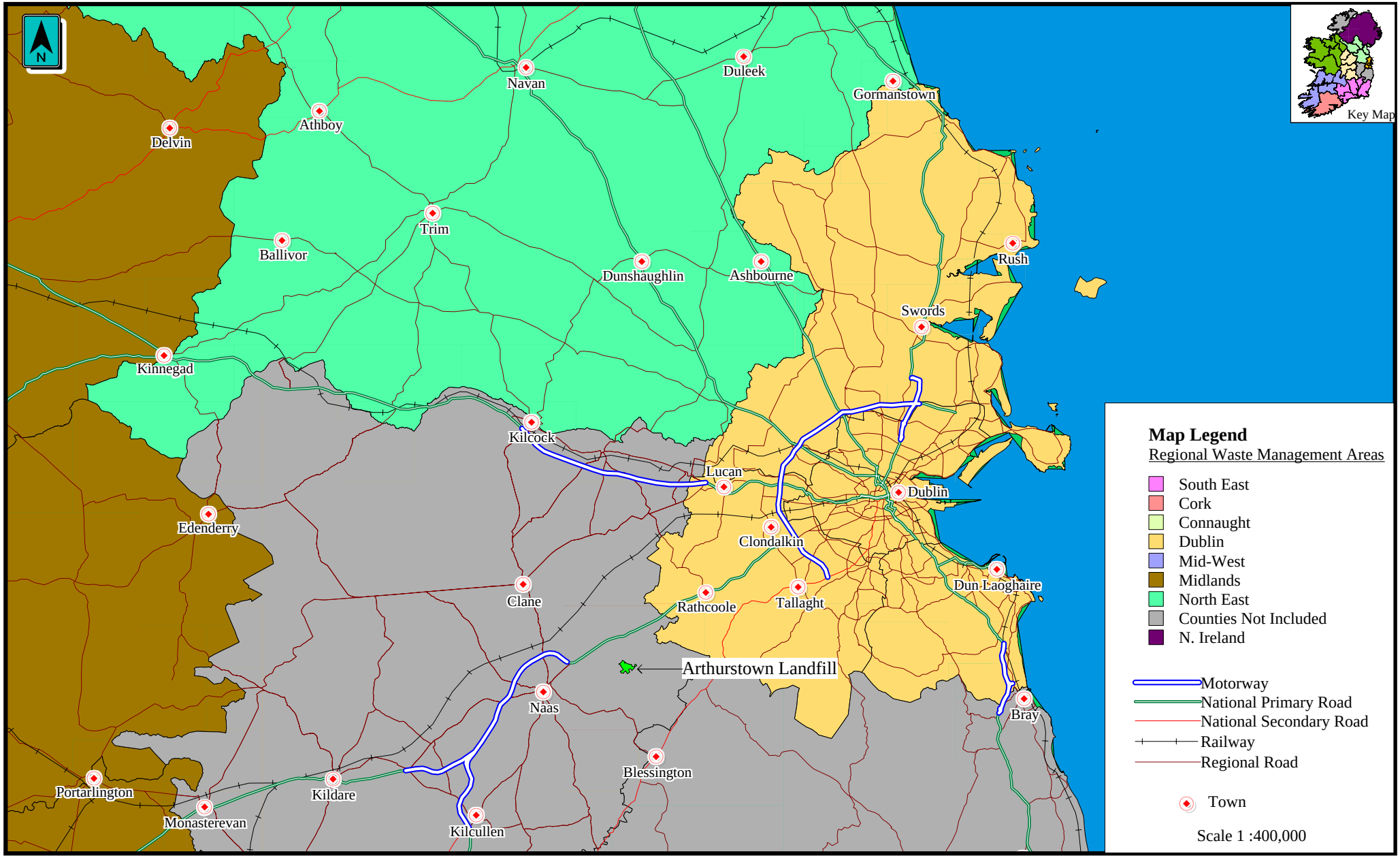
SDC-AP_Figure 2.1_ Site Location-Regional _Rev A



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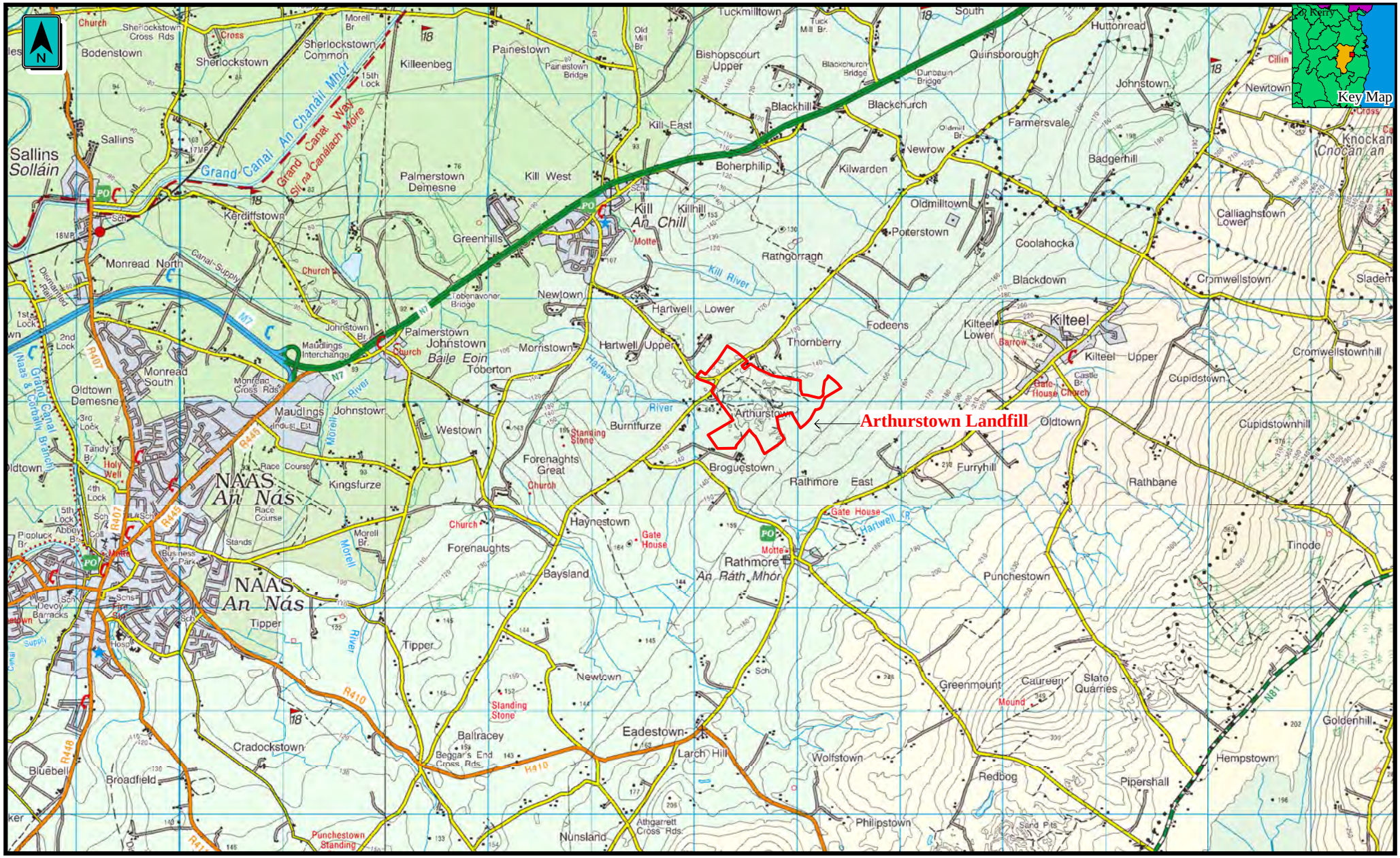
Site Location - Regional

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 16th 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 2014 to 31st December 2014.

This is the fourth 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 and restoration phase.

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 progression of the aftercare and restoration phase of closure programme.

Table 2.2 Resource Use and Energy Consumption

Resource/Energy	Units	Quantity Used in 2014
Diesel Oil	(Litres)	5,000 (Approx)
Electricity (As per SCADA)	(kWh)	296,771

2.4. Leachate Generation

In 2014 leachate was collected from the waste cells and pumped to the leachate treatment plant. Treated leachate 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 2014. 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 2014 is 25,118.51 tonnes or m^3. (8,657.80 tonnes less than 2013)

Month	Tonnes leachate tankered off site 2014	Tonnes Leachate Discharged to Sewer 2014	Total Discharged
January	4,534.94	1,366.95	5,901.89
February	1,353.60	1,201.75	2,555.35
March	1,932.42	939.99	2,872.41
April	0	1,345.64	1,345.64
May	0	1,088.79	1,088.79
June	1,745.98	1,027.98	2,773.96
July	0	1,824.95	1,824.95
August	0	1,641.16	1,641.16
September	0	1,329.89	1,329.89
October	0	938.35	938.35
November	1,305.00	774.18	2,079.18
December	0	766.95	766.95
Total	**10,871.94**	**14,246.57**	**25,118.51**

Table 2.3 Leachate Removal Off-Site for 2014.

ENVIRONMENTAL MONITORING

This is a summary of results and interpretation of environmental monitoring carried out in the period 1st January 2014 to 31st December 2014.

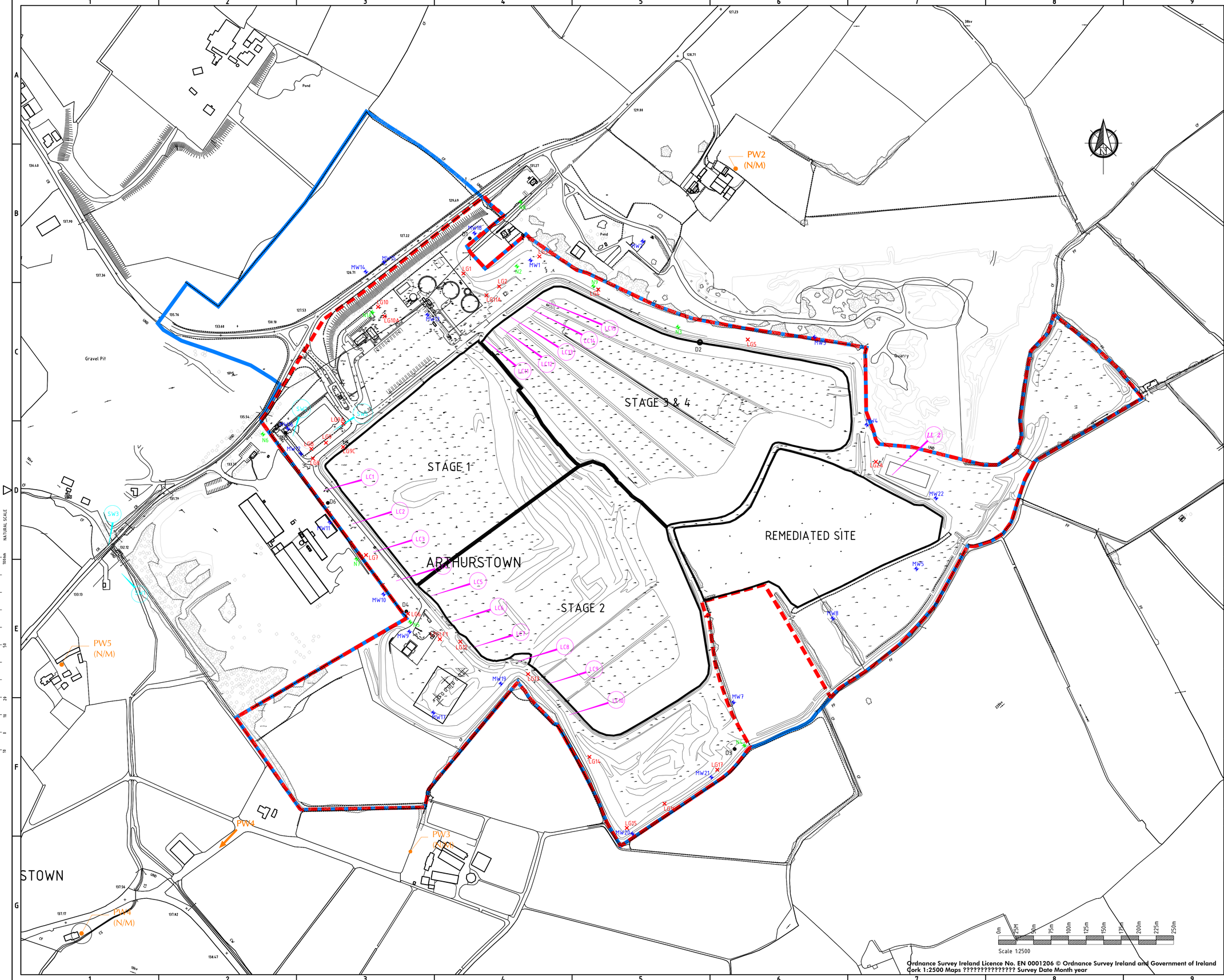
Environmental monitoring of the following is carried out in compliance with Condition 8 and Schedule D of the licence. (W0004-004)

- 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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A	KL	ME	CC	Cork 14.12.06	ISSUE FOR PLANNING
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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

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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, proximity to old percolation areas etc. and was not due to landfill gas migration.

Appendix 3.2 shows methane and carbon dioxide levels measured in perimeter wells in 2014. The levels are comparable to levels recorded in 2012 & 2013. Methane levels in LG10 are at last showing a reduction during 2014.

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.

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 2014.

- 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 consultants 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 2014 was 4,500 m^3/hour; this was generated by 5 no. engines. The 2 no. enclosed flares within the compound are on standby. A further 2 no 2,500m3 per hour enclosed flares operated by SDCC were not operational during 2014 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 2014 and the tables are 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 201

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:

- ___ 02nd May 2014
- ___19th June 2014
- ___ 02nd Dec 2014

2.7.1. Dust Deposition

Dust deposition results for 2014 are shown appendix 3.3.

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 2014. The maximum recorded during 2014 was only 98 mg/m2/day.

2.8. Noise

In compliance with Schedule D (D.4) of the waste licence, noise monitoring was carried during 2014.

The noise monitoring event took place as follows:

Day time monitoring – 27th February, 4th, 5th, and 10th March 2015
Night time monitoring – 27th February, 4th, 5th, and 10th March 2015
As the landfill is now closed the Noise monitoring will be reduced to one round per year.

Noise Results

The results of noise monitoring events are shown in Appendix 3.4.
Noise levels are consistent with previous years monitoring. Only one location exceeded the 55dBA L_{aeq} for daytime limits at N5. This was due to the close proximity to the neighbouring timber processing facility, which explains the tonal noise readings of 315 Hz at this location.
Similarly for night time readings, there were exceedances of 45 dBA night time limit at locations N5 and N6 due to the timber facility adjacent.
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 2014. 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 on site 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

Chemical Analysis

The results of surface water analysis are shown in tables and charts in Appendix 3.5.

2.9.2. Interpretation of Surface Water Results

During 2014 the biological quality rating for surface water has remained consistent with previous years for SW1 and SW3. SW4 results are slightly lower than previous years as can be seen in the Q rating table 3.1 overleaf.
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 2014 there were slightly elevated levels of NH_4 Ammonia, nitrite, conductivity, sulphates and suspended solids mainly at locations SW2 and SW5. 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 2014. This proves that the surface water retention pond is working effectively.
During 2014 all SW reports were sent to the Agency, Kildare County Council and the Department of Inland Fisheries Ireland.

Biological Sampling

During 2014 biological sampling was carried out in the Hartwell and Kill Rivers. The Hartwell received a Q rating of 4 and the Kill River a Q rating of 3-4. This is consistent with previous years for the Hartwell River but a slight reduction in water quality for the Kill River.

Biological sampling is carried out annually in accordance with the licence. It was carried out during the third quarter of 2014. (29th July 2014) 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 2014.

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

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.
Quality at point SW4 is slightly lower than last year's results. This point is on the Kill River which is approximately 500m northeast of the site. No discharges are taking place to the Kill River from Arthurstown landfill.

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 0.1 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.

2.9.3. Groundwater Results

Tables and charts showing groundwater results and trends are included in Appendix 3.6.

2.9.4. 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 2014 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 68 ug/l (IGV 50ug/l) and Ortho Phosphate 0.04 mg/l (IGV 0.03)
MW8 – Manganese 68 ug/l (IGV 50ug/l)
MW16 –Manganese 1407 ug/l (IGV 50ug/l)
MW20 – Calcium 222 (IGV 200 mg/l) and Sulphate 260 mg/l (IGV 187.50 mg/l)
MW22 – Manganese 235 ug/l (IGV 50ug/l)

Levels of total coli-forms and E-coli were detected in locations MW8, MW16, MW20 and MW22. The highest reading for E-coli was taken at MW16. (31 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 standards).

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 2014 are included in the appendix.

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, PW2 and PW4.
All well owners were notified.

The location of all wells are rural agricultural.

All other results for 2014 were below MAC limits.

Quarterly

PW 1 is the only private well that is sampled every quarter. See appendix for quarterly results for PW1 2014. All quarterly PW1 analysis was below the prescribed limits for drinking water for 2014.

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 2014.

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

Tables and charts showing leachate results and trends are included as follows in Appendix 3.8:

2.11.2. Interpretation of Leachate Results

Leachate results for 2014 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.
Final capping was completed in 2013, which should reduce leachate volumes in the coming years.

During 2014 treated leachate was discharged to the twin rising main connection to the local sewer in Kill.
The annual leachate results are enclosed in Appendix 3.8.

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 2014 was 945.90 mm, which is 312.90 mm higher than the previous year. Five months recorded rainfall levels higher than 100 mm. the highest amount of rainfall in one month period was 133.5 mm in November 2014.

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 2014 was 49.9 km/hr.

Annual summary of meteorological conditions is included in Appendix 3.9 for 2014.

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 – 13th March 2014 – One location at Well head 861 (<500ppm)
- Q2 – 13th May 2014 - Fully Compliant.
- Q3 – 02nd September 2014 - Fully Compliant.
- Q4 – 11th November 2014 – Fully Compliant.

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.

2.13.1. Odour Results 2014

During 2014 only one location was detected as a source of VOC emission in quarter 1 2014. The results for Q2, Q3 and Q4 2014 are 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 2014.

The total number of complaints for 2014 was 7. This is the lowest amount of complaints in one year at Arthurstown.
There was only one complaint due to odour and may have been as a result of an alternative source as Arthurstown is now fully capped.
The balance of complaints has been due to traffic related issues.
See complaint summary chart overleaf for 2014.

Q1 – 2013	Total Complaints	2
Q2 – 2013	Total Complaints	2
Q3 – 2013	Total Complaints	3
Q4 – 2013	Total Complaints	3

Total Complaints for 2013 was 10.

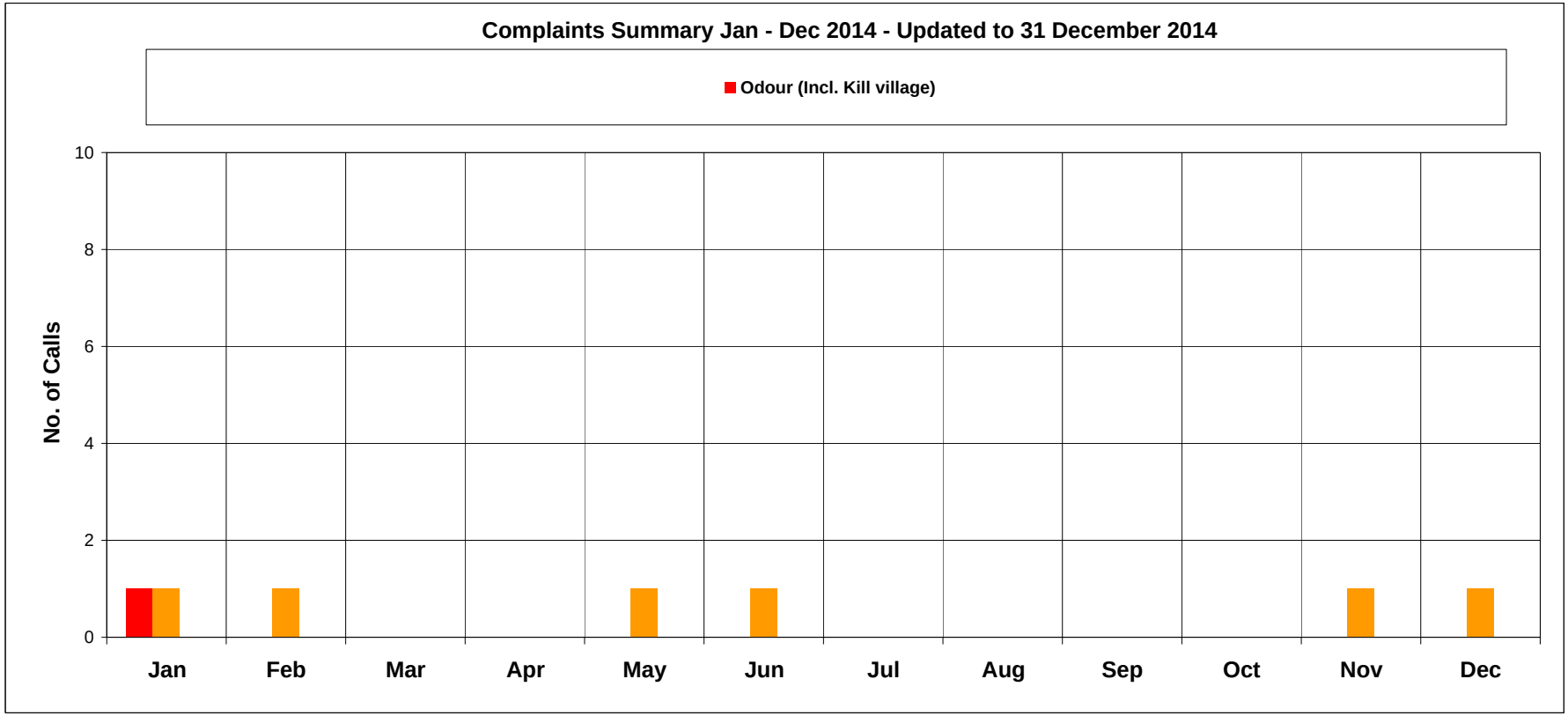
Q1 – 2014	Total Complaints	3
Q2 – 2014	Total Complaints	2
Q3 – 2014	Total Complaints	0
Q4 – 2014	Total Complaints	2

Total Complaints for 2014 was 7.

The complaints have reduced further by 30% compared to the previous year.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Odour (Incl. Kill village)	1	0	0	0	0	0	0	0	0	0	0	0	1
Odour (Kill Village only)	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise (Anywhere)	0	0	0	0	0	0	0	0	0	0	0	0	0
Traffic (Anywhere)	1	1	0	0	1	1	0	0	0	0	1	1	6
Callers	2	1	0	0	1	1	0	0	0	0	1	1	7
Max Calls from 1 Caller	1	1	0	0	1	1	0	0	0	0	1	1	6
Callers on Max	2	1	0	0	1	1	0	0	0	0	1	1	7
Monthly Total Calls	**2**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**7**
Most Frequent Callers													

Updated by M.Heffernan



2.15. Landfill Gas Emissions

Approximately 35,040,000 m^3 of landfill gas was utilised by the gas extraction system in 2014. **(based on an average of 4,000 m^3 per hour)*
From July 2009 onwards all gas captured was sent to the utilisation plant.
During 2014 all gas is now being 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 2014 was 36,884,211 m^3.**

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

- Electricity production from landfill gas in 5 no. engines at the Bioverda compound (Approx. 5 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 4,000 m3 per hour.
All gas is now being extracted by the utilisation plant. The 4 no enclosed flares are currently on stand by.

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 2014.

2.16 Estimated Emissions from the Landfill Gas Generation Plant.

In summary, 27,643 kg / year of methane and 22,880,609 kg / year of CO_2 were produced at Arthurstown Landfill during 2014. (as per PRTR Table produced by Odour Monitoring Ireland Ltd. (as per Table 1.)

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.

Table 4.2 Estimated Electricity Production at Arthurstown Landfill from Landfill Gas.

During 2014 the amount of electricity produced at Arthurstown Landfill by converting the landfill gas via the 5 gas engines is outlined as follows:

Month 2014	MW per month
January	3,956
February	3,380
March	4,078
April	4,027
May	4,149
June	3,881
July	3,979
August	3,921
September	3,732
October	3,839
November	3,658
December	3,650
Total 2014 MW produced	**46,249 MW h**

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 2014.

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	1,091	20	1,959	-	123	9	2,064,790
Flare 2	1,140	19	2,105	-	178	9	2,042,753
AR02	6,670	24,205	12,662	270	429	6,636	4,226,237
AR05	5,453	24,216	10,882	214	294	5,377	4,209,728
AR06	4,615	18,350	10,710	196	357	5,718	3,836,062
AR07	6,131	20,062	10,511	143	199	5,131	3,411,810
AR08	4,525	14,834	6,551	160	243	4,763	3,089,229
Totals	**29,624**	**101,706**	**55,379**	**984**	**1,823**	**27,643**	**22,880,609**

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).

2.17. 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.

Table 0.2 Calculation of Direct and Indirect Emissions to Groundwater

Location	Direction	Relative Position	Summary of Results since March 1999 - Dec 2014				
			Ammonia (mg/l)		Chloride (mg/l)	Conductivity (uS/cm)	
			Max	Avg	Avg	Max	Avg
MW3	260 M NE	US	2.45 (April'04)	0.13	19.27	913 (May'07)	669
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)	0.04	14.1	716 (Nov '10)	636
MW20	150 m S	US	1.7 (Feb '03)	0.03	22.2	2815 (Nov '09)	1421
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)**	4.3	219 (July '13)	2363 (Nov'10)	1460
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	542	542
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	16	591 (Q3 2014)	591
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	13.4	992 (Nov'08)	657
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 no increases in levels during 2014.

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 2014.

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

Absorptive Capacity of Waste

Due to the nature of baled waste, cells with new waste will have a lower absorptive capacity. This increases with the age of the waste and as the waste is in contact with moisture for longer periods. An absorptive capacity of 15% of the traditional value of 0.07 m^3/t has been assumed.

The volume of leachate tankered off-site and discharged to sewer in 2014 was 25,119 m3.
Results of the water balance calculation estimate that a theoretical figure of approximately 22,960 m3 of leachate was produced during 2014.
Therefore for the first time at Arthurstown the leachate leaving the site by tanker and sewer has exceeded the theoretical figure of leachate produced. This is due to the progression of the final capping works. This figure should improve even further next year as the entire landfill footprint is now capped.

The pumping of the leachate from each cell will continue during 2014. 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.

A summary of the calculation is shown overleaf in Table 5.1.

Table 5.1 Water Balance Calculation Summary 2014.

Month	Rainfall	Evaporation	Effective Rainfall	Waste Input	Active Area	Intermediate Area (temporarily capped)	Fully Capped Area	Total Predicted Leachate	Cumulative Predicted Leachate	Actual leachate removed off site	Actual SW/GW discharged to river
		(mm)	(mm)	(tonnes)	(m2)	(m2)	(m2)	(m3)	(m3)	(m3)	(m3)
Jan 14	97.10	21.1	76.0	0	0	0	290,000	0	0	5,901.89	
Feb 14	106.10	32.1	74.0	0	0	0	290,000	0	0	2,555.35	
Mar 14	58.8	49.9	8.9	0	0	0	290,000	0	0	2,872.41	
Apr 14	35.6	82.2	-46.6	0	0	0	290,000	0	0	1,345.64	
May 14	124.20	93.5	30.7	0	0	0	290,000	0	0	1,088.79	
June 14	45.0	118.4	-73.4	0	0	0	290,000	0	0	2,773.96	
Jul 14	40.2	121.9	-81.7	0	0	0	290,000	0	0	1,824.95	
Aug 14	111.80	98.8	13.0	0	0	0	290,000	0	0	1,641.16	
Sept 14	6.6	61.5	-54.9	0	0		290,000	0	0	1,329.89	
Oct 14	115.20	44.1	71.1	0	0	0	290,000	0	0	938.35	
Nov 14	133.50	17.5	116.0	0	0	0	290,000	0	0	2,079.18	
Dec 14	76.8	17.0	59.8	0	0	0	290,000	0	0	766.95	
Total	**950.90**	**758.0**	**192.9**	0	0	0		**0**	**0**	**25,118.51**	

3. FACILITY DEVELOPMENT

3.1. Site Survey

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

3.2. Developments Undertaken in 2014.

3.2.1. Bioverda Power Systems Utilisation Plant

The plant is now extracting on average 4,500 m3 of gas per hour.
No further works were carried out during 2014 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.

3.2.2. Staff reductions during 2014

It was with great sadness that we said farewell to our colleague Mr. Senan Fitzgerald who was our Assistant site foreman since the facility opened.
Senan passed away during 2014 after a short illness.
He is greatly missed by all of us here on site. May he rest in peace.

3.3. Developments Proposed for 2015.

3.3.1. 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

3.3.2. Completed Cells

Cells 1-15 are now fully capped and restored.

The landfill is now in the restoration and aftercare phase.

3.3.3. Restoration

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

Landscaping and fencing continued during 2014 due to the wettest winter on record, these works had to be postponed.

All works were completed during 2014 with the exception of areas to the rear of the facility which still need to be top-soiled and seeded.
Some fencing may still need to be undertaken over the coming years.

4. ENVIRONMENTAL OBJECTIVES AND TARGETS

4.1. Objectives and Targets

The list of objectives and targets for 2015 will be submitted as part of the EMP revision which will be submitted in the coming weeks.

5. FACILITY MANAGEMENT

5.1. 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.

5.2. 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 2015 of all tanks, pipelines and bunds.

5.3. Reported Incidents

5.3.1. Reported Incidents

A summary of reported incidents during 2014 is shown as per table below.
Incidents are defined by Condition 1.6 of the current waste licence (W0004-04).

There were 23 incidences reported to the EPA in 2014.

	Incident Date	Cause	Mitigation Measure
Gas borehole trigger levels	290114	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 290114 (submitted to Agency)
	270214	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 270214 (submitted to Agency)
	280314	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 280314 (submitted to Agency)
	300414	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 300414 (submitted to Agency)
	300514	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 300514 (submitted to Agency)
	300614	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 300614 (submitted to Agency)
	160714	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 160714 (submitted to Agency)
	010914	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 010914 (submitted to Agency)
	011014	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 011014 (submitted to Agency)
	041114	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 041114 (submitted to Agency)
	281114	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 281114 (submitted to Agency)
	111214	Elevated trigger levels in Perimeter Gas Boreholes	See Report dated 111214 (submitted to Agency)
Leachate Sump Levels	280314	Breach of the 1m limit in the Leachate cells.	See Report dated 280314 (submitted to Agency)
	040414	Breach of the 1m limit in the Leachate cells.	See Report dated 040414 (submitted to Agency)
	240414	Breach of the 1m limit in the Leachate cells.	See Report dated 240414 (submitted to Agency)
	090514	Breach of the 1m limit in the Leachate cells.	See Report dated 090514 (submitted to Agency)
	260514	Breach of the 1m limit in the Leachate cells.	See Report dated 260514 (submitted to Agency)
	170614	Breach of the 1m limit in the Leachate cells.	See Report dated 170614 (submitted to Agency)

	150714	Breach of the 1m limit in the Leachate cells.	See Report dated 150714 (submitted to Agency)
	020914	Breach of the 1m limit in the Leachate cells.	See Report dated 020914 (submitted to Agency)
	171014	Breach of the 1m limit in the Leachate cells.	See Report dated 171014 (submitted to Agency)
	041114	Breach of the 1m limit in the Leachate cells.	See Report dated 041114 (submitted to Agency)
Surface VOC Emissions	140414	Quarterly Surface VOC Emissions Monitoring: Breach in emission levels.	See Report dated 140414 (submitted to Agency)

5.4. Review of Nuisance Controls

The review of litter, birds and vermin no longer takes place since the facility is now final capped for over a year 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.

5.5. Report on Staff Training

The following training courses/seminars were attended by the staff at Arthurstown Landfill during 2014.

Table 5.1 Staff Training Log 2014.

Training Course /Seminar	Staff Attendees
Confined Space – Medium Level	John Smith
Confined Space – Medium Level	Mark Heffernan
FAS SafePass	John Smith
FAS SafePass	Mark Heffernan
FAS SafePass	Edward Comerfod
Aggression Training	John Smith
Aggression Training	Mark Heffernan
Aggression Training	Edward Comerford

5.6. Non-Compliances at Arthurstown Landfill during 2014.

During 2014 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

Table 5.3 Non-Compliance Log for 2014.

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

The non compliance during 2014 was as a result of an incident of leachate levels in sumps on the day of an E.P.A. audit inspection carried out 7th March 2014 and report dated 18th March 2014.

Total number of non compliances for 2014 is 1.

5.7. 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 2014 were in the region of € 1.1 m.
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 €10.2 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. During 2014 there were numerous visits conducted at the facility for interested parties including schools and university groups, local and other international visitors.
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.
A site DVD is now complete since March 2003. This 12 minute short film describes the site from the landfill construction and operational perspectives. It is used during site visits to present visitors with a clear understanding of the nature of the site activities. The site has also featured in televised waste management documentaries as being the most state of the art and well managed landfill to date in Ireland.

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 2014 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.

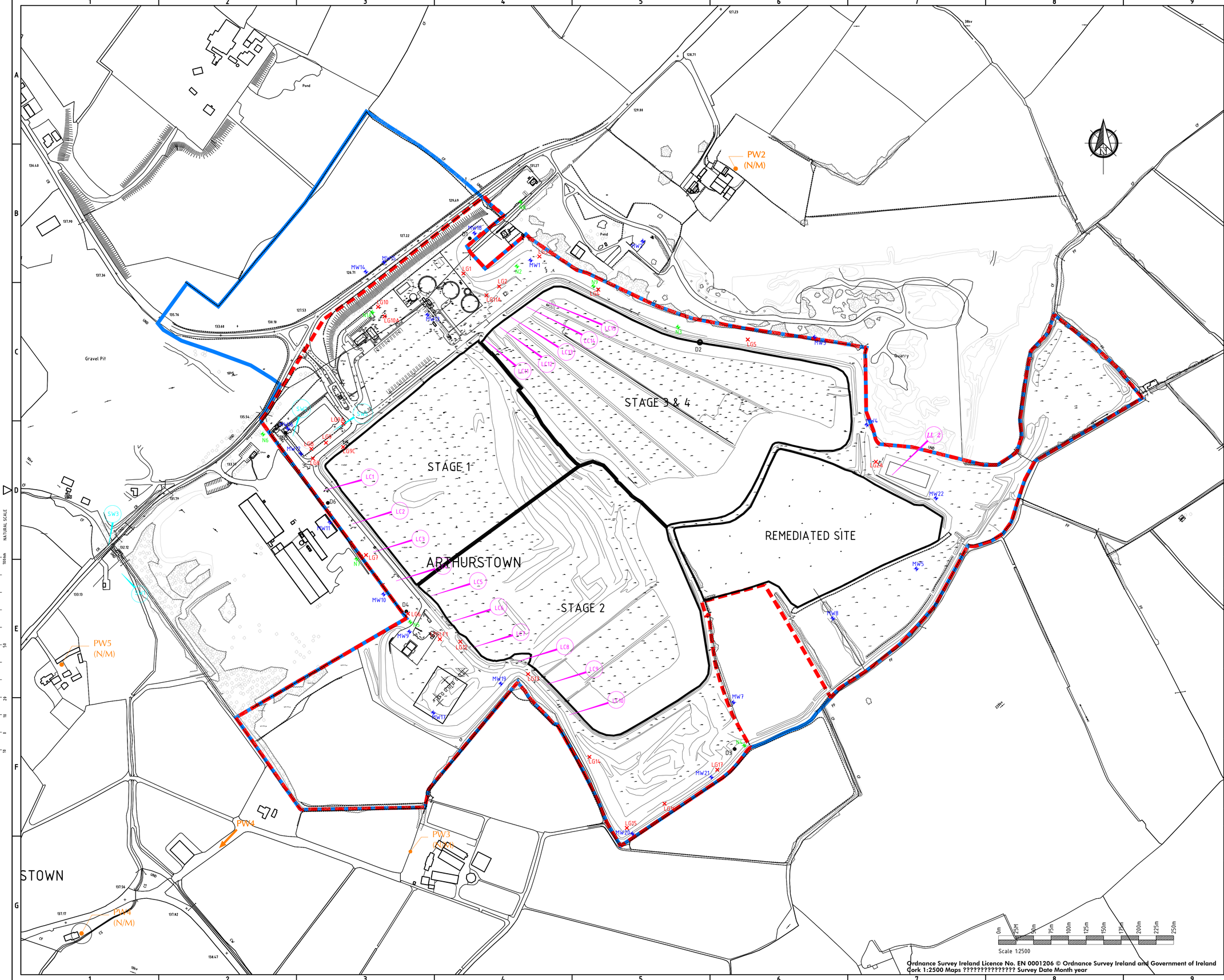
5.8. Local Environmental Project Funding

There was no local environmental funding during 2014.

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

APPENDIX 3.1

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.	Rev.
2006-054-03-FIG2.4	A

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Scale 1:2500

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APPENDIX 3.2

Landfill Gas Charts and Tables (Perimeter monitoring wells and Audit Sheet for Landfill Gas Wells)

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Jan-14**
Address :	**Kill, Co. Kildare.**	Date :	**29th January 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 12:30hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**996 mb**	Next Calibration :	**Mar-14**

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	**1.8**	16.0	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	0.8	15.0	
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	**3.2**	12.0	
LG7	BH	6.00	0.0	0	0.0	20.8	
LG8	BH	7.00	0.0	0	**2.0**	17.8	
LG9	BH	7.00	**0.8**	**16**	0.8	15.0	
LG9A	BH	7.40	0.0	0	**1.0**	14.0	
LG9B	BH	5.80	0.0	0	0.0	20.8	
LG9C	BH	7.00	0.0	0	0.0	19.0	
LG10	BH	5.60	**15.5**	**310**	**2.8**	2.0	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	0.0	19.0	
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	**2.2**	16.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	**1.8**	15.0	
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	0.8	20.0	

Note : Bold type denotes attainment or excedence 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 15.5/ 5 x 100 = 310

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Feb-14**
Address :	**Kill, Co. Kildare.**	Date :	**27th February 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 12:30hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1003 mb**	Next Calibration :	**Mar-14**

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**	17.0	
LG2	BH	7.90	0.0	0	0.0	20.9	
LG2A	BH	4.40	0.0	0	0.8	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	**2.8**	14.0	
LG7	BH	6.00	0.0	0	0.0	20.9	
LG8	BH	7.00	0.0	0	**2.2**	18.0	
LG9	BH	7.00	**1.4**	**28**	1.0	12.0	
LG9A	BH	7.40	0.0	0	**2.0**	14.0	
LG9B	BH	5.80	0.0	0	0.0	20.9	
LG9C	BH	7.00	0.0	0	0.0	20.0	
LG10	BH	5.60	**12.5**	**250**	**3.2**	3.0	Located in Old Percolation Area.
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	**1.8**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	**2.8**	14.0	
LG16	BH	9.32	0.0	0	0.8	19.0	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	1.0	19.8	

Note : Bold type denotes attainment or excedence 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 12.5/ 5 x 100 = 250 Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Mar-14**
Address :	**Kill, Co. Kildare.**	Date :	**27th March 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 12:30hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1016 mb**	Next Calibration :	**Mar-14**

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	18.0	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	0.0	19.0	
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	**2.0**	14.0	
LG7	BH	6.00	0.0	0	0.0	20.8	
LG8	BH	7.00	0.0	0	**1.8**	18.0	
LG9	BH	7.00	0.8	16	**2.0**	11.0	
LG9A	BH	7.40	0.0	0	**3.2**	10.5	
LG9B	BH	5.80	0.0	0	0.0	20.8	
LG9C	BH	7.00	0.0	0	0.0	20.2	
LG10	BH	5.60	**14.5**	**290**	**4.2**	2.0	Located in Old Percolation Area.
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	20.8	
LG13	BH	13.05	0.0	0	**2.2**	15.5	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	**2.0**	15.5	
LG16	BH	9.32	0.0	0	**1.8**	16.5	
LG17	BH	8.15	0.0	0	0.0	20.5	
LG18	BH	4.42	0.0	0	**2.0**	18.0	

Note : Bold type denotes attainment or excedence 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 14.5/ 5 x 100 = 290 Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Apr-14**
Address :	**Kill, Co. Kildare.**	Date :	**30th April 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 12:30hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1008 mb**	Next Calibration :	**Oct-14**

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	16.5	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	1.0	18.0	
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	**2.2**	12.5	
LG7	BH	6.00	0.0	0	0.0	20.8	
LG8	BH	7.00	0.0	0	1.2	19.0	
LG9	BH	7.00	**2.2**	**44**	**1.8**	8.0	
LG9A	BH	7.40	0.0	0	**2.8**	12.0	
LG9B	BH	5.80	0.0	0	0.0	20.8	
LG9C	BH	7.00	0.0	0	0.0	20.6	
LG10	BH	5.60	**13.8**	**276**	**3.5**	1.5	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	0.0	18.0	
LG11A	BH	7.10					UTM (Obstructed)
LG11B	BH	4.63					UTM (Obstructed)
LG12	BH	11.12	0.0	0	0.0	20.8	
LG13	BH	13.05	0.0	0	**1.8**	17.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	0.0	17.5	
LG16	BH	9.32	0.0	0	**2.0**	15.5	
LG17	BH	8.15	0.0	0	0.0	20.8	
LG18	BH	4.42	0.0	0	**1.8**	17.5	

Note : Bold type denotes attainment or excedence 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 13.8/ 5 x 100 = 276

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**May-14**
Address :	**Kill, Co. Kildare.**	Date :	**30th May 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 13:00hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1024 mb**	Next Calibration :	**Oct-14**

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	18.0	
LG2	BH	7.90	0.0	0	0.0	20.9	
LG2A	BH	4.40	0.0	0	**2.2**	18.0	
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	**2.6**	12.0	
LG7	BH	6.00	0.0	0	0.0	20.9	
LG8	BH	7.00	0.0	0	**1.8**	18.0	
LG9	BH	7.00	**2.0**	**40**	**1.6**	12.5	
LG9A	BH	7.40	0.0	0	0.0	18.0	
LG9B	BH	5.80	0.0	0	0.0	20.9	
LG9C	BH	7.00	0.0	0	0.0	20.9	
LG10	BH	5.60	**18.5**	**370**	**6.8**	2.0	Located in Old Percolation Area.
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	**2.8**	15.5	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.2	18.0	
LG16	BH	9.32	0.0	0	**2.2**	14.0	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	**2.0**	18.0	

Note : Bold type denotes attainment or excedence 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 18.5/ 5 x 100 = 370 Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Jun-14**
Address :	**Kill, Co. Kildare.**	Date :	**30th June 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 14:00hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1015 mb**	Next Calibration :	**Oct-14**

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	19.0	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	**1.8**	19.0	
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	20.9	
LG6	BH	7.00	0.0	0	**2.2**	14.0	
LG7	BH	6.00	0.0	0	0.0	20.8	
LG8	BH	7.00	0.0	0	**1.8**	18.0	
LG9	BH	7.00	**2.2**	**44**	**1.8**	9.0	
LG9A	BH	7.40	0.0	0	0.0	19.0	
LG9B	BH	5.80	0.0	0	0.0	20.8	
LG9C	BH	7.00	0.0	0	0.0	20.9	
LG10	BH	5.60	**20.2**	**404**	**4.4**	2.8	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	0.0	19.0	
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	**2.2**	16.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.0	19.0	
LG16	BH	9.32	0.0	0	**2.0**	17.0	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	**1.0**	19.5	

Note : Bold type denotes attainment or excedence 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 20.2/ 5 x 100 = 404

Facility Manager

Date :-

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Jul-14**
Address :	**Kill, Co. Kildare.**	Date :	**16th July 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 14:00hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1014 mb**	Next Calibration :	**Oct-14**

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	19.0	
LG2	BH	7.90	0.0	0	0.0	20.9	
LG2A	BH	4.40	0.0	0	1.3	19.2	
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	**1.8**	16.0	
LG7	BH	6.00	0.0	0	1.4	20.0	
LG8	BH	7.00	0.0	0	**1.6**	19.0	
LG9	BH	7.00	**2.8**	**56**	**2.0**	7.0	
LG9A	BH	7.40	0.0	0	0.0	18.0	
LG9B	BH	5.80	0.0	0	0.0	20.8	
LG9C	BH	7.00	0.0	0	0.0	20.9	
LG10	BH	5.60	**22.0**	**440**	**6.2**	1.0	Located in Old Percolation Area.
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	**2.0**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.2	18.0	
LG16	BH	9.32	0.0	0	1.0	18.0	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	1.3	19.0	

Note : Bold type denotes attainment or excedence 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 22/ 5 x 100 = 440

Signed :- P.M. Heffernan Facility Manager

Date :- 16/7/2014

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Aug-14**
Address :	**Kill, Co. Kildare.**	Date :	**01st Sept 2014**
Licensee :	**South Dublin County Council**	Time :	**11:00hrs - 14:00hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1020 mb**	Next Calibration :	**Oct-14**

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	**2.0**	18.0	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	**2.2**	17.5	
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**	18.0	
LG7	BH	6.00	0.0	0	1.2	19.0	
LG8	BH	7.00	0.0	0	**1.8**	18.5	
LG9	BH	7.00	**3.0**	**60**	**2.0**	5.5	
LG9A	BH	7.40	0.0	0	0.0	19.0	
LG9B	BH	5.80	0.0	0	0.0	20.8	
LG9C	BH	7.00	0.0	0	0.0	20.8	
LG10	BH	5.60	**20.5**	**410**	**4.5**	1.0	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	0.0	20.8	
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	**2.2**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	**2.8**	15.0	
LG16	BH	9.32	0.0	0	1.2	19.0	
LG17	BH	8.15	0.0	0	0.0	20.8	
LG18	BH	4.42	0.0	0	**1.8**	18.0	

Note : Bold type denotes attainment or excedence 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 20.5/ 5 x 100 = 410

Signed :- pp M. Heffernan
Facility Manager

Date :- 2/Sept/2014

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Sep-14**
Address :	**Kill, Co. Kildare.**	Date :	**01st Oct 2014**
Licensee :	**South Dublin County Council**	Time :	**10:45hrs - 12:00hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**1025 mb**	Next Calibration :	**Oct-14**

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**	19.0	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	**1.8**	18.0	
LG3	BH	9.30					UTM (Obstructed)
LG4	BH	6.50	0.0	0	0.4	20.8	
LG5	BH	5.70	0.0	0	0.8	20.8	
LG6	BH	7.00	0.0	0	**2.2**	18.0	
LG7	BH	6.00	0.0	0	0.8	20.0	
LG8	BH	7.00	0.0	0	**1.8**	18.0	
LG9	BH	7.00	**1.8**	**36**	**1.5**	8.0	
LG9A	BH	7.40	0.0	0	0.0	20.0	
LG9B	BH	5.80	0.0	0	0.0	20.8	
LG9C	BH	7.00	0.0	0	0.0	20.4	
LG10	BH	5.60	**14.1**	**282**	**2.0**	0.1	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	0.5	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	1.4	19.0	
LG16	BH	9.32	0.0	0	1.2	19.0	
LG17	BH	8.15	0.0	0	0.0	20.8	
LG18	BH	4.42	0.0	0	**1.5**	19.0	

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Oct-14**
Address :	**Kill, Co. Kildare.**	Date :	**4th Nov 2014**
Licensee :	**South Dublin County Council**	Time :	**11:30hrs - 12:30hrs**
Licence Reg.:	**W0004-004**	Personnel :	**M.Heffernan**
Site Status :	**Closed: Aftercare Phase**	Instrument :	**GA 2000**
Atmospheric Pressure :	**995 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	**1.8**	18.5	
LG2	BH	7.90	0.0	0	0.0	20.9	
LG2A	BH	4.40	0.0	0	**2.2**	17.0	
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	**1.6**	19.0	
LG7	BH	6.00	0.0	0	0.0	20.8	
LG8	BH	7.00	0.0	0	**2.0**	16.0	
LG9	BH	7.00	**2.1**	**42**	**1.8**	5.0	
LG9A	BH	7.40	0.0	0	0.0	20.8	
LG9B	BH	5.80	0.0	0	0.0	20.9	
LG9C	BH	7.00	0.0	0	0.0	20.6	
LG10	BH	5.60	**18.2**	**364**	**2.8**	1.8	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	0.5	18.0	
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	**2.0**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.0	20.2	
LG16	BH	9.32	0.0	0	0.8	20.0	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	**1.8**	19.8	

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Nov-14**
Address :	**Kill, Co. Kildare.**	Date :	**28th Nov 2014**
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 :	**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	**1.5**	19.0	
LG2	BH	7.90	0.0	0	0.0	20.8	
LG2A	BH	4.40	0.0	0	**2.0**	18.0	
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	**2.8**	15.0	
LG9	BH	7.00	**2.8**	**56**	**2.0**	2.0	
LG9A	BH	7.40	0.0	0	0.0	20.9	
LG9B	BH	5.80	0.0	0	0.0	20.9	
LG9C	BH	7.00	0.0	0	0.0	19.8	
LG10	BH	5.60	**22.8**	**456**	**3.0**	1.0	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	1.0	17.0	
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	**2.2**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.2	19.0	
LG16	BH	9.32	0.0	0	0.8	20.8	
LG17	BH	8.15	0.0	0	0.0	20.8	
LG18	BH	4.42	0.0	0	**1.5**	19.0	

MONTHLY MONITORING OF PERMIETER GAS BOREHOLES

Site Name :	**Arthurstown Landfill**	Period :	**Dec-14**
Address :	**Kill, Co. Kildare.**	Date :	**11th Dec 2014**
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 :	**1006 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	**2.0**	18.0	
LG2	BH	7.90	0.0	0	0.0	20.9	
LG2A	BH	4.40	0.0	0	**2.2**	18.0	
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	**2.0**	18.0	
LG7	BH	6.00	0.0	0	0.0	20.9	
LG8	BH	7.00	0.0	0	**1.5**	18.0	
LG9	BH	7.00	0.8	16	**2.0**	5.5	
LG9A	BH	7.40	0.0	0	0.0	20.9	
LG9B	BH	5.80	**1.2**	**24**	0.4	18.0	
LG9C	BH	7.00	0.0	0	0.0	18.0	
LG10	BH	5.60	**20.5**	**410**	**4.5**	2.0	Located in Old Percolation Area.
LG10A	BH	0.00	0.0	0	1.2	16.0	
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	**2.0**	18.0	
LG14	BH	8.55					UTM (Flooded)
LG15	BH	9.34	0.0	0	1.4	18.0	
LG16	BH	9.32	0.0	0	0.8	20.2	
LG17	BH	8.15	0.0	0	0.0	20.9	
LG18	BH	4.42	0.0	0	**2.2**	16.0	

APPENDIX 3.3

Dust Charts and Tables

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	SampleDate 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	Comment	Dust Deposition
Units			**mg/m2/day**
D1	02/05/14		87
D2	02/05/14		68
D3	02/05/14		31
D4	02/05/14		98
D5	02/05/14		84
D6	02/05/14	Jar Broken	0

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 Date: 07/05/2014

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

Dust Template "For Reporting"

Sampler	**Odour Monitoring Ireland**
Sampling Purpose	**Dust**
Period	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	SampleDate 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	Comment	Dust Deposition
Units			**mg/m2/day**
D1	02/12/14		93
D2	02/12/14		69
D3	02/12/14		35
D4	02/12/14		95
D5	02/12/14		78
D6	02/12/14		95

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	SampleDate 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	Comment	Dust Deposition
Units			**mg/m2/day**
D1	19/06/14		91
D2	19/06/14		70
D3	19/06/14		33
D4	19/06/14		94
D5	19/06/14		80
D6	19/06/14		71

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 Date: 08/07/2014

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

APPENDIX 3.4

Noise Charts and Tables

TABLE 4.1: BOUNDARY NOISE MEASUREMENT RESULTS (DAY TIME)									
Location No.	Duration (min)	Date	Start Time	LA_{eq} dB(A)	L_{A10} dB(A)	L_{A90} dB(A)	L_{AFMax} dB(A)	Tonal Noise	Comments / Site Observations Summary
N1A	30min each	04/03/2015	09:34	49	52	44	63	X	**Site:** No audible noise detected from Arthurstown landfill at this location. **Off-Site:** Passing traffic on the adjacent Kilteel road – Dominant - LAFMAX. Continuous humming from operations at the neighbouring timber processing plant on the western boundary i.e fans, motors and machinery. Distant Machinery operating north of the landfill on the Kill road. Birds singing.
			15:11	48	41	43	65	X	
		10/03/2015	17:15	48	50	43	62	X	
N-2	30min each	04/03/2015	09:09	50	51	47	68	X	**Site:** Car on access road around the site (approx 4 m from noise meter) - LAFMAX in round 2 **Off-Site:** Distant traffic on the adjacent Kilteel road on northern boundary. Low hum of machinery operating in quarry on the north eastern boundary with intermittent reversing alarms. Continuous humming from operations at the neighbouring timber processing plant on the western boundary i.e fans, motors and intermittent reversing alarms - Dominant noise source Crows overhead.
			14:37	47	48	43	75	X	
		05/03/2015	11:26	46	48	42	67	X	
N-3	30min each	27/02/2015	13:40	45	48	41	69	X	**Site:** No audible noise detected from Arthurstown landfill at this location. **Off-Site:** Distant traffic on roads to the north. Machinery operating in quarry on north eastern boundary with intermittent reversing alarms and banging of steel on-occasion - Dominant noise source. Birds singing and sounds of jet engine/plane over head – LAFMAX during round 3
		04/03/2015	12:30	48	51	37	72	X	
		05/03/2015	10:25	51	50	44	75	X	
N-4	30min each	04/03/2015	11:59	41	42	37	67	X	**Site:** Distant hum from gas utilisation plant on south western boundary **Off-Site:** Machinery operating in quarry on north eastern boundary with intermittent reversing alarms. Birds singing. Faint humming from operations at the neighbouring timber processing plant on western boundary. Birds singing and sounds of jet engine/plane over head – LAFMAX.
			17:08	40	41	34	68	X	
		10/03/2015	13:34	41	44	30	63	X	
N5	30min each	04/03/2015	11:20	61	63	59	70	Yes @ 315Hz	plant. **Off-Site:** Continuous humming from operations at the neighbouring timber processing plant on the western boundary i.e fans, motors and machinery operating -Dominant noise source contributing to exceedance of 55 dB(A) limit Birds singing.
			16:29	57	58	55	68	X	
		10/03/2015	16:07	57	58	54	66	X	
N-6	30min each	04/03/2015	10:08	51	52	49	66	X	**Site:** Water flowing from lagoon – Continuous. **Off-Site:** Continuous humming from operations at the neighbouring timber processing plant on the western boundary i.e fans, motors and intermittent reversing alarms -Dominant noise source Traffic on the adjacent Kilteel road on northern boundary.
			15:52	52	54	51	68	X	
		10/03/2015	16:39	52	53	51	63	X	
N-9	30min each	27/02/2015	14:08	48	51	41	74	X	**Off-Site:** Crows overhead – Dominant noise source Distant traffic on the adjacent Kilteel road on northern boundary. Machinery operating in quarry on the north eastern boundary with intermittent reversing alarms. Jet engine/plane over head - LAFMAX during round 1
		04/03/2015	14:10	44	46	39	66	X	
		05/03/2015	10:52	45	47	41	64	X	

TABLE 4.2: BOUNDARY NOISE MEASUREMENT RESULTS (NIGHT TIME)									
Location No.	**Duration (min)**	**Date**	**Start Time**	**LA_{eq} dB(A)**	**L_{A10} dB(A)**	**L_{A90} dB(A)**	**L_{AFMax} dB(A)**	**Tonal Noise**	**Comments / Site Observations Summary**
N1A	15 min each	04/03/2015	22:51	44	46	42	63	*X*	**Site**: No audible noise detected from Arthurstown landfill. **Off-Site:** Distant traffic on motorway north of the landfill – LAFMAX. Traffic on adjacent Kilteel road. Humming from fan/motors in neighbouring timber processing plant on the western boundary Dominant noise source
		05/03/2015	00:57	42	44	40	64	*X*	
N-2	15 min each	04/03/2015	22:32	42	44	40	52	*X*	**Site:** No audible noise detected from Arthurstown landfill. **Off-Site:** Distant traffic on motorway north of the landfill. Humming from fan/motors and intermittent reversing alarms in neighbouring timber processing plant on the western boundary. Dominant noise source. Dogs barking in nearby dwelling – LAFMAX.
		05/03/2015	00:36	44	45	41	68	*X*	
N-3	15 min each	04/03/2015	22:00	40	41	38	59	*X*	Site: Water trickling from landfill pipe to stream. Off-Site: Distant traffic on roads.
		05/03/2015	00:03	39	41	38	47	*X*	
N-4	15 min each	04/03/2015	23:46	42	43	37	68	*X*	**Site:** No audible noise. **Off-Site:** No audible noise. Gusts of wind increasing average LAeq
		05/03/2015	01:50	40	43	35	54	*X*	
N-5	15 min each	04/03/2015	23:28	**53**	54	52	70	*X*	**Site:** Humming from gas utilisation plant (60m away) – Continuous. **Off-Site**: Humming from fan/motors in neighbouring timber processing plant on the western boundary Dominant noise source
		05/03/2015	01:32	**53**	55	52	57	*X*	
N-6	15 min each	04/03/2015	23:10	**49**	50	48	68	*X*	**Site:** Water flowing from Lagoon. **Off-Site:** Humming from fan/motors in neighbouring timber processing plant on the western boundary Dominant noise source. Distance traffic on adjacent Kilteel road.
		05/03/2015	01:15	**48**	49	47	67	*X*	
N-9	15 min each	04/03/2015	22:10	40	41	38	62	*X*	**Site:** No audible noise detected from Arthurstown landfill. **Off-Site:** Humming from fan/motors in neighbouring timber processing plant on the western boundary Dominant noise source. Distance traffic on adjacent Kilteel road.
		05/03/2015	00:20	39	41	37	46	*X*	

APPENDIX 3.5

Surface Water Charts and Tables

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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: Mr. Eamonn Lee
Environmental Consultant

Reviewed by: Mr. Peter Coogan
Environmental Team Leader

Report No: ECS4972-SW

Monitoring Date: 28th July 2014 (Annual)

Report Date: 9th October 2014

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 two Environmental Scientists from ANUA Environmental on the 28th of July 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)"*, the *European Communities "Quality of Surface Water Intended for the Abstraction of Drinking Water Regulations, 1989 (S.I. No. 294 of 1989)"* and the *European Communities "Quality of Salmonid Waters Regulations, 1988 (S.I. No. 293 of 1988)".*

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

The Conductivity (665→1032µs/cm), Ammonia (0.04→0.14mg/l) and Nitrite (0.02→0.1mg/l) display increases from the Retention Pond Inlet to the Retention Pond Outlet and exceed their respective water quality standard limits. The Manganese concentration is considerable higher at the Outlet (209µg/l) compared to the Inlet (7 µg/l) and exceeds its respective water quality standard limit of 50 µg/l.

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. 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) / excellent (using the LQI interpretation of water quality) upstream and downstream of the landfill.

Kill River (SW-4)

The following parameters demonstrated an increase in concentration compared to the previous quarterly monitoring event; Ammonia (0.02→0.14mg/l), Orthophosphate (0.02→0.04mg/l) and Nitrite (<0.02→0.05mg/l). These parameters exceed their respective limits values for '*Good Status'* water quality. All remaining parameters analysed were found to be within their respective limits and similar to the previous monitoring event.

The results of this biological survey indicate that the quality of water in the Kill River is moderate (using the Q-value system) / excellent (using the LQI interpretation of water quality.

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

Respectively Submitted,

Ms. Eamonn Lee
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 and Kill Rivers is required on an annual basis. ANUA Environmental was commissioned to perform the quarterly and annual assessments.

Environmental Scientists from ANUA Environmental visited the five surface water monitoring locations on the 29th of July 2014 to conduct the third quarterly / annual sampling event of 2014. 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 Athurstown 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 5667-3-2004	*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 ANUA 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, SW-3 and SW-4 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 metre 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.

TABLE 2.3: CHEMICAL AND MICROBIOLOGICAL ANALYSIS OF SAMPLES			
Parameter	**Limit of**	**Method**	
Visual Inspection	-	On-Site Visual Determination	-
Odour	-	On-Site Sensory Determination	-
pH (pH units)	0.1 – 14	G/05	✓ (INAB)
Temperature (°C)	-	*In-Situ* Calibrated Thermometer	-
Dissolved Oxygen	-	*In-Situ* Dissolved Oxygen Probe	-
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, 21st Edition, 2005.

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

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

X – None Accredited Test Method

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%

3.3 BMWP System

The Biological Monitoring Working Party (BMWP) system was set up in the UK by the Department of the Environment to recommend a biological classification system for use in national river pollution surveys. The system assigns different scores depending on their sensitivity or tolerance to organic pollution (1 for tolerant and up to 12.5 for sensitive). All samples are two minute kick samples as per the EPA Q index. The average score per taxa (ASPT) is calculated which divides the BMWP score by the number of taxa present. A revised BMWP score was subsequently introduced which takes in to consideration the habitat type i.e. riffles, riffles/pools and pools. Table 3.4 overleaf has the complete Revised BMWP score for each family.

Once the BMWP and the ASPT are known, the overall quality rating (OQR) and the Lincoln Quality Index (LQI) and Interpretation are used to better qualify environmental conditions at macrofaunal sampling sites. An integer for *quality rating* is assigned to both the BMWP score (rating X on a scale of 1 to 7) and to the ASPT (Rating Y on a scale of 1 to 7) for each taxon. The Tables used to convert a BMWP score and an ASPT in to X and Y quality ratings are given in Table 3.5 overleaf. An Overall Quality Rating (OQR) is then calculated as the average of the X and Y ratings. The Lincoln Quality Index (LQI, on a scale of A++ to I) and LQI Interpretation (On a scale of Excellent Quality to Very Poor Quality) is then assigned to each OQR.

TABLE 3.4–TABLE OF REVISED BMWP SCORE (WALLEY AND HAWKES, 96-97')						
Common Name	Family	Original BMWP Score	Revised BMWP Score	Habitat Specific Scores		
				Riffles	Riffle/Pools	Pools
Flatworms	Planariidae	5	4.2	4.5	4.1	3.7
	Dendrocoelidae	5	3.1	2.3	4.1	3.1
Snails	Neritidae	6	7.5	6.7	8.1	9.3
	Viviparidae	6	6.3	2.1	4.7	7.1
	Valvatidae	3	2.8	2.5	2.5	3.2
	Hydrobiidae	3	3.9	4.1	3.9	3.7
	Lymnaeidae	3	3.0	3.2	3.1	2.8
	Physidae	3	1.8	0.9	1.5	2.8
	Planorbidae	3	2.9	2.6	2.9	3.1
Limpets and Mussels	Ancylidae	6	5.6	5.5	5.5	6.2
	Unionidae	6	5.2	4.7	4.8	5.5
	Sphaeriidae	3	3.6	3.7	3.7	3.4
Worms	Oligochaeta	1	3.5	3.9	3.2	2.5
Leeches	Piscicolidae	4	5.0	4.5	5.4	5.2
	Glossiphoniidae	3	3.1	3.0	3.3	2.9
	Hirudididae	3	0.0	0.3	-0.3	
	Erpobdellidae	3	2.8	2.8	2.8	2.6
Crustaceans	Asellidae	3	2.1	1.5	2.4	2.7
	Corophiidae	6	6.1	5.4	5.1	6.5
	Gammaridae	6	4.5	4.7	4.3	4.3
	Astacidae	8	9.0	8.8	9.0	11.2
Mayflies	Siphlonuridae	10	11.0	11.0		
	Baetidae	4	5.3	5.5	4.8	5.1
	Heptageniidae	10	9.8	9.7	10.7	13.0
	Leptophlebiidae	10	8.9	8.7	8.9	9.9
	Ephemerellidae	10	7.7	7.6	8.1	9.3
	Potamanthidae	10	7.6	7.6		
	Ephemeridae	10	9.3	9.0	9.2	11.0
	Caenidae	7	7.1	7.2	7.3	6.4
Stoneflies	Taeniopterygidae	10	10.8	10.7	12.1	
	Nemouridae	7	9.1	9.2	8.5	8.8
	Leuctridae	10	9.9	9.8	10.4	11.2
	Capniidae	10	10.0	10.1		
	Perlodidae	10	10.7	10.8	10.7	10.9
	Perlidae	10	12.5	12.5	12.2	
	Chloroperlidae	10	12.4	12.5	12.1	
Damselflies	Platycnemidae	6	5.1	3.6	5.4	5.7
	Coenagriidae	6	3.5	2.6	3.3	3.8
	Lestidae	8	5.4			5.4
	Calopterygidae	8	6.4	6.0	6.1	7.6
Dragonflies	Gomphidae	8				
	Cordulegasteridae	8	8.6	9.5	6.5	7.6
	Aeshnidae	8	6.1	7.0	6.9	5.7
	Corduliidae	8				
	Libellulidae	8	5.0			5.0

TABLE 3.4 – CONTINUED..

Common Name	Family	Original BMWP Score	Revised BMWP Score	Habitat Specific Scores Common Name		
				Riffles	Riffle/Pools	Pools
Bugs	Mesoveliidae *	5	4.7	4.9	4.0	5.1
	Hydrometridae	5	5.3	5.0	6.2	4.9
	Gerridae	5	4.7	4.5	5.0	4.7
	Nepidae	5	4.3	4.1	4.2	4.5
	Naucoridae	5	4.3			4.3
	Aphelocheiridae	10	8.9	8.4	9.5	11.7
	Notonectidae	5	3.8	1.8	3.4	4.4
	Pleidae	5	3.9			3.9
	Corixidae	5	3.7	3.6	3.5	3.9
Beetles	Haliplidae	5	4.0	3.7	4.2	4.3
	Hygrobiidae	5	2.6	5.6	-0.8	2.6
	Dytiscidae	5	4.8	5.2	4.3	4.2
	Gyrinidae	5	7.8	8.1	7.4	6.8
	Hydrophilidae	5	5.1	5.5	4.5	3.9
	Clambidae	5				
	Scirtidae	5	6.5	6.9	6.2	5.8
	Dryopidae	5	6.5	6.5		
	Elmidae	5	6.4	6.5	6.1	6.5
	Chrysomelidae *	5	4.2	4.9	1.1	4.1
	Curculionidae *	5	4.0	4.7	3.1	2.9
Alderflies	Sialidae	4	4.5	4.7	4.7	4.3
Caddisflies	Rhyacophilidae	7	8.3	8.2	8.6	9.6
	Philopotamidae	8	10.6	10.7	9.8	
	Polycentropidae	7	8.6	8.6	8.4	8.7
	Psychomyiidae	8	6.9	6.4	7.4	8.0
	Hydropsychidae	5	6.6	6.6	6.5	7.2
	Hydroptilidae	6	6.7	6.7	6.8	6.5
	Phryganeidae	10	7.0	6.6	5.4	8.0
	Limnephilidae	7	6.9	7.1	6.5	6.6
	Molannidae	10	8.9	7.8	8.1	10.0
	Beraeidae	10	9.0	8.3	7.8	10.0
	Odontoceridae	10	10.9	10.8	11.4	11.7
	Leptoceridae	10	7.8	7.8	7.7	8.1
	Goeridae	10	9.9	9.8	9.6	12.4
	Lepidostomatidae	10	10.4	10.3	10.7	11.6
	Brachycentridae	10	9.4	9.3	9.7	11.0
	Sericostomatidae	10	9.2	9.1	9.3	10.3
True flies	Tipulidae	5	5.5	5.6	5.0	5.1
	Chironomidae	2	3.7	4.1	3.4	2.8
	Simuliidae	5	5.8	5.9	5.1	5.5

TABLE 3.5 – LINCOLN QUALITY INDEX (LQI) INTERPRETATION AND OQR. STANDARD RATING DERIVED FROM BMWP SCORES AND ASPT (EXTENCE ET AL., 1987)			
1. HABITAT RICH RIFFLES			
BMWP Score	**Rating X**	**ASPT**	**Rating Y**
151+	7	6.0+	7
121 - 150	6	5.5 - 5.9	6
91 - 120	5	5.1 – 5.4	5
61 - 90	4	4.6 – 5.0	4
31 - 60	3	3.6 – 4.5	3
15 - 30	2	2.6 – 3.5	2
0 - 14	1	0.0 – 2.5	1
2. HABITAT POOR RIFFLES AND POOLS			
BMWP Score	**Rating X**	**ASPT**	**Rating Y**
121+	7	5.0+	7
101 - 120	6	4.5 – 4.9	6
81 - 100	5	4.1 – 4.4	5
51 – 80	4	3.6 – 4.0	4
25 – 50	3	3.1 – 3.5	3
10 - 24	2	2.1 – 3.0	2
0 - 9	1	0.0 - 2.0	1
3. OVERALL QUALITY RATING (OQR)			
OQR = (X+Y) / 2			
OQR	**LQI Index**	**LQI Interpretation**	
6+	A++	Excellent Quality	
5.5	A+	Excellent Quality	
5	A	Excellent Quality	
4.5	B	Good Quality	
4	C	Good Quality	
3.5	D	Moderate Quality	
3	E	Moderate Quality	
2.5	F	Poor Quality	
2	G	Poor Quality	
1.5	H	Very Poor Quality	
1	I	Very Poor Quality	

4.0 COMMITMENT TO QUALITY

4.1 INAB Accreditation

ANUA 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. ANUA 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 ANUA Environmental, measures are taken to ensure controlled chain of custody. An outline of the chain of custody is given below.

CONTROLLED CHAIN OF CUSTODY

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

5.0 RESULTS

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

Table 5.1: Results of Weather data taken from the nearest Met Éireann station, i.e. Casement.

Table 5.2: Results of Field Measurements taken at each Surface Water Sampling Station

Table 5.3: Results of Chemical Analysis of Surface Water Samples.

Table 5.4: Results of Metal Scan of Surface Water Samples.

Table 5.5 Calculated Biological Quality Rating (Q rating) for Surface Waters.

Table 5.6 Counts of Macroinvertebrates species per sample station with Revised BMWP and ASPT scores.

Table 5.7 Revised BMWP Scores, ASPT Scores and LQI Interpretation; results summary.

TABLE 5.1: WEATHER DATA FROM MET EIREANN – CASEMENT

Date	Rainfall (mm)	Max Temp. (^{0}C)	Min Temp. (^{0}C)
25/07/14	0	24.7	11.6
26/07/14	0.1	21.3	11.3
27/07/14	2.2	20.8	10.8
28/07/14	0.6	20.3	13.4
	Total = 2.9	***Avg. = 21.8***	***Avg. = 11.8***

TABLE 5.2: RESULTS OF FIELD MEASUREMENTS AT EACH LOCATION

Parameter	SW-1	SW-2	SW-3	SW-4	SW-5
Temperature (^{o}C)	17.3	18.4	16.6	16.1	17.6
Dissolved Oxygen (mg/l)	9.94	10.44	8.72	8.35	9.81
Dissolved Oxygen (%)	104.4	112	90.2	85.3	103.6
Odour / Visual	Clear, no s.s., no odour	Clear, no s.s., no odour	Clear, no s.s., no odour	Clear, no s.s., no odour	Clear, no s.s., no odour

TABLE 5.3: 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)	***6.0 – 9.0*** *Note 1*	8.1	7.8	7.7	7.1	8
Conductivity (µS/cm @ 25^0C)	***1000*** *Note 2*	543	660	665	**1032**	555
BOD (TCMP) (mg/l)	***High Status: ≤ 2.2 Good Status: ≤2.6*** *Note 1*	<2	<2	<2	<2	<2
COD (mg/l)	***40*** *Note 2*	<10	<10	24	<10	<10
Ammonia as N (mg/l) (Konelab)	***High Status: ≤ 0.04 Good Status ≤0.065*** *Note 1*	0.02	0.03	0.04	**0.14**	**0.16**
Suspended Solids (mg/)l	***25*** *Note3*	<5	<5	<5	<5	<5
Total Alkalinity ($CaC0_3$) (mg/l)	-	260	275	199	370	260
Chloride (mg/l)	***250*** *Note 2*	14	22	33	46	16
Sulphate (mg/l)	***200*** *Note 2*	15	37	100	95	16
Total Phosphorous (mg/l)	-	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-phosphate as P (mg/l)	***High Status:≤0.025 Good Status:≤0.035*** *Note 1*	0.01	<0.01	<0.01	<0.01	**0.04**
Nitrate as N (mg/l)	***11.29**** *Note 2*	1.9	2.1	0.68	3.3	1.1
Nitrite (mg/l)	**0.015** *Note 3*	<0.02	<0.02	**0.02**	**0.1**	**0.05**
TON as N (mg/l)	-	1.9	2.2	0.7	3.4	1.2
Cyanide (free) (mg/l)	-	<0.01	<0.01	<0.01	<0.01	<0.01
VOC's (µg/l)	-	<1	-	-	-	<1

Notes:

Note 1: *Water Quality Standard = Water Quality Standards set in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Limit values for A1 waters are shown.*

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

Note 3: *Water Quality Standard = 1988 Statutory Instrument No. 293, European Communities (Quality of Salmonid Waters) Regulations 1988.*

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

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

TABLE 5.4: 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***	13	29	56	96	15
Calcium (total) (mg/l)	***200***[Note 2]	109	117	100	175	100
Chromium (total) (µg/l)	***50***	<2	<2	<2	<2	<2
Cadmium (total) (µg/l)	***5***	<2	<2	<2	<2	<2
Copper (total) (µg/l)	***50***	<2	<2	<2	<2	<2
Iron (total) (mg/l)	***0.20***	<0.1	<0.1	<0.1	<0.1	0.13
Potassium (total) (mg/l)	***5***	1.7	2.1	0.8	3.7	4.4
Magnesium (total) (mg/l)	***50***[Note 2]	8.8	10	14	17	7.9
Manganese (total) (µg/l)	***50***	8	36	7	**209**	39
Sodium (total) (mg/l)	***200***[Note 2]	9.5	16	28	45	11
Nickel (total) (µg/l)	***20***	<2	<2	2	5	<2
Lead (total) (µg/l)	***50***	<2	<2	<2	<2	<2
Zinc (total) (µg/l)	***3,000***	6	16	11	13	14
Mercury (total) (µg/l)	***1***	<1	<1	<1	<1	<1

Note 1: *S.I. 294 of 1989: Water Quality Standard = Water Quality Standards set in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Limit values for A1 waters are shown.*

***Note 2**: European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988)*

< Indicates less than the laboratory detection limit

Results highlighted in **red bold** represent an exceedence of water quality standard.

TABLE 5.5: CALCULATED BIOLOGICAL QUALITY RATING (Q RATING) FOR SURFACE WATERS [Note 1]			
Location	**SW-1**	**SW-3**	**SW-4**
Q-Rating	4	4	3-4

Note 1: All sampling stations classified as Eroding Substrata

TABLE 5.6: COUNTS OF MACROINVERTEBRATES SPECIES PER SAMPLE STATION WITH REVISED BMWP AND ASPT SCORES			
Species	**SW-1**	**SW-3**	**SW-4**
Gammarus spp	8	6	6
Baetidae	0	2	2
Ephemeridae	>100	>100	6
Caenis	20	3	4
Isoperla	20	0	0
Chloroperlidae	0	5	8
Lymnaeidae	0	0	0
Limnius spp.	0	0	0
Nemoura spp.	0	0	0
Ecdyonuridae	0	0	0
Rhyacophilidae	1	0	0
Simulidae	0	0	0
Chironomidae	2	0	0
Odontoceridae	0	0	0
Assellus spp.	>50	>50	9
Hydropsychida	0	0	0
Hirudididae	3	0	0
Tipula spp	0	1	1
Hydrobidae	0	0	0
Valvatidae	0	0	0
Number Of Taxa	**8**	**8**	**7**
Revised BMWP Score	46.9	47.2	44.6
ASPT Score	5.86	5.9	6.37

Not included in calculations of BMWP score

TABLE 5.7: REVISED BMWP SCORES, ASPT SCORES AND LQI INTERPRETATION; RESULTS SUMMARY							
Sampling Station	**BMWP Score**	**ASPT Score**	**X Rating**	**Y Rating**	**OQR**	**LQI**	**LQI Interpretation**
SW-1	46.9	6.78	3	7	5.0	A	Excellent Quality
SW-3	47.2	6.6	3	7	5.0	A	Excellent Quality
SW-4	44.6	6.37	3	7	5.0	A	Excellent Quality

5.0 DISCUSSION

For discussion purposes, all parameters analysed will be compared to the most current surface-water standards i.e. (a) the *"European Communities Environmental Objectives (Surface Waters) Regulations, 2009",* (b) the *"European Communities Quality of Surface Water Intended for the Abstraction of Drinking Water Regulations, 1989"* and (c) the "*European Communities (Quality of Salmonid Waters) Regulations, 1988".* Results of chemical analysis for Surface waters are also compared to the previous quarterly monitoring event, conducted in April 2014 (Ref: ANUA ENV. ECS4868-SW**).**

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

The Ammonia concentration at the Retention Pond Inlet (SW-5) was 0.04mg/l, while the Outlet (SW-2) was 0.14mg/l. This would suggest the water is of *''high status"* at the inlet but not at the outlet, in accordance with the *''Water Quality Standard = 1988 Statutory Instrument No. 293, European Communities (Quality of Salmonid Waters) Regulations 1988*.''

The Manganese concentration is considerable higher at the Outlet (209µg/l) compared to the Inlet (7 µg/l) and exceeds its respective water quality standard limit of 50 µg/l.

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

The Nitrate (0.68→3.3mg/l) and Nitrite (0.02→0.1mg/l) display notable increases from the Retention Pond Inlet to the Retention Pond Outlet. The Nitrite levels exceeded the respective limit (0.015mg/l) for surface water in accordance with *'Water Quality Standard = 1988 Statutory Instrument No. 293, European Communities (Quality of Salmonid Waters) Regulations 1988*.''

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 Statutory Instrument No.293; Quality of Salmonid Waters Regulations, 1988.

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) /excellent (using the LQI interpretation of water quality) 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. The LQI interpretation of water quality has also remained unchanged at the Hartwell River being of "Excellent Quality".

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

The Ammonia level displays an increase (0.02→0.14mg/l) compared to the previous quarterly monitoring event and now exceeds its respective limit (≤0.065mg/l) for '*Good Quality*' water.

The Orthophosphate level displays an increase (0.02→0.04mg/l) compared to the previous quarterly monitoring event and now exceeds its respective limit (≤0.025mg/l) for '*Good Quality*' water.
The Nitrite level also displays an increase (<0.02→0.05mg/l) compared to the previous quarterly 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.

The results of this biological survey indicate that the quality of water in the Kill River is moderate (using the Q-value system) /excellent (using the LQI interpretation of water quality. It received a Q value of 3.5 compared to a Q-value of 4 upon the previous annual monitoring event. The LQI interpretation of water quality has remained unchanged at the Kill River being of "Excellent Quality".

APPENDIX 3.6

Groundwater Charts and Tables

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:	Mr. Eamonn Lee Environmental Consultant
Reviewed by:	Mr. Peter Coogan Environmental Team Leader
Report No:	ECS4972-GW
Monitoring Date:	28th July 2014 (Annual)
Report Date:	19th September 2014

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. ANUA Environmental was commissioned to perform the required sampling and analysis. The site was subsequently visited by ANUA Environmental Scientists on the 28th of July to conduct the annual sampling event of 2014. Groundwater, leachate and private well samples were returned to the laboratory for subsequent analysis.

Groundwater

Samples were taken from seven (MW-1A, MW-8, MW-9, MW-14A, MW-16, MW-20 and MW-22) 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 & Manganese
MW-8 –Manganese
MW-16 –Manganese
MW-20 – Sulphate & Calcium
MW-22 –Manganese

Total and Faecal Coliforms were detected in four of the boreholes sampled. The highest levels of Faecal Coliforms were detected at groundwater monitoring location MW-16 (31cfu/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 three of the private monitoring wells; PW-1, PW-2 and PW-4.

Leachate

Three Leachate Cells; LC-1, LC-8 and LC-11 along with two treatment stages, LL and LBT, 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 (LBT) indicated that key indicator parameters such as; BOD, COD and Ammonia, show considerable decrease in concentration levels as leachate moves through the treatment system.

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

Respectively Submitted,

Mr. Peter Coogan
Environmental Team Leader

Mr. Eamonn Lee
Environmental Consultant

CONTENTS

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. ANUA Environmental was commissioned to perform the sampling and analysis. The site was subsequently visited by ANUA Environmental Scientists on the 28th of July to conduct the annual monitoring event of 2014. 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 (LBT)**: 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

Groundwater's 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 5667-3-2004	*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 ANUA 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.

2.3 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)	-	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-$N0_2B/NH_3$ & 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, ANUA Environmental Standard Operating Procedures Manual
✓ - INAB Accredited Test Method – INAB Registration Reference No. 083T.
X – None Accredited Test Method

3.0 COMMITMENT TO QUALITY

3.1 INAB Accreditation

ANUA 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.

3.2 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. ANUA Environmental Analytical Laboratory Services is listed on the EPA's register of Quality Controlled Laboratories

3.3 Control Chain of Custody

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

CONTROLLED CHAIN OF CUSTODY

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

4.0 RESULTS

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

4.1 Groundwater Results

Table 4.1: Weather data taken from nearest Met Éireann station (Casement).

Table 4.2: Results of Field Measurements Taken at Each Groundwater Borehole

Table 4.3: Results of Chemical Analysis of Groundwater Samples

4.2 Private Well Results

Table 4.4: Results of Chemical Analysis of Private Well Samples

4.3 Leachate Results

Table 4.5: Results of Chemical Analysis of Leachate Samples.

Table 4.6: Results of Metal Analysis of Leachate Samples

TABLE 4.1: WEATHER DATA FROM MET ÉIREANN - CASEMENT

Date	Rainfall (mm)	Max Temp. (^{0}C)	Min Temp. (^{0}C)
25/07/14	0	24.7	11.6
26/07/14	0.1	21.3	11.3
27/07/14	2.2	20.8	10.8
28/07/14	0.6	20.3	13.4
	Total = 2.9	***Avg. = 21.8***	***Avg. = 11.8***

4.1 Groundwater Results

TABLE 4.2: 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	36.88	9.72	50	11
MW-2	Well replaced by MW1A			
MW-3 [b]	Well inaccessible / Sampling not required			
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	31.05	7.41	300	10.6
MW-9	28.44	7.34	150	11.9
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	-	8.29	75	11.1
MW-15	2.86	Sampling not required		
MW-16	22.84	6.27	75	12.3
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	6.35	18	11.6
MW-21	7.17	Sampling not required		
MW-22	4.80	3.21	6	11.2
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 4.3(A): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE				
Parameter	**MW-1A**	**MW-8**	**MW-9**	***GTV*** [Note1] ***IGV*** [Note2]
pH (pH units)	7.5	7.4	7.2	*≥ 6.5 -≤9.5*[1]
Temperature (°C)	11	10.6	11.9	*25*[2]
Odour	No odour	No odour	No odour	-
Visual	Clear, No suspended solids	Clear, No suspended solids	Clear, No suspended solids	-
Conductivity (uS/cm)	542	604	599	*800 – 1875*[1]
Ammonia as N (mg/l)	<0.02	<0.02	0.03	*0.05 – 0.136*[1**]
Chloride (mg/l)	11	12	13	*24 – 187.5*[1]
Nitrate as N (mg/l)	<0.2	<0.2	<0.2	*8.47*[1*]
Nitrite (mg/l)	<0.02	<0.02	<0.02	*0.11*[1*]
TON (mg/l)	<0.2	<0.2	<0.2	-
Cyanide (mg/)	<0.01	<0.01	<0.01	*0.03751*
Fluoride (mg/l)	<0.10	<0.10	<0.10	*1.02*
Sulphate (mg/l)	27	10	19	*187.5*
Total Alkalinity (mg/l)	254	298	291	-
Ortho. P (mg/l)	**0.04**	<0.01	0.02	0.03[2]
Total Dissolved Solids (mg/l)	324	353	354	-
TOC (mg/l)	<5	<5	<5	-

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 EC Drinking Water Standards

< Indicates less than the laboratory detection limit

TABLE 4.3(B): RESULTS OF CHEMICAL ANALYSIS AT EACH GROUNDWATER MONITORING BOREHOLE					
Parameter	**MW-14A**	**MW-16**	**MW-20**	**MW-22**	***GTV*** [Note1] / ***IGV*** [Note2]
pH (pH units)	7.6	7.2	7.1	7.4	*≥ 6.5 -≤9.5*
Temperature (°C)	11.1	12.3	11.6	11.2	*25*[2]
Odour	No odour	No odour	No odour	No odour	-
Visual	Clear, No suspended solids	Clear, No suspended solids	Pale Orange, Some suspended solids	Clear, No suspended solids	-
Conductivity (uS/cm)	591	625	1117	511	*800 – 1875*[1]
Ammonia as N (mg/l)	<0.02	<0.02	<0.02	0.07	*0.05 – 0.136*[1*]
Chloride (mg/l)	16	13	19	12	*24 – 187.5*[1]
Nitrate as N (mg/l)	0.62	<0.2	3.4	<0.2	*8.47*[1*]
Nitrite (mg/l)	<0.02	<0.02	<0.02	<0.02	*0.11*[1*]
TON (mg/l)	0.62	<0.2	3.4	<0.2	-
Cyanide (mg/)	<0.01	<0.01	<0.01	<0.01	*0.03751*
Fluoride (mg/l)	<0.10	<0.10	<0.10	<0.10	*1.02*
Sulphate (mg/l)	14	13	**260**	24	*187.5*
Total Alkalinity (mg/l)	293	311	352	239	-
Ortho. P (mg/l)	<0.01	<0.01	<0.01	<0.01	**0.03**[2]
Total Dissolved Solids (mg/l)	338	352	794	302	-
TOC (mg/l)	<5	<5	<5	<5	-

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 EC Drinking Water Standards

TABLE 4.4(A): RESULTS OF METAL SCREENING OF GROUNDWATER SAMPLES				
Parameter	**MW-1A**	**MW-8**	**MW-9**	***GTV*** [Note1] ***IGV*** [Note2]
Sodium mg/l	16	7.5	13	*150*[2]
Potassium mg/l	0.92	0.74	1.4	*5*[2]
Magnesium mg/l	17	9.9	18	*50*[2]
Calcium mg/l	84	115	102	*200*[2]
Boron µg/l	15	9	18	*750*[1]
Cadmium µg/l	<2	<2	<2	*3.75*[1]
Chromium µg/l	<2	<2	<2	*37.5*[1]
Copper µg/l	<2	<2	<2	*1500*[1]
Iron mg/l	<0.1	<0.1	<0.1	*0.2 mg/l* [2]
Lead µg/l	<2	<2	<2	*18.75*[1]
Manganese µg/l	**68**	**68**	44	*50*[2]
Nickel µg/l	<2	<2	<2	*15*[1]
Zinc µg/l	11	6	3	*100*[2]
Mercury µg/l	<1	<1	<1	*0.75*[1]

TABLE 4.4(B): RESULTS OF METAL SCREENING OF GROUNDWATER SAMPLES					
Parameter	**MW-14A**	**MW-16**	**MW-20**	**MW-22**	***GTV*** [Note1] ***IGV*** [Note2]
Sodium mg/l	20	14	15	14	*150*[2]
Potassium mg/l	2	1.2	1.3	1	*5*[2]
Magnesium mg/l	24	19	12	14	*50*[2]
Calcium mg/l	78	102	**222**	82	*200*[2]
Boron µg/l	20	12	24	12	*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	<2	*1500*[1]
Iron mg/l	<0.1	<0.1	<0.1	<0.1	*0.2 mg/l* [2]
Lead µg/l	6	<2	<2	<2	*18.75*[1]
Manganese µg/l	<2	**1407**	<2	**235**	*50*[2]
Nickel µg/l	<2	<2	<2	<2	*15*[1]
Zinc µg/l	4	9	22	<2	*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 EC Drinking Water Standard

TABLE 4.5: RESULTS OF MICROBIOLOGICAL ANALYSIS OF GROUNDWATER SAMPLES		
Borehole I.D	**Total Coliforms (cfu/100 ml)**	**E.Coli (cfu/100 ml)**
MW-1A	0	0
MW-8	38	2
MW-9	0	0
MW-14A	0	0
MW-16	41	31
MW-20	301	1
MW-22	2	2

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

TABLE 4.6: RESULTS OF ORGANIC ANALYSIS OF GROUNDWATER SAMPLES		
Borehole I.D	**VOC's USEPA 524.2 (µg/l)**	**IGV (µg/l)**
MW-1A	<1	10
MW-8	<1	10
MW-22	<1	10

4.3 Leachate Results

TABLE 4.9 (A): RESULTS OF LABORATORY ANALYSIS OF LEACHATE SAMPLES					
Parameter	**LC-1**	**LC-8**	**LC-11**	**LL**	**LBT**
pH (pH units)	7.5	7.8	7.8	8	6.8
Conductivity (uS/cm)	21110	29490	30300 ***	25800	21110
Temperature (ºC)	21.9	22.2	23.2	22.7	21.9
Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour	Foul Odour
Visual Inspection	Brown/black	Brown	Brown	Black/brown	Black
BOD – TCMP (mg/l)	60	192	172	145	25
COD (mg/l)	2862	4770	5475	5185	3045
Ammonia-N (mg/l)	2015	2848	2946	2475	44
Chloride (mg/l)	1708	2460	2195	70	2088
Fluoride (mg/l)	<0.10	<0.10	<0.10	<0.10	<0.10
Total P (mg/l)	24	38	43	38	32
Nitrate-N (mg/l)	2.2	2.9	3.1	2.8	1554
Nitrite-N (mg/l)	<0.03	<0.03	<0.03	<0.03	22
Sulphate (mg/l)	2.6	28	4.2	27	75
TON (mg/l)	0.6	0.23	<0.2	0.26	2016 ***
Calcium (mg/l)	61	65	40	59	76
Iron (mg/l)	3.5	4.2	1.8	1.8	2.2
Potassium (mg/l)	674	1204	647	776	818
Sodium (mg/l)	1183	1769	1332	1428	3146
Magnesium (mg/l)	36	38	31	36	39
Total Chromium	305	428	412	408	387
Manganese (µg/l)	286	173	178	208	334
Nickel (µg/l)	308	368	352	342	342
Copper (µg/l)	<20	30	602	<20	<20
Zinc (µg/l)	70	303	342	132	273
Cadmium (µg/l)	<20	<20	<20	<20	<20
Lead (µg/l)	<20	22	24	<20	<20
Boron (µg/l)	2084	2410	2455	2472	2455
Mercury (µg/l)	<10	<10	<10	<10	<10

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

5.0 Discussion

5.1 Groundwater

Samples were taken from seven (MW-1A, MW-8, MW-9, MW-14A, MW-16, MW-20 and MW-22) 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 MW2 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 October 2014 (*See ANUA Report ECS4457*). All annual parameters are compared to the 2013 annual monitoring event (*See ANUA Report ECS4456).*

5.1.1 Chemical Analysis

The results of chemical analysis carried out on each of the groundwater samples are presented in Tables 4.3A and 4.3B.

Monitoring wells; MW8, MW-9, MW14A, MW-16 and MW-22 were within the relevant EPA groundwater limits for all chemical parameters analysed (see Tables 4.3A/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 (0.04mg/l) slightly exceeded its respective IGV limit (0.03mg/l).
The Sulphate concentration at MW-20 decreased significantly compared to the previous annual monitoring event (488→260mg/l), but remains in exceedence of its respective IGV (187.5mg/l).

5.1.2 Metals Analysis

Results of metals analysis carried out on 7 boreholes are presented in Tables 4.4(a) and 4.4(b). Cadmium, Chromium, Copper, Iron, Lead, 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-8 (152→68µg/l), MW-16 (1291→1407 µg/l) and MW-22 (174→235µg/l), have displayed typical fluctuations but remain above the respective Groundwater Threshold Value 50µg/l.

It is observed that the replacement of old well MW-2 with MW1A has resulted in a decrease in; Sodium (151→16mg/l) and Calcium (214→84mg/l) levels, which no longer exceed their respective guideline limit values. It was observed that Manganese levels also reduced (155→68mg/l) but remain above the respective Groundwater Threshold Value 50µg/l.
The replacement of old well MW-14 with MW14A has resulted in a decrease in Manganese levels (1519→<2µg/l) which no longer exceeds its Interim guideline limit value (50µg/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.

5.1.3 Microbial Analysis

Groundwater samples were analysed for Total and Faecal Coliforms and the results of the analysis are shown in Table 4.5. Total and Faecal Coliforms were detected in four of the boreholes sampled. The highest levels of Faecal Coliforms were detected at groundwater monitoring locations: MW-16 (31cfu/100ml). It is worth noting that the levels of E.Coli at locations MW-8, MW-9 and MW-20 have reduced significantly compared to the previous annual monitoring event. The replacement of old wells MW2 with MW1A and MW14 with MW14A has resulted in a vast reduction in E.Coli levels.

5.2 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 monitoring wells; PW-1 (19→1600cfu/l00ml), PW-2 (81→10 cfu/l00ml) and PW-4 (133→6000 cfu/l00ml). E.Coli was not detected above the laboratory limit of detection at PW-3 or PW-5.

5.3 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 LC8 was taken from Cell 8 which is part of the Landfill which was capped with clay more recently.
- Sample LC11 was taken from Cell 11 which is part of the Landfill which was capped with clay more recently.

In addition, although not required by the facility's Waste Licence, samples were taken from the different phases associated with the onsite leachate treatment system: LL (Leachate Lagoon) and LBT (Leachate Balance Tank).

The results of this monitoring event are compared to the previous monitoring event which was conducted in April 2014 (*see ANUA Report Ref ECS4868*).

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

Leachate Cells

The majority of parameters at leachate cells; LC-1, LC-8 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 (LBT).

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

APPENDIX 3.7

Private Wells (Groundwater) Charts and Tables

4.2 Private Well Results

TABLE 4.7: RESULTS OF CHEMICAL ANALYSIS OF PRIVATE WELL SAMPLES						
Parameter	*Water Quality Standard MAC*[Note 2]	**PW-1**	**PW-2**	**PW-3**	**PW-4**	**PW-5**
pH (pH units)	***6.5-9.5***	7.1	7.5	7	7.3	7
Odour	**-**	None	None	None	None	None
Visual	**-**	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids	Clear, No visible Suspended Solids
Conductivity µS/cm	***1500***	892	560	732	692	778
Ammonia as N mg/l	***0.23***[Note 3]	<0.02	0.03	<0.02	<0.02	<0.02
Ortho P mg/l	**-**	<0.01	0.04	<0.01	0.02	<0.01
Total Alkalinity $CaCO_3$ mg/l	**-**	350	292	363	293	326
**TOC mg/l	**-**	<5	<5	<5	<5	<5
*Cyanide mg/l	***0.05***	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoride mg/l	***1.0***	<0.10	<0.10	<0.10	<0.10	<0.10
Chloride mg/l	***250***	33	14	15	22	39
Sulphate mg/l	***250***	70	15	17	27	21
Nitrate mg/l	***11.29*** [Note 4]	2.7	<0.2	1.1	4.2	2.8
Nitrite mg/l	**0.02** [Note 5]	<0.02	<0.02	<0.02	<0.02	<0.02
Total Oxidised Nitrogen[1]	**-**	2.7	<0.2	1.1	4.2	2.8
Total Dissolved Solids mg/l	***1000***	604	318	418	420	458
*Calcium mg/l	***200***	153	84	149	110	131
*Sodium mg/l	***150***	24	14	8.6	9.1	15
*Magnesium mg/l	***50***	15	15	7.9	17	22
*Potassium mg/l	***12***	7.4	0.96	0.54	0.88	1.2
*Chromium µg/l	***50***	<2	<2	<2	<2	<2
*Manganese µg/l	***50***	<2	27	<2	<2	<2
*Nickel µg/l	***20***	<2	<2	<2	<2	<2
*Copper µg/l	***2,000***	3	<2	<2	36	14
*Zinc µg/l	***5,000***	10	27	5	28	23
*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***	35	10	12	11	14
*Mercury µg/l	***1***	<1	<1	<1	<1	<1

TABLE 4.8: 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***	2000	1600
PW-2	***0***	330	10
PW-3	***0***	0	0
PW-4	***0***	28000	6000
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 Eclipse laboratories

APPENDIX 3.8

Leachate Charts and Tables

4.3 Leachate Results

TABLE 4.9 (A): RESULTS OF LABORATORY ANALYSIS OF LEACHATE SAMPLES					
Parameter	**LC-1**	**LC-8**	**LC-11**	**LL**	**LBT**
pH (pH units)	7.5	7.8	7.8	8	6.8
Conductivity (uS/cm)	21110	29490	30300 ***	25800	21110
Temperature (ºC)	21.9	22.2	23.2	22.7	21.9
Odour	Strong Odour	Strong Odour	Strong Odour	Strong Odour	Foul Odour
Visual Inspection	Brown/black	Brown	Brown	Black/brown	Black
BOD – TCMP (mg/l)	60	192	172	145	25
COD (mg/l)	2862	4770	5475	5185	3045
Ammonia-N (mg/l)	2015	2848	2946	2475	44
Chloride (mg/l)	1708	2460	2195	70	2088
Fluoride (mg/l)	<0.10	<0.10	<0.10	<0.10	<0.10
Total P (mg/l)	24	38	43	38	32
Nitrate-N (mg/l)	2.2	2.9	3.1	2.8	1554
Nitrite-N (mg/l)	<0.03	<0.03	<0.03	<0.03	22
Sulphate (mg/l)	2.6	28	4.2	27	75
TON (mg/l)	0.6	0.23	<0.2	0.26	2016 ***
Calcium (mg/l)	61	65	40	59	76
Iron (mg/l)	3.5	4.2	1.8	1.8	2.2
Potassium (mg/l)	674	1204	647	776	818
Sodium (mg/l)	1183	1769	1332	1428	3146
Magnesium (mg/l)	36	38	31	36	39
Total Chromium	305	428	412	408	387
Manganese (µg/l)	286	173	178	208	334
Nickel (µg/l)	308	368	352	342	342
Copper (µg/l)	<20	30	602	<20	<20
Zinc (µg/l)	70	303	342	132	273
Cadmium (µg/l)	<20	<20	<20	<20	<20
Lead (µg/l)	<20	22	24	<20	<20
Boron (µg/l)	2084	2410	2455	2472	2455
Mercury (µg/l)	<10	<10	<10	<10	<10

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

APPENDIX 3.9

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

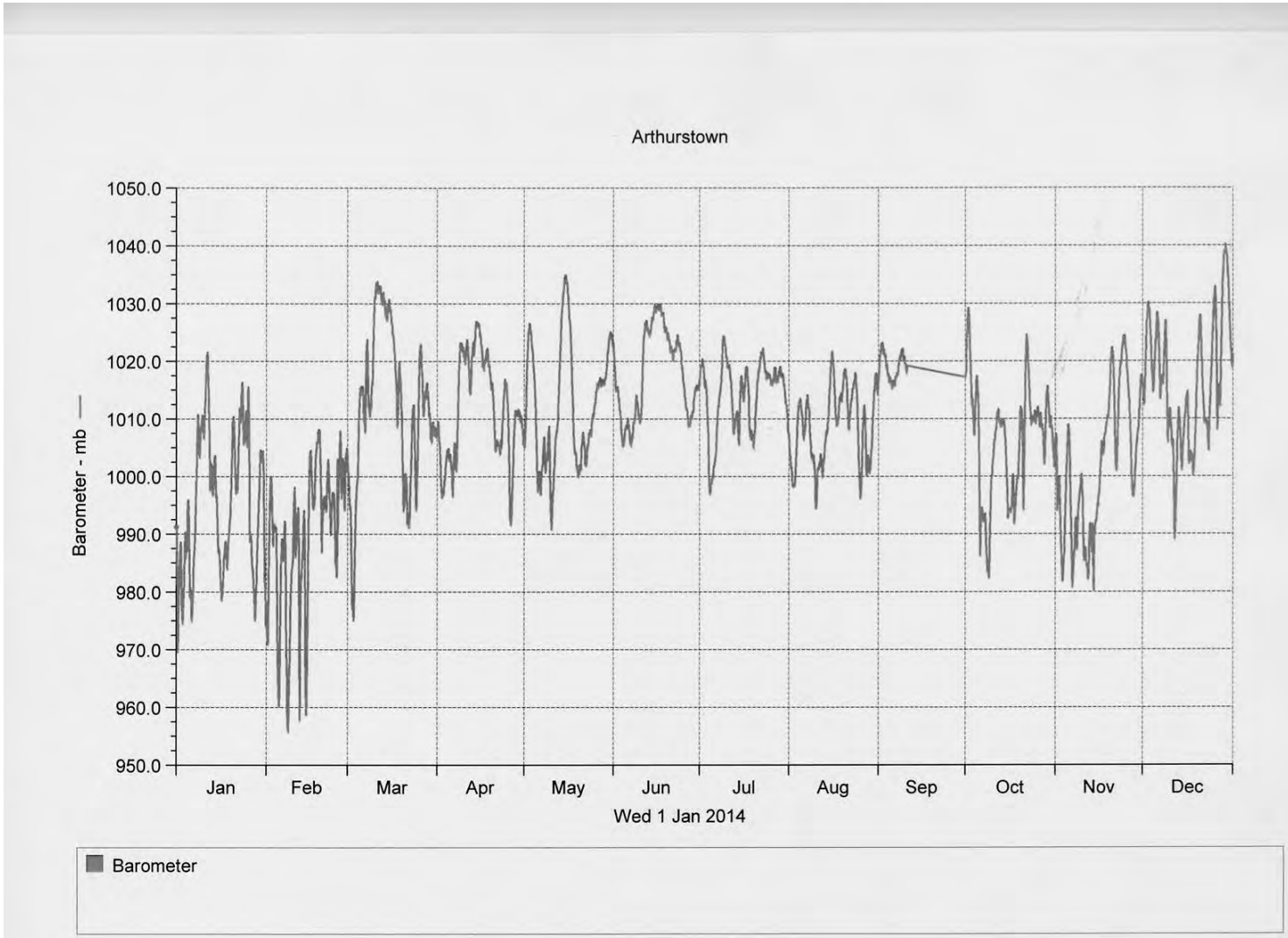
YR	MO	MEAN MAX	MEAN MIN	MEAN	DEP. FROM NORM	HEAT DEG DAYS	COOL DEG DAYS	HI	DATE	LOW	DATE	MAX >=32	MAX <=0	MIN <=0	MIN <=-18
14	1	8.0	3.0	5.5	0.0	396	0	11.8	5	0.2	13	0	0	0	0
14	2	8.1	2.9	5.4	0.0	360	0	10.6	17	-0.4	10	0	0	2	0
14	3	10.4	3.4	6.8	0.0	357	0	14.6	19	-0.8	12	0	0	3	0
14	4	13.8	6.1	10.0	0.0	249	0	18.8	29	0.9	11	0	0	0	0
14	5	15.0	8.2	11.3	0.0	216	0	21.2	31	4.4	27	0	0	0	0
14	6	18.9	10.0	14.7	0.0	117	7	25.5	18	4.7	29	0	0	0	0
14	7	21.1	12.6	16.7	0.0	71	23	26.1	25	7.3	5	0	0	0	0
14	8	17.8	10.6	13.9	0.0	140	2	21.3	1	5.6	20	0	0	0	0
14	9	18.7	8.8	13.7	0.0	49	2	22.8	4	4.2	8	0	0	0	0
14	10	14.5	8.2	11.4	0.0	215	0	17.5	31	1.1	29	0	0	0	0
14	11	10.6	4.6	7.8	0.0	316	0	14.1	1	-0.5	27	0	0	2	0
14	12	7.7	2.9	5.2	0.0	405	0	12.7	21	-2.8	28	0	0	6	0
		13.5	6.7	10.0	0.0	2891	35	26.1	JUL	-2.8	DEC	0	0	13	0

PRECIPITATION (mm)

YR	MO	TOTAL	DEP. FROM NORM	MAX OBS. DAY	DATE	DAYS OF RAIN OVER .2	OVER 2	OVER 20
14	1	97.1	0.0	10.8	24	27	17	0
14	2	106.2	0.0	15.8	5	25	18	0
14	3	58.8	0.0	10.4	20	20	9	0
14	4	35.6	0.0	10.6	26	13	6	0
14	5	124.2	0.0	23.6	24	22	17	1
14	6	45.0	0.0	13.2	4	11	7	0
14	7	40.2	0.0	11.4	19	20	7	0
14	8	111.8	0.0	45.4	2	24	11	1
14	9	1.6	0.0	1.4	6	2	0	0
14	10	115.2	0.0	30.4	3	24	13	1
14	11	133.5	0.0	33.2	13	25	12	2
14	12	76.8	0.0	15.0	16	25	11	0
		945.9	0.0	45.4	AUG	238	128	5

WIND SPEED (m/s)

YR	MO	AVG.	HI	DATE	DOM DIR
14	1	1.2	10.7	26	SW
14	2	1.7	13.9	23	SW
14	3	1.1	11.2	20	SW
14	4	1.0	10.3	6	SSW
14	5	0.8	8.5	5	SW
14	6	0.6	6.7	8	NE
14	7	0.6	7.6	25	WSW
14	8	0.7	7.6	27	WSW
14	9	0.3	4.0	3	NE
14	10	1.2	9.8	6	SW
14	11	0.7	10.3	14	SW
14	12	1.1	9.8	9	WSW
		0.9	13.9	FEB	SW


Arthurstown
Barometer - mb
1050.0
1040.0
1030.0
1020.0
1010.0
1000.0
990.0
980.0
970.0
960.0
950.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Wed 1 Jan 2014
Barometer

APPENDIX 4.1

Landfill Gas Emissions (gas extraction system)

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 2014.

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	1,091	20	1,959	-	123	9	2,064,790
Flare 2	1,140	19	2,105	-	178	9	2,042,753
AR02	6,670	24,205	12,662	270	429	6,636	4,226,237
AR05	5,453	24,216	10,882	214	294	5,377	4,209,728
AR06	4,615	18,350	10,710	196	357	5,718	3,836,062
AR07	6,131	20,062	10,511	143	199	5,131	3,411,810
AR08	4,525	14,834	6,551	160	243	4,763	3,089,229
Totals	**29,624**	**101,706**	**55,379**	**984**	**1,823**	**27,643**	**22,880,609**

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).

APPENDIX 5.1

Discharge to Sewer Results
(as per PRTR reporting)

T.E. LABORATORIES LIMITED
Trading as
TelLab

Loughmartin Business Park, Tullow, Co. Carlow
Phone: 059-9152881 Fax: 059-9152886

CERTIFICATE OF ANALYSIS

Project Description: Analysis of Aqueous Sample

Attention:	Mr. Mark Heffernan	**Lab ID:**	115699
Company:	South Dublin Co. Co.	**Date Sampled:**	10.06.2014
Address:	Arthurstown Landfill Arthurstown, Kill, Co. Kildare		
Certificate No:	L/14/1062	**Date Rec'd:**	10.06.2014
Issue Date:	30.06.2014	**Our Ref:**	WS-36639, 14-08023 &, 14-37413-1

One sample was analysed for a range of determinands.
Please see page 2-5 for results. Terms & Conditions and methods used are outlined in the attached appendix.

No. of Pages: Results page 2-5

Mr Peter O'Byrne
Quality Manage

Ms Breda Moore
Technical Manager

TelLab

ANALYSIS OF AQUEOUS SAMPLE

Date Sampled:10.06.2014
Date Received:10.06.2014
Date Analysis Commenced:.06.2014
Our Ref.:WS-36639, 14-08023 & 14-37413-1
Your Ref : Arthurstown
Certificate No. L/14/1062

DETERMINAND	Sample ID Lab ID	Balance Tank 115699
Alkalinity	n/a	590
Ammonia as NH_3	n/a	0.30
Ammoniacal Nitrogen	n/a	0.25
Arsenic (ug/l)#	++	140
BOD	n/a	49
Cadmium (ug/l)# (note2)	++	0.60
Chloride	**	1756
Chromium # (note 2)	++	260
COD	n/a	2226
Copper #	**	<0.05
Cyanide	n/a	0.04
Fluoride	**	<1.0 (note 1)
Kjeldhal Nitrogen	n/a	53
Lead (ug/l)# (note2)	++	6.8
Magnesium	**	57
Manganese#	**	0.36
Mercury (ug/l)#	++	<0.01
Nickel#	**	0.47
Nitrate as N	n/a	1788
Nitrite as N	**	<0.61(note1)
Orthophosphate as P	**	22
pH	**	7.7
Selenium (ug/l)#	++	1.8
Sulphate	**	82
Suspended Solids	n/a	120
TOC	n/a	808
Zinc#	**	0.18
Faecal Coliforms (cfu/20mls)	n/a	13
Total Coliforms (cfu/20mls)	n/a	>100

Concentrations are expressed as mg/l (ppm)
unless otherwise specified.
Analysis of metals are performed on the filtered sample.
** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests
Note 1: LOD raised due to matrix interference.
Note 2: Subcontracted due to instrument breakdown.
The above results relate only to the sample tested

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:10.06.2014
Date Received:10.06.2014
Date Analysis Commenced:.06.2014
Our Ref.:WS-36639, 14-08023 & 14-37413-1
Your Ref : Arthurstown
Certificate No. L/14/1062

Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	**Lab ID**	**115699**
Dichlorodifluoromethane	ug/l	<1
Chloromethane	ug/l	<1
Vinyl Chloride	ug/l	<1
Bromomethane	ug/l	<1
Chloroethane	ug/l	<1
Trichlorofluoromethane	ug/l	<1
1,1-dichloroethylene	ug/l	<1
Trans-1,2-dichloroethylene	ug/l	<1
1,1-dichloroethane	ug/l	<1
Cis-1,2-dichloroethylene	ug/l	<1
2,2-dichlororopane	ug/l	<2
Bromochloromethane	ug/l	<4
Chloroform	ug/l	<1
1,1,1-trichloroethane	ug/l	<1
1,1-dichloropropene	ug/l	<1
Carbon tetrachloride	ug/l	<1
Benzene	ug/l	<1
1,2-dichloroethane	ug/l	<1
Trichloroethylene	ug/l	<1
1,2-dichloropropane	ug/l	<1
Dibromomethane	ug/l	<1
Bromodichloromethane	ug/l	<4
cis-1,3-dichloropropene	ug/l	<1
Toluene	ug/l	<1
trans-1,3-dichloropropene	ug/l	<1
1,1,2-trichloroethane	ug/l	<1
Tetrachloroethylene	ug/l	<1
1,3-dichloropropane	ug/l	<1
Dibromochloromethane	ug/l	<1
1,2-dibromoethane	ug/l	<1
Chlorobenzene	ug/l	<1
1,1,1,2-tetrachloroethane	ug/l	<1
Ethylbenzene	ug/l	<1
m+p-Xylene	ug/l	<2
o-Xylene	ug/l	<1
Styrene	ug/l	<1
Bromoform	ug/l	<1
Isopropylbenzene	ug/l	<1
1,1,2,2-tetrachloroethane	ug/l	<1
Bromobenzene	ug/l	<1
1,2,3-trichloropropane	ug/l	<1
n-propylbenzene	ug/l	<1
2-chlorotoluene	ug/l	<1
1,3,5-trimethylbenzene	ug/l	<1
4-chlorotoluene	ug/l	<1
Tert-butylbenzene	ug/l	<1
1,2,4-trimethylbenzene	ug/l	<1
sec-butylbenzene	ug/l	<1
p-isopropyltoluene	ug/l	<1
1,3-dichlorobenzene	ug/l	<2
1,4-dichlorobenzene	ug/l	<1
n-butylbenzene	ug/l	<1
1,2-dichlorobenzene	ug/l	<1
1,2-dibromo-3-chloropropane	ug/l	<1
1,2,4-trichlorobenzene	ug/l	<1
Hexachlorobutadiene	ug/l	<1
Naphthalene	ug/l	<1
1,2,3-trichlorobenzene	ug/l	<1

Concentrations expressed as ug/l (ppb)
unless otherwise stated

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests

The above results relate only to the sample tested

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:10.06.2014
Date Received:10.06.2014
Date Analysis Commenced:.06.2014
Our Ref.:WS-36639, 14-08023 & 14-37413-1
Your Ref : Arthurstown
Certificate No. L/14/1062

Semi Volatile Organic Compounds ug/l ++

	Sample ID	Balance Tank
Determinand	**Lab ID**	**115699**
Phenol	ug/l	<5.0
Aniline	ug/l	<5.0
2-Chlorophenol	ug/l	<5.0
Benzyl Alcohol	ug/l	<5.0
2-Methylphenol	ug/l	<5.0
Bis(2-chloroisopropyl)ether	ug/l	<5.0
3&4-Methylphenol	ug/l	<5.0
Bis(2-chloroethoxy)methane	ug/l	<5.0
2,4-Dimethylphenol	ug/l	<5.0
2,4-Dichlorophenol	ug/l	<5.0
1,2,4-Trichlorobenzene	ug/l	<5.0
4-Chloro-3-methylphenol	ug/l	<5.0
2-Methylnaphthalene	ug/l	<5.0
1,2-Dinitrotoluene	ug/l	<5.0
Hexachlorocyclopentadiene	ug/l	<5.0
2,4,6-Trichlorophenol	ug/l	<5.0
2,4,5-Trichlorophenol	ug/l	<5.0
2-Chloronaphthalene	ug/l	<5.0
2-Nitroaniline	ug/l	<5.0
2,4-Dinitrotoluene	ug/l	<5.0
Acenaphthylene	ug/l	<5.0
3-Nitroaniline	ug/l	<5.0
Acenaphthene	ug/l	<5.0
4-Nitrophenol	ug/l	<5.0
Dibenzofuran	ug/l	<5.0
2,6-Dinitrotoluene	ug/l	<5.0
2,3,4,6-Tetrachlorophenol	ug/l	<5.0
Diethylphthalate	ug/l	<5.0
4-Chlorophenylphenylether	ug/l	<5.0
Fluorene	ug/l	<5.0
4-Nitroaniline	ug/l	<5.0
Diphenylamine	ug/l	<5.0
4-Bromophenylphenylether	ug/l	<5.0
Hexachlorobenzene	ug/l	<5.0
Bis(2-ethylhexyl)esther	ug/l	<5.0
Pentachlorophenol	ug/l	<5.0
Phenanthrene	ug/l	<5.0
Anthracene	ug/l	<5.0
Di-n-butylphthalate	ug/l	<5.0
Fluoranthene	ug/l	<5.0
Pyrene	ug/l	<5.0
Butylbenzylphthalate	ug/l	<5.0
Benzo(a)anthracene	ug/l	<5.0
Chrysene	ug/l	<5.0
Bis(2-ethylhexyl)phthalate	ug/l	<5.0
Di-n-octylphthalate	ug/l	<5.0
Benzo(b)fluoranthene	ug/l	<5.0
Benzo(k)fluoranthene	ug/l	<5.0
Benzo(a)pyrene	ug/l	<5.0
Indeno(123cd)pyrene	ug/l	<5.0
Dibenzo(ah)anthracene	ug/l	<5.0
Benzo(ghi)perylene	ug/l	<5.0
1,4-Dinitrobenzene	ug/l	<5.0
Dimethylphthalate	ug/l	<5.0
1,3-Dinitrobenzene	ug/l	<5.0
2,3,5,6-Tetrachlorophenol	ug/l	<5.0
Azobenzene	ug/l	<5.0
Carbazole	ug/l	<5.0

Concentrations expressed as ug/l (ppb)
unless stated otherwise

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests
The above results relate only to the sample tested
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

TelLab

ANALYSIS OF AQUEOUS SAMPLES.

Date Sampled:10.06.2014
Date Received:10.06.2014
Date Analysis Commenced:.06.2014
Our Ref.:WS-36639, 14-08023 & 14-37413-1
Your Ref : Arthurstown
Certificate No. L/14/1062

Organochlorine Pesticides

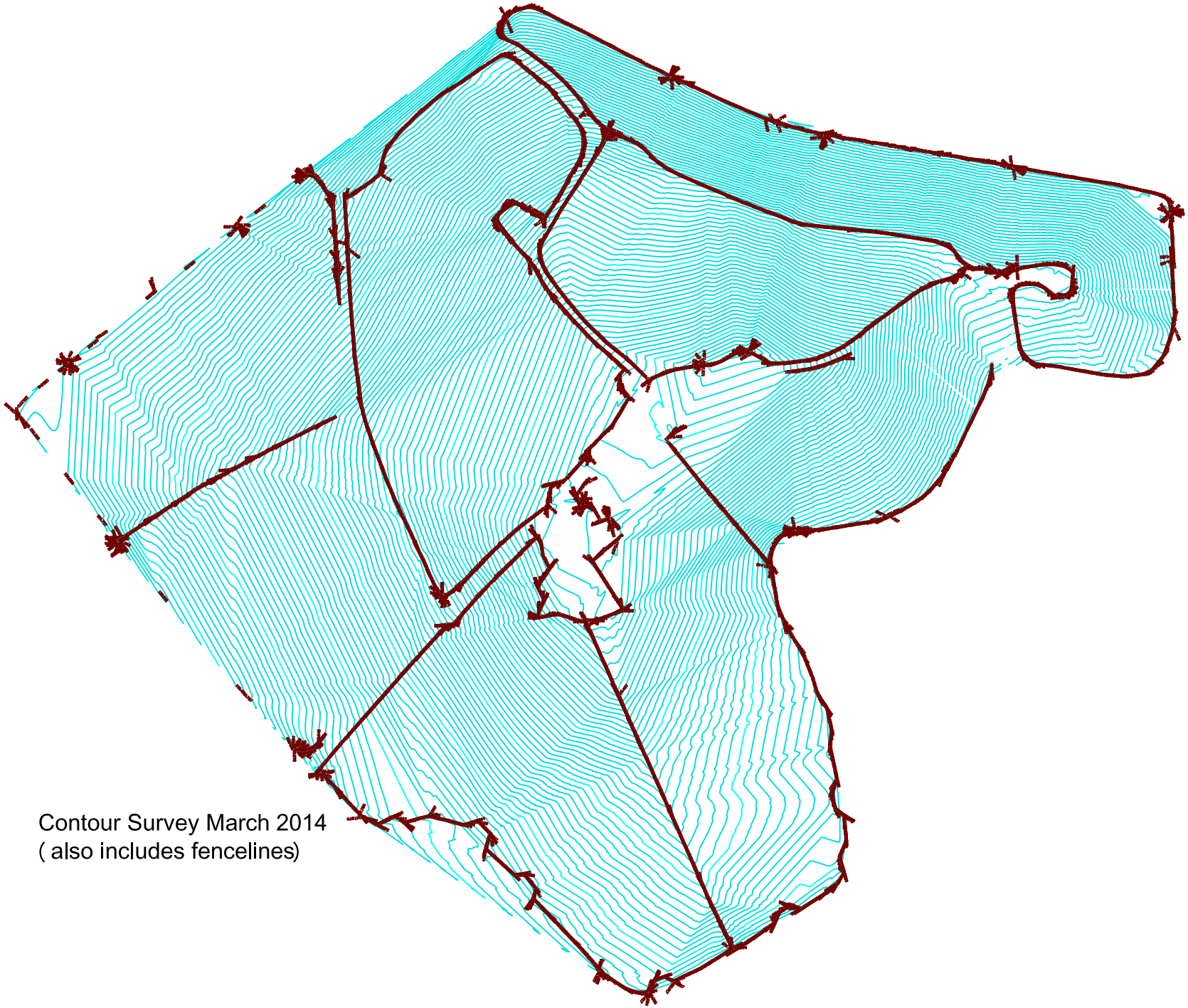
Determinand	Sample ID Lab ID	Balance Tank 115699
Aldrin	++	<0.02
Cis-Chlordane	++	<0.02
Trans-chlordane	++	<0.02
Dieldrin	++	<0.02
Endrin	++	<0.02
Endosulfan A	++	<0.02
Endosulfan B	++	<0.02
Hexachlorobenzene (HCB)	++	<0.02
Heptachlor Epoxide	++	<0.02
Heptachlor	++	<0.02
Isodrin	++	<0.02
Methoxychlor	++	<0.02
Trifluralin	++	<0.02
alpha-hexachlorocyclohexane (alpha - HCH)	++	<0.02
beta-hexachlorocyclohexane (beta - HCH, beta-BHC)	++	<0.02
delta-hexachlorocyclohexane (delta - HCH)	++	<0.02
gamma-hexachlorocyclohexane (lindane)	++	<0.02
o,p'-DDD (o,p'-TDE)	++	<0.02
o,p'-DDE	++	<0.02
o,p'-DDT	++	<0.02
o,p'-DDD (o,p'-TDE)	++	<0.02
p,p'-DDE	++	<0.02
p,p'-DDT	++	<0.02

Concentrations expressed as ug/l
unless stated otherwise

** = INAB Accredited Tests ++ = Subcontracted Tests n/a = Non-INAB Accredited Tests
The above results relate only to the sample tested
This report should not be regenerated except in full and with the consent of T.E. Laboratories Ltd.

APPENDIX 6.1

Topographical Survey



Contour Survey March 2014
(also includes fencelines)

APPENDIX 7.1

PRTR Returns

Environmental Protection Agency

Guidance to completing the PRTR workbook

AER Returns Workbook

Version 1.1.18

REFERENCE YEAR	2014

1. FACILITY IDENTIFICATION

Parent Company Name	South Dublin County Council
Facility Name	Arthurstown Landfill
PRTR Identification Number	W0004
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	Mark Heffernan
AER Returns Contact Email Address	arthurstownlandfill@eircom.net
AER Returns Contact Position	Assistant Landfill Manager
AER Returns Contact Telephone Number	045877674
AER Returns Contact Mobile Phone Number	
AER Returns Contact Fax Number	045877849
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	5
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

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

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

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

4. WASTE IMPORTED/ACCEPTED ONTO SITE Guidance on waste imported/accepted onto site

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

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

4.1 RELEASES TO AIR Link to previous years emissions data

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	AR02	AR05	AR06	AR07	AR08			
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
08	**Nitrogen oxides (NOx/NO2)**	M	ALT	Chemiluminescence	14.95	15.62	5,811	5,065	3,439	5,409	3,976	##########	0.0	0.0
02	Carbon monoxide (CO)	M	ALT	HCIR by Horiba OG-250	0.27	0.26	21,088	22,491	13,675	17,699	13,036	0.0	0.0	0.0
11	Sulphur oxides (SOx/SO2)	M	OTH	NDIR Absoption	26.84	28.84	11,032	10,107	7,981	9,273	5,757	0.0	0.0	0.0
07	Non-methane volatile organic compounds (NMVOC)	M	EN 13649:2001	Thermal Desorption	1.68	2.44	374	273	266	176	214	0.0	0.0	0.0
03	Carbon dioxide (CO2)	M			28,285	27,983	3,682,037	3,909,857	2,858,654	3,009,871	2,714,713	0.0	0.0	0.0
01	Methane (CH4)	C			0.12	0.12	5,782	4,994	4,261	4,527	4,186	##########	0.0	409480.0

* 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		AR02	AR05	AR06	AR07	AR08			
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	235	199	146	126	141	235.232876712	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: Method Code	Method Used: Designation or Description	Facility Total Capacity m3 per hour	
Total estimated methane generation (as per site model)	9654692.0	C	OTH	Gassim 2	N/A	
Methane flared	150320.0	M	OTH	Measured at flare	10000.0	(Total Flaring Capacity)
Methane utilised in engine/s	9094892.0	M	OTH	measured at engines	5000.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	409480.0	C	OTH	calculated	N/A	

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

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	14246.57	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	10871.94	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